Intergovernmental Oceanographic Commission
Reports of Governing and Major Subsidiary Bodies

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

Fifteenth Session

27–29 April 2021 (online)

UNESCO

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[1] This report contains a summary in English, French, Spanish and Russian.

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Executive summary

The Intergovernmental Coordination Group for the Tsunami and other Coastal Hazards Warning System for the Caribbean and Adjacent Regions (ICG/CARIBE-EWS) held its 15th session online, from 27 to 29 April 2021. Eighty-nine (89) participants from twenty-five (25) Caribbean countries and territories and four (4) observer organizations, the Puerto Rico Seismic Network (PRSN), UNAVCO, UNDRR-Regional Office of the Americas and the University of the West Indies-Seismic Research Centre, attended the meeting.

The ICG recognized a lack of specifically identified and easily accessible volcanic and landslide tsunami sources for the Caribbean region , therefore, it **acknowledged** the need to progressively include volcanic and landslide sources and to build a dataset of scenarios for the Caribbean.

The ICG recommended the Task Team on Evacuation Maps with the support from Working Group 2, Working Group 4, and the Caribbean Tsunami Information Center (CTIC) to create a repository at the regional level to hold all national evacuation maps and "How to" manuals and supplemental manuals used for the creation of the tsunami inundation and evacuation maps.

The ICG recommended Nicaragua after finalizing its experimental mode to enter routine functioning of the Central American Tsunami Advisory Centre (CATAC) established at the Instituto Nicaraguense de Estudios Territoriales (INETER), Managua, and establish the internal organizational structures for it.

The ICG noted that from the CARIBE WAVE survey and Pacific Tsunami Warning Center (PTWC) communication tests there is almost complete reliance on email for reception of products from Tsunami Service Providers (TSPs) and very few Tsunami Warning Focal Points (TWFPs) and National Tsunami Warning Centres (NTWCs) are using more robust methods, like WMO Information System (Global Telecommunications System- GTS), GEONETCAST, and EMWIN.

The ICG instructed Working Group 3 to resume the initiatives analysing use of new technology applications such as web 2.0 or others to facilitate the dissemination of information in case of tsunami emergencies.

The ICG recommended that ICG/CARIBE-EWS communities prone to tsunami risk, aspire to become Tsunami Ready, as this recognition includes many aspects of preparedness essential for an effective local tsunami response.

The ICG further recommended to the TOWS-WG that consideration be given across all four ICGs to establish a quick-response capability for volcanoes and potential landslides that pose an imminent tsunami threat through instrumentation with sea-level gauges, real-time GNSS stations, HF Radar, and/or other instruments that can be used by NTWCs and/or TSPs for the purpose of quickly detecting and assessing a local tsunami threat to nearby coastal populations.

The ICG noted the successful conduct of the CARIBE WAVE 20 and CARIBE WAVE 21 exercises with the participation of 98 percent of the Member States and Territories and almost 400,000 people in total despite the COVID-19 pandemic.

The ICG decided that CARIBE WAVE 22 in 2022 will consist of three scenarios that include: (i) a tsunamigenic earthquake along the Muertos Trough south of the Dominican Republic; (ii)

a flank collapse of the Cumbre Vieja Volcano (La Palma, Canary Island); and (iii) an offshore event north of Panama along the Northern Panama Deformed Belt.

The ICG recommended giving a higher priority to the integration of social sciences in the Key Performance Indicators (KPIs) and Implementation Plan to be developed by the system associated with the interaction with the communities.

The ICG recognized that the United Nations Decade of Ocean Science for Sustainable Development 2021–2030 is an opportunity to develop and enhance partnerships and collaborations with stakeholders from other coastal hazards in the Caribbean and Adjacent Regions.

The ICG decided to establish an ICG/CARIBE-EWS Task Team on the Ocean Decade.

The ICG urged 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.

The ICG decided to include a permanent agenda item on the Ocean Decade in the Policy section of ICG sessions.

Résumé exécutif

Le Groupe intergouvernemental de coordination de la COI du Système d'alerte aux tsunamis et autres risques côtiers dans la mer des Caraïbes et les régions adjacentes (GIC/CARIBE-EWS) a tenu sa 15e session en ligne, du 27 au 29 avril 2021. Quatre-vingt-neuf (89) participants de 25 pays et territoires des Caraïbes et 4 organisations observatrices, le Puerto Rico Seismic Network (PRSN), l'UNAVCO, l'UNDRR-Bureau régional des Amériques et l'University of the West Indies-Seismic Research Centre, ont assisté à cette réunion.

Le GIC a reconnu un manque de sources et d'informations accessibles sur les tsunamis dûs à une éruption volcanique ou à un glissement de terrain pour la région des Caraïbes. **Il a donc souligné** la nécessité d'inclure progressivement ces types de sources (éruption volcaniques et glissements de terrain) et de constituer un ensemble de données de scénarios pour les Caraïbes.

Le GIC a recommandé à l'équipe spéciale chargée des cartes d'évacuation - avec le soutien du groupe de travail 2, du groupe de travail 4 et du Caribbean Tsunami Information Center (CTIC) - de créer un référentiel au niveau régional pour conserver les cartes d'évacuation nationales, les manuels pratiques et les autres supplémentaires utilisés pour la création des cartes d'inondation et d'évacuation en cas de tsunami.

Le GIC a recommandé au Nicaragua, après avoir finalisé son mode expérimental, d'intégrer le fonctionnement de routine du Centre consultatif sur les tsunamis en Amérique centrale (CATAC) établi à l'INETER, à Managua, et d'en établir les structures organisationnelles internes.

Le GIC a noté que - d'après l'enquête CARIBE WAVE et les tests de communication du Centre d'alerte aux tsunamis dans le Pacifique (PTWC) - les communications des prestataires de services relatifs aux tsunamis (TSP) sont presque entièrement reçues par e-mail et que très peu de points focaux pour l'alerte aux tsunamis (TWFP) et de centres nationaux d'alerte aux tsunamis (NTWC) utilisent des méthodes plus robustes, comme le système d'information de l'OMM (système mondial de télécommunications - GTS), GEONETCAST et EMWIN.

Le GIC a chargé le groupe de travail 3 de reprendre les initiatives visant à analyser l'utilisation des applications des nouvelles technologies telles que le Web 2.0 ou autres pour faciliter la communication des informations urgentes liées à un tsunami.

Le GIC a recommandé aux communautés ICG/CARIBE-EWS exposées au risque de tsunami de suivre le programme « Tsunami Ready », car cette reconnaissance comprend de nombreux aspects de préparation essentiels pour une intervention locale efficace face aux tsunamis.

Le GIC a en outre recommandé au TOWS-WG d'envisager, dans les quatre GIC, la mise en place d'une capacité d'intervention rapide pour les volcans et les glissements de terrain potentiels qui représentent une menace imminente de tsunami, en les équipant de jauges du niveau de la mer, de stations GNSS en temps réel, de radars HF et/ou d'autres instruments pouvant être utilisés par les centres nationaux d'alerte aux tsunamis (NTWC) et/ou les prestataires de services relatifs aux tsunamis (TSP) afin de détecter et d'évaluer rapidement une menace locale de tsunami pour les populations côtières proches.

Le GIC a noté le bon déroulement des exercices CARIBE WAVE 20 et CARIBE WAVE 21 avec la participation de 98 % des États membres et des territoires et de près de 400 000 personnes au total malgré la pandémie de COVID-19.

Le GIC a décidé que les exercices CARIBE WAVE 22 de 2022 comprendront trois scénarios, à savoir : (i) un séisme tsunamigène le long de la fosse Muertos au sud de la République dominicaine ; (ii) un effondrement du flanc du volcan Cumbre Vieja (La Palma, île des Canaries) ; et (iii) un événement au large des côtes au nord du Panama, le long des ceintures déformées au nord du Panama.

Le GIC a recommandé d'accorder une plus grande priorité à l'intégration des sciences sociales dans les indicateurs clés de performance (KPI) et le plan de mise en œuvre que doit élaborer le système associé à l'interaction avec les communautés.

Le GIC a reconnu que la Décennie des Nations Unies pour les sciences océaniques au service du développement durable 2021-2030 est une occasion de développer et de renforcer les partenariats et les collaborations avec les parties prenantes d'autres risques côtiers dans les Caraïbes et les régions adjacentes.

Le GIC a décidé de créer une équipe de travail GIC/CARIBE-EWS sur la Décennie.

Le GIC a exhorté les États membres à s'engager et à contribuer à la conception et à la mise en œuvre conjointes des sciences océaniques au service du développement durable et du Programme sur les tsunamis de la Décennie.

Le GIC a décidé d'inclure un point permanent à l'ordre du jour sur la Décennie dans la section Politique des sessions du GIC.

Resumen dispositivo

El Grupo Intergubernamental de Coordinación del Sistema de Alerta contra los Tsunamis y otras Amenazas Costeras en el Caribe y Regiones Adyacentes (ICG/CARIBE-EWS) celebró su 15.ª reunión en línea, del 27 al 29 de abril de 2021. Ochenta y nueve (89) participantes de 25 países y territorios del Caribe y 4 organizaciones observadoras, la Red Sísmica de Puerto Rico (PRSN), UNAVCO, UNDRR-Oficina Regional de las Américas y el Centro de Investigación Sísmica de la Universidad de las Indias Occidentales, asistieron a la reunión.

El ICG reconoció que existe una falta de fuentes de tsunami volcánicas y de deslizamiento de tierra específicamente identificadas para la región del Caribe y/o fácilmente accesibles, por lo que **reconoció** la necesidad de incluir progresivamente las fuentes volcánicas y de deslizamiento de tierra y de construir un conjunto de datos de escenarios para el Caribe.

El ICG recomendó al equipo de trabajo sobre mapas de evacuación que, con el apoyo del grupo de trabajo 2, el grupo de trabajo 4 y el Centro de Información sobre los Tsunamis en el Caribe (CTIC), creara un depósito a nivel regional para conservar todos los mapas de evacuación nacionales y los manuales de procedimientos y los manuales complementarios utilizados para la creación de los mapas de inundación y evacuación por tsunami.

El ICG recomendó a Nicaragua que, tras finalizar su modalidad experimental, entrara en el funcionamiento rutinario del Centro de Asesoramiento de Tsunamis para América Central (CATAC) establecido en INETER, Managua, y estableciera las estructuras organizativas internas del mismo.

El ICG observó que, a partir de la encuesta CARIBE WAVE y de las pruebas de comunicación del Centro de Alerta de Tsunamis del Pacífico (PTWC), existe una dependencia casi total del correo electrónico para la recepción de los productos de los Proveedores de Servicios de Tsunamis (TSP) y muy pocos Puntos Focales de Alerta contra los Tsunamis (TWFP) y Centros Nacionales de Alerta contra Tsunamis (NTWC) están utilizando métodos más sólidos, como el Sistema de Información de la OMM (Sistema Global de Telecomunicaciones, en inglés GTS), GEONETCAST y EMWIN.

El ICG encargó al grupo de trabajo 3 que retomara las iniciativas que analizan el uso de aplicaciones de nuevas tecnologías, como la web 2.0 u otras, para facilitar la difusión de información en caso de emergencias por tsunami.

El ICG recomendó que las comunidades del ICG/CARIBE-EWS propensas a sufrir riesgo de tsunamis, aspiren a estar dentro de Tsunami Ready, ya que este reconocimiento incluye muchos aspectos de la preparación esenciales para una respuesta local eficaz ante los tsunamis.

El ICG recomendó además al TOWS-WG que se considerara en los cuatro GIC la posibilidad de establecer una capacidad de respuesta rápida para los volcanes y posibles deslizamientos de tierra que representen una amenaza inminente de tsunami, dotándolos de instrumentos de medición del nivel del mar, estaciones GNSS en tiempo real, radares de alta frecuencia y/u otros instrumentos que puedan ser utilizados por los Centros Nacionales de Alerta contra los Tsunamis (NTWC) y/o los Proveedores de Servicios contra los Tsunamis (TSP) con el fin de detectar y evaluar rápidamente una amenaza de tsunami local para las poblaciones costeras cercanas.

El ICG ha destacado el éxito de los ejercicios CARIBE WAVE 20 y CARIBE WAVE 21, en los que han participado el 98 % de los Estados y Territorios Miembros y casi 400 000 personas en total, a pesar de la pandemia de la COVID-19.

El ICG decidió que CARIBE WAVE 22 consistirá en 3 escenarios que incluyen: (i) un terremoto tsunamigénico a lo largo de la Trinchera de los Muertos al sur de la República Dominicana; (ii) un colapso del flanco del volcán Cumbre Vieja (La Palma, Islas Canarias); y (iii) un fenómeno marítimo al norte de Panamá a lo largo del Cinturón Deformado del Norte de Panamá.

El ICG recomendó dar mayor prioridad a la integración de las ciencias sociales en los Indicadores Clave de Rendimiento (KPI) y el Plan de Ejecución que debe desarrollar el sistema asociado a la interacción con las comunidades.

El ICG reconoció que el Decenio de las Naciones Unidas de las Ciencias Oceánicas para el Desarrollo Sostenible 2021-2030 es una oportunidad para desarrollar y mejorar las asociaciones y colaboraciones con las partes interesadas de otros peligros costeros en el Caribe y regiones adyacentes.

El ICG decidió crear un equipo de trabajo ICG/CARIBE-EWS sobre el Decenio de los Océanos.

El ICG instó a los Estados Miembros a comprometerse y contribuir a la concepción y ejecución conjunta de las Ciencias Oceánicas para el Desarrollo Sostenible y el Programa sobre Tsunamis del Decenio de los Océanos.

El ICG decidió incluir un punto del orden del día permanente sobre el Decenio de los Océanos en la sección de política de las reuniones del GIC.

Рабочее резюме

Межправительственная координационная группа по Системе раннего предупреждения о цунами и опасности других бедствий в прибрежных районах Карибского бассейна и прилегающих регионов (МКГ/КАРИБ-СРП) провела свою 15-ю сессию в режиме онлайн с 27 по 29 апреля 2021 года. На совещании присутствовали 89 (восемьдесят девять) участников из 25 стран и территорий Карибского бассейна и 4 организаций-наблюдателей — Пуэрториканской сейсмической сети (ПСС), UNAVCO, Регионального офиса УСРБ ООН в Северной и Южной Америке и Центра сейсмических исследований Университета Вест-Индии.

МКГ признала, что существует и/или легко достижима нехватка специально определенных источников цунами вулканического и оползневого происхождения для Карибского региона, поэтому она **признала** необходимость постепенного включения источников вулканического и оползневого происхождения и создания массивов данных сценариев для Карибского бассейна.

МКГ рекомендовала Целевой группе по картам эвакуации при поддержке Рабочей группы 2, Рабочей группы 4 и Карибского центра информации о цунами (КЦИЦ) создать на региональном уровне хранилище для хранения всех национальных карт эвакуации и практических руководств, а также дополнительных руководств, используемых для создания карт вызванных цунами наводнений и эвакуации.

МКГ рекомендовала Никарагуа после завершения экспериментального режима перевести Консультативный центр по цунами для региона Центральной Америки (КЦЦЦА), созданный при Никарагуанском институте территориальных исследований (Манагуа), в обычный режим функционирования и создать для него внутренние организационные структуры.

МКГ отметила, что по результатам исследования «Карибская волна» и коммуникационных испытаний Центра предупреждения о цунами в Тихом океане (ПТВЦ) можно почти полностью положиться на электронную почту в том, что касается получения продуктов от провайдеров данных слежения за цунами (ПДСЦ). Лишь немногие координаторы по предупреждению о цунами (КПЦ) и национальные центры предупреждения о цунами (НЦПЦ) используют более надежные методы, такие как Информационная система ВМО (Глобальная телекоммуникационная система ГТС), ГЕОНЕТКаст и ЕМВИН.

МКГ поручила Рабочей группе 3 возобновить инициативы по анализу использования новых технологических приложений, таких как Веб 2.0 или других, для содействия распространению информации в случае чрезвычайных ситуаций, связанных с цунами.

МКГ рекомендовала, чтобы сообщества МКГ/КАРИБ-СРП, подверженные риску цунами, стремились получить статус «К цунами готов», поскольку этот сертификат включает многие аспекты готовности, необходимые для эффективного местного реагирования на цунами.

МКГ также рекомендовала РГ-СПЦО рассмотреть возможность создания во всех четырех МКГ потенциала быстрого реагирования на вулканическую деятельность и потенциальные оползни, представляющие непосредственную угрозу цунами, путем оснащения их датчиками уровня моря, станциями ГНСС в режиме реального времени, высокочастотными радарами и/или другими приборами, которые могут использоваться национальными центрами предупреждения о цунами (НЦПЦ) и/или провайдерами данных слежения за цунами (ПДСЦ) с целью быстрого обнаружения и оценки местной угрозы цунами для населения близлежащих прибрежных районов.

МКГ отметила успешное проведение учений «Карибская волна-2020» и «Карибская волна-2021» с участием 98 процентов государств-членов и территорий и почти 400 000 человек в целом, несмотря на пандемию COVID-19.

МКГ решила, что «Карибская волна-2022» в 2022 году будет предусматривать 3 сценария, включающие: (i) цунамигенное землетрясение вдоль желоба Муэртос к югу от Доминиканской Республики; (ii) обрушение склона вулкана Кумбре Вьеха (Ла Пальма, Канарские острова); (iii) событие в море к северу от Панамы вдоль Северного деформированного пояса Панамы.

МКГ рекомендовала отдать более высокий приоритет интеграции социальных наук в ключевые показатели эффективности (КПЭ) и план реализации, которые должны быть разработаны системой, связанной с взаимодействием с сообществами.

МКГ признала, что Десятилетие ООН, посвященное науке об океане в интересах устойчивого развития (2021–2030 гг.), предоставляет возможность для развития и укрепления партнерских отношений и сотрудничества с заинтересованными сторонами из других подверженных опасности прибрежных зон в Карибском бассейне и прилегающих регионах.

МКГ приняла решение о создании Целевой группы МКГ/КАРИБ-СРП в рамках Десятилетия науки об океане.

МКГ призвала государства-члены принять участие и внести свой вклад в совместную разработку и совместное осуществление Десятилетия, посвященного науке об океане в интересах устойчивого развития и Программы по цунами в рамках Десятилетия науки об океане.

МКГ приняла решение включить постоянный пункт повестки дня, посвященный Десятилетию науки об океане, в раздел «Политика» сессий МКГ.

1. WELCOME AND OPENING

1 The 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) was held online from 27 to 29 April 2021.

2 The Session was opened on Tuesday, 27 April 2021, under the guidance of the Chair of the ICG/CARIBE-EWS, Ms Silvia Chacón Barrantes.

3 Dr Chacón Barrantes warmly welcomed the participants and began the session by inviting all the participants to hold one minute of silence to honour and remember colleagues that have passed away due to COVID-19. She recalled difficulties associated with the COVID-19 pandemic, including the postponement of the ICG/CARIBE-EWS-XV Session originally planned for April 2020, the maintenance of monitoring networks and the cancelation of other meetings, workshops and outreach and capacity building activities. She also noted the occurrence of two tsunamis (both in January 2020) since the last ICG/CARIBE-EWS Session (ICG/CARIBE-EWS-XIV/3). Fortunately, both events were small, no lives were lost and they have had a positive impact on awareness. In spite of these challenges, she highlighted several important achievements realized since the last ICG/CARIBE-EWS Session. These included three Officers' meetings which maintained momentum of activities, a CARIBE WAVE 2021 exercise with more participants than expected and extensive work from Working Groups (WGs) and Task Teams (TTs). She expressed deep appreciation for the work of the Vice-Chairs and Member States representatives to WGs and TTs during these last two challenging years.

4 She highlighted the advantages of conducting a virtual Session, including the ability for more participants to attend the meeting. Indeed, 23 Member States and almost 100 people were registered to participate in this Session, compared to 16 Member States and 40 participants at the ICG/CARIBE-EWS-XIV in 2019. Finally, she encouraged participants to give their best during the three days of this Session as well as during the upcoming intra-sessional meetings.

5 Dr Vladimir Ryabinin, Executive Secretary of the Intergovernmental Oceanographic Commission (IOC), provided welcoming remarks. He noted that despite global changes during the last two years, the IOC has continued to perform its functions and follow its mandate. Specific achievements include coordinating the United Nations Decade of Ocean Science for Sustainable Development (2021–2030) (Ocean Decade), placing oceans in the arena of conventional climate change, addressing marine biodiversity in areas beyond national jurisdiction and promoting integrated ocean management. He also highlighted the work of the High-Level Panel for a Sustainable Ocean Economy which resulted in 14 Heads of State committing themselves to sustainably manage 100 percent of areas under national jurisdiction, by 2025. He noted that the key to achieve this goal is closer collaboration between science, data, planning and the financial sector, including on national accounting.

6 Dr Ryabinin presented different methods for ocean management, noting that early warning systems are key to management for a safe and sustainable ocean. He noted that science is essential to effective ocean management, not only for diagnosing problems but also for providing solutions. He further noted that the Implementation Plan for the Ocean Decade (IOC/2021/ODS/20) was created with this need in mind, bringing together diverse scientists and communities of practitioners from around the world. With regards to ocean-related risks, he emphasized the need to observe, digitally represent and model the ocean as well as to find inclusive solutions and emphasize behaviour change. He noted that the Tsunami Programme will submit a proposal for the Ocean Decade and that he expects significant developments in the IOC tsunami system during the Decade.

7 Dr Ryabinin expressed his appreciation for the devotion and work of the Tsunami Unit (TSU) Secretariat and the entire Caribbean and Adjacent Regions tsunami community, notably drawing attention to key pioneer initiatives in the region such as Tsunami WAVE exercises, Tsunami Ready and work on volcano-generated tsunamis.

8 Dr Chacón Barrantes declared open the Fifteenth Session of the Intergovernmental Coordination Group for the Tsunami and Other Coastal Hazards Warning System for the Caribbean and Adjacent Region.

2. ORGANIZATION OF THE SESSION

2.1 ADOPTION OF AGENDA

9 The Chairperson informed the Plenary that the agenda was discussed at the call-conference of Officers of the ICG/CARIBE-EWS in January 2021, taking into account the Recommendations and instructions given at ICG/CARIBE-EWS-XIV, as well as the relevant parts of the IOC Rules of Procedures.

10 **The ICG approved** the Agenda without any changes.

2.2 DESIGNATION OF THE RAPPORTEUR

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, Spanish and French.

12 Mr Carlos Buritica (Colombia), Ms Laura Gonzalez Rodriguez (Colombia) and Ms Gloria Romero (Venezuela) for Spanish; Ms Marie-Noëlle Raveau (France) with assistance from Ms Valérie Clouard (France) for French; and Ms Susan West (United States of America) for English, were proposed as rapporteurs.

13 **The ICG approved** the proposals and **thanked** Colombia, France, Venezuela and the USA for providing rapporteurs.

2.3 CONDUCT OF THE SESSION, TIMETABLE AND DOCUMENTATION

14 Dr Chacón Barrantes recalled that the ICG/CARIBE-EWS Officers and the TSU Secretariat decided to hold ICG/CARIBE-EWS-XV online due to COVID-19 restrictions. She informed that the Session was being held on the Kudo platform including interpretation in English, Spanish and French. She informed the Plenary that, in order to facilitate the proceedings of the meeting, a timetable was prepared by the Secretariat in coordination with the Chair. At this point, she requested the Secretariat to provide logistic details for the meeting.

15 Mr Bernardo Aliaga, the Technical Secretary, provided information about documentation and other logistic details for the meeting. He explained that the documentation is only available in English. All documents and presentations delivered at this meeting are available from the following website: http://www.ioc-tsunami.org/index.php?option=com_oe&task=viewEventRecord&eventID=2987.

16 Mr Aliaga also noted that seven national reports have been received prior to the meeting and reminded that national reports could be submitted throughout the duration of the meeting/after the meeting as these are useful documents to the work of the ICG

17 **The ICG approved** the provisional timetable without changes.

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

- CARIBE-EWS Implementation Plan and Key Performance Indicators (KPIs): Chair Ms Mary Rengifo (Colombia). Members: Christa von Hillebrandt-Andrade (US), Silvia Chacon (Costa Rica), Marie-Noëlle Raveau (France), Gloria Romero (Venezuela), Ana Pérez (Venezuela) and Miguel Sócrates Ibarra (México).
- Caribe Wave 2022: Chair Dr Elizabeth Vanacore (US). Members: Laura Gonzalez (Colombia), Emilio Talavera (Nicaragua), Rino Hermans (Aruba), Gerard Metayer (Haiti), Christa von Hillebrandt-Andrade (US), Ilena Osorio (Venezuela), Antonio Aguilar (Venezuela), Robin Yani (Guatemala), Anthony Murillo (Costa Rica), Franklin Ridderstaat (Aruba), Oureika Lennon Petty (St Kitts and Nevis), Roselly Pepin (France), Jana Pursley (USGS) and Regina Browne (US).
- United Nations Decade of Ocean Science for Sustainable Development: Chair Mr Mike Angove (US). Members: Christa von Hillebrandt-Andrade (US), Rodolfo Alvarado Sosa (Guatemala), Jason Perez (Colombia), Roberto Pineda (Panama) and Ana Pérez (Venezuela).
- Recommendations Committee: Chair Ms Angela Hibbert (UK). Members: Christa von Hillebrandt-Andrade (US), Joshua Lemus Castillo (Guatemala) and Lloyd Lynch (SRC).
- Local Tsunami SOPs: Chair Charles (Chip) McCreery (US). Members: Joshua Lemus Castillo (Guatemala), Carlos Buritica (Colombia), Wilfried Strauch (Nicaragua), Raphaël Paris (France), Valérie Clouard (France), Saide Shakeer (Trinidad and Tobago), Rino Hermans (Aruba), Nicole Jones (Grenada), Eric Mackie (Trinidad and Tobago), Juritzy Pérez (México), Juan Munares (Venezuela), Miguel Castro (Venezuela), Bryan Dyer (Saint Vincent and the Grenadines), Christa von Hillebrandt-Andrade (US), Fabio Rivera (Costa Rica), Victor Huerfano (PRSN) and Daniel McNamara (US).

19 The Chair recalled that these WGs will report to the Plenary under their designated agenda items. She requested WGs to produce a recommendation for approval by the ICG or re-draft the ones presented by the intersessional WGs and TTs, as needed.

3. REPORT ON INTERSESSIONAL ACTIVITIES

3.1 CHAIR'S REPORT

20 Dr Silvia Chacón Barrantes (Costa Rica), the Chairperson of ICG/CARIBE-EWS, presented her report.

21 She began by noting key activities which she had coordinated, participated in or supported during 2019 and 2020. These included the Allied Forces Humanitarian (FAHUM per its Spanish acronym) exercise in the Dominican Republic (May 2019), the Caribbean Tsunami Information Center (CTIC) Board Meeting (July 2019), the Tsunami Ready pre-verification of two communities in Belize (September 2019), a Tsunami Ready workshop and MACH20 in the Dominican Republic (December 2019), and the 13th Session of the WG on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems (IOC/TOWS-WG-XIII) (February 2020). Activities also included creating a best practices document for tsunami services and evacuation under pandemic circumstances (April 2020), and producing videos about tsunamis and COVID-19 with the United Nations Office for Disaster Risk Reduction (UNDRR) (October 2020). She also participated in several online forums for World Tsunami Awareness Day (WTAD) (November 2020), MACH21 (December 2020), the EuroSea Tide

Gauge Network Workshop (January 2021), the IOC/TOWS-WG-XIV (February 2021) and the Caribbean Disaster Emergency Management Agency (CDEMA) Development Partners Group. She also noted that she has been following activities related to the La Soufrière eruption, including the CDEMA-led Development Partners Group online meeting. She also highlighted that the workshop on Tides and Water Levels (in Spanish) co-funded by MACHC was postponed and is expected to take place in October 2021 or at a later date.

22 She also recalled that both tsunamis that occurred since 2019, on 7 January 2020 and on 28 January 2020, were generated by earthquakes. Sirens activated to halt maritime traffic also warned the population and triggered an evacuation. Both events provided an opportunity to review procedures and warning products, identify gaps, and raise awareness and preparedness.

23 She highlighted that 22 April 2021 marked the 30th anniversary of the 1991 Limón (Costa Rica) tsunami. She noted that, at the time, a team from the United States Geological Survey (USGS), the University of Costa Rica (UCR) and the Comisión Nacional de Emergencias (CNE) in Costa Rica had performed a post-tsunami survey which is now being published to commemorate the anniversary. It will be published as a special volume of the *Revista Geológica de América Central*.

24 She noted that the ICG also has many upcoming challenges, including achieving goals related to the UN Ocean Decade such as to have 100 percent Tsunami Ready communities, Science Monitoring and Reliable Telecommunications (SMART) cables and a tsunami Decade programme. Other activities must also resume under a “new normal”, noting that monitoring and sea-level stations have been affected by COVID-19 restrictions due to dependence on Hawaii to perform maintenance. She also noted that threat assessments must be resumed, community awareness and preparedness activities need to continue and adapt, and momentum must be maintained to expand Tsunami Ready. She expressed appreciation that CARIBE WAVE exercises were able to continue and adapt despite COVID-19. She specifically noted the importance of responding to the La Soufrière volcanic crisis, including developing warning products for volcanic crises and deploying new tide gauges near La Soufrière.

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

3.2 ICG/CARIBE-EWS SECRETARIAT REPORT

26 Mr Bernardo Aliaga, the Technical Secretary for ICG/CARIBE-EWS, presented the report of the Secretariat. He noted that his presentation would only highlight key activities since 2019 and that additional information can be found in the Secretariat’s report.

27 He noted that he structured his report according to the recommendations of ICG/CARIBE-EWS-XIV Session.

28 With regards to the ICG/CARIBE-EWS-XIV’s recommendation that “any updates or changes to personnel and contact information from Member States’ NTWCs [National Tsunami Warning Centre] and TWFPs [Tsunami Warning Focal Point] be sent to the PTWC [Pacific Tsunami Warning Centre] and the ICG/CARIBE-EWS Secretariat”, Mr Aliaga reported that the data has been updated on an ongoing basis, with the latest update performed 21 April 2021. He emphasized that updates were being performed on an ongoing, not regular, basis because updates are only performed when substantive changes occur.

29 With regard to the recommendation to invite the International Hydrographic Organization (IHO) and the Chair of the Meso American Caribbean Sea Hydrographic Commission (MACHC) to this meeting (ICG/CARIBE-EWS-XV), he informed that an invitation was sent to the latter but no response was received. He also noted the Tides and Water Levels

workshop to be organized in collaboration with MACHC, which will hopefully take place in 2021 or 2022.

30 With regard to recommendations pertaining to Tsunami Ready, the Secretariat has facilitated the creation of guidelines for the use of the Tsunami Ready approved logo which will soon be disseminated. It also supported work on finalizing the draft Manual and Guides 74 *Tsunami Ready Guidelines*, which still require final approval from the TOWS-WG.

31 With regard to the recommendation for the Central America Tsunami Advisory Centre (CATAC), he noted that the Secretariat reported to the Centro de Coordinación para la Prevención de los Desastres en América Central y República Dominicana (CEPREDENAC) and Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System (ICG/PTWS) Member States about endorsing the initial trial of CATAC services for Central America. The Secretariat also supported three meetings of officers and one ICG/CARIBE-EWS information session (online).

32 Finally, Mr Aliaga noted that the Secretariat supported the creation of two videos for WTAD 2020.

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

3.3 REPORT OF THE CARIBBEAN TSUNAMI INFORMATION CENTER (CTIC)

34 Ms Alison Brome, the Programme Officer for Coastal Hazards and the Caribbean Tsunami Information Center (CTIC), presented the CTIC report.

35 Ms Brome began by highlighting key activities conducted by CTIC between 2019 and March 2021.

36 She noted the UNESCO/IOC-CTIC-European Commission Humanitarian Aid Department's Disaster Preparedness Programme (DIPECHO) project “Strengthening Capacities of Early Warning and Response for Tsunamis and Other Coastal Hazards in the Caribbean” implemented from 2018 to 2020. This project involved seven pilot states and produced several outputs, including regional coordination annexes to the CDEMA-led Regional Response Coordination Plan, a generic national tsunami protocol for adaptation by CDEMA participating States, enhanced national tsunami warning and communication protocols for pilot states, an Expert Meeting on Tsunami Hazard for the Lesser Antilles and the establishment of a Regional Group of Experts to develop a work and implementation plan for integrating other coastal hazards within ICG/CARIBE-EWS (the latter is still ongoing). In addition, four communities were recognized as Tsunami Ready through this project, with key activities including a regional workshop and a school competition within Tsunami Ready communities.

37 Ms Brome noted other key activities of the intersessional period. The Tsunami Ready programme has now recognized a total of nine communities (four of which under the DIPECHO project), with five others under way and two renewals also under way. Since 2019, CTIC has also contributed to WG4 activities, organized the CTIC Board Meeting on 22 July 2019 and supported the UN Ocean Decade through various initiatives and CARIBE WAVE exercises. She also noted that CTIC participated in WTAD (2019, 2020 and planned for 2021), continued ocean literacy activities including the development and dissemination of materials and resources, and continued to support requests from Member States and partner engagement. She also noted that support from the Government of Barbados was secured for another three years through a Memorandum of Understanding (MOU) (signed June 2020). She also noted that the CTIC website is in the process of being updated and revitalized, and that CTIC is working on formalizing agreements with technical partners and resource mobilization and strategic development under IOC.

38 She next highlighted key challenges, which included financial and resource constraints, the COVID-19 pandemic and related constraints, and limited avenues for distributing hard copy education and outreach materials. To address these, CTIC is seeking to maximize opportunities for enhanced technical collaboration and resource mobilization. She also noted that key considerations were the need for sustained preparedness activities for tsunamis, deepening existing mechanisms and exploring new opportunities to facilitate the integration of impacts and risks associated with other coastal hazards within CARIBE-EWS.

39 Ms Brome set out the proposed CTIC work plan for the next intersessional period, noting that funding had been secured to support an additional community in Grenada with enhancing tsunami preparedness and Tsunami Ready recognition.

40 Finally, she presented recommendations from CTIC to this ICG/CARIBE-EWS-XV Session.

41 The US noted that a new online order-form for public awareness and educational materials will soon be available through the International Tsunami Information Centre (ITIC).

42 **The ICG noted** the report on CTIC.

3.4 REPORTS FROM UN AND NON-UN ORGANIZATIONS (WORLD TSUNAMI AWARENESS DAY-WTAD)

Report from IOCARIBE/GOOS

43 Dr Cesar Toro, the Technical Secretary of the IOC Sub-Commission for the Caribbean and Adjacent Regions Global Ocean Observing System (IOCARIBE-GOOS), gave a presentation on IOCARIBE/GOOS activities.

44 Dr Toro reported that during the last intersessional period, IOCARIBE-GOOS developed the Sargassum Monitoring and Forecasting System in the Tropical Atlantic. He noted that IOCARIBE is cooperating with different partners, including the US National Oceanic and Atmospheric Administration (NOAA) CoastWatch and Atlantic Oceanographic and Meteorological Laboratory (AOML) who are working on updating, improving and transitioning to operational production and distribution of Sargassum monitoring products produced in collaboration with the University of South Florida (USF). He also noted that IOCARIBE is working with the Intergovernmental Oceanographic Sub-Commission for Africa and Adjacent Island States (IOCAFRICA) because Sargassum is an issue across the entire tropical Atlantic. The Sargassum Information Hub was launched on 31 July 2020 was also highlighted as a mechanism to provide information about sargassum in the tropical Atlantic, improve communication among stakeholders and increase visibility of activities. He noted that this Hub was the result of a joint collaboration between IOCARIBE, GEO Blue Planet, AtlantOS, and the Atlantic International Research Centre (AIR Centre). He mentioned that tsunami early warning systems (TEWS) provided good “lessons learned” for coordination among stakeholders to have an effective Sargassum Monitoring and Forecasting System.

45 Dr Toro also drew attention to IOCARIBE-GOOS’s work on other coastal hazards in their Coastal Inundation Forecasting Initiative (CIFI). This initiative was recommended in 2019 by IOCARIBE Member States during their 15th Session in Aruba. He recalled that the objective of this initiative is to develop a comprehensive early warning and response for tsunamis and other coastal hazards in the Caribbean, with cooperation between different scientific disciplines and user communities and by using an integrated approach to forecasting. As such, he emphasized that TEWS are a key element of this initiative. He noted that this initiative is based on the work of the Joint World Meteorological Organization (WMO)-IOC Collaborative Board.

He also pointed out that this initiative will be developed within the framework of the UN Ocean Decade to pursue the expansion of CIFI across the wider Caribbean region.

46 He reported that a regional pilot programme for Satellite Oil Spill monitoring for the wider Caribbean region was created in response to the abundance and socio-economic importance of maritime transportation in the Caribbean. He emphasized the threat was not only due to large oil spills, but also, importantly, chronic oil spills. The pilot programme will develop a capacity development programme to train regional satellite analysts and will establish a GIS-based oil spill information webpage to host information, including about the location of platforms, ports, and past and potential current spills, as requested by end users. He reported that the programme will begin by focusing on small areas and noted that Trinidad and Tobago was selected as a partner, given the abundance of oil facilities and monitoring needs. He mentioned that other key partners would be involved in this programme, including IOCARIBE, NOAA's National Environmental Satellite Data and Information Service (NESDIS), GEO Blue Planet Initiative and the Institute of Marine Affairs in Trinidad and Tobago.

47 Dr Toro also drew attention to the IOCARIBE pilot project on the Hurricane Observing Forecasting Capacity which aims to better forecast the strength of hurricanes. He noted the objective to improve paths and trajectories of hurricanes have been achieved. The objective of this new project is to build supporting physical and social infrastructure and conduct a long-term, critical-region sampling programme using Autonomous Ocean Gliders, High Frequency Radars and other existing and developing technologies to provide real-time information resulting in hurricane forecast improvement. Key partners are national ocean-meteorological services, universities and research institutions, and the WMO.

48 He noted that IOCARIBE-GOOS has been supporting different relevant activities in the region developed under the Ocean Decade. He added that IOCARIBE-GOOS plans to coordinate with the Western Tropical Atlantic Region (WTA) Planning Group, established to coordinate the development of necessary transformative actions for the Decade in the region. CARIBE-GOOS will participate in the different WGs established by the Planning Group.

49 Finally, he stated that cooperation and strong partnerships are essential to developing the necessary science for solving economic problems in the region. The work of CARIBE-EWS for tsunamis and other coastal hazards will be a critical component for the next decade and for post-COVID-19 recovery.

Report from the Puerto Rico Seismic Network (PRSN)

50 Dr Victor Huerfano, Director of the Puerto Rico Seismic Network (PRSN), gave a presentation on the status of instrumentation in local and regional monitoring and detection systems, noting recovery efforts since significant storms impacted Puerto Rico in 2017.

51 Dr Huerfano noted that the PRSN sea level network has five stations in the region which have been equipped with radars; however, only one of the five stations is fully operational (in Barahona, Dominican Republic). He noted that, in addition to data being transmitted every six minutes via the Geostationary Environmental Satellite System GOES, data is now also being transmitted every minute via EarthWorm/SeedLink export modules. The data can be accessed through the PRSN portal and the IOC Sea Level Data Facility. He also noted several ongoing projects including work on repairing two stations and creating a third in Puerto Rico, installing an accelerometer in each tide gauge site, installing cellular capability in each station and recovering and upgrading stations in the Port of Santo Domingo (Dominican Republic) and in Tortola (British Virgin Islands).

52 He also reported that the PRSN seismic network currently has 30 functional seismic stations in larger Puerto Rico and is working on recovering others. He noted that, through

funding from USGS, 22 stations have been repaired and are using posthole seismometers, 12 of which are connected via satellite, and short period analog stations were upgrade to medium range seismometers. He also reported that, in cooperation with the Puerto Rico Strong Motion Programme (UPRM), PRSN has incorporated 45 near real-time accelerometers to the location systems. The automatic detection system – entitled “EarlyBird” – has also been upgraded and now uses artificial intelligence and machine learning. He further noted that other ongoing projects include installing a strong motion seismometer, a local relocation project funded by the National Science Foundation (NSF), updating the seismic hazard map of Puerto Rico, continuing to set up a large network of instruments in the area of the 2020 earthquake epicenter, and repairing stations in the Virgin Islands.

53 He next reported on tide gauges, noting that the PRSN operates a Geodetic Network of 20 high rate stations, 16 of which are permanent stations and were upgraded to GNSS and real-time corrections RTX. He also noted that six stations were recently upgraded to alloy receivers, that corrected real-time stations are now feeding the central EarthWorm system, that real-time data is shared with UNAVCO, and that continuous data are simultaneously logged to three sessions with different sampling rates, 15-sec per sample, 1-sec per sample (1 Hz), and 10-samples per second (10 Hz). He further noted that ongoing projects include upgrading all stations to alloy receivers, incorporating RTX GNSS streams into the EarlyBird automatic system. In addition, a rapid proposal was funded by NSF to install six temporary stations Puerto Rico.

54 Finally, Dr Huerfano reported on TsunamiReady® in Puerto Rico. He noted that 46 communities have been recognized TsunamyReady and Puerto Rico has 12 TsunamiReady supporters recognized by the US National Weather Service. In addition, a new DartCom EMWIN satellite receiver was installed in the PRSN and the system is now fully functional, 35 EMWIN systems were upgraded with the NOAA/NWWS capability and hundreds of NOAA radios were distributed. He further noted that PRSN coordinates an annual training to emergency personnel and first responders in tsunami response plans and protocols, four new tsunami “pedestrian” evacuation models were implemented, and the Puerto Rico tsunami Map Tool now includes “community evacuation maps”. He added that guidance for the maritime community, visitors and tourists had been updated, the local media kit was being reviewed, and the local sirens array was being repaired. He highlighted that thousands of participants were involved in the annual CARIBE WAVE and ShakeOut exercises. He drew attention to the fact that PRSN is working to have systems like EAS, IPAWS, WEA and ARES be active partners in exercises (WEA was already part of the exercise this year).

Report from the Seismic Research Centre (SRC) of the University of the West Indies

55 Mr Lloyd Lynch, representing the Seismic Research Centre (SRC) of the University of the West Indies, gave a presentation on the eruption of the 2020 eruption of the La Soufrière volcano in Saint Vincent and the Grenadines.

56 He began noting that the SRC has been severely impacted by the COVID-19 pandemic. They have notably lost four of their 12 seismic stations and border restrictions have impeded repairs.

57 The eruption of La Soufrière volcano in Saint Vincent and the Grenadines was highlighted as the key issue for SRC during the past intersessional period. Mr Lynch provided background information of volcanic activity in La Soufrière. This volcano is one of over 19 active volcanic systems in the Eastern Caribbean. Eruptions of La Soufrière have occurred several times, including in 1718, 1812, 1902, 1971, 1972 and 1979. A volcanic hazard map for La Soufrière was created in 1995 by the SRC and partner institutions.

58 He provided a summary of events, activities and responses of the 2020 eruption of La Soufrière. He noted that, when the eruption started, a team was mobilized to install additional seismic and GPS stations to monitor the seismicity, deformation, gas and petrology, and photogrammetric levels of the event. The eruption was characterized by very low seismicity during the pre-eruption phase. He also noted that, although location capabilities were lost in June or July 2020, three stations were back in operation from November 2020. Seismicity in the pre-explosive phase was characterized by dome growth activity – this phase occurred between 26 December 2020 and 9 April 2021 – and two intense volcano tectonic swarms (the first in late March 2021 and the second on 5 April 2021). During the explosive phase (9 April 2021 to present), 32 eruptions have occurred; however, the frequency and intensity of eruptions are decreasing. He also reported that the event generated extensive ash, with preliminary reports suggesting the eruption has thus far extruded between 8 and 10 million cubic meters of material. He also noted that many pyroclastic flows are now reaching the sea. In addition, the volcano seems to be growing another dome.

59 He then explained the prognosis for the La Soufrière event, proposing that dome growth will continue for an indefinite period of time, explosive eruption will diminish in intensity and frequency, and the eruption will end with dome growth stopped and all activity returned to the background.

60 Finally, he highlighted that this eruption has led to the displacement of an estimated 20,000 people and that no lives have been lost. He also noted that, in addition to Saint Vincent, a lot of ash has been dumped onto Barbados, with a smaller quantity also dumped on Saint Lucia and Grenada. He also noted that these “sister islands” provided support and relief to Saint Vincent and the Grenadines.

Report from UNAVCO

61 UNAVCO did not give a presentation due to time constraints but noted that their contributions are included in the Report of WG1.

Report from UNDRR

62 Mr Jair Torres, Disaster Risk Reduction Advisor at UNDRR, provided a brief summary of the Sendai Framework for Disaster Risk Reduction (2015–2030), noting that Target G is the most relevant for the tsunami community.

63 He noted that UNDRR has been working on providing coherence in national and regional Disaster Risk Reduction (DRR) strategies, as well as across other areas such as Climate Change and Sustainable Development Goal frameworks. UNDRR’s on-going efforts in creating a *Hazard Definition and Classification Review* to present the latest taxonomy for different hazard clusters was also highlighted. Different types of hazards, including societal hazards, have been included with the aim of better understanding the systemic nature of risk and integrating it into national and regional plans. In recognition of the fact that risk is managed by different systems, UNDRR plans to support national and regional management systems to connect these different risk management entities in order to create a systemic approach. He further noted that the Caribbean region needs to shift from an emergency response approach to one based on prevention, mitigation and protection that understands the different elements from different entities/sectors at the national, regional and global levels. He reported that UNDRR has been working with CDEMA to prepare and develop several country work programmes which will incorporate elements of coherence, systemic risk and multi-hazard mentioned above.

64 He highlighted several recent studies and publications of UNDRR in the Caribbean region. Notably, UNDRR and the Economic Commission for Latin America and the Caribbean

(ECLAC) conducted a study on challenges, opportunities and recommendations for risk-informed recovery and development in the Caribbean region in the aftermath of the COVID-19 pandemic; they concluded that COVID-19 provides an opportunity to improve governance of risk and shift from a reactive to a proactive approach. Another publication was developed on key barriers to the resilience of small and medium enterprises (SMEs), examining challenges of SMEs to integrate DRR in their day-to-day activities and plans. He also noted that UNDRR, WMO and other UN organizations are working on a methodology to measure the effectiveness of early warning systems through in the framework of a Climate Risk Early Warning Systems (CREWS) Caribbean project.

65 He drew attention to the theme of this year's WTAD: target F of the Sendai Framework on international cooperation. He also noted that the Seventh Regional Platform for DRR in the Americas and the Caribbean (RP20), due to be held in 2020 in Montego Bay, Jamaica, was postponed to 1–4 November 2021, due to the COVID-19 pandemic. This will provide an opportunity to showcase progress on TEWS and other coastal hazards.

66 He reported that UNDRR is currently developing a UNDRR Strategic Framework (2022–2025) aligned with target G of the Sendai Framework. Key aims include continuing work on early warning and early action in collaboration with existing partners, leveraging partnerships within the UN system and beyond to promote the Sendai Framework, and accelerating financing for DRR and de-risking investment. He highlighted that a key opportunity for pursing these aims is to create linkages and synergies with the CREWS Caribbean project, and specifically the component for developing a regional strategy and identifying priority investments. Finally, he noted that UNDRR aims to support collaborations with the private sector through their Private Sector Alliance for Disaster Resilient Societies.

Report from NOAA's National Centers for Environmental Information (NCEI)

67 Mr Nicolas Arcos, Natural Hazards Scientific Data Specialist of the NOAA National Centers for Environmental Information (NCEI), delivered a presentation on the International Council of Science (ICSU) World Data System (WDS).

68 He recalled that ICSU/WDS is a world data service for geophysics which provides long-term archives, data management and access to global tsunami data. The historical tsunami database, which is notably used for forecasting, warning, model validation and hazard assessment, has a new interface which provides functionality by using a REST API for programmatic access, flexible sorting and filtering of data through a new graphical user interface that will make tsunami datasets more discoverable. He further noted that sources are diverse, all the data is referenced and that the database is mobile-friendly. The data is not only available in the database, but also through interactive web-maps. Various types of data, including socio-economic data, is included. Through a collaboration between NCEI and the ITIC, static products of this data (e.g. maps and posters) have also been created for confirmed tsunamis and significant earthquakes and volcanic eruptions.

69 The natural hazards images database contains over 1,550 free and open access images from earthquakes, tsunamis, volcanos and other geologic events. He invited participants to not only use but also contribute to this database.

70 With regard to tsunami water level data, the NCEI has marigrams which are historic paper records (1854–1994) that have been scanned, sometimes digitized and made available to the public. However, he underlined the dearth of marigrams in the Caribbean region; indeed, there are only five in the region, of which only three have tsunami records. Once again, he invited participants and the tsunami community to share any paper records which they wish to make available to the WDS to contribute to this database. For recent significant events, the

NCEI has tsunami event online summaries which include authoritative event reports, DART and tide gauge data and tsunami-travel-time maps.

71 Mr Arcos noted that the NCEI also develops digital elevation models (DEMs) for specific locations, drawing attention to the Continuously Updated DEM (CUDEM) programme. He noted that the NCEI is in the process of updating the ETOPO, a global relief model of the earth's surface that integrates land topography and ocean bathymetry; this update is expected to be available in 2022. One of the objectives of this update is to improve coastal land elevation estimates in international non-US communities.

72 Finally, he emphasized that NCEI is continuously looking for and open to partnerships, and he encouraged participants and the tsunami community to use and contribute to their data and databases.

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

3.5 STATUS OF OTHER ICGs

74 A presentation on this item was not heard by the Plenary due to time constraints.

3.6 TSUNAMI SERVICES PROVIDER REPORT (PTWC)

75 Dr Charles McCreery, Director of the Pacific Tsunami Warning Centre (PTWC), presented the report of the PTWC.

76 Dr McCreery reported that, since April 2019, the PTWC has recorded 16 events in the Caribbean and Atlantic region that have prompted messages from the PTWC. The only message that rose to a threat level was for the 28 January 2020 event; five messages were issued for this event. He examined key performance indicators (KPIs) for these events, including elapsed time to the initial message, difference in the magnitude between what PTWC produced in its message and what is currently in the USGS Catalogue, difference in depth, and difference in location (in kilometers). Most events met the KPI criteria. In terms of elapsed time, those that failed to meet the criteria were primarily located in the Atlantic region, where seismometers are scarcer.

77 He next reported on events in the Southern Atlantic, noting that seven of the 16 events were Southern Atlantic earthquakes. A Mw 8.5 earthquake is unlikely in the region and it would only produce a 0.3-1m water rise in Bermuda with a 14–hour travel time. He proposed that the Plenary consider whether they wish for the PTWC to continue issuing messages to the Caribbean for events in this area. He remarked that this area is closer to the Pacific area of responsibility because of proximity to the coast of Chile and Antarctica. For this reason, he suggested that it may be more appropriate for this zone to be included in the Pacific. He also emphasized that PTWC would still issue a message for the Caribbean in the case of a large event.

78 Next, Dr McCreery reported on notable issues which disrupted activities during the past intersessional period, including impacts from the COVID-19 pandemic, unusual outages (due to maintenance and hurricane Douglas) and a website failure during the 28 January 2020 tsunami event. In response to the latter, routine tests (every 15 minutes) of connection to the web server have been implemented to quickly identify failures.

79 In response to follow-up actions from ICG/CARIBE-EWS-XIV, the PTWC has implemented more frequent quarterly unscheduled communication tests; however, the response has not been very successful and the PTWC plans to work with the Technical Secretary to simplify methods for responding to and compiling these tests. In addition, the

PTWC is also in the process of making format and substance changes to threat messages, including alphabetizing country or territory names, organizing estimated time of arrivals (ETAs) by country or territory, adding codes to indicate types of tsunami wave measurement and changing default criteria for the initial threat area. The User's Guide (for) the Pacific Tsunami Warning Center Enhanced Products for the Tsunami and other Coastal Hazards Warning System for the Caribbean and Adjacent Regions (CARIBE-EWS) (IOC/2017/TS/135 REV.) will be updated once these format and substance changes are implemented.

80 He reported on the PTWC response to the recent La Soufrière eruption, noting that PTWC began monitoring nearby sea level gauges at the outset of the event. He further noted that PTWC coordinated with SRC and the TT on Volcano Sources, reviewed the CARIBE WAVE 19 exercise for Kick-em-Jenny, and advised all TNCs, TWFPs and NTWCs of potential threats and PTWC responses to alert Member States. In addition, the PTWC wrote software and procedures for PTWC duty scientists to generate and disseminate products of tsunami detection, and wrote and implemented software for simple tsunami detectors to put on relevant gauges for this event. He explained that a simple tsunami detector based on amplitude thresholds, has been back-tested for 480 days to determine the false alarm rate and is connected to the PTWC paging system to alert duty scientists upon detection. It is also being used for La Soufrière removing tide signals using tidal components.

81 Dr McCreery also presented other PTWS activities and projects, including developing GNSS capabilities for more rapidly characterizing a tsunami source to create a forecast, implementing a regional Centroid Moment Tensor (CMT) of the earthquake mechanism which would take 10-15 minutes, developing a Common Message Code for the PTWC and US NTWC centres, and enhancing the SIFT forecast model. In addition, a training video for CARIBE-EWS TSP products has also been created through a collaboration with ITIC.

82 The Chair enquired about the impacts on ICG/CARIBE-EWS Member State Brazil if the PTWC ceased issuing messages for the South Atlantic region to PTWC. The PTWC Director responded that, for the areas of Brazil which are covered by this ICG, forecast heights are below 0.3 m; however, if we are considering the whole of Brazil, southern areas will likely be threatened. The Chair concluded that further discussion on this topic was needed.

83 The Chair also commented that, in Costa Rica, PTWC communications tests occur outside of working hours. Because the Costa Rica NTWC – SINAMOT – is not functional 24/7 and the message does not have the format of a real bulletin or threat information message, the CNE (which is 24/7) does not alert SINAMOT. In addition, only a few of the CNE operators speak English. As such, Costa Rica rarely answers the communications tests. The Chair suggested that this be taken into account when developing future tests.

84 The US inquired about the ListServ. The PTWC explained that the ListServ currently in use for the Tsunami Bulletin Board (TBB) will be changed during the next few months. This will also have an impact on the mailing list used to issue information to TNCs, TWFPs and NTWCs. ITIC is managing this change and will issue relevant information.

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

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

86 Dr Wilfried Strauch, Coordinator of CATAC and Chair of ICG/PTWS, presented this report.

87 He recalled that, in 2015, the government of Nicaragua offered that CATAC be established in Nicaragua. CATAC was developed between 2016 and 2019 through several projects. In August 2019, CATAC began with experimental functions based on the decisions

of ICG/PTWS-XXVIII, ICG/CARIBE-EWS-XIV and the IOC Assembly at its 30th session. CATAC is responsible for sending technical information to the six Central American countries about potential tsunamis on the Pacific and Caribbean coasts of Central America.

88 He reported that the CATAC Tsunami Database has been created and is now available. CATAC is now able to compare results in this database with the TOAST programme, which is being used in their SeisComP system. CATAC will begin this work during this coming year. In addition, CATAC organized two regional tsunami exercises during the past intersessional period. The first exercise, which took place on 18 August 2019, used the scenario of a Mw 8.6 earthquake and the second exercise, which occurred on 11 November 2020, used the scenario of a Mw 7.6 slow earthquake and tsunami in the front of Fonseca Gulf.

89 Mr Strauch also indicated that CATAC is working to improve the monitoring system/seismic network. Currently, there are over 500 seismic stations implemented in Central America, the US, Mexico and northern South America. CATAC also has a number of stations from the global network. A key challenge has been that networks in the region are primarily located in volcanic zones, with few in coastal areas. In response to this issue, CATAC installed around 100 accelerometers in Nicaragua, El Salvador, Guatemala and Costa Rica; he noted that Nicaragua has already completed installation of its accelerometers. This initiative aims to accelerate earthquake early warning for Central America, with CATAC in charge of tsunami warning for areas where a tsunami can impact within less than 10 minutes after the earthquake.

90 He presented CATAC's working plan for 2021 and 2022. This plan included two regional tsunami exercises for Central America prepared by CATAC (in 2021 and 2022), continued capacitation of CATAC watch standers for tsunami advisory, capacitation of recipient institutions of CATAC messages and massive installation of new seismic stations and integration of tsunami processing. In addition, there is a proposal for CATAC to begin providing full tsunami services in January 2022.

91 The Chair enquired about CATAC's legal framework in Nicaragua. Dr Strauch recalled that this was discussed during TOWS-WG-XIV in February 2021, and explained that CATAC does have legal documentation proving and confirming its existence as an entity. CATAC is currently having discussions in Nicaragua to seek formal recognition. The Chair expressed her desire for CATAC to achieve recognition as soon as possible to ensure the continuity of the services of CATAC.

92 **The ICG noted** the report of CATAC.

3.8 REPORT OF EXERCISE CARIBE WAVE 2021

93 Dr Elisabeth Vanacore, Chair of the Task Team on CARIBE WAVE, presented on CARIBE WAVE 21.

94 She reported that CARIBE WAVE 21 was successfully held on 11 March 2021, with 47 of 48 Member States and Territories participating and a total of 333,515 people directly engaged. She noted that these results were particularly impressive considering the context of the COVID-19 pandemic. She also remarked that it was left up to the Member States and Territories to determine if any additional activities would be carried out and whether to use the simulated messages for one of the two scenarios: Jamaica and Northern Lesser Antilles.

95 She presented the metrics, goals and results from CARIBE WAVE 21. For instance, the metric for participation of ICG/CARIBE-EWS Member State designated focal points aimed for 100 percent participation, and the result was a promising 98 percent. She also highlighted an increase in satisfaction in CARIBE WAVE 21 compared to past exercises.

96 She also reported on the CARIBE WAVE 21 evaluation form, which contained 27 questions for participating countries to provide feedback on the exercise and was available from 19 March to 11 May 2021. She noted that 97 percent of Member States and Territories responded, with a total of 36 surveys completed by 45 of the 48 Member States and Territories. Results from the evaluation form show that email remains the most used system of communication; she noted that it is crucial not to have a single mechanism for receiving messages, but to also have other mechanisms such as WMO GTS/WIS, AFTN, fax, EMWIN or other communication devices. In terms of the type of participation in CARIBE WAVE 21, the international communications test had the most participation compared to a national level test. Despite COVID-19, she noted that five countries reported conducting a full-scale exercise. With regards to Tsunami Ready, 87 percent of the countries reported interest in implementing Tsunami Ready, with 342 as a total number of target communities to be recognized.

97 Dr Vanacore reported on media engagement of CARIBE WAVE 21, noting that the #CaribeWave21 hashtag had over 300 mentions on social media, reaching over two million people worldwide between 21 February and 17 March 2021. She expressed her desire for CARIBE WAVE hashtags to have enough participation on Twitter and/or Facebook in the next couple years to be trending.

98 She mentioned that a highlight of CARIBE WAVE 21 was the Hot-Wash meeting which was conducted for the first time and provided the opportunity to discuss and give feedback on the exercise in an open forum. She suggested that a Hot-Wash be included in future CARIBE WAVE exercises.

99 The Chair expressed her appreciation for the work of Dr Vanacore and the TT on CARIBE WAVE during the past few years, noting that CARIBE WAVE remains the largest tsunami exercise worldwide.

100 The Chair also noted that the lack of redundancy in communications methods and an overreliance on email was problematic, and suggested that a webinar on alternative methods of receiving tsunami warnings be organized.

101 The PRSN enquired whether GEONETCast Americas (GNC-A) issued dummy or other messages. Dr Vanacore and the US reported that there was a GNC-A issued message during CARIBE WAVE 21.

102 **The ICG noted** the report of exercise CARIBE WAVE 21.

4. WORKING GROUP PROGRESS REPORTS

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

103 Dr Daniel McNamara, Chair of Working Group 1 (WG 1), and Dr Karl Feaux, Vice-Chair of WG1-GNSS, presented the report of WG1 and delivered a presentation.

104 Dr McNamara recalled the mission of WG1 to define standards for operating instrumentation and facilitate communications between countries in the region. He also presented a summary of activities undertaken by WG1 during the past intersessional period, including online calls with WG1, the NOAA Caribbean Tsunami Warning Programme (CTWP) and network operators as well as transitions in WG1 membership.

105 He provided an update on the status of the seismic network. Major seismic station outages have occurred in 2020 with significant data problems in Venezuela, Honduras, Nicaragua, Costa Rica, Panama and El Salvador. Many outages are likely due to out-of-date

meta-data and IP addresses at PTWC. A station in Panama which is operated by the USGS is also down; although equipment has been shipped, travel restrictions have impeded repairs. The station will be repaired as soon as restrictions are lifted. In addition, PRSN seismic station upgrades have mostly been completed, except in a few outer islands (e.g. Virgin Islands and Dominican Republic). He also noted that Cuba now has 10 stations streaming real-time data to PTWC, USGS, PRSN and IRIS. Lastly, 150 stations have been added to Central America for an earthquake early warning system.

106 Next, Dr McNamara offered an update on the status of the sea level network. Sea level station outages have increased significantly over the past few years and stations in Haiti, Jamaica, Saint Martin and Barbados are not operational. In addition, NOAA DART buoys have been returned to their locations and are once again transmitting real-time data after becoming unmoored and failing to transmit data. He also noted that there have been efforts to install new stations in the eastern Caribbean near active volcanoes on Martinique and Saint Vincent; this should be considered a high priority.

107 Dr Feaux provided an update on the status of GNSS in the region. He recalled the goals set out for WG1 in 2019. He noted that the goal to "improve the operational status of the NOTA network in the Caribbean region to at least 75 percent" was difficult to achieve due to the COVID-19 pandemic, but that the performance of GNSS stations collected at the UNAVCO Network Operation Centre is expected to improve in the next year. In addition, he noted that 18 GNSS stations available for TEWS have been added. Currently, 130 real-time GNSS stations are processed at UNAVCO. He also indicated that the goal to "identify the status of all 193 suitable real-time GNSS stations in the Caribbean region" is currently in progress and will continue as a goal for 2021.

108 He also reported that the NOAA Pacific Marine Environmental Lab (PMEL) continues to test the integration of the G-FAST software into the SIFT system. The testing has been in place for about five months. Since initial problems with set up were overcome, testing has been on-going. He expressed appreciation for the work of Dr Diego Arcas at PMEL.

109 Finally, Dr Feaux reported that he would be resigning from his role of Vice-Chair or WG1-GNSS. He expressed his appreciation for the work, accomplishments and members of WG1 and the ICG/CARIBE-EWS.

110 The Chair expressed her deep appreciation for the work of Dr Feaux as Vice-Chair of WG1-GNSS.

111 **The ICG noted** the report of Working Group 1 and adopted Recommendation ICG/CARIBE-EWS-XV.1.

4.2 PROGRESS REPORT OF WORKING GROUP 2 ON HAZARD ASSESSMENT

112 Mr Nicolas Arcos (United States of America), Chair of Working Group 2 (WG2), presented the report of WG2 and delivered a presentation.

113 He recalled key achievements of WG2 during this past intersessional period. He noted that an Experts Meeting on Sources of Tsunamis for the Lesser Antilles took place from 18 to 20 March 2019. A technical report from the meeting was prepared by WG2 in the intersessional period and is available at the UNESDOC digital library as "Experts Meeting on Sources of Tsunamis in the Lesser Antilles, Fort-de-France, Martinique (France), 18–20 March 2019" (IOC/2020/WR/291). He expressed appreciation for the support of Dr Alberto Lopez Venegas and Mr Bernardo Aliaga for their role in publishing the report.

114 He highlighted that another achievement was the updates made to CATSAM, including the addition of a Tsunami Ready Community layer in collaboration with WG4. Although only Caribbean coastal communities are currently included, he expressed his hope that Pacific communities would soon be added. Other updates included improvements to colour-hillshade visualization; fixed and improved codes; and the addition of five new modelled scenarios for a total of 29, in collaboration with the Universidad Nacional Costa Rica and EDANYA Group.

115 Mr Arcos also reported work on DEM and inundation modeling. A regional tsunami workshop in Belize highlighted issues with DEM related to a dearth of elevation data. WG2 has been trying to address elevation data sharing issues, including through a DEM training workshop proposal which has been submitted to the ICG/CARIBE-EWS Technical Secretary. The proposal is intended to promote a sustainable approach to DEM development in the region when data sharing is not possible. He also noted that WG2 is considering the creation of a Data Trust for the region, which would provide a repository for regional elevation data. WG2 identified that the Caribbean Marine Atlas may be an appropriate platform for this Data Trust and is currently in communication with the Caribbean Marine Atlas to discuss this option.

116 He recalled that the ICG/CARIBE-EWS-XIV noted that the Caribbean will benefit from the implementation of a Probabilistic Tsunami Hazard Assessment (PTHA) project considering best practices and current state of knowledge. Interest from several groups in the region was particularly noted and so WG2 developed a letter of support for probabilistic tsunami hazard assessment in the Caribbean during the intersessional period which is available to any group in the region who wish to pursue this issue.

117 Next, he reported on an update of the Tsunami Coastal Assessment Tool (TsuCAT) by NOAA/PMEL NCTR in collaboration with ITIC. A key change is the new ability to be a stand-alone product/application. In addition, the requested epicenter location and the position of the closest epicenter have been added to the catalog. Other improvements relate to selecting the closest source for very large events, graphical and text message changes in the Test Messages feature to be consistent with PTWC regional output, and new sources added to the catalog.

118 He noted that historical tsunami posters have also been updated by NCEI/WDS in collaboration with ITIC and CTWP. A Historical Tsunami Effects in Caribbean, Central America, Mexico and Adjacent Regions poster was updated in 2020 and is available digitally in English and Spanish.

119 **The ICG noted** the report of Working Group 2 and adopted Recommendation ICG/CARIBE-EWS-XV.2.

4.3 PROGRESS REPORT OF WORKING GROUP 3 ON TSUNAMI RELATED SERVICES

120 Mr Emilio Talavera (Nicaragua), Chair of the Working Group 3 (WG3), delivered a presentation on the report of WG3.

121 Mr Talavera recalled the mandate of WG3 to “examine current and developing capacities in each country of the region and advise the ICG about the definition and composition of early warnings and tsunami products and the methods and best practices for effective procedures for end-to-end communication and dissemination of early warnings and tsunami products”. He also provided a summary of the key functions of WG3.

122 He reported on the status of activities of WG3, acknowledging that WG3 activities have been heavily impacted by the COVID-19 pandemic. For instance, information dissemination and dissemination systems have reduced information transmission capacity. The

dissemination of information and warnings has been conducted through email. During CARIBE WAVE 21, concern was noted about the overreliance on email for receiving messages, suggesting that Member States should have at least three methods for disseminating information.

123 The US expressed concern about difficulties with dissemination of information and communication. They enquired whether WG3 has considered transitioning to other methods, such as satellite communications, to move away from internet-based services. WG3 indicated its desire to receive feedback or suggestions on different communication dissemination methods. The Chair suggested organizing a webinar or a roundtable on this issue, noting that this should be considered by the Plenary in the Recommendations.

124 The **ICG noted** the report of Working Group 3 and adopted Recommendation ICG/CARIBE-EWS-XV.3.

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

125 Ms Christa von Hillebrandt Andrade (US), Chair of WG4, presented the report of WG4.

126 She recalled the key functions of WG4: identifying public awareness and education strategies and tools, supporting the development of guidelines and closely cooperating with CTIC. Currently, WG4 includes 20 members and three *ex-officio* members; WG4 will follow up with the ICG/CARIBE-EWS Secretariat to confirm, renew and nominate new members.

127 She presented key activities and outputs of the last intersessional period, including contributions to the *COVID-19 Guidance* and the *Multi-Annual Community Tsunami Exercise programme: Guidelines for the Tsunami and other Coastal Hazards Warning System for the Caribbean and Adjacent Regions* (Manuals and Guides 86). In addition, WG4 updated the signage inventory in 2019 with contributions from 50 percent of ICG/CARIBE-EWS Member States. She also noted that WG4 has been working with CTIC to contribute to WTAD, and that several past and present members of WG4 have been supporting and contributing to discussions on the UN Ocean Decade.

128 She specifically highlighted two new activities. The first relates to the inclusion of social sciences in the work of WG4. In response to the recommendation of ICG/CARIBE-EWS-XIV to address the social science component of early warning systems, the CTWP created an article database on the social dimension of DRR in the Caribbean and Adjacent Regions and included a question in the CARIBE WAVE evaluation form on whether social scientists were engaged in the planning of activities. Results from this evaluation form show that six Member States responded “yes”. The second new activity is the development of an online tool to order tsunami educational and outreach materials from ITIC or CTIC, in collaboration with the CTWP. The US provides funds to deliver and ship these materials internationally. This initiative is in support of Tsunami Ready efforts.

129 Ms von Hillebrandt Andrade highlighted key considerations, challenges and opportunities in the last two years. She noted challenges related to the COVID-19 pandemic, including related impacts on human and financial resources, especially in Disaster Risk Management Offices. She also highlighted the impacts that other hazards have had on coastal communities in the Caribbean and Adjacent Regions, including hurricanes, storm surges, sargassum, volcanic eruptions and floods. There has also been a lack of financial resources to implement actions of WG4 which in turn has limited engagement of members in WG4 activities. Another challenge relates to complacency regarding tsunamis; because tsunamis are low-frequency events, they often lead to complacency despite their high impact. Communicating tsunami risk effectively is therefore critical. She also noted that the dearth in

availability of ITIC educational and outreach materials in languages other than Spanish and English (such as French and Dutch) is challenging and is related to limited financial resources. She indicated that, in order to minimize these challenges, it is crucial to maximize opportunities provided by CARIBE WAVE, WTAD and Tsunami Ready to advance tsunami preparedness, readiness and resilience

130 Lastly, she presented the WG4 Action Plan 2021-2022. She highlighted several activities, including conducting a final review of Manuals and Guides 86 with Member States and the TOWS-WG, developing a strategy to increase familiarization with and use of the Methodological Guidelines document for community tsunami exercise planning, updating the Tsunami Signage Database, developing the National Tsunami Databases, promoting and contributing to WTAD 2021, promoting and participating in UN Ocean Decade activities, identifying a mechanism to interact with corresponding WGs/TTs of other ICGs in addition to TOWS-WG, and engaging social scientists to study tsunami risk perception in the CARIBE-EWS region.

131 The US commented that they support capacity development through CTWP and ITIC, encouraged Member States to take advantage of these resources and welcomed support for translations into other languages.

132 Venezuela offered support for translation into Spanish.

133 The Chair emphasized again that further support would be needed for translations into languages other than English and Spanish.

134 **The ICG noted** the report of Working Group 4 and adopted Recommendation ICG/CARIBE-EWS-XV.4.

5. POLICY MATTERS

5.1 EXERCISE CARIBE WAVE 2022

135 Dr Elisabeth Vanacore, Chair of the TT on CARIBE WAVE, presented on CARIBE WAVE 22.

136 Dr Vanacore presented on provisional ideas and plans for CARIBE WAVE 22. She highlighted that key metrics to improve are increasing of participation to 100 percent of TWFPs, with all TWFPs receiving the dummy message, as well as increasing of community engagement to around 75 percent. Other metrics to improve include bringing the number of participants back up to their pre-COVID-19 levels and having 100 percent of participant countries submitting evaluation form. She noted that achieving several of these metrics will depend on the status of the COVID-19 pandemic.

137 She explained that a new Scenario Suggestion Form has been created to facilitate Member State suggestions for possible future CARIBE WAVE scenarios. The Google form is available at: https://forms.gle/fqPvw4SVU6U97Cmc8. She invited Member State participants to submit proposals via this form.

138 She presented the TT's scenario suggestions for consideration for CARIBE WAVE 22: 1) A tsunamigenic earthquake along the Muertos Trough, 2) A flank collapse of the Cumbre Viejo volcano (La Palma, Canary Island) and 3) An offshore event near Costa Rica, based off the 1882a plane available in the CATSAM catalog. With regards to the third proposed scenario, the key element is that it should be an event in the Western Caribbean region, and suggestions have also been made for an event offshore of Panama or Colombia.

139 The above proposed CARIBE WAVE 22 potential scenarios were discussed in the intra-sessional WG on CARIBE WAVE 22, which met on 28 April 2021.

140 She also presented the TT's scenario suggestions for CARIBE WAVE 23: 1) A landslide along the Nicaragua Rise, 2) A Lesser Antilles landslide or flank collapse (potentially in Dominica or Pele) and 3) A landslide near the Puerto Rico Trench.

141 She provided a provisional timetable for CARIBE WAVE 22 key activities, including issuing a Circular Letter by IOC to Member States, circulating a Draft Handbook among ICG/CARIBE-EWS TNCs and TWFPs, making available the Exercise Handbook online, organizing and holding two CARIBE WAVE webinars, conducting the exercise and holding a post-exercise Hot-Wash webinar.

142 The Chair noted that she had been in communications with the TT on CARIBE WAVE 22 about a scenario proposal for a source near Cartagena in Colombia. She also encouraged participants to submit proposals via the online Google form.

143 **The ICG adopted** Recommendation ICG/CARIBE-EWS-XV.5.

5.2 REPORT OF THE TASK TEAM ON TSUNAMI READY PROGRAMME

144 Mr Jasen Penn (British Virgin Islands, UK), Co-Chair of the Task Team on Tsunami Ready Programme, gave a presentation.

145 Mr Penn began by expressing his appreciation for the support of the CTWP and CTIC in helping the TT achieve its goals and implement activities.

146 He presented key activities of the TT during the last intersessional period, noting that four new communities have been recognized Tsunami Ready; these are: Saint John's City (Antigua and Barbuda); Shermans, Saint Lucy to Mullins and Saint Peter (Barbados); Union Island (Saint Vincent and the Grenadines); and Carenage (Trinidad and Tobago). He further noted that a fifth community has ongoing work to become Tsunami Ready; this is the community of Puerto Plata in the Dominican Republic.

147 He indicated that several pilot communities received equipment through funding from the European Union (EU). These communities were in Anguilla (UK), Antigua, Barbados, the British Virgin Islands (UK), Saint Vincent and the Grenadines, and Trinidad and Tobago. He also noted that CTIC held several meetings with Anguilla (UK) and the British Virgin Islands (UK) to help facilitate their Tsunami Ready recognition renewal process.

148 He reported specific achievements of Tsunami Ready recognized communities. Holetown (Barbados) had a national initiative, led by the Department of Emergency Management, to provide support with identifying potential funds for procurement of signage. They also developed an Emergency Operation Plan (EOP) and installed signage and equipment. However, Public Awareness and Educational (PAE) activities are still pending. For the British Virgin Islands (UK), the national initiative is spearheaded by the Department of Disaster Management. There has been a review of Tsunami Ready guideline indicators for a renewal process.

149 Next, he reported on the USAID/OFDA and NOAA-CTWP led initiative in Saint Vincent and the Grenadines, Saint Kitts and Nevis, Belize and Jamaica. In Belize City (Belize), progress with the nomination process is ongoing. In Saint George (Saint Vincent and the Grenadines), the national protocol and SOPs are being developed, and the EOP still needs to be completed. In Old Harbour (Jamaica), progress with the nomination process is ongoing. In

Saint Kitts and Nevis, the renewal process is also ongoing. He also noted that there are a number of new projects under development.

150 He highlighted that, through a survey conducted by ICG/CARIBE-EWS, 87 percent of countries said they were interested on implementing a Tsunami Ready recognition programme. In addition to the survey, a review of Tsunami Ready communities and their statistics was conducted. Results showed that a number of countries requested that a target number of communities be set in terms of communities to be recognized. However, Mr Penn noted that numbers suggested were very high, and he speculated that perhaps countries did not fully understand the question asked.

151 Finally, he noted that the membership of the TT on Tsunami Ready Programme would need to be reviewed and renewed. He noted that frequency of group meetings for the TT had been low and encouraged participants to consider people's availability and ability to contribute when identifying new individuals for the TT.

152 The Chair recalled the goal of the UN Ocean Decade to achieve 100 percent Tsunami Ready recognized communities for at-risk communities.

153 France expressed interest in Tsunami Ready recognition for the town of Deshaies, Guadeloupe; this would provide a pilot community for the rest of the island.

154 Panama also expressed interest in being included in Tsunami Ready recognition efforts.

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

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

156 Ms Valerie Clouard (France), Chair of the Task Team on Tsunami Procedures for Volcanic Crises, presented this report.

157 She recalled that the TT on Tsunami Procedures for Volcanic Crises was created in 2015 following the unrest of the Kick-em-Jenny volcano.

158 She reported on advances made during the intersessional period. The TT developed relations with several volcano observatories. In the Caribbean, there are at least 11 volcano observatories in charge of potentially threatening volcanoes. She noted that one of the goals of the TT is to create links between volcano observatories and the PTWC – the regional TSP. SOPs can be implemented later on in the process to formalize these links. She presented the TT's proposal to construct tsunami procedures for volcano crises follows two phases: 1) A volcano observatory alerts the TSP in case of changes to a monitored volcano and 2) Once informed, the TSP monitors tide gauge data and will issue a message to NTWCs if a pre-defined threshold is reached. The TT aims to produce a first draft of a MOU that could be used between the ICG/CARIBE EWS TSP and the Seismic Research Centre (SRC). In November 2020, the Saint Vincent volcano observatory and the SRC were selected for a pilot MOU. Although the plan was initially to test this connection during CARIBE WAVE 22, this is no longer feasible because of the La Soufrière crisis.

159 Another key activity of the intersessional period was work on tide gauges. The only feasible solution to directly monitor volcano and submarine landslide-triggered tsunamis is through continuous monitoring of offshore sea level gauges. However, the temporal and spatial distribution of stations is currently too sparse to implement tsunami monitoring for these

potential tsunami sources. The tide gauge network also usually does not match the distribution of volcanoes in the region.

160 She reported that the TT examined the potential of GNSS reflectometry (GNSS-R) to improve sea level monitoring. GNSS-R is a relatively new method based on the reflection of a GNSS signal, which enables, in case of reflection on the marine surface, to determine sea level variations. Once the theoretical tide effects are removed, the result is the surge variation. An advantage is that the installation and maintenance of GPS is easier and less expensive compared to tide gauges. However, there is an issue with receiving real-time monitoring; indeed, the signal cannot be treated in real-time. She noted that the TT has contacted two research teams in the US and in France that are working on GNSS-R and specifically on improving real-time treatment of information.

161 Ms Clouard provided a brief summary of ongoing volcanic activity in the Lesser Antilles, noting that several virtual TT meetings this year have focused special attention on this region. She noted that the Mount Pelée volcano in Martinique went from a green to yellow warning indicator due to an increase in seismic activity. However, information about this change in monitoring level was not disseminated to relevant tsunami groups in a systematic way. She indicated that the TT has since requested that volcano observatories in Guadeloupe and Martinique inform several key tsunami entities in case of a change in warning level; these include the TT Chair, the Caribbean TSP (PTWC), the CTWP and the Chair of ICG/CARIBE-EWS.

162 She also reported on recent volcanic activity at La Soufrière. The eruptive phase of La Soufrière began in December 2020 with an effusive phase and the building of a new dome in the crater floor, nearby to the 1979 dome. Following two periods of volcano-tectonic earthquake swarms experienced on 23 March and 5 April 2021, the volcano entered an explosive phase, which has continued to present and has produced ash plumes and pyroclastic flows. She noted that the PTWC is following the situation and that, should the SRC inform them of any major eruptive activity, PTWC would monitor sea level data from the nearest coastal sea level gauges. She also noted that the TT is working on an information message to the NTWCs, NTFPs and TNCs, which would contain: 1) A statement on the present eruption and its relation to the tsunami warning system and 2) The template messages that the PTWC could send in case of an identified tsunami event.

163 The UK indicated that its National Oceanographic Centre is working on delivering GNSS-R data in real-time. The Chair suggested that the UK and TT on Tsunami Procedures for Volcanic Crises discuss further about possible cooperation.

164 Barbados shared that the threat of pyroclastic flows from the La Soufrière eruption is a concern. They enquired about tsunami risk for Barbados in the event of significant pyroclastic flows from the Eastern coast of Saint Vincent. The Chair also asked whether any modelling of tsunami scenarios caused by pyroclastic flows from La Soufrière had been conducted. Barbados noted that such modelling had not been conducted and that they would need to contact other agencies to enquire about capacity to conduct such modelling. The TT responded that modelling on pyroclastic flows is a challenge due to current tools and maintenance of current sea level stations. The TT noted that the absence of tide gauges in Barbados is problematic, so the latter should instead rely on the Saint Vincent indicators.

165 France indicated that there is an ongoing collaboration between the SRC, the USF and the Centre national de la recherche scientifique (CNRS) on simulations of tsunamis generated by the La Soufrière volcano.

166 The US noted that such tsunami modelling is very challenging, because estimates of pyroclastic flow magnitudes and other data are difficult to estimate accurately in a short

timeframe. As such, tide gauges generally provide the only real-time data, and the absence and scarcity of these in some areas is a critical impediment to tsunami modelling.

167 The SRC informed that the likelihood of a large enough pyroclastic flow to enter the sea from La Soufrière is small, thus the threat of a large tsunami is limited. This is due to the shape of the crater and crater walls which constrain most of the materials. In addition, the side of the volcano facing Barbados has a solid wall, so a collapse is unlikely in this sector. Thus, the likelihood of a tsunami is very remote.

168 France recalled that the 1902 eruption of La Soufrière generated 1m waves in Saint Lucia, Barbados and Grenada, according to the NCEI database.

169 The Chair concluded that even a small threat of tsunami, especially with a historic precedent, needs to be monitored.

170 **The ICG noted** the report of the Task Team on Tsunami Procedures for Volcanic Crises.

5.4 REPORT OF THE TASK TEAM ON TSUNAMI EVACUATION MAPPING

171 Mr Norwin Acosta (Nicaragua), Chair of the Task Team on Tsunami Evacuation Mapping, presented this report.

172 He reported on the evolution of Geographic Information Systems, particularly in relation to mapping with paper and digital formats. These systems are tools that integrate various components which allow for the organization, storage, manipulation, analysis and modeling of large amounts of real-world spatial data. They include social-cultural, economic and environmental dimensions which can inform effective decision-making.

173 Evacuation maps primarily illustrate evacuation areas, safe zones, meeting points, evacuation routes, locations and buildings of interest, and information relating to emergency management. This information is important, both for the population and for decision-makers to create effective contingency and emergency plans in the event of a tsunami.

174 He reported on the Web Map Service (WMS) of the Open Geospatial Consortium (OGC), which allows digital mapping. He highlighted a map tool developed at the University of Puerto Rico in which all mapping for evacuation maps were included. The goal is to have a tool that can be used by the population and decision-makers to make appropriate contingency plans in the event of a tsunami. Recently, two exercises were carried out to demonstrate how this tool can be used. One example calculated the best evacuation route for a school, showing the evacuation time and necessary route.

175 Mr Acosta noted that in Nicaragua, this type of tool has also been developed with open source maps. The goal is to inform the population about how their area would be impacted in the event of a tsunami, as well as to endow them with the necessary tools to use appropriate routes and evacuate to safe areas.

176 He next reported on methods for sharing and disseminating evacuation maps. He noted that such maps would ideally be accessible through mobile devices. Because mobile phones have a location device through GPS, the Web Map could detect someone’s location and send an informative message if an individual is within a tsunami evacuation area. Moreover, this would help populations locate safe areas. He underlined that to get these maps, it is not necessary to wait for the best data; the most important element of this on-going process is the appropriation and use of these tools and data.

177 The US commented that additional information on tsunami evacuation maps can be found through ITIC and UNESCO-IOC Manuals and Guidelines 82 (IOC/2020/MG/82), available in English and Spanish.

178 The Chair added that ITIC also created a document on best practices on Vertical Evacuation Guidance in the event of a tsunami and another document on Marine Ports Guidance. Both documents are available on the ITIC website.

179 **The ICG noted** the report of the Task Team on Tsunami Evacuation Maps.

5.5 UNITED NATIONS DECADE OF OCEAN SCIENCE FOR SUSTAINABLE DEVELOPMENT

180 Mr Michel Angove, Director of the NOAA Tsunami Programme, gave a presentation on the UN Decade of Ocean Science for Sustainable Development and recommendations finalized by the intra-sessional WG on the United Nations Decade of Ocean Science for Sustainable Development, which met on 28 April 2021.

181 Mr Angove recalled the work of the TOWS-WG in framing the structure of a Tsunami Programme within the Ocean Decade. He further recalled key activities which have contributed to tsunami recommendations for the Decade, including the UN Ocean Decade Western Tropical Atlantic workshop on 27 and 28 April 2020, the mechanism and opportunities of IOCARIBE, the Regional Planning Group and WGs established by Societal Outcomes and Capacity Development in July 2020, as well as the virtual Ocean Decade series.

182 He set out key challenges and opportunities of the Decade to advance tsunami capability in the areas of science, technology and preparedness. These include improving data exchange, improving speed of tsunami detection and measurement systems on the basis of new technologies scaling the IOC Tsunami Ready programme, increasing capacities for tsunami warning and mitigation with Small Island Developing States (SIDS) and less developed states, and ensuring interoperability with other components of a global coastal Multi-Hazard Early Warning System. Key capabilities that the tsunami group will aim to focus on within the UN Ocean Decade include instrumenting SMART cables and expanding use of GNSS stations from public networks around the world. He emphasized the aim to link together science, capacity development, preparedness and early warning systems. The Ocean Decade provides a unique opportunity for achieving this.

183 Next, he reported on the expected structure and linkages of the Tsunami Programme under the UN Ocean Decade. The ICG structure will be important for managing activities under the programme. In addition, TOWS-WG will perform functions of the Global Steering Committee for the programme. A Scientific Committee with an advisory role will be established under the TOWS-WG to help develop a Ten-year Research, Development and Implementation Plan. This Plan will be presented for endorsement at the next TOWS-WG session. The four ICGs will perform regional Steering Committee functions. Lastly, specific coalitions will be created, including a special Coalition for Tsunami Ready which will be established in collaboration with other critical stakeholders across the UN structure and national civil protection agencies.

184 France commented that they fully encourage the proposal and recommendations for the Ocean Decade, and expressed France will volunteer to participate in the Tsunami Programme.

185 **The ICG adopted** Recommendation ICG/CARIBE-EWS-XV.6.

6. PROGRAMME AND BUDGET FOR 2020-2021

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

187 Mr Aliaga reported that the regular budget of IOC for its Tsunami programme is organized around three main themes: 1) Promoting integrated and sustained monitoring and warning systems, 2) Educating communities at risk with respect to ocean-related hazards prevention, and 3) Contributing to develop Member States capacities for coastal hazard assessment.

188 He noted that the regular global budget for 2020 and 2021 is close to US$20,000. Of this amount, US$18,000 has already been spent: US$5,000 for Secretariat support, US$2,000 for WTAD 2020 and US$11,000 for Secretariat support to ICG and WG/TT meetings.

189 With regard to 'educating communities at risk with respect to ocean-related hazards prevention', the available amount for CARIBE-EWS is US$52,000 for 2020 and 2021. Of this amount, US$27,000 has already been spent: US$5,000 for participation of CTIC coastal hazards specialists to TOWS-WG sessions, US$10,000 for support to Tsunami Ready processes and US$12,000 to support Ocean Teacher Global Academy (OTGA) trainings on tsunami awareness (lead by ITIC) and Tsunami Ready (lead by BMKG). For the latter, the first online trainings for tsunami awareness are expected in June 2021 and for Tsunami Ready in September 2021. These trainings will be available online. For this second line of budget, IOC will contribute US$10,000 to WTAD 21, specifically for creating videos. He noted that any left-over funds, which have to be spent before the end of the year, will likely be allocated to Tsunami Ready. With regard to extra-budgetary expenditure, Mr Aliaga noted the EUR€500,000 from DIPECHO-CTIC which was running from 2018 to 2020 as well as the US$38,000 from Australia Aid (AusAid) for 2021 which will specifically support two communities becoming Tsunami Ready in Grenada.

190 With regard to the third theme to 'contribute to develop Member States' capacities for coastal hazards assessments', the available amount for CARIBE-EWS is US$26,000. Of this amount, only US$1,000 has been spent or committed.

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

7. NEXT SESSIONS

7.1 CONFIRMATION OF DATE AND PLACE OF ICG/CARIBE-EWS-XVI

192 The Chairperson recalled that, at the Fourteenth session of ICG/CARIBE-EWS, Haiti had confirmed its willingness to host the Fifteenth session; however, this Session was held online due to limitations related to the COVID-19 pandemic. The Chair also recalled that Cuba and Aruba had indicated that they would consider hosting the Sixteenth or Seventeenth session, and that Cuba had confirmed its intent to host the Sixteenth session.

193 Representatives from Cuba were unable to join the session, so the Chair noted that they would be contacted via email to discuss their hosting of the Sixteenth session.

194 Haiti noted that it will be unable to confirm hosting of the Sixteenth session due to current political unrest and safety concerns. Haiti added that it could host the Eighteenth session in 2024.

195 Aruba noted that it was also unable to confirm hosting of the Sixteenth session due to an imminent change in government.

196 The dates for the Sixteenth session were provisionally set for 25 to 29 April 2022.

197 The Chair noted that if a virtual Sixteenth session was held, the duration would also be four days.

198 **Action:** The Chair and Secretariat will reach out to Cuba, Haiti and Aruba during the second half of 2021 to explore hosting of the Sixteenth session.

7.2 TARGET DATE FOR ICG/CARIBE-EWS-XVII

199 The dates for the Seventeenth session were provisionally set for 24 to 28 April 2023.

8. ANY OTHER BUSINESS

200 No other business was reported.

9. ADOPTION OF DECISIONS AND RECOMMENDATIONS

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

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

- Working Group 1 on Monitoring and Detection Systems:
  - Chair: Dan McNamara (USA, 2019–2022)
  - Vice-Chair (Seismology): Wilfried Strauch (Nicaragua, 2019–2022)
  - Vice-Chair (Sea Level): Laura González (Colombia, 2021–)
  - Vice-Chair (GNSS): Gloria Romero (Venezuela, 2021–)
- Working Group 2 on Hazard Assessment:
  - Chair: Nicolas Arcos (USA, 2018–2023)
  - Vice-Chair: Raphaël Paris (France, 2021–)
- Working Group 3 on Tsunami Related Services:
  - Chair: Emilio Talavera (Nicaragua, 2018–2023),
  - Vice-Chair (Technology and communications platform for alerts): Ana Pérez (Venezuela, 2021–)
  - Vice-Chair (Protocols for end to end communication and dissemination of warnings): Elizabeth Vanacore (PRSN, USA, 2018–2023)
- Working Group 4 on Preparedness, Readiness and Resilience:
  - Chair: Christa von Hillebrandt Andrade (USA, 2018–2023)
  - Vice-Chair (Resilience): Patrick Tyburn (France, 2018–2023)
  - Vice-Chair (Public Awareness): Jose Antonio Aguilar (Venezuela, 2020–)

203 **The ICG decided** on the continuation or establishment of the following Task Teams and Group of Experts:

- Task Team Tsunami Ready
  - Co-Chair: Matthieu Peroche (France, 2021–)
  - Co-Chair: Fabian Hinds (Barbados, 2021–)
- Task Team Caribe Wave 20
  - Elizabeth Vanacore (USA, 2017–2022)
- Task Team Volcanic Sources
  - Chair: Valerie Clouard, (France, 2018–2023)
- Task Team Tsunami Evacuation Mapping
  - Chair: Norwin Acosta (Nicaragua, 2018–2023)
- Task Team on Future Goals and Performance Indicators
  - Chair: Mary Rengifo (Colombia, 2019–2023)
  - Vice-Chair: Wagner Rivera (Dominican Republic, 2019–)
- Group of Experts on the Work and Implementation Plan to Enhance the Warning System by including Other Coastal Hazards
  - Chair: *tbd*
  - Vice-Chair: *tbd*

204 **The ICG decided** the following Member States for the Task Team on the UN Decade of Ocean Science for Sustainable Development:

- France: tbd (2021–)
- USA: Mike Angove (2021–)
- Venezuela: Ileana Osorio Acosta (2021–)

10. CLOSE OF THE SESSION

205 The Chair, Dr Chacón Barrantes, thanked the Plenary, WGs, TTs and intra-sessional WGs for their involvement and contributions during the three days of the Session and the whole intersessional period, despite the limitations of the context of the COVID-19 pandemic. She also gave a special thanks to the Chairs and Vice-Chairs of WGs and TTs that had been replaced, and welcomed the new Chair and Vice-Chairs.

206 The Chair and Technical Secretary also expressed appreciation for the work of the Secretariat team and Kudo interpreters. The Chair expressed her hope that the next ICG/CARIBE-EWS Session will be able to be held in person.

207 The Group thanked the Chair for the success of the Session.

208 The meeting closed at 17:00 (UTC) on 29 April 2021.

ANNEX I

AGENDA

1. WELCOME AND OPENING

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

1.2 WELCOME BY INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION OF UNESCO

2. ORGANIZATION OF THE SESSION

2.1 ADOPTION OF AGENDA

2.2 DESIGNATION OF THE RAPPORTEUR(s)

2.3 CONDUCT OF THE SESSION, TIMETABLE AND DOCUMENTATION

3. REPORT ON INTERSESSIONAL ACTIVITIES

3.1 CHAIR'S REPORT

3.2 CARIBE-EWS SECRETARIAT REPORT

3.3 REPORT OF THE CARIBBEAN TSUNAMI INFORMATION CENTER (CTIC)

3.4 REPORTS FROM UN AND NON-UN ORGANISATIONS (WORLD TSUNAMI AWARENESS DAY-WTAD)

3.5 STATUS OF OTHER ICGs

3.6 TSUNAMI SERVICES PROVIDER REPORT (PTWC)

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

3.8 REPORT OF CARIBE WAVE 2021

4. WORKING GROUP PROGRESS REPORTS

4.1 WORKING GROUP 1: MONITORING AND DETECTION SYSTEMS

4.2 WORKING GROUP 2: HAZARD ASSESSMENT

4.3 WORKING GROUP 3: TSUNAMI RELATED SERVICES

4.4 WORKING GROUP 4: PREPAREDNESS, READINESS AND RESILIENCE

5. POLICY MATTERS

5.1 EXERCISE CARIBE WAVE 2022

5.2 REPORT OF THE TASK TEAM ON TSUNAMI READY PROGRAMME

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

5.4 REPORT OF THE TASK TEAM ON TSUNAMI EVACUATION MAPPING

5.5 UN DECADE OF OCEAN SCIENCE FOR SUSTAINABLE DEVELOPMENT

6. PROGRAMME AND BUDGET FOR 2020-2021

7. NEXT SESSIONS

7.1 CONFIRMATION OF DATE AND PLACE OF ICG/CARIBE EWS-XVI

7.2 TARGET DATE FOR ICG/CARIBE EWS-XVII

8. ANY OTHER BUSINESS

9. ADOPTION OF DECISIONS AND RECOMMENDATIONS

10. CLOSE OF THE SESSION

ANNEX II

RECOMMENDATIONS

Recommendation ICG/CARIBE-EWS-XV.1

Tsunami Monitoring and Detection Systems

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

Considering the report of Working Group 1 (WG1) on Monitoring and Detection Systems,

Also considering the status of the availability of observational data in the Caribbean and Adjacent Regions,

Appreciates the NOAA Caribbean Tsunami Warning Programme (CTWP) for improving the automated processing and reporting on the status of seismic and sea level stations,

Acknowledges NOAA support for the Puerto Rico Seismic Network (PRSN) to coordinate a training workshop for seismic network operators in the region,

Noting that the PTWC reports significant seismic station outages throughout the Caribbean,

Further noting that many of these stations are available at the USGS, PRSN, the European Data Centre and the Incorporated Research Institutions for Seismology (IRIS) Data Management Centre (DMC),

Recommends WG1 together with PTWC to perform a study to quantify the impact of tsunami detection parameters and messaging performance,

Further recommends PTWC with the help of WG1 develop real-time seismic data backup systems and SOPs for the PTWC,

Also recommends PTWC with the help of WG1 perform a detailed review and update of seismic metadata and Internet Protocol (IP) addresses at PTWC and NTWCs,

Noting that a high percentage of the stations in the CARIBE-EWS sea level network are currently non-operational or partially operational, which can delay the proper assessment of tsunami events and the issuance of timely and accurate tsunami alerts,

Further noting the ongoing eruption at La Soufrière, St Vincent and the recent change in warning level at Mount Pelée, Martinique, France,

Considering the progress in the use of GNSS reflectometry (GNSS-R) at GNSS stations to measure sea level,

Urges Member States and sea level station operators contributing to CARIBE-EWS to maintain their sea-level stations to an operational standard,

Also urges Member States and sea level station operators to regularly review and update the status of sea level stations in the web pages of the IOC's Sea Level Station Monitoring Facility and in the CTWP reports prepared on behalf of the CARIBE-EWS,

Recommends evaluation of and action towards the use of GNSS-R in real time, to increase the sea level station network,

Encourages the Member States that have non-operational stations to inform the Secretariat of their plans or needs for repair,

Recommends the rapid deployment of sea-level monitoring instrumentation on St Vincent (particularly at Chateaubelair) and on Martinique,

Also recommends the establishment of a group to advise on the installation of temporary sea level sensor networks around volcanoes when volcanic activity increases,

Encourages the Secretariat, WG1 and Chair of the Task Team for Volcanic Crises to explore with the Joint Research Centre (JRC), the feasibility of deploying the sea-level-based tsunami detection system that was developed for Anak Krakatau,

Recommends a survey of sea-level network operator status by WG1 and CTWP with the goal of improving the up time of the sea-level network,

Also recommends that seismic and sea-level network operators seriously consider the experience from Hurricanes Harvey, Irma, Maria, Eta, Iota and Nate to increase the resilience of instrumentation to powerful hurricanes,

Further recommends the recovery and expansion of Deep-ocean Assessment and Reporting of Tsunamis (DART) services in the Caribbean basin,

Recognizes the efforts of UNAVCO and specifically Karl Feaux for his service on WG1 as vice-chair for GNSS and his efforts to increase the availability of high rate, real-time GNSS data to improve earthquake and tsunamis detection and assessment,

Recommends upgrading as necessary the 193 GNSS stations identified by the GNSS Task Team and make these stations available for tsunami early warning,

Also recommends the continuation of GNSS integration into the tsunami forecasting work with periodic updates from NOAA on the progress of the system,

Recommends Nicaragua after finalizing its experimental mode to enter routine functioning of the Central American Tsunami Advisory Centre (CATAC) established at INETER, Managua, and establish the internal organizational structures for it,

Recognizes the recent commissioning of several government Wide Area Networks,

Recommends that Member States reserve capacities on such networks for geophysical monitoring.

Financial Implications: None

Recommendation ICG/CARIBE-EWS-XV.2

Tsunami Hazard Assessment

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

Considering the report of Working Group 2 (WG2) on Tsunami Hazard Assessment,

Acknowledges the completion of the report of the Experts Meetings on 'Sources of tsunamis for the Lesser Antilles',

Recognizes a lack of specifically identified and easily accessible volcanic and landslide tsunami sources for the Caribbean region, therefore, **acknowledges** the need to progressively include volcanic and landslide sources and to build a dataset of scenarios for the Caribbean,

Acknowledging that many countries in the Caribbean region lack the internal scientific resources and capacity to conduct an evidence-based risk analysis and hazard assessment of their own vulnerability to the tsunami threat,

Recognizing that baseline data is needed to provide a logical foundation and evidence-based framework for their internal tsunami preparedness programmes,

Acknowledges the need for a step-by-step best practice guide for countries seeking to conduct their micro zonation tsunami risk assessments and wave run up modelling for their islands and States,

Acknowledges the updates to Caribbean and Adjacent Regions Tsunami Sources and Models (CATSAM) by WG2 members and invited experts, specifically Universidad Nacional Costa Rica, EDANYA Group and NOAA's National Centers for Environmental Information (NCEI),

Encourages the ongoing maintenance and updates to CATSAM,

Encourages Member States to provide historical tsunami data and/or publications to NOAA's NCEI and collocated World Data Service for Geophysics to be available on CATSAM,

Recommends exploring ways to provide access to and/or compile non-seismic sources in CATSAM or another format,

Encourages a numerical modelling and probabilistic analysis of tsunamis related to volcanic activity and instability (i.e., large landslides, etc.) in the Caribbean,

Instructs the Secretariat to provide regular updates of Tsunami Ready communities to WG2 for CATSAM,

Requests the Task Team CARIBE WAVE provides WG2 with the parameters, including associated files (e.g. shapefiles, geotiff, etc.) of the corresponding scenarios once they are available for future CARIBE WAVE exercises,

Recognizing the need for adequate bathymetric and topographic data to perform tsunami numerical modelling and obtain tsunami inundation and evacuation maps, and **considering** the elevation data sharing challenges in the Caribbean region,

Recommends WG2 develop a "roadmap", or general guidance, on how to upload elevation data to the Caribbean Marine Atlas (CMA), and **encourages** Member States to upload in CMA

their elevation data, and to provide status of available data (e.g., extent, resolution, access, etc.) to WG2,

Encourages the execution of a regional training on the development of Digital Elevation Models (DEMs) for tsunami inundation modelling **considering** the recent development of a DEM Training Workshop proposal,

Considering that the survey on tsunami evacuation mapping sent to Member States had low participation rates,

Recommends re-opening the survey on tsunami evacuation mapping in the next intersessional period to obtain a better understanding of the current state of evacuation mapping and planning process in the region,

Recognizing that Probabilistic Tsunami Hazard Assessment (PTHA) for the Caribbean would result in improved tsunami source characterization and, ultimately, improved evacuation planning and mapping,

Notes that the Caribbean will benefit from the implementation of a PTHA project considering best practices and current state of the knowledge, and **further notes** ICG/CARIBE-EWS Chair's Letter of Support for PTHA in the Caribbean,

Recognizes the need for adequate bathymetric data to perform tsunami numerical modeling and to obtain tsunami inundation and evacuation maps,

Further recognizes the ongoing efforts of International Hydrographic Organization (IHO) and Meso American Caribbean Sea Hydrographic Commission (MACHC), General Bathymetric Chart of the Oceans (GEBCO) as well as the storm surge modelling community to bring together all available bathymetric data,

Recommends the Task Team on Evacuation Maps with the support from WG2, WG4, and CTIC to create a repository at the regional level to hold all National Evacuation Maps and "How to" manuals and supplemental manuals used for the creation of the tsunami inundation and evacuation maps,

Further recommends the repositories should be shared with ICG/CARIBE-EWS via national links from Member States websites and be placed at the ICG/CARIBE-EWS webpage at the IOC website,

Also recommends Member States to share web map, interactive maps, and mobile apps through their websites and make these links available to the Task Team on Tsunami Evacuation Maps for posting at the ICG/CARIBE-EWS webpage on the IOC website.

Financial Implications: None

Recommendation ICG/CARIBE-EWS-XV.3

Tsunami Related Services

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

Considering the report of Working Group 3 (WG3) on Tsunami Related Services,

Recalling that from CARIBE WAVE survey and Pacific Tsunami Warning Centre (PTWC) communication tests indicate that there is almost complete reliance on Email for reception of products from Tsunami Service providers (TSPs) and very few Tsunami Warning Focal Points (TWFPs) and National Tsunami Warning Centres (NTWCs) are using more robust methods, like the World Meteorological Organization (WMO) Information System (Global Telecommunications System, GTS), GEONETCAST, and EMWIN,

Recommends to Member States:

a) To diversify their means of communication, so as to guarantee the redundancy of communications between national centres and the PTWC (3 or more means to receive the message), and between national centres and emergency management agencies (3 or more means to receive and disseminate the message),

b) To explore the use of social network applications and other web-based digital media, for the dissemination of educational and public awareness messages, for community preparation, and for the dissemination of emergency notifications. These communication methods/vehicles should also be used in national and international tests and exercises, as alternative methods of communication,

c) To review the training proposal addressing social media communicators, in order to win them as allies in case of emergencies caused by tsunamis, but above all, to secure their involvement for information campaigns on self-protection measures and preparation for this threat. The experiences in the region suggest that the focus should be on integrating these communications professionals as part of the national alert system, guiding them on the important role they should play as part of the system.

Requests WG3 to conduct an analysis or survey of Member States' redundant communication systems including GOES satellite system upgrades and assessing their future applicability, noting that the survey quality will depend on active Member States/territories participation,

Recommends Member States to actively incorporate voluntary amateur radio organizations in each country, as support mechanism in national and international communications systems and protocols, and in CARIBE WAVE exercises, as an alternative and effective means of communication in case of alert or disaster, and to ensure redundancy of communications,

Further recommends Member States to document and share their experiences regarding current communication problems, in terms of means and technologies for communications, or in terms of messages and types of messages received and given, and also share how those challenges are being overcome (and the way they are doing it), and successful experiences, in order to serve as a reference to the rest of the countries in the region,

Instructs WG3 to resume the initiatives analysing use of new technology applications such as web 2.0 or others to facilitate the dissemination of information in case of tsunami emergencies,

Recognizing that email is not always an effective way of delivering emergency notifications that may require immediate action to promote public safety and minimize loss of life,

Recommends PTWC explore the costs and feasibility of a Geographical Information Systems (GIS) based, robo-call feature to issue tsunami warning messages to tsunami warning focal points.

Financial Implications: None

Recommendation ICG/CARIBE-EWS-XV.4

Preparedness, Readiness and Resilience and the Caribbean Tsunami Information Centre

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

Considering the reports of the Caribbean Tsunami Information Center (CTIC), UNDRR, Working Group 4 (WG4), the Task Team on Tsunami Ready; and progress of inventories on Tsunami Signage and Social Science, COVID-19 and Multiannual Exercise Guidelines and Tsunami Ready pilot implementation,

Notes the significant actions and strong cooperation of the CTIC, NOAA Caribbean Tsunami Warning Programme (CTWP), WG4 and the Tsunami Ready Task Team to the advancement of preparedness, readiness and resilience to mitigate the impacts of tsunamis and other coastal hazards in the Caribbean and Adjacent Regions during the April 2019 to March 2021 period, and the associated reports,

Requests CTIC in association with the Tsunami Ready Task Team to administer the Tsunami Ready evaluation survey for Tsunami Ready communities recognized since 2019,

Further requests CTIC in association with the Tsunami Ready Task Team and Member States determine the target number of communities in the CARIBE-EWS for Tsunami Ready recognition by 2030,

Acknowledges with appreciation the Caribbean Tsunami Warning Program (CTWP) for the revision and update of Manual and Guide 86 *The Multi-Annual Community Tsunami Exercise Programme: Guidelines for the Tsunami and other Coastal Hazards Warning System for the Caribbean and Adjacent Regions* (MG 86)*,* originally developed by France,

Notes with appreciation that the Universidad Nacional Costa Rica is reformatting in a style more conducive for community engagement,

Instructs the WG4 to finalize the MG 86 and develop a strategy to increase the familiarization and use of the Guide among CARIBE EWS Member States and TOWS-WG,

Notes the importance of having an updated inventory of Tsunami Signage and Public Displays employed in the region and its support to the implementation of the Tsunami Ready programme,

Further notes that 50 percent of the Member States have contributed examples of the signage used,

Reminds Member States in coordination with local authorities to respond to the annual call to provide updates, including the location metadata, artwork and photographs of installed signs for inclusion in the signage database,

Encourages Member States in coordination with local authorities to develop an inventory of the signage installed in the country,

Requests the WG4 to provide guidance on tools and resources used for inventory of installed signage,

Further requests the CTWP to continue updating and posting annually the Signage Inventory and include a section on best practices for national inventories as well as new best practices for the public display of tsunami guidance information,

Notes the theme for the World Tsunami Awareness Day (WTAD) for 2021 is aligned with the Sendai Framework for Disaster Risk Reduction 2015–2030 and focuses on Target G to 'Substantially enhance international cooperation to developing countries through adequate and sustainable support to complement their national actions for implementation on the present framework',

Encourages Member States to commemorate WTAD on November 5, and share their activities,

Recommends for CTIC to work on WTAD 2021 with the UNDRR, UNESCO/IOC, ICG/CARIBE-EWS WG4 and Member States to coordinate a CARIBE-EWS activity,

Noting that the International Tsunami Information Center (ITIC) and the Indonesia BMKG have been designated as Ocean Teacher Global Academy Specialized Training Centres (OTGA STC) in 2020.

Further noting the ITIC will be developing courses to support Tsunami Awareness, Tsunami Early Warning Systems, Tsunami Warning and Emergency Response Standard Operating Procedures, Tsunami Evacuation, Mapping, Planning and Procedures (TEMPP), and Tsunami Warning Centre Staff Competencies, while BMKG will be developing courses on Tsunami Ready and Tsunami Hazard and Risk Assessment.

Requests the ITIC to report on the progress to the ICG/CARIBE-EWS WG4,

Noting the initial work in identification of social science resources through the preparation of the database on social science articles focused on Disaster Risk Reduction (DRR),

Recommends WG4 to engage social scientists for a tsunami and other coastal hazards risks and early warning systems perception study in the CARIBE-EWS, and to collaborate in this particular topic with other initiatives in the region, such as the CREWS Caribbean, aiming to improve institutional and community response's capabilities,

Noting the CTIC and WG4's contribution to the development of COVID-19 Guidelines for Member States which was issued in support of CARIBE WAVE 2020,

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

Further recognizing the current work of the CTIC on the review and development of framework and partnership agreements with regional organizations in particular,

Notes the recommendations of the CTIC Board, and as defined at 6.0 of the CTIC Board Terms of Reference, **accepts** the recommendation of the ICG/CARIBE-EWS Secretariat for the CTIC Board to develop a strategic plan to align the terms of reference for the CTIC, mobilize funding and in-kind support for the CTIC from ICG/CARIBE-EWS Member States, donors, universities and other technical institutions and report to ICG/CARIBE-EWS-XVI,

Recommends deeper cooperation between CTIC, CTWP, ITIC, ICG/CARIBE-EWS WG4, the Task Team on Tsunami Ready, and partners including UNDRR and the Regional Early Warning System Consortium (REWSC) to support Member State preparedness and resilience,

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

Urges the IOC Secretariat and CTIC to work with the CARIBE-EWS officers to mobilize funding and in-kind support for Tsunami Preparedness, Readiness and Resilience Activities.

Financial Implications: None

Recommendation ICG/CARIBE-EWS-XV.5

Exercise CARIBE WAVE 22

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

Noting the successful conduct of the CARIBE WAVE 20 and CARIBE WAVE 21 exercises with the participation of 98 percent of the Member States and Territories and almost 400,000 people in total despite the COVID-19 pandemic,

Congratulates all the Member States and Territories for promoting, coordinating, participating and providing feedback on the CARIBE WAVE 21 exercise,

Appreciates the Caribbean Tsunami Warning Program (CTWP) and Pacific Tsunami Warning Center (PTWC) for their support in generating the handbook and simulated products and overall conduct of the CARIBE WAVE 20 and 21 exercises,

Further appreciates the United States Geological Survey (USGS) for their support in generating simulated ShakeMap and PAGER products for the exercises,

Further appreciates the work of the Tsunami Ready Task Team and Tsunami Ready and TsunamiReady® communities for encouraging participation in the CARIBE WAVE exercise and synergetic activities increasing tsunami awareness in the region,

Further appreciates the University of Southern California and its funding agencies for the making available TsunamiZone.org for registration,

Acknowledges the good collaboration between the CTIC, CTWP and the CARIBE WAVE Task Team in planning, promoting, executing and evaluating the annual CARIBE WAVE exercises,

Instructs the CTIC to identify actions arising from Caribe Wave Exercise 2021 and coordinate with corresponding Working Groups and Task Teams follow up actions,

Recommends that volcanic eruptions and/or landslides as a source of tsunamis in the Caribbean basin should be considered for future CARIBE WAVE exercises,

Notes that PTWC, the Tsunami Service Provider (TSP) for the region, does not have the ability to run forecasts for these kinds of events and so alternative strategies for notifying public of the dangers must be discussed,

Decides that CARIBE WAVE 22 will consist of 3 scenarios that include 1) a tsunamigenic earthquake along the Muertos Trough south of Dominican Republic, 2) a flank collapse of the Cumbre Vieja Volcano (La Palma, Canary Island), and 3) an offshore event north of Panama along the Northern Panama Deformed Belt,

Suggests that the CARIBE WAVE 23 exercise consist of 3 scenarios that include 1) a volcanic eruption of one of the volcanic islands of the Lesser Antilles, 2) a tsunamigenic earthquake in the vicinity of Jamaica, and 3) a tsunamigenic earthquake near the Panama-Colombia Caribbean boundary,

Suggests that the exercise CARIBE WAVE 2022 will take place on Thursday March 10, 2022, commencing at 14:00 UTC with one dummy message, and the 1st message for the scenarios shortly after according to PTWC simulated procedures for the corresponding scenarios,

Recommends following a similar timetable and benchmarks on CARIBE WAVE 21 and that preparatory webinars follow the same or similar process as used in previous exercises,

Further recommends that an additional webinar be added to the timetable approximately two weeks after the exercise as an official “hot wash” to provide an opportunity for Member States to provide direct feedback to the Task Team and share knowledge gained from the exercise and identify gaps and strengths in the warning system,

Further recommends that the registration process remains at www.tsunamizone.org,

Recommends CARIBE WAVE 22 Task Team to modify exercise evaluation metrics to reflect level of satisfaction with type and quality of resources available,

Decides to establish a CARIBE WAVE 22 Task Team modelled after past CARIBE WAVE Task Teams,

Recommends a timetable for CARIBE WAVE 22 modelled after previous timetables,

Further recommends the representatives of the ICG/CARIBE-EWS in the TOWS-WG Task Team on Disaster Management and Preparedness share the exercise results and best practices and seek global coordination of exercises, including standardization of the questionnaire.

Financial Implications: None

Recommendation ICG/CARIBE-EWS-XV.6

UNITED NATIONS DECADE OF OCEAN SCIENCE FOR SUSTAINABLE DEVELOPMENT

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

Recognizes that the United Nations Decade of Ocean Science for Sustainable Development (Ocean Decade) is an opportunity to develop and enhance partnerships and collaborations with stakeholders from other coastal hazards in the Caribbean and Adjacent Regions,

Appreciates the coordinating function of the IOCARIBE for the Ocean Decade in the Western Tropical Atlantic,

Notes and **supports** the TOWS-WG-XIV recommendation with noted edits to the recommendations of TOWS-WG and the Terms of Reference of the Scientific Committee (Appendix 1) to establish an Ocean Decade Tsunami Programme with a 10-year Research, Implementation and Development Plan,

Decides to establish an ICG/CARIBE-EWS Task Team on the Ocean Decade. The Task Team will reflect the geographic diversity of the region and will strive to achieve gender balance with the following Terms of Reference:

Membership:

- Three (3) Member States, representative of each of the main language groups, selected by the ICG/CARIBE-EWS,
- Four (4) representatives nominated by each of the technical Working Groups of the ICG,
- Two (2) representatives nominated by Permanent Observers of the ICG/CARIBE-EWS,
- A representative of the CTIC,
- A representative of the IOCARIBE,
- Elected and nominated representatives are elected in personal capacities and remain members for two (2) years. Elected and nominated members are eligible for a second term,
- Chair to be named by the Members of the ICG/CARIBE-EWS Task Team on Ocean Decade,
- Chair will reserve right to name experts as additional Task Team members based on subject matter needs or individual Member States requests.

Mission: to provide advice and support ICG/CARIBE-EWS and its Member States in the implementation and monitoring of the 10-year Research, Implementation and Development Plan for the Ocean Decade Tsunami Programme.

Functions:

- To closely cooperate with Member States and Territories to collate, coordinate, guide and monitor the implementation of actions in support of the 10-year Research, Implementation and Development Plan for the Ocean Decade Tsunami Programme in the Caribbean and Adjacent Regions,

- To coordinate ICG/CARIBE-EWS Ocean Decade work with the corresponding Ocean Decade Western Tropical Atlantic Working Groups, as well as the actions of regional partners and other stakeholders including the private sector,

- To work closely with other UNESCO/IOC-led ICGs to support the development and monitoring of the 10-year Research, Implementation and Development Plan for the Ocean Decade Tsunami Programme,

- Report to ICG/CARIBE-EWS on an annual basis and to the ICG/CARIBE-EWS Officers on regular basis.

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 ICG sessions.

Financial Implications: None

Appendix 1 to Recommendation ICG/CARIBE-EWS-XV.6

Terms of reference:
Ocean Decade Tsunami Programme Scientific Committee

The Scientific Committee has an advisory role for the duration of *the programme.*

Membership:

- Four (4) members nominated by each of the TOWS-WG Task Teams,

- Three (3) members nominated by the TOWS-WG on the basis of their scientific expertise,

- All members will serve for a period of two years and would be eligible for renewal once.

The Scientific Committee will:

1. 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*",

2. Identify and address gaps in global tsunami hazard assessment as follows:

a. Comprehensive assessment to include all potential tsunamis, anywhere in the world, regardless of their source,

b. Identify strategies to validate historical tsunami sources, through the application of paleotsunami techniques and historical seismology,

3. Identify gaps in tsunami detection, measurement, forecasting, with a special emphasis on tsunamis generated close to populated coastlines,

4. Propose to enhance sensing and analysis strategies to enable the rapid characterization of tsunami sources through the combined use of land-based seismic and geodetic sensors, GNSS terminals, coastal sea level gauges, deep-ocean tsunameters, SMART repeaters on deep-ocean fiber-optic cables and satellite-based observations,

5. Propose a roadmap for collaboration with the Joint Task Force ITU/WMO/IOC SMART cable initiative to fully explore the feasibility of widespread deployment of scientific instrumentation on deep-ocean fiber-optic cables to improve the capability to rapidly detect and characterize tsunami sources as well as propagating tsunami wave fields,

6. Consider and propose strategies, programmes, and content to enhance societal resilience for tsunami and other ocean hazards,

a. Build the framework needed to ensure the training and development of the next generation of technical-scientific expertise,

b. Identify strategies that allow to characterize structural and social vulnerability in tsunami hazard zones,

7. Review the consolidation of inputs to IOC Circular Letter 2825 *Inventory of actions being* considered *under the United Nations Decade of Ocean Science for Sustainable Development (2021–2030) - Tsunamis and Other Sea-Level Related Hazards*,

8. Submit a Draft 10-Year Research, Development and Implementation Plan for endorsement by the TOWS-WG at its next session.

Recommendation ICG/CARIBE-EWS-XV.7

Local Tsunami Standard Operating Procedures (SOPs)

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

Considering the threat of local tsunamis to the Caribbean and Adjacent Regions – those that can strike coastlines within an hour from the time they were generated,

Further considering the current local tsunami threat to Saint Vincent and the Grenadines, and nearby island states from the ongoing eruption of La Soufrière volcano,

Taking into account past eruptions of undersea volcano Kick-em-Jenny off the northern coast of Grenada and the increased seismic activity at Mount Pelée, Martinique, that may indicate an eruption,

Understanding the challenges (including instrumentation and monitoring capacity) faced by early warning systems to rapidly detect and characterize aseismic tsunami sources such as those from volcanoes and landslides,

Noting further challenges faced by early warning systems to effectively disseminate warnings to at-risk populations for local tsunamis due to time taken for data transmission, analysis and detection, as well as simultaneous breaks in the communication chain caused by the earthquake or eruption,

Further noting the varying characteristics of ICG/CARIBE-EWS Member States with respect to size and land mass, and the resultant implications for travel times in respect of local tsunamis,

Considering the critical role of local authorities within at-risk communities and the importance of community level interventions to plan for local tsunamis threats,

Also considering the information in IOC Manuals and Guides 82 *Preparing for Community Tsunami Evacuations - from Inundation to Evacuation Maps, Response Plans, and Exercises* that includes SOP guidance for local tsunamis,

Further considering the very relevant information in the document, 'Local-Source Tsunami Response Best Practice' prepared for the Pacific Tsunami Warning and Mitigation System (PTWS), with later input from the Indian Ocean Tsunami Warning and Mitigation System (IOTWMS) that was discussed at the Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems (TOWS-WG) and Task Team meetings in Paris 17 – 21 Feb 2020,

Recommends that ICG/CARIBE-EWS Member States work to investigate and understand their potential local tsunami sources as well as the tsunami travel times from those sources to their coasts for Standard Operating Procedures (SOPs) planning purposes,

Also recommends that Member States enhance communication between institutes/authorities involved in tsunami and volcano monitoring and hazard assessment,

Urges Member States to produce an assessment of potential impacts from local tsunamis, for evacuation zone and route planning,

Also urges Member States to educate at-risk populations on the natural tsunami warning signs for their respective sources and emphasize that formal integration of tsunami preparedness programs in the school curricula, the development of family plans, and self-evacuation are the best personal SOP practices for survival,

Encourages Member States to conduct regular tsunami exercises involving the public and including information on local tsunami threats and response, based on self-evacuation as well as official warnings,

Advises Member States to develop SOPs to warn for local tsunamis,

Recommends to the ICG/CARIBE-EWS National Tsunami Warning Centers (NTWCs) and Tsunami Service Providers (TSPs) to manage and be explicit about their limitations regarding local tsunami warning capabilities,

Also recommends that NTWCs encourage populations at risk, to take personal responsibility for their safety and to motivate improvements in those capabilities,

Further recommends that NTWCs and TSPs explore traditional and new methods such as amateur radio, Common Alerting Protocol (CAP), telegram services, SMS, social network messaging, Slack, and GeoNetcast for a more rapid, redundant and effective warning chain and for communication to the public of a local tsunami threat,

Urges NTWCs and TSPs to be ready with pre-scripted and automatically created messages for dissemination, that are specific to the circumstances of each potential local tsunami threat,

Proposes that local authorities, NTWCs and possibly TSPs consider the application of seismological methods of Earthquake Early Warning (EEW) for tsunami warning,

Recommends that ICG/CARIBE-EWS communities prone to tsunami risk, aspire to become Tsunami Ready, as this recognition includes many aspects of preparedness essential for an effective local tsunami response,

Requests the Caribbean Tsunami Information Center (CTIC) to develop specific public awareness materials for local tsunami events,

Recommends to the TOWS-WG that consideration be given across all four ICGs to establish a quick-response capability for volcanoes and potential landslides that pose an imminent tsunami threat through instrumentation with sea-level gauges, real-time GNSS stations, HF Radar, and/or other instruments that can be used by NTWCs and/or TSPs for the purpose of quickly detecting and assessing a local tsunami threat to nearby coastal populations,

Considering the ongoing eruption at La Soufrière in Saint Vincent and the recent change in warning level at Mount Pelée in Martinique,

Recommends the Task Team on Volcanic Crises continue working with the PTWC on the development of SOP and products for potential tsunamis from volcanic activities, which could be tested at CARIBE WAVE 22.

Financial Implications: None

Recommendation ICG/CARIBE-EWS-XV.8

Implementation Plan and Key Performance Indicators

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

Considering the recommendation of the Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems (TOWS-WG) to establish a common and harmonized system for future goals and for monitoring the performance of all ICGs engaged in Tsunami Warning and Mitigation Systems,

Recognizing the good progress in the Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System (ICG/PTWS), in developing a useful Goals and Performance Monitoring Framework,

Considering that ICG/CARIBE-EWS-XIV established the Task Team on Implementation Plan and Key Performance Indicators (KPIs),

Urges Member States to become part of the Task Team on Implementation Plan and KPIs,

Considering the work advanced in the harmonization of the Caribbean implementation plan and the formulation of performance indicators of the system,

Recommends review progress of the activities of the working groups in the short (2019) and medium term (2021) since they may have been affected by the inconveniences generated by the situation of the pandemic and determine the need to extend the Implementation Plan,

Recommends measuring the indicators proposed in the implementation plan to establish the status of the Working Groups of ICG/CARIBE-EWS,

Recommends modifying some activities and indicators where it is identified that efforts are being duplicated in the Implementation Plan,

Recognizing the need to deliver accurate science-based information in understandable language to communities,

Recommends giving a higher priority to the integration of social sciences in the KPIs and Implementation Plan to be developed by the system associated with the interaction with the communities,

Considering that the current country report format does not allow for the identification of the progress of member states in improving tsunami risk management or the impact of the actions of the Working Groups of ICG/CARIBE-EWS,

Recommends develop a new format for the Member States report that allows to measure the real progress of the member countries and Working Groups according to the implementation plan,

Considering the strategy and objectives set by the UN Decade of Ocean Sciences for Sustainable Development,

Recommends complementing the current Implementation Plan with activities to meet the objectives of the UN Decade of Ocean Sciences for Sustainable Development and extend its validity to 10 years,

Recommends focusing the mobilization of resources and international cooperation for least developed countries (LCDs), Small Island Developing States (SIDS) and developing countries,

Considering the need to monitor compliance with the Implementation Plan and annual measurement of the indicators to evaluate ICG/CARIBE-EWS progress status,

Recommends that once the suggested changes to the plan are approved and the work to harmonize KPIs has been completed, the Task Team be in charge of carrying out the annual monitoring of progress against the Implementation Plan and measurement of the indicators.

Financial Implications: None

ANNEX III

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ANNEX IV

PHOTOS OF PARTICIPANTS


PEPIN


Juan Munares

ANNEX V

LIST OF ACRONYMS

AIR Centre	Atlantic International Research Centre
AISR/AFTN	Airborne Intelligence, Surveillance and Reconnaissance/ Aeronautical Fixed Telecommunications Network
AOML	NOAA's Atlantic Oceanographic and Meteorological Laboratory
AusAid	Australian Aid
BMKG	Agency for Meteorological, Climatological and Geophysics (Indonesia)
CARIBE-EWS	Tsunami and Other Coastal Hazards Warning System for the Caribbean and Adjacent Regions
CARIBE WAVE	Caribbean Wave Exercise
CATAC	Central America Tsunami Advisory Centre
CDEMA	Caribbean Disaster Emergency Management Agency
CEPREDENAC	Coordination Centre for the Prevention of Natural Disasters in Central America
CIFI	Inundation Forecasting Initiative
CMT	Centroid Moment Tensor
CNE	Comisión Nacional de Emergencias (Costa Rica)
CNRS	Centre national de la recherche scientifique (France)
CREWS	Climate Risk Early Warning Systems
CTIC	Caribbean Tsunami Information Center
CTWP	Caribbean Tsunami Warning Programme
CUDEM	Continuously Updated Digital Elevation Model
DART	Deep-ocean Assessment and Reporting of Tsunami
DEM	Digital Elevation Model
DIPECHO	European Commission Humanitarian Aid Department's Disaster Preparedness Programme
DRR	disaster risk reduction
EAS	Emergency Alert System

ECLAC	Economic Commission for Latin America and the Caribbean
EMWIN	Emergency Managers Weather Information Network
EOP	Emergency Operation Plan
ETA	estimated time of arrival
EU	European Union
FAHUM	Humanitarian Allied Forces (Spanish acronym for Fuerzas Aliadas Humanitarias)
GIS	Geographic Information System
GNSS	Global Navigation Satellite System
GNSS-R	Global Navigation Satellite System-Reflectometry
GOES	Geostationary Environmental Satellite System
GOOS	Global Ocean Observing System
GPS	Global Positioning System
GTS	Global Telecommunication System
ICG	Intergovernmental Coordination Group (Tsunami programme)
ICG/CARIBE-EWS	IOC Intergovernmental Coordination Group for the Tsunami and other Coastal Hazards Warning System for the Caribbean and Adjacent Regions
ICG/PTWS	IOC Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System
ICSU	International Council for Science
IHO	International Hydrographic Organization
INITER	Instituto Nicaraguense de Estudios Territoriales (Nicaragua)
IOC	Intergovernmental Oceanographic Commission (UNESCO)
IOCAFRICA	IOC Intergovernmental Oceanographic Sub-Commission for Africa and Adjacent Island States
IOCARIBE	IOC Sub-Commission for the Caribbean and Adjacent Regions
IOCARIBE-GOOS	IOC Sub-Commission for the Caribbean and Adjacent Regions-Global Ocean Observing System
IPAWS	Integrated Public Alert and Warning System
IRIS	Incorporated Research Institutions for Seismology

ITIC	International Tsunami Information Centre
KPIs	Key Performance Indicators
LDCs	least developed countries
MACHC	Meso American - Caribbean Sea Hydrographic Commission
MOU	Memorandum of Understanding
NCEI	National Centers for Environmental Information (NOAA, US)
NCTR	NOAA Center for Tsunami Research
NESDIS	National Environmental Satellite Data and Information Service (NOAA, US)
NOAA	National Oceanic and Atmospheric Administration (US)
NOTA	Network of the Americas
NSF	National Science Foundation
NTWC	National Tsunami Warning Center
NWWS	NOAA Weather Wire Service
OGC	Open Geospatial Consortium
OTGA	IOC Ocean Teacher Global Academy
PMEL	Pacific Marine Environmental Laboratory (NOAA, US)
PRSN	Puerto Rico Seismic Network
PTHA	Probabilistic Tsunami Hazard Assessment
PTWC	Pacific Tsunami Warning Center
SCSTAC	South China Sea Tsunami Advisory Centre Sendai Framework for Disaster Risk Reduction
SFDRR	Sendai Framework for Disaster Risk Reduction
SIDS	Small Island Developing States
SIFT	Short-term Inundation Forecasting for Tsunamis system
SINAMOT	Sistema Nacional de Monitoreo de Tsunamis
SMART	Science Monitoring and Reliable Telecommunications
SMEs	small and medium enterprises
SOP	Standard Operating Procedures

SRC	Seismic Research Centre (of the University of the West Indies)
TEWS	Tsunami Early Warning System
TNC	Tsunami National Contact
TOAST	Tsunami Observation and Simulation Terminal
TOWS-WG	IOC Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems
TSP	Tsunami Service Provider
TSU	Tsunami Unit (of IOC)
TsuCAT	Tsunami Coastal Assessment Tool
TT	Task Team
TWFP	Tsunami Warning Focal Point
UCR	University of Costa Rica
UK	United Kingdom of Great Britain and Northern Ireland
UN	United Nations
UNAVCO	NAVCO, Inc. (independent, non-profit,corporation]
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNDRR	United Nations Office for Disaster Risk Reduction
UPRN	Puerto Rico Strong Motion Programme
US	United States of America
USF	University of South Florida (US)
USGS	U.S. Geological Survey
WDS	World Data Service for Geophysics
WG	Working Group
WEA	Wireless Emergency Alerts
WIS	WMO Information System
WMO	World Meteorological Organization
WMS	Web Map Service
WTA	Western Tropical Atlantic Region
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
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5.	First Session of the IOC Sub-Commission for the Caribbean and Adjacent Regions	E, F, S
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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	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*
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*