



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

## **Eleventh Session**

Cartagena de Indias, Colombia  
5–7 April 2016

**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)**

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**UNESCO 2016**

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<sup>1</sup> This report contains a summary in English, French, Spanish and Russian

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## Executive summary

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The Intergovernmental Coordination Group for the Tsunami and other Coastal Hazards Warning System for the Caribbean and Adjacent Regions (ICG/CARIBE-EWS-XI) held its 11th session in Cartagena de Indias, Colombia, from 5 to 7 April 2016, hosted by the Government of Colombia. The meeting was attended by 70 participants from 20 Caribbean countries and territories and three observer organizations: Puerto Rico Seismic Network ([PRSN](#)), [UNAVCO](#), and the World Meteorological Organization (WMO);

The participants reviewed accomplishments in 2015–2016 including the transition to the Pacific Tsunami Warning Center (PTWC) Enhanced Products on March 1, 2016, the development of the requirements for the CARIBE-EWS Tsunami Service Providers, and the very successful conduct of the Caribe Wave '16 exercise with over 330,000 participants from 47 Member States and Territories in the Caribbean and Adjacent Regions making it the largest international tsunami exercise to date.

**The ICG accepted** changes in the Terms of Reference of CTIC as proposed by the CTIC Task Team **and broadened** the scope of the CTIC to include other coastal hazards and put more emphasis on community preparedness.

**The ICG reiterated** the concern that the Caribbean Tsunami Information Center (CTIC), despite its essential function in the region, is not able to continue to function without sustained core funding, **and strongly recommended** that the IOC Executive Council at its 49<sup>th</sup> session and its Financial Committee consider, while preparing the draft programme and budget for 2018–2021 (Draft 39 C/5) the reinforcement of the CTIC, including through core staffing, as part of the implementation of the UNESCO Action Plan for Small Island Developing States (SIDS).

**The ICG approved** the Technical, logistical and administrative requirements of a Regional Tsunami Service Provider for the CARIBE-EWS including the proposed key performance indicators and goals.

**The ICG decided** that the Pacific Tsunami Warning Center (PTWC) be henceforth referred to as a CARIBE-EWS Regional Tsunami Service Provider (RTSP), removing the term "Interim". This recommendation is based on PTWC meeting the criteria established in the CARIBE-EWS Tsunami Service Model, and successful operational performance in support of CARIBE-EWS in a RTSP role.

**The ICG decided** to establish a Task Team on Volcanic Sources under the Chairmanship of Mr Paul Martens (Sint Maarten, Kingdom of Netherlands).

**The ICG requested** the Technical Secretary to draft Terms of Reference for a Group of Experts (GoE) to advise it on the work and implementation plan required to enhance the warning system by including other coastal hazards.

**The ICG also recognized** that a strong need exists in the region for workshops with regional network operators on the evaluation of the calibration and accuracy of seismic and sea-level data and meta-data, and on the technical daily operations of sea-level stations.

**The ICG decided** that Working Group 2 and Member States perform tsunami numerical simulations from sources that were included in the list presented by members of the Working Group 2 at the [Fall 2016 American Geophysical Union annual meeting](#), **and further decided** expanding the list of sources for the Caribbean to include those sources from non-seismic origin.

**The ICG decided** the continued piloting of the approved guidelines for the *Tsunami Ready* Community Performance Based Tsunami Recognition Programme for the Caribbean and Adjacent Regions.

**The ICG decided** a series of workshops similar to the Tsunami Evacuation Maps, Plans Procedures (TEMPP) project be organized for its Member States requiring training in tsunami simulations and development of tsunami inundation and evacuation maps.

**The ICG considered** the outcomes and the delivery of the Tsunami Evacuation Mapping and Planning Procedures process in the CARIBE-EWS in support of the implementation of the *Tsunami Ready* Community Performance Based Tsunami Recognition Programme for the Caribbean and Adjacent Regions.

**The ICG encouraged** Member States to include organisations such as the amateur radio user community to help spread emergency alerts.

**The ICG suggested** that Member States promote and encourage tsunami awareness training for journalists and other representatives of the media who can play a key part in dissemination of information to communities about tsunamis, in terms of preparation, response, and risk reduction.

**The ICG decided** that Caribe Wave 17 will have three scenarios: a Santiago de Cuba; Costa-Rica based on the Limon earthquake 1991; and a North-eastern Antilles based on the 1843 event. This last scenario will be used for the European Union Civil Protection Mechanism Rescue Exercise that is scheduled on 22–23 March 2017. **It further decided** that the exercise takes place on Tuesday 21 March 21 2017 and commences at 1400 UTC.

**The ICG elected** by acclamation Ms Christa von Hillebrandt-Andrade (United States) as Chairperson for the period 2016–2018 and **elected** Mr Paul Maarten (Sint Maarten, Kingdom of Netherlands), Mr Gerard Metayer (Haiti) and Mr Milton Gabriel Puentes (Colombia) as Vice-chairs for the period 2016–2018.

**The ICG accepted** the offer of Costa Rica to host its 12<sup>th</sup> session in April 2017 and **acknowledged** the offer of Curacao to host the 13<sup>th</sup> session in 2018.

## Résumé exécutif

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La onzième session du Groupe intergouvernemental de coordination du Système d'alerte aux tsunamis et autres risques côtiers dans la mer des Caraïbes et les régions adjacentes (GIC/CARIBE-EWS-XI) s'est tenue à Carthagène des Indes (Colombie), du 5 au 7 avril 2016, sous les auspices du Gouvernement colombien. Elle a rassemblé 70 participants venus de 20 pays et territoires des Caraïbes, ainsi que trois organismes observateurs : le Réseau sismique de Porto Rico ([PRSN](#)), l'[UNAVCO](#) et l'Organisation météorologique mondiale (OMM).

Les participants ont passé en revue les réalisations accomplies sur la période 2015-2016, notamment le passage aux produits améliorés du Centre d'alerte aux tsunamis dans le Pacifique (PTWC), qui a eu lieu le 1<sup>er</sup> mars 2016, mais aussi l'établissement de critères s'appliquant aux Prestataires de services relatifs aux tsunamis (RTSP) pour le CARIBE-EWS, ainsi que la mise en œuvre de l'exercice Caribe Wave 16, qui fut un succès et qui a rassemblé plus de 330 000 participants venus de 47 États membres et territoires des Caraïbes et des régions adjacentes, devenant ainsi le plus grand exercice international d'alerte aux tsunamis jamais organisé à ce jour.

**Le GIC a accepté** les modifications apportées au mandat du Centre d'information sur les tsunamis dans les Caraïbes (CTIC) proposées par l'équipe spéciale du CTIC **et a élargi** le champ d'action de ce dernier, en y intégrant d'autres risques côtiers et en mettant davantage l'accent sur la préparation des communautés.

**Le GIC a de nouveau exprimé** son inquiétude quant au fait que le Centre d'information sur les tsunamis dans les Caraïbes (CTIC) ne pouvait, en dépit de son rôle essentiel dans la région, continuer de fonctionner sans un financement de base durable, et **a fermement recommandé** que le Conseil exécutif de la COI, à sa 49<sup>e</sup> session, envisage avec le Comité financier, à l'occasion de la préparation du Projet de programme et de budget pour la période 2018-2021 (Projet de 39 C/5), de renforcer les moyens du CTIC, notamment à l'aide une dotation en personnel permanent dans le cadre de la mise en œuvre du plan d'action de l'UNESCO pour les petits États insulaires en développement (PEID).

**Le GIC a approuvé** les critères techniques, logistiques et administratifs s'appliquant au Prestataire régional de services relatifs aux tsunamis (RTSP) pour le CARIBE-EWS, y compris les indicateurs de performance et les objectifs clés proposés.

**Le GIC a décidé** que le Centre d'alerte aux tsunamis dans le Pacifique (PTWC) aurait désormais le titre de Prestataire régional de services relatifs aux tsunamis (RTSP) pour le CARIBE-EWS, et a supprimé le terme d'« interim » qui lui était associé. Cette recommandation s'appuie sur le fait que le Centre d'alerte aux tsunamis dans le Pacifique répond aux critères définis dans le modèle de service relatif aux tsunamis pour le CARIBE-EWS ainsi que sur la qualité de ses performances opérationnelles en tant que Prestataire régional de service relatif aux tsunamis pour le CARIBE-EWS.

**Le GIC a décidé** de créer une équipe spéciale sur les sources volcaniques, sous la présidence de M. Paul Martens (Sint Maarten, Royaume des Pays-Bas).

**Le GIC a prié** le secrétaire technique d'élaborer un projet de mandat pour un groupe d'experts chargé de le conseiller sur le plan de travail et de mise en œuvre nécessaire à l'amélioration du système d'alerte, en y intégrant d'autres risques côtiers.

**Le GIC a également reconnu** qu'il était absolument nécessaire de mettre en place dans la région, en collaboration avec les opérateurs du réseau régional, des ateliers portant sur l'évaluation de l'étalonnage et la précision des données et métadonnées d'observation du



niveau de la mer et de l'activité sismique et sur les opérations techniques quotidiennes des stations d'observation du niveau de la mer.

**Le GIC a décidé** que les États membres et le Groupe de travail 2 réaliseraient des simulations numériques de tsunamis à partir des sources figurant dans la liste présentée par les membres de ce dernier à l'occasion du [Congrès d'automne annuel de l'Union américaine de géophysique](#). **Il a également décidé** d'élargir la liste des sources pour la région Caraïbes aux sources d'origine non sismiques.

**Le GIC a décidé** de poursuivre l'application à titre expérimental des directives approuvées pour le Programme communautaire de reconnaissance des tsunamis fondée sur la performance pour les Caraïbes et les régions adjacentes intitulé « Tsunami Ready ».

**Le GIC a décidé** d'organiser une série d'ateliers semblables à ceux du projet Cartes, plans et procédures d'évacuation en cas de tsunami (TEMP), destinés aux États membres qui ont besoin d'être formés à la simulation de tsunamis et à l'élaboration de cartes d'inondations et d'évacuation.

**Le GIC a examiné** les conclusions et les résultats du processus de cartographie des voies d'évacuation et de planification des procédures d'évacuation en cas de tsunami du CARIBE-EWS, en vue d'aider à la mise en œuvre du Programme communautaire de reconnaissance des tsunamis fondée sur la performance pour les Caraïbes et les régions adjacentes intitulé « Tsunami Ready ».

**Le GIC a encouragé** les États membres à inclure des organisations telles que la communauté des radioamateurs, susceptibles d'aider à diffuser les alertes d'urgence.

**Le GIC a suggéré** que les États membres fassent mieux connaître et encouragent les formations de sensibilisation aux tsunamis destinées aux journalistes et autres professionnels des médias, qui peuvent jouer un rôle crucial auprès des communautés dans la diffusion d'informations sur la préparation, la réaction et la réduction des risques en cas de tsunami.

**Le GIC a décidé** que l'exercice Caribe Wave 17 reposerait sur trois scénarios : le premier se déroulera à Santiago de Cuba, le deuxième sera situé au Costa Rica et s'inspirera du tremblement de terre de 1991 à Limon, et le troisième se déroulera dans le nord-est des Antilles et sera basé sur le séisme de 1843. Ce dernier scénario servira d'exercice de secours au Mécanisme européen de protection civile, programmé les 22 et 23 mars 2017. **Le GIC a également décidé** que l'exercice Caribe Wave 17 aurait lieu le mardi 21 mars 2017 et qu'il débuterait à 14:00 TUC.

**Le GIC a élu** par acclamation Mme Christa von Hillebrandt-Andrade (États-Unis) à sa présidence pour la période 2016-2018 et **a élu** M. Paul Maarten (Sint Maarten, Royaume des Pays-Bas), M. Gerard Metayer (Haïti) et M. Milton Gabriel Puentes (Colombie) aux postes de vice-présidents pour la même période.

**Le GIC a accepté** l'offre du Costa Rica, qui a proposé d'accueillir sa 12<sup>e</sup> session en avril 2017 et a **pris acte** de l'offre de Curaçao d'accueillir sa 13<sup>e</sup> session en 2018.

## Resumen dispositivo

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El Grupo Intergubernamental de Coordinación del Sistema de Alerta contra los Tsunamis y otras Amenazas Costeras en el Caribe y Regiones Adyacentes celebró su 11ª reunión (ICG/CARIBE-EWS-XI) en Cartagena de Indias (Colombia) del 5 al 7 de abril de 2016, acogida por el Gobierno de Colombia. Asistieron a la reunión 70 participantes de 20 países y territorios del Caribe y tres organizaciones observadoras: la Red Sísmica de Puerto Rico (PRSN), UNAVCO y la Organización Meteorológica Mundial (OMM).

Los participantes en la reunión pasaron revista a los logros conseguidos en 2015-2016, como la transición a los productos mejorados del Centro de Alerta contra los Tsunamis en el Pacífico (PTWC) el 1º de marzo de 2016, la elaboración de los requisitos para los proveedores de servicios sobre tsunamis del CARIBE-EWS y la exitosa celebración del ejercicio Caribe Wave 16, que contó con más de 330.000 participantes de 47 Estados Miembros y territorios del Caribe y regiones adyacentes, lo que hizo de este ejercicio internacional de alerta contra tsunamis el más grande celebrado hasta la fecha.

**El ICG aceptó** las modificaciones en el mandato del Centro de Información sobre los Tsunamis en el Caribe (CTIC) propuestas por el Equipo de Trabajo sobre el CTIC y **amplió** el alcance de la labor del CTIC para que abarcara también otras amenazas costeras y prestara más atención a la preparación de las comunidades.

**El ICG reiteró** su preocupación por el hecho de que el CTIC, pese a la función esencial que desempeñaba en la región, no podía seguir operando sin una financiación básica sostenida y **recomendó encarecidamente** al Consejo Ejecutivo de la COI, en su 49ª reunión, y a su Comité de Finanzas que, en la preparación del Proyecto de Programa y Presupuesto para 2018-2021 (39 C/5-Proyecto), se fortaleciera el CTIC, entre otras cosas mediante la dotación del personal básico, como parte de la ejecución del plan de acción para los pequeños Estados insulares en desarrollo (PEID) de la UNESCO.

**El ICG aprobó** los requisitos técnicos, logísticos y administrativos de un proveedor regional de servicios sobre tsunamis del CARIBE-EWS, en particular los indicadores clave del desempeño y las metas propuestos.

**El ICG decidió** que el PTWC pasaría a denominarse en lo sucesivo Proveedor Regional de Servicios sobre Tsunamis (RTSP) del CARIBE-EWS, eliminando la palabra “provisional”. Esta recomendación obedecía al hecho de que el PTWC cumplía los criterios establecidos en el modelo de servicios sobre tsunamis del CARIBE-EWS y al éxito de su funcionamiento operativo en apoyo del CARIBE-EWS en su capacidad de RTSP.

**El ICG decidió** establecer un equipo de trabajos sobre fuentes volcánicas, presidido por el Sr. Paul Martens (Sint Maarten, Reino de los Países Bajos).

**El ICG pidió** al Secretario Técnico que redactara el mandato de un grupo de expertos encargado de prestarle asesoramiento sobre el plan de trabajo y ejecución necesario para mejorar el sistema de alerta incluyendo otras amenazas costeras.

**El ICG reconoció también** que en la región existía una necesidad imperiosa de talleres con operadores de la red regional sobre la evaluación de la calibración y la precisión de los datos y metadatos sísmicos y relativos al nivel del mar y sobre el funcionamiento técnico cotidiano de las estaciones de medición del nivel del mar.

**El ICG decidió** que el Grupo de Trabajo 2 y los Estados Miembros realizaran simulaciones numéricas de tsunamis desde fuentes incluidas en la lista que presentarían los miembros del

Grupo de Trabajo 2 en la [reunión anual de la Unión Geofísica Estadounidense celebrada en otoño de 2016](#), y **decidió también** ampliar la lista de fuentes para el Caribe a fin de incluir las de origen no sísmico.

**El ICG decidió** que se siguieran aplicando de forma experimental las directrices aprobadas para el programa de acreditación de la preparación comunitaria frente a los tsunamis del Caribe y sus regiones adyacentes.

**El ICG decidió** que se organizara una serie de talleres similares al proyecto de elaboración de mapas y planificación para la evacuación en caso de tsunami (TEMPP) dirigidos a los Estados Miembros que precisaban capacitación en materia de simulación de tsunamis y elaboración de mapas de inundación y de evacuación en caso de tsunami.

**El ICG examinó** los resultados y la ejecución del proyecto TEMPP en el CARIBE-EWS en apoyo de la puesta en práctica del programa de acreditación de la preparación comunitaria frente a los tsunamis del Caribe y sus regiones adyacentes.

**El ICG alentó** a los Estados Miembros a dar cabida a organizaciones como la comunidad de radioaficionados a fin de difundir las alertas de emergencia.

**El ICG sugirió** que los Estados Miembros promovieran y alentaran formación en materia de sensibilización a los tsunamis dirigida a los periodistas y otros representantes de los medios de comunicación que pueden desempeñar un papel fundamental en la difusión de información a las comunidades acerca de los tsunamis, en lo que respecta a actividades de preparación, respuesta y reducción de riesgos.

**El ICG decidió** que el ejercicio Caribe Wave 17 se desarrollaría en tres escenarios: Santiago de Cuba, Costa Rica (por el terremoto de Limón de 1991) y las Antillas nororientales (por lo ocurrido en 1843). Este último escenario se utilizaría además para llevar a cabo el ejercicio de rescate del mecanismo de protección civil de la Unión Europea previsto los días 22 y 23 de marzo de 2017. **El ICG decidió también** que el ejercicio tendría lugar el martes 21 de marzo de 2017 y comenzaría a las 14.00 horas UTC.

**El ICG eligió** por aclamación a la Sra. Christa von Hillebrandt-Andrade (Estados Unidos de América) Presidenta para el periodo 2016-2018, y **eligió** al Sr. Paul Maarten (Sint Maarten, Reino de los Países Bajos), al Sr. Gerard Metayer (Haití) y al Sr. Milton Gabriel Puentes (Colombia) Vicepresidentes para el periodo 2016-2018.

**El ICG aceptó** el ofrecimiento de Costa Rica de acoger su 12ª reunión en abril de 2017 y **agradeció** el ofrecimiento de Curaçao de acoger la 13ª reunión en 2018.

## Рабочее резюме

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Межправительственная координационная группа по Системе предупреждения о цунами и других опасных явлениях в прибрежных районах Карибского бассейна и прилегающих регионов (МКГ/КАРИБ-СРП-XI) провела свою одиннадцатую сессию в Картахене де Индиас, Колумбия, с 5 по 7 апреля 2016 г. по любезному приглашению правительства Колумбии. На сессии присутствовали 70 участников из 20 стран и территорий Карибского региона и наблюдатели от трех организаций: Сейсмической сети Пуэрто-Рико ([PRSN](#)), Консорциума [UNAVCO](#) и Всемирной метеорологической организации (ВМО).

Участники рассмотрели результаты работы за 2015–2016 гг., включая переход с 1 марта 2016 г. на усовершенствованные продукты Центра предупреждения о цунами в Тихом океане (ПТВЦ), разработку требований для поставщиков услуг по цунами для КАРИБ-СРП и успешное проведение учений «Карибская волна-2016», в которых участвовали 330 000 человек из 47 стран и территорий Карибского бассейна и прилегающих регионов, что стало самым крупным на сегодняшний день международным учением по цунами.

**МКГ утвердила** предложенные целевой группой по Карибскому центру информации о цунами (КЦИЦ) изменения в круге ведения КЦИЦ и **расширила его**, включив прочие опасные явления в прибрежных районах и сделав упор на подготовке общин.

**МКГ вновь выразила озабоченность** тем, что, несмотря на выполнение ключевых задач в регионе, КЦИЦ не может продолжать функционировать без устойчивого основного финансирования, и **настойчиво рекомендовала** Исполнительному совету МОК на его 49-й сессии и финансовому комитету рассмотреть при подготовке проекта программы и бюджета на 2018-2021 гг. (проект 39 С/5) возможность укрепления КЦИЦ, в том числе за счет предоставления основного персонала, в рамках осуществления плана действий ЮНЕСКО для малых островных развивающихся государств (МОСРГ).

**МКГ утвердила** технические, организационные и административные требования для поставщика услуг для КАРИБ-СРП, включая предложенные ключевые показатели деятельности и цели.

**МКГ постановила**, что Центр предупреждения о цунами в Тихом океане (ПТВЦ) будет отныне именоваться Региональный поставщик связанных с цунами услуг (РПУЦ) для КАРИБ-СРП без использования слова «временный». Данная рекомендация основывается на соответствии ПТВЦ критериям, установленным в модели связанных с цунами услуг для КАРИБ-СРП, и успешной оперативной деятельности в качестве РПУЦ в поддержку КАРИБ-СРП.

**МКГ постановила** учредить целевую группу по вулканическим источникам под председательством г-на Пола Мартенса (Синт Маартен, Королевство Нидерланды).

**МКГ обратилась** к техническому секретарю с просьбой подготовить круг ведения группы экспертов по содействию в области мер и плана осуществления, необходимых для укрепления системы предупреждения за счет включения других опасных явлений в прибрежной зоне.

**МКГ также признала** насущную необходимость проведения в регионе совместных с региональными сетевыми операторами семинаров по оценке калибровки и точности сейсмических данных и данных об уровне моря, а также метаданных, и по повседневным техническим операциям станций наблюдения за уровнем моря.

**МКГ постановила**, что рабочая группа 2 и государства-члены проведут цифровое моделирование цунами на основе источников, включенных в представленный членами рабочей группы 2 на [ежегодном заседании Американского геофизического союза 2016 г. список](#), **и постановила далее** расширить список источников для Карибского бассейна, [включив источники несейсмического происхождения](#).

**МКГ постановила** продолжить пилотное применение утвержденных Руководящих принципов Программы сертификации готовности общин к цунами на основе показателей эффективности для Карибского бассейна и прилегающих регионов.

**МКГ постановила** организовать ряд семинаров по примеру проекта по картам, планам и процедурам эвакуации при цунами (ТЕМРР) для государств-членов, нуждающихся в подготовке в области моделирования цунами и разработки карт наводнений и эвакуации при цунами.

**МКГ рассмотрела** результаты и итоги процесса разработки карт, планов и процедур эвакуации при цунами в КАРИБ-СРП в поддержку осуществления Программы сертификации готовности общин к цунами на основе показателей эффективности для Карибского бассейна и прилегающих регионов.

**МКГ рекомендовала** государствам-членам задействовать такие организации, как сообщества пользователей любительских радиостанций, для участия в распространении сообщений о чрезвычайных ситуациях.

**МКГ предложила** государствам-членам содействовать подготовке журналистов и других представителей СМИ в сфере осведомленности о цунами, поскольку они могут сыграть ключевую роль в распространении информации о цунами среди общин и в подготовке, реагировании и смягчении риска.

**МКГ постановила**, что учения «Карибская волна-2017» будут осуществляться по трем сценариям: в Сантьяго де Куба, в Коста-Рике на основе параметров землетрясения 1991 г. в Лимоне и на северо-восточных Антильских Островах на основе параметров землетрясения 1843 г. Последний сценарий будет использоваться в учениях Системы спасения гражданской обороны Европейского союза, которые запланированы на 22-23 марта 2017 г. **МКГ также постановила**, что учения пройдут во вторник 21 марта 2017 г. и начнутся в 14.00 ВКВ.

**МКГ избрала** путем аккламации Председателем на период 2016–2018 гг. г-жу Кристу фон Хиллебрандт-Андрате (США) и заместителями Председателя на период 2016-2018 гг. г-на Пола Мартенса (Синт Маартен, Королевство Нидерланды), г-на Жерара Метейера (Гаити) и г-на Милтона Габриэля Пуэнтеса (Колумбия).

**МКГ приняла** предложение Коста-Рики выступить в качестве принимающей стороны ее 12-й сессии, которая должна состояться в апреле 2017 г., **и приняла к сведению** предложение Курасао принять 13-ю сессию в 2018 г.

## 1. WELCOME AND OPENING

- 1           The 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) was held in Cartagena de Indias, Colombia, from 5 to 7 April 2016, hosted by the Government of Colombia.
- 2           The Session was opened on Tuesday, 5 April 2016, under the Chairship of Ms Christa von Hillebrandt-Andrade (USA), Chair of the ICG/CARIBE-EWS.
- 3           Ms Christa von Hillebrandt-Andrade, Chair of the ICG/CARIBE-EWS, recalled the establishment of the ICG/CARIBE EWS, 10 years ago, in 2006, in Bridgetown, Barbados, and commended the efforts of all parties to achieve a working system as demonstrated by the massive participation at the Caribe Wave 16 Exercise. She recalled that instead of the three hours it took in 2006, confirming the generation of a tsunami is now only taking 5-30 minutes in the Caribbean thanks to a significant development of sea level observing systems. She mentioned that the [Sendai Framework for Disaster Risk Reduction 2015-2030](#) put the communities at the centre of early warning systems and not at the end of a sequence of decisions, and highlighted in that sense the ICG/CARIBE EWS Tsunami Ready Recognition Programme, which points exactly in that direction. She suggested that after an intense development phase the ICG is entering a stage of consolidation and maintenance. She concluded by providing a few strategic suggestions: to strengthen the relationships with other IOC and UNESCO components, to focus on SIDS that are one of the priorities of IOC and expand the responsibility of the ICG to other coastal hazards as per its mandate.
- 4           She thanked the Government of Colombia and Rear Admiral Juan Manuel Soltau Ospina, Executive Secretary of the Colombian Commission for the Oceans (CCO) for kindly hosting the Eleventh session of the ICG/CARIBE-EWS.
- 5           Mr Stephen Hall, Vice-chair of the Intergovernmental Oceanographic Commission (IOC) of UNESCO, commended Caribbean Member States for the tremendous progress achieved in the region.
- 6           Mr Cesar Toro, Head of the IOCARIBE Office, on behalf of Mr Vladimir Ryabinin, Executive Secretary of the Intergovernmental Oceanographic Commission (IOC), recalled the pioneer role of the Intra-Americas Sea proposal to develop a tsunami warning system in the Caribbean. He evoked George Maul and other distinguished scientists that generously offered their knowledge and contributions to the system at the Preparatory Meeting for the Second Session of the Intergovernmental Coordination Group for the Tsunami and other Coastal Hazards Warning System for the Caribbean and Adjacent Regions ICG/CARIBE-EWS, November 29–30, 2006, San Juan, Puerto Rico.
- 7           Rear Admiral Juan Manuel Soltau Ospina, Executive Secretary of the Colombian Commission for the Oceans (CCO) emphasized the importance of timely and expeditious exchange of data and technical knowledge among countries in the Caribbean region, as key to the success of the operation of early warning centres. He declared officially open the ICG/CARIBE EWS Eleventh session.
- 8           The address of Ms Christa von Hillebrandt-Andrade is included in full under [Annex III](#).



## 2. ORGANIZATION OF THE SESSION

### 2.1. ADOPTION OF AGENDA

9 The Chairperson informed the Plenary that the agenda was prepared by the Secretariat and the Chair taking into account the Recommendations and instructions given at [ICG/CARIBE-EWS-X](#), as well as the relevant parts of the IOC Rules of Procedure ([IOC/INF-1166](#)).

10 She indicated that under agenda item 10 Any Other Business it is proposed to briefly introduce the discussions leading to the development of a new Plan of Implementation for the period 2018-2022.

11 The ICG approved the [Agenda](#) as presented.

### 2.2. DESIGNATION OF THE RAPPORTEUR

12 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 three languages of the meeting: English, French and Spanish.

13 Mr Gerald Bawden, Mr Karl Feaux and Ms Jeniffer Lewis (all from USA) volunteered for English, France proposed Steve Symphor for French, and Colombia proposed Mr Ronald Sanchez for Spanish.

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

### 2.3. CONDUCT OF THE SESSION, TIMETABLE AND DOCUMENTATION

15 The Chairperson, Ms Christa von Hillebrandt-Andrade, noted that interpretation was available in English, French, and Spanish. She informed the Plenary that, in order to facilitate the proceedings of the meeting, a timetable had been prepared by the Secretariat in coordination with the Chair and the local organizing committee. At this point, she offered the floor to the local host to provide logistic details about Wi-Fi services, lunch, and for working groups, Plenary and Secretariat. CCO staff, on behalf of the host organizing committee, provided detailed logistic information.

16 Ms Hillebrandt requested the Secretariat to introduce the documentation for the meeting. On behalf of the Secretariat, Mr Aliaga explained that due to financial constraints the documentation is available only in English and posted to the meeting website. Only the provisional agenda, provisional timetable, and provisional list of participants had been printed. Mr Aliaga asked Delegates to check the participants' provisional list and confirm details to the Secretariat.

17 In order to smooth the work of the session and facilitate the generation of recommendations and agreements, the Plenary decided to set up the following intrasessional Working Groups and Committees to discuss more in detail some of the major issues addressed at the meeting:

- Monitoring and Detection Systems (includes Tsunami Services Model). Chair Mr Jean Marie Saurel (France)
- Hazard Assessment Group: Chair: Mr Leonardo Madariaga (Colombia)
- Caribe Wave 17. Chair: Mr Patrick Tyburn (France)

- Tsunami Recognition Programme. Chair: Ms Kerry Hinds (Barbados)
- Recommendations Committee. Chair: Mr Stephen Hall (UK)
- Elections Committee. Chair: Mr Albert Martis (Curacao)

18 The Chair requested Working Groups to produce a recommendation for approval by the Intergovernmental Coordination Group (ICG) or re-draft the ones presented by the intersessional Working Groups, as needed.

19 Ms Hillebrandt suggested that while in Plenary the time used to reporting be reduced as much as possible to concentrate on the exchange of views and decisions on policy matters. The Plenary decided that national reports be delivered without PowerPoint presentations, with a focus on their main achievements and expected areas of future work.

20 The Chair reminded delegates that elections were due at this session. She asked the Secretariat to recall the rules for elections of Officers. Mr Cesar Toro, on behalf of the Secretariat indicated that nominations for Officers were due by 18h00 on Tuesday 5th April, using Forms attached to the invitation Circular Letter and supported by two delegations in addition to the proposing Delegation.

21 **The ICG approved** the Timetable as presented.

### **3. REPORT ON INTERSESSIONAL ACTIVITIES**

#### **3.1. CHAIR'S REPORT**

22 The Chairperson of ICG/CARIBE-EWS, Ms Christa von Hillebrandt-Andrade, reported that The Intersessional 2015-2016 period was extremely busy as we continue to strengthen and promote the Tsunamis and Other Coastal Hazards Warning System for the Caribbean and Adjacent Regions. Between the two sessions she sought to provide guidance and support to all focus areas of the CARIBE-EWS: Monitoring and Detection, Tsunami Hazard, Communications and Preparedness, Readiness and Resilience in coordination with Secretariat, CTIC, Officers and Member States. Major areas of focus were the sustainability of CTIC, the new service model, the transition to the PTWC enhanced products and the Caribe Wave 16 exercise.

23 The Chair indicated she represented the ICG at several intergovernmental, international and national coordination and scientific meetings and activities, including the [28<sup>th</sup> session of the Assembly](#) in June 2015, the IUGG Assembly in Prague in June/July 2015, the ASTARTE (Assessment, Strategy and Risk Reduction for Tsunami in Europe) Project Annual Meeting in October 2015 in Turkey, the American Geophysical Union Annual Meeting in San Francisco in December 2015, the [9<sup>th</sup> session of Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems \(TOWS-WG\)](#) in February 2016. In addition, hosted webinars and served as a trainer for PTWC enhanced products in Colombia and Barbados. She also participated through conference calls and webinars in several Task Team and Working Group (Tsunami Services, Tsunami Ready, CTIC, Sea Level and Seismic Station Operators). In June 2015 she was also honored to be elected to the IUGG IAPSO (International Association of Physical Sciences of the Oceans) Executive Committee where she hopes to promote advances in coastal and ocean hazards research.

24 Ms Hillebrandt-Andrade reported that she appreciated the opportunity to visit several Member States and Territories to see firsthand their operations and especially would like to recognize the support and hospitality of the Governments of Anguilla, Colombia, Barbados and IOC Tsunami Unit in Paris for the corresponding invitations and their hospitality and support. It has been very gratifying for her to see the commitment of the colleagues and institutions in



the strengthening of our tsunami warning system. As part of the preparation and follow-up to [Exercise Caribe Wave 2016](#) she had the opportunity to also speak with many of the Tsunami Warning Focal Points and National Contacts and appreciated these exchanges.

25 She recalled that the CARIBE EWS is the ICG which has the highest percentage of Member States with designated Tsunami National Contacts and Tsunami Warning Focal Points (47/48 for a 98%). Brazil is the only Member State which is still in the process of making these designations. She reported that this matter was discussed with the Permanent Delegation of Brazil to UNESCO in June 2015 and February 2016. She recognized that Brazil did participate in Caribe Wave 16. All of the Member States and all but one Territory (French Guyana) participated in Caribe Wave 16, with over 330,000 registered participants making it the largest international tsunami exercise to date.

26 Contact was maintained with the Officers, the Secretariat, CTIC, Working Groups and Task teams through meetings, conference calls, webinars and email correspondence. She highlighted the strategic support from the staff of the Caribbean Tsunami Warning Program (CTWP), Carolina Hincapié, new CTWP Deputy Manager and the student interns. She is indebted for their professionalism, contributions and commitment to the advancement of CARIBE EWS. Also, she thanked the continual support of the Puerto Rico Seismic Network ([PRSN](#)) with whom CTWP is collocated, the Puerto Rico Emergency Management Agency ([PREMA](#)) for being a testbed for many of ICG's initiatives and Bernardo Aliaga, Technical Secretary of the ICG. Last, but not least, she acknowledged the key support of National Oceanic and Atmospheric Administration ([NOAA](#)) and the National Weather Service ([NWS](#)) [Tsunami Program](#) for the approval of time, effort and funding to carry out her duties as Chair.

27 Colombia congratulated the Chair for her active work and support to the ICG and asked which are the challenges ahead for the ICG in the framework of the IOC and the region. Ms Hillebrandt-Andrade indicated that one of the difficult challenges is the sustainability of the Caribbean Tsunami Information Center (CTIC). It is a long process for a project or programme to be part of a plan and allocation of budgets. One of the challenges is then that IOC in preparing its plan for 2018-2021 addresses the key issues for ICG/CARIBE-EWS and in particular CTIC. For that to happen there is a need to speak as tsunami programme national managers and also engage IOC and UNESCO representatives whether they are National Commissions or Permanent Delegates of countries to UNESCO and its IOC. Another challenge she sees is that ICG has 32 Member States that needs to be engaged, including by having more countries represented at the ICG meetings. In addition, a key and strategic challenge is to include other coastal hazards in the activities of the ICG, without dismissing the main focus on tsunami.

28 Curacao recalled that ICG started with some dreams and an Implementation Plan back in 2006. It is good to see that the system has evolved and that it is possible to see the results of the enthusiastic work of the Chair and the team. We are starting a new phase with more community's involvement and further strengthening of the communications with IOC and UNESCO. It is important to keep the momentum and showcase the work of the ICG to look for funding to enable broader reach of the ICG. Curacao thanked the Chair for her engagement and results. The Chair also acknowledged the support and contributions of the ICG Vice Chairs, Aura Fernandez (Venezuela) and Denis Lopez (France) and Milton Puentes (Colombia),

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

### 3.2. ICG/CARIBE-EWS SECRETARIAT REPORT

30 The Technical Secretary for ICG/CARIBE-EWS, Mr Bernardo Aliaga, presented the report of the Secretariat. He provided information on the status of nominations of Tsunami

Warning Focal Points (TWFPs), Tsunami National Contacts (TNCs) and National Tsunami Warning Centres (NTWC) and reported on the renewal of funding from the European Commission's Humanitarian Aid Office ([ECHO](#)) for tsunami preparedness projects in Haiti and Dominican Republic, as well as the possibility of additional funds for a project in Central America.

31 Mr Aliaga noted the very valuable support provided by the Caribbean Tsunami Information Centre (CTIC) through Ms Alison Brome, Interim Director, and by United Nations Development Programme ([UNDP](#)) in Barbados and the OECS as well as from the Caribbean Disaster Emergency Management Agency ([CDEMA](#)) that provided direct support to CTIC. He indicated that despite all the efforts provided by all parties the continuity and sustainability of CTIC remains to be achieved.

32 USA inquired if a group could be organised to discuss issues related to extra budgetary funding for CTIC. The Chair suggested that this discussion takes place under agenda item 3.2.

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

### 3.3. REPORT OF THE CARIBBEAN TSUNAMI INFORMATION CENTRE (CTIC)

34 Ms Hillebrandt-Andrade reported that Ms Pedzi Girigori (Curacao) was nominated Chair of the Task Team installed by the Officers to review the Terms of Reference and Business Model of CTIC. She asked her to present the report of the Task Team via videoconference.

35 Ms Girigori reported that the Task Team reviewed the governing documents of CTIC and provided the following summarised recommendations.

- To modify the language of 'CITC Purpose' to help facilitate the functionality of CTIC.
- Introduce a modification to the CTIC Functions to adjust the mandate to the current status of development of CTIC
- On the CTIC Business model the Task Team suggested reducing the staffing to 1 director and 1 administrator and lobbying for a permanent post for the CTIC director by UNESCO/IOC

36 The Task Team also suggested broadening the scope of CTIC to include other coastal hazards and put more emphasis on community preparedness.

37 The Secretariat reported that CTIC staffing is on top of the priority list. Continuity of and staffing of CTIC is important for IOC as Member States have indicated clearly this priority at several fora.

38 Barbados indicated it would like to encourage Member States to provide support to the CTIC reiterating it will continue to support and host CTIC.

39 **The ICG noted** the report of the Task Team on CTIC and **adopted** [Recommendation ICG/CARIBE-EWS-XI.1](#).

### 3.4. REPORTS FROM UN AND NON-UN ORGANIZATIONS

40 Dr Victor Huerfano from the Puerto Rico Seismic Network (PRSN) provided a brief introduction to the activities of PRSN in support of the Tsunami and other Coastal Hazards Warning System for the Caribbean and Adjacent Regions, including through instrumentation

and observing networks coordinated through Working 1. He further reported on PRSN's contribution to the **TsunamiReady™** recognition programme in Caribbean US communities, with 100% of coastal communities recognised in Puerto Rico (USA) and indicated PRSN is increasing capacities for tsunami modelling.

41 Mr Karl Feaux, GPS Operations Manager of **UNAVCO** Inc., provided an update on the status of UNAVCO-managed community networks in the Caribbean region and Mexico. The Continuously Operating Caribbean GPS Observational Network (**COCONet**) project, which is scheduled for completion by August of 2016, can help with tsunami early warning and response. The total number of new, refurbished, or co-located stations installed to date is 81. There is one remaining station to be installed. As of December 15, 2015, 96% the core GPS-Met stations are operating as designed and delivering data to the UNAVCO archive. Two Regional Data Centres (Colombian Geological Survey in Colombia and the Universidad de Guadalajara in Mexico) and two Data Mirrors (Caribbean Institute for Meteorology and Hydrology in Barbados and the Instituto Nicaraguense de Estudios Territoriales in Nicaragua) were established in 2015. COCONet data along with other regional GNSS-Met data are mirrored and managed at these regional centres under contract with UNAVCO and with COCONet support. All of the COCONet data is open access and freely available from these different data centres. As part of the COCONet project, UNAVCO completed the construction of sea level monitoring instrumentation at two locations in the Caribbean Basin. The locations for these stations (Port Royal, Jamaica and Puerto Morelos, Mexico) enhance the coverage of tide gauge instrumentation in the Caribbean region. Each station consists of tide gauge instrumentation (radar and pressure gauge) on a marine pier co-located with a cGPS-Met system. A second cGPS system is installed a short distance away (<5km). Two existing tide-gauge stations in the Dominican Republic and Panama were augmented with GPS to provide absolute sea-level control. All tide-gauge data are freely available and flow seamlessly into the UNESCO/IOC archive (<http://www.ioc-sealevelmonitoring.org/index.php>).

42 Mr Feaux reported on the Trans-boundary, Land and Atmosphere Long-term Observational and Collaborative Network (**TLALOCNet**) project which is focused on the development of a continuous GPS-MET array in Mexico for atmospheric, climatic and seismotectonic research in the Americas to be implemented in a four year project started on 1 September 2013. The TLALOCNet siting plan calls for six new cGPS-MET stations and 18 upgrades to existing stations in Mexico, with a contribution of 13 new stations from the Universidad Nacional Autónoma de México (UNAM). TLALOCNet construction began in 2014 and is scheduled for completion by the end of FY2016. The total number of new, refurbished, or co-located TLALOCNet stations currently installed in Mexico to date is 36.

43 The GPS-MET arrays (i.e., COCONet and TLALOCNet) in Central America, the Caribbean and parts of South America provide observational data that can help with tsunami early warning. Additional resources are necessary to ensure the data are integrated into tsunami early warning efforts and to support the operation and maintenance of the networks and databases.

44 Mr Edgard Cabrera, Chief, Marine Meteorology and Ocean Affairs Division of the World Meteorological Organisation (WMO) reported on the Coastal Inundation Forecasting Demonstration Project (CIFDP). He indicated that recognizing the extreme vulnerability of coastal areas and reducing the risk of disaster is a priority in WMO, the Joint IOC-WMO Technical Commission for Oceanography and Marine Meteorology (JCOMM) and the Commission for Hydrology (CHy) developed the CIFDP which was established in 2013. CIFDP is conceived as a multi-hazard early warning system, integrating river flow, storm surge, wave and flood forecasting to enhance coastal inundation forecasting and warning systems, that can be sustained by the responsible national agencies. The project is being implemented in South East Asia, South West Pacific and the Caribbean where a demonstration pilot project is undergoing in Dominican Republic and Haiti. Mr Cabrera reported that as part of the initiative

a translation and adaptation of some COMET<sup>®</sup> programme modules in French and Spanish is envisaged for end of 2016 or 2017.

45 Colombia inquired about the design and timeline of the project in Dominican Republic. Mr Cabrera responded that the pilot projects are designed for 1 to 3 years and in the case of Dominican Republic the plan is to test the project concept and then use it as an example and transfer the technology to other Caribbean States, leaving it to countries to use it and expand its capabilities.

46 Haiti and the Chair commented about the difficulties in receiving tsunami bulletins through GTS for some Caribbean Member States. Mr Cabrera responded that this has been informed to WMO and the corresponding technical unit is addressing it.

47 Mr Cabrera indicated that arrangements have been made to enable the participation of the ICG/CARIBE-EWS Chair Ms Christa Hillebrandt-Andrade at the 38th session of the WMO Regional Association (RA) IV Hurricane Committee, in San Juan, Puerto Rico from 23 to 26 April 2016, to strengthen cooperation between the ICG and the Hurricane Committee.

### 3.5. STATUS OF OTHER ICGs

48 Mr Stephen Hall provided a report for ICG/NEAMTWS. He recalled that ICG/NEAMTWS has four centres, known as Candidate Tsunami Service Providers (CTSPs), which are currently providing tsunami products on a subscription only basis. The hosting countries of these CTSPs are: France (Western Mediterranean and North-Eastern Atlantic), Italy (All Mediterranean), Greece (Eastern Mediterranean) and Turkey (Eastern Mediterranean and Black Seas). He indicated that the basic challenge of the ICG/NEAMTWS is to have a clear link between disaster management offices and warning centres, where it has been difficult to convince emergency managers and decision makers to include the tsunami hazard in their regular work. Issues between neighbouring countries with territorial disputes have also conspired towards a greater pace in building the system. The absence of scientific evidence of current threats in the North Eastern Atlantic region have also conspired against a clearer and decided involvement in the system, where five countries have not nominated official focal points. He provided some examples of difficulties of implementing the system at local level in areas that are close to recognised sources in the Mediterranean.

49 France and PRSN commented on the tsunami hazard in the North Eastern Atlantic, specifically about the Cumbre Vieja volcano and the need for a closer coordination of the ICG/NEAMTWS with the Caribbean system on this matter. Mr Hall indicated that at the moment, there is not a coordinated system between Europe, North Africa, and the Caribbean but both the French and the Spanish centre may provide tsunami information in this case.

50 Ms Hillebrandt-Andrade reported on the Ninth session of the Working Group on Tsunamis and Other Hazards related to Sea-Level Warning and Mitigation Systems (IOC/TOWS-WG-IX) held in Paris, France, the 25 and 26 February 2016. She provided details about the results and main recommendations of the Inter-ICG Task Teams that reported to TOWS-WG. She highlighted that TOWS-WG requested the Task Team on Disaster Management and Preparedness to consider development of Key Performance Indicators in line with the Sendai Framework and to facilitate reporting by ICGs to the IOC Governing Bodies in line with XXVIII Dec 8.2. The TOWS-WG also recognised the adoption of the Tsunami Ready program by the ICG/CARIBE-EWS and that these guidelines are now available for other ICGs.

51 PRSN inquired if bathymetry requirements for tsunami modelling were discussed at TOWS-WG. Chair Hillebrandt-Andrade responded that TOWS-WG noted the ongoing review of the IHO-IOC General Bathymetric Chart of the Oceans (GEBCO) Project (IOC Decision

XXVIII 6.2) and acknowledged the importance of the project for tsunami modelling and forecasting.

### 3.6. NATIONAL PROGRESS REPORTS

- 52        Barbados reported it has continued to support the Caribbean Tsunami Information Centre (CTIC) as host country through its agreement with UNESCO/IOC. The CTIC is hosted by the Coastal Zone Management Unit in Barbados (as of September 2015) who provides financial support for CTIC projects and programmes as well in-kind support through office space and supplies. The CZMU and Department of Emergency Management's administrative staff continue to support as needed through day-to-day support to the Interim Director as well as enhanced support for specific events (meetings, workshops etc.). The Barbados Government is seeking to further enhance this support by presenting a paper to the Cabinet of Barbados inviting them to agree to further supporting the post of the Interim CTIC Director.
- 53        Barbados has improved its internal communication mechanisms, with a clearer definition of national agencies roles for tsunami warning and response. Storm surges and tsunami modelling have been enabled as well. Testing of warning communication and systems is done on a regular basis including through the Caribe Wave 16 exercise. The presentation of the Barbados Tsunami Warning Protocol and Standing Operating Procedures to the Emergency Management Advisory Council (EMAC) took place in 2015. The EMAC is the highest governance structure of the Barbados National Emergency Management System (NEMS) with responsibility for recommending policy and providing oversight to the system and its programmes, to engage and guide the efforts of government, non-government, voluntary and private agencies in comprehensive and coordinated ways to respond to the entire spectrum of our emergency needs. The Department of Emergency Management in conjunction with the Coastal Zone Management Unit continue to collaborate as chairs of the DEM Standing Committee on Coastal Hazards tasked with the responsibility for the development and implementation of the National Tsunami and Coastal Hazards Programme in Barbados. Emphasis is being placed on the public education and awareness programme regarding this particular hazard with focus on the involvement of coastal communities, the private sector and the youth population
- 54        British Virgin Islands reported that the products launched by the Pacific Tsunami Warning Center were shared with the Tsunami Warning Focal Point and Tsunami National Contact. These products were then used in the Caribe Wave 2016 Simulation Exercise to ensure both entities were familiar with how they work. A standalone computer for the CISON software and Tide Tool were secured. A similar setup will be installed at the TWFP in 2016.
- 55        British Virgin Islands reported that its tide gauge continues to provide data to the IOC Sea Level Station Monitoring Facility. To improve its data acquisition, they will install a rain gauge making it a full weather station and would like to thank PRSN for assisting in resolving the communication issues via GOES. It reported that their warning system is being upgraded in phases and for the first phase, the entire repeater system was upgraded to digital. Before the close of 2016 the National Emergency Broadcast System will be upgraded to digital as this will allow them to move closer to Common Alerting Protocol (CAP) compliancy. To further improve their system, they are evaluating the siren network and have sought quotations for a digital and voice siren as a means of upgrading and improving the fleet. A MOU with all Cell Providers who allow emergency text messages to be sent over their networks has been signed. This has worked very well and was utilized during Caribe Wave 2016. Minor maintenance was done on the Seismic Stations and, to expand the GPS Network, approval was given to install a third station. Two of the stations currently send data to the COCONET Network.
- 56        To improve community base efforts a number of Community Emergency Response Teams (CERT) have been formed in British Virgin Islands and to date, close to 100 volunteers



have been trained in CPR, radio communications, basic search and rescue and incident command. In this same area, Caribe Wave 2016 prove to be a success with an increase from 40,000 to 46,000 participants. This is a large number compared to the size of BVI's population. There was also the need for a well-trained search and rescue team and the Territory Search and Rescue Team (TSART) was formed with 22 members from various agencies such as Police and Fire. The territory is making preparations for renewal of their TsunamiReady status and every effort is being made to ensure that they are still compliant.

57 British Virgin Islands thanked Puerto Rico, especially the University of Puerto Rico, Puerto Rico Seismic Network (PRSN), Puerto Rico Strong Motion Program (PRSMP), the Caribbean Tsunami Warning Program (CTWP), the Caribbean Tsunami Information Centre (CTIC) and the IOC & ICG Members for their support over the years in helping the BVI to improve its state of readiness in relation to natural hazards especially those involving tsunamis.

58 Colombia reported that during 2015 it updated the Communication and Coordination Protocol of the National System of Detection and Early Warning, in which the expected performance of each entity for distant or local tsunamis is described and alternative communication means are defined. TWFP's protocols were reviewed and adapted in accordance with the PTWC Tsunami Enhanced Products. Additionally, Colombia is in the process of updating the National Tsunami Risk Management Plan. It has an assessment of the current state of scientific development and tsunami risk management. It compiles information available from coastal towns about their preparedness and response to a possible tsunami and it consolidates a comprehensive national database on tsunami related scientific research.

59 During 2015 phase III of the Information Management Model of the National Alert System for Marine Threats Project was developed, which aims to strengthen the technical knowledge and monitoring system, as well as improving tsunami warning centre and backup centres staff competencies. Colombia has 26 stations providing sea level data every two minutes via GPRS and GOES; additionally, a tsunami detecting sensor was installed in 2014 off the coast of the Colombian island of Tumaco on Colombia's Pacific coast. On seismic monitoring Colombia has 112 seismic stations, 41 of them in real time, which can measure, seismic waves of high amplitude and high frequency typical of large local earthquakes, extending the range of strategies on disaster response and specific protocols for tsunamis. The municipalities to which technical assistance has been provided have been implemented with tsunami signs (10 municipalities). During the Caribe Wave 2016 Exercise a test of the national coordination and communication protocol of the national tsunami warning system was conducted, whereby the instrument was validated by the country to have a more efficient mechanism for the dissemination of warnings to the tsunami threat.

60 Costa Rica reported that during the inter-session period its Tsunami National Monitoring System (SINAMOT, Sistema Nacional de Monitoreo de Tsunamis) performed three internal exercises. SINAMOT led the organization of the CaribeWave16 in Costa Rica. This year the exercise included functional tests of the communications between SINAMOT, National Emergency Commission (CNE) and municipal emergency committees (CME) and tested the SOPs of the CNE for warning communication and evacuation. SINAMOT received a donation of three computers, an electric generator, and a laptop for field trips from OFDA/USAID. The computers replaced the only one left at the moment of the three second hand computers with which it started in 2014. The rough laptop will be used on maintenance of the tidal gauges administrated by RONMAC Program, to which SINAMOT is linked.

61 Costa Rica also reported that CNE contracted a LiDAR survey to measure high-resolution topography along the South Pacific and the Caribbean coast. The data will be available in April 2016. Same survey was performed at the North and Central Pacific coast during 2013, and the data is being used to build tsunami evacuation maps along that region

as the first stage of the project. The second stage will cover the South Pacific coast and the Caribbean coast, and will likely start in 2018.

62 On the occasion of the 25th anniversary of the 1991 Limón earthquake and tsunami the CNE is preparing a commemorative activity to increase awareness, as this tsunami caused the only two tsunami casualties in Costa Rica's history, and its arrival time was extremely short. Also there are reports of previous events in the same region during the 19th and early 20th centuries.

63 Costa Rica reported that the community of Tortuguero in the northern Caribbean coast of Costa Rica, is interested to be recognized as a community prepared for tsunamis and have shown interest in the programme Tsunami Ready.

64 Cuba reported that coordination meetings and exchange of information between the Cuban TNC and TWFP have been organised in the intersessional period. Following the official nomination of TNC and TWFP by Cuba Dr Marcelino Hernández González participated at the ITP-Colombia training on "Tsunami Warning and Emergency Response Using the PTWC Enhanced Products for National Tsunami Threat Decision-Making", 5–9 October 2015, Bogota, Colombia, sponsored by General Maritime Directorate of Colombia (DIMAR) and UNESCO-IOC. During the same period software for tsunami forecasting and real-time access to Caribbean data were installed in computers of the Oceanography Department of the [Institute of Oceanology](#) (IDO) and training of IDO staff took place through workshops and seminars about tsunamis, forecasts and use of computational tools and pre-calculated scenarios. Basis for information and prioritization in mapping evacuation were developed in conjunction with the National Staff of the Civil Defense of Cuba (EMN-DC) as well as issuing bulletins for EMN-DC about possible scenarios of tsunami seismic activity south of the eastern region of Cuba. Coordination meetings of national tide gauge networks, oceanographic and seismic monitoring, altimetry and bathymetry took place.

65 For the Caribe Wave Exercise 2016 Cuba reported that warnings were issued to some municipalities and towns on the east coast of Cuba, through local warning systems. The population were told, through its governing bodies populations and directors of workplace and school next to the coast, not to approach the coastline and not go into the sea for this exercise. IDO developed a theoretical and practical evacuation exercise for children, parents and teachers of a primary school, with the participation of a hundred people. Before and during the exercise practical classes and seminars designed for the institutions related to civil defense were made. During these classes materials - mainly texts and videos - obtained from the training in Bogota were used, so that the population, mainly young people and children, as well as decision makers gained in awareness and sensitivity and with them in risk perception risk. Cuba is working on putting in real-time the tide gauge stations in Los Morros, Gibara, Maisi (with a new installation), Cabo Cruz and Casilda. Overall it improved the National Tide Gauge Network and the National Seismic Network. The issue of tsunamis has been addressed by schools thru contests and events, as performed in the last MarCuba of Marine Science last year.

66 Dominican Republic reported that its Tsunami Warning Unit, between 2014 and 2015, performed 85 training talks aimed at emergency management personnel, public schools, universities and visitors to the institution were made. It worked on creating a map of evacuation and training of a Tsunami Action Team (TAT) in the community of San Cristobal, Haina, Palenque and Nigua, with the project "Life-saving actions: preventing disasters in seismic and tsunami events".

67 Updates to the Tsunami Standard Operating Procedures (SOP) of the TWFP National Meteorological Office (ONAMET) were performed, to align it with the PTWC Enhanced Products for CARIBE-EWS. ONAMET received the cooperation of DIMAR of Colombia, by

sharing their programme called EVIDA used to make faster tsunami bulletins. Currently this programme has offered good results in the transmission of messages related to Caribe Wave 2015 and 2016. A total of 90 people enrolled in the Caribe Wave 16 Exercise using the [www.tsunamizone.org](http://www.tsunamizone.org) page plus 10 members of the Tsunami Warning Unit participated, including three forecasters and four assistants: all bulletins were made and transmitted on time.

68           This week an expert from the University of Hawaii, will be performing maintenance, calibration, leveling of tide gauges in Puerto Plata and Punta Cana with two members of the Tsunami Warning Unit.

69           Dominican Republic reported they have selected the aeronautical meteorology office of Santiago as alternate or back up to the main Tsunami Warning Unit, to handle and issue bulletins in case the main unit has problems or difficulties. Other possible alternative centres are under study.

70           On behalf of the National Director of Meteorology Engineer Gloria M. Ceballos and members of the Tsunami Warning Unit, Dominican Republic thanked Victor Huerfano and the team of the Seismic Network of Puerto Rico for assistance, support, coordination and cooperation as well as Bernardo Aliaga for being willing to assist them at distance, answering questions and providing guiding ideas. It further thanked the Chair Ms Christa Hillebrandt-Andrade for her assistance on Prevention, Mitigation and Preparedness for tsunamis.

71           France reported it has officially nominated its focal points for all the territories in the Caribbean, also reinforcing its representation in the Working Groups. Two large implementation projects ended in 2014 and two sea level stations will be installed in Saint Martin (co-located with GPS). A GPS will also be installed in Pointe-à-Pitre and a new sea level station will be installed in Saint Barthelemy. Inundation Maps have been developed and provided to the authorities for Martinique and Saint Martin. Exercises with local evacuation took place for Caribe Wave 16 in Martinique and Guadeloupe, with 20,000 registered participants in Martinique and 2,000 registered in Guadeloupe.

72           Haiti reported it participated in the Exercise CaribeWave 2016 for two days: one day for an orientation seminar on procedures based on the PTWC Enhanced Products and another day for exercise itself. The objectives of this exercise in Haiti were to 1) test the reception of PTWC messages 2) test the ability of CODOMAR as National Centre for Tsunami Alert 3) test the communication lines with Mayors of towns impacted 4) test and validate the New Procedures.

73           In 2015, the Seismic Technical Unit (UTS) of the Bureau of Mines and Energy ([BME](#)) of Haiti conducted seismic monitoring of the territory with 4 Nanometrics type broad band stations installed in Leogane, Jacmel, Port-au-Prince (Juvénat), and Cap-Haitian. UTS has also benefited from regional stations installed in the Dominican Republic, Jamaica and Cuba. The stations broadcast in real time and the UTS has a data centre where the records are received and interpreted and then archived (calculation of magnitude, epicenter location, depth, etc.). UTS issued in 2015 four quarterly newsletters reporting local seismicity. On the occasion of the anniversary of the earthquake of 12 January 2010, UTS has brought out a special newsletter and a chronological catalog of seismic events recorded during the year 2015. All information provided by the UTS are available on its website.

74           Mexico reported that it has maintained an operational Mobile Tsunami Warning Centre, however to ensure continuity of operations, the country implemented an Alternate Tsunami Warning Centre in the port of Veracruz, which is a low seismic risk area, and was tested during exercise "CARIBE WAVE 16". In addition, and as part of the National Tsunami Warning System, Mexico implemented an alternate communication means between Local, Federal, and



State Civil Protection in the areas most at risk of tsunami, which allows links and issuance of alerts for tsunamis and other phenomena, using a high availability service. This year Mexico is in the process of increasing to 41 the number of tide gauge stations of its national network with data transmission in real time.

75 Nicaragua recalled that at the [Third meeting of the Regional Working Group for Central America of the Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System \(ICG/PTWS\)](#), held on 29 and 30 September 2014 in Managua, Nicaragua., the [Nicaraguan Institute for Territorial Studies](#) (Instituto Nicaraguense de Estudios Territoriales-INETER) proposed the creation of a Tsunami Warning Centre for Central America, and the ICG decided to support the efforts and progress of Nicaragua for the establishment of it under the ICG/PTWS and ICG/CARIBE-EWS. As a follow up to this support on August 25, 2014, a Memorandum of Understanding on the Central America Tsunami Advisory Centre (CATAC) project, between the Japan International Cooperation Agency (JICA), the Ministry of Foreign Affairs of Nicaragua and authorities of the INETER was signed. The amount of the project is approximately US\$ 4 million with a duration of three years from the arrival of the Japanese experts. The general objective is that tsunami products are issued by CATAC and used by Central American countries. The project objective is that the ability for quantitative forecasting for tsunami warning is improved. The project will start in May/June 2016. Nicaragua provided details about the equipment and training for Central America countries included in the proposal

76 Panama reported it increased the representation of national agencies in the tsunami national coordination group and also in the nominated TWFPs, adding ETESA and Fire Workers. In 2016 Panama will be increasing its sea level monitoring capacities with 10 sea level stations, five in the Caribbean and five in the Pacific. Panama also reported that the Caribe Wave 16 Exercise took place in an isolated community in the Caribbean coast.

77 USA reported significant progress on a Sea Level Project with UK (NOC) in Turks and Caicos and Anguilla. USA has received funds from UK and expects to procure, install, and test the new gauges over the next 18 months. USA notes advances in GNSS sensing capability being supported by UNAVCO, PRSN, USGS, and NASA. NASA remains committed to developing new capabilities and techniques that it is hoped will lead to new operational capabilities at the Tsunami Warning Centres (TWCs) in support of both the domestic and international mission. USA noted initial success in deployment and testing of 4th Generation (4G) DART Systems as part of a joint project with the Chilean Navy. The new DART 4G technology can measure seismic activities at the source. These new buoys will help the TWCs to produce forecasts more quickly. USA noted that the USGS in conjunction with the Caribbean Tsunami Warning Programme (CTWP) of the National Oceanic and Atmospheric Administration ([NOAA](#)) and France recently published a paper revealing minimum performance requirements are met throughout the CARIBE EWS seismic network. The goal now is to ensure gaps that may require additional redundancy are covered.

78 On forecast and warning the USA has actively supported and endorses the CARIBE-EWS's Tsunami Service Model. This model is based on designated Tsunami Service Providers providing guidance information to National Tsunami Warning Centres (NTWCs) in order to enable NTWCs to provide warnings and alerts to their citizens. The USA enthusiastically endorses this approach. The USA is pleased to announce that the new CARIBE EWS tsunami threat bulletin and enhanced graphical products became operational on 1<sup>st</sup> March 2016. These were developed and tested in the PTWS and have been exercised in both Caribe Wave 14 and 15 prior to full implementation prior to Caribe Wave 16. The PTWC threat bulletin will continue to remain public with the graphics packages emailed to TWFPs and/or NTWCs.

79 On community preparedness the USA congratulated all CARIBE-EWS Member States for the success of Caribe Wave 16 which saw over 331,000 participants; a truly remarkable

and a testament to the continuing dramatic increase in tsunami awareness, communications and standard operating procedures across the region. The USA will continue to enhance capabilities of the CTWP as a vital tsunami education, outreach and mitigation component of NOAA's Tsunami Forecast and Warning System. CTWP will continue to work closely with the US NWS International Tsunami Information Center (ITIC) and the Caribbean Tsunami Information Centre (CTIC). The National Weather Service has recognized 47 TsunamiReady communities in the US Caribbean and together with UNESCO as part of a pilot project recognized Anguilla and the British Virgin Islands. The US also looks forward to working and supporting the recently approved CARIBE-EWS Tsunami Ready Recognition Programme.

80 USA noted a change in satellite communications with GOES-R, the next generation of NESDIS GOES satellites, which is scheduled for launch in October 2016 and should become operational in by October 2017. EMWIN data, NESDIS imagery and GOES Data Collection System (DCS) data will be transmitted together over the GOES-R transponder at 400kbps. The increased bandwidth is expected to improve the throughput of the EMWIN data stream. The new service will require new receiver hardware as there will be a receiver frequency shift to 1694.1 MHz, from 1692.7 MHz (EMWIN) and 1691.0 (LRIT) and a change in modulation for EMWIN users. A new antenna or antenna components may also be required. The NWS will be hosting and online Webinar on April 14, 2016, to identify and review the upcoming changes to EMWIN services. An advisory page for EMWIN has been developed: <http://www.nws.noaa.gov/emwin/index.htm>.

81 Venezuela reported that is close to acquire seven new sea level stations with the support of the United Nations Development Programme (PNUD). It reported that the Venezuelan Foundation of Seismological Research (FUNVISIS) tsunami project has some problems to finalise the acquisition of some materials due to foreign exchanges limitations. Venezuela reported that for Caribe Wave 16 all (14) coastal States participated: Zulia, Falcón, Vargas, Miranda, Anzoátegui, Nueva Esparta, Sucre, Carabobo, Aragua, Monagas, Delta Amacuro, Trujillo, Mérida y Territorio Insular Miranda, with over 60,000 participants.

### 3.7. INTERIM ADVISORY SERVICES REPORT (PTWC)

82 Dr Charles McCreery, PTWC Director, gave a report on the activities of PTWC during the intersessional period. He showed up-to-date maps of the seismic and sea level stations currently supporting PTWC operations for the Caribbean and thanked Member States for their support to these networks.

83 Regarding PTWC operations, he noted that PTWC duty staff responded to several thousand earthquakes worldwide (seismic alarms sound as signals reach nearest stations – 10 per day typical), issued 284 Observatory Messages for the larger of these (typically, ones with magnitudes  $\geq 5.8$ ). Parameters are reported immediately via the CISN. Five (5) Tsunami Information Statements were issued for qualifying events ( $M_w \geq 6.0$  in Caribbean,  $M_w \geq 6.5$  in the Atlantic), 2 in the eastern Caribbean, 2 in the western Caribbean and 1 in the mid-Atlantic. No CARIBE-EWS tsunamis Watches or Threats were issued and no tsunamis were observed since ICG/CARIBE-EWS-X in 2015.

84 Dr McCreery recalled that the Enhanced Products for CARIBE-EWS began on March 1<sup>st</sup>, 2016 and that only one Information Statement was issued after that date, on March 19, 2016, for an earthquake located in Leeward Islands with  $M_w = 6.0$ .

85 He also reported that two Unscheduled Communication Test took place in the intersessional period: on February 19, 2016 with 40 of 67 places confirming receipt and 32 of 40 countries or territories confirming receipt, and on March 31, 2016 with 32 of 67 places confirming receipt and 25 of 40 countries or territories confirming receipt. He suggested that for a more comprehensive continuous confirmation of operational communications as well as

to streamline the compilation and distribution of communication test results, PTWC recommends more frequent unscheduled tests and collecting responses with an online survey

86           Lastly, the PTWC Director recalled that in early 2015, PTWC moved its operations from its old buildings in Ewa Beach, Hawaii, where it has been located since the early 1960s, to a newly-built facility called the NOAA's Daniel K. Inouye Regional Centre (IRC) located on Ford Island inside Pearl Harbour, Hawaii. Looking forward he informed the Group that common hardware and software for PTWC and the US National Tsunami Warning Center (NTWC) as well as a common Web Portal are in the plans, as well as integration of GPS data for more rapid and accurate earthquake characterization.

87           Barbados commented that on 19 March 2016 there was an earthquake of magnitude 6.9 close to Antigua. There was no communication from PTWC for this event but a retransmission. PTWC Director indicated that the initial bulletin went out in 3 minutes but there was a problem with the transmission software that was addressed afterwards. France indicated that there were first several empty messages, through GTS that were not decoded.

88           Curacao inquired about the reasons for the change of service from the warning to the threat products. Dr McCreery explained that there is a background for that decision that was originated and implemented first in the Pacific, with some false alarms generated by warning messages that were disseminated through the focal points but miss-interpreted in some localities generating panic and unnecessary evacuations. The final decision after several discussions was to have the warning issuing authority at national level and the tsunami regional services delivering threat information.

89           Haiti asked why the PTWC does have a category of 300 km for a local tsunami? Haiti has a classification that indicates 100 km. Dr McCreery indicated that the distance of 300 km around the source is an empiric measure that assumes there is no tsunami damage beyond that distance. The 300 km is the distance from the epicentre that PTWC would search for countries. These countries would receive an initial threat warning. This is the radius where you expect to see destructive tsunami effects.

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

### 3.8. REPORT OF EXERCISE CARIBE WAVE 16

91           Ms Christa von Hillebrandt Andrade (USA), on behalf of Elizabeth Vanacore (PRSN), Task Team Leader Caribe Wave 2016 reported on the Exercise Caribe Wave 16. She recalled that on 17 March 2016, two regional tsunami exercises took place in the Caribbean and adjacent regions, the Caribe Wave Venezuela and the Caribe Wave Northern Hispaniola scenario. Thirty-two Member States and 15 territories participated in this fifth regional tsunami exercise. This represents a participation rate of 100% of all the Member States of the ICG/CARIBE-EWS. Registered participants included designated CARIBE-EWS Tsunami Warning Focal Points (TWFPs) and National Tsunami Warning Centers (NTWCs), as well as emergency and preparedness organizations, K-12 Schools, government agencies, colleges and universities, healthcare and hotels, among others. According to the registration system hosted by TsunamiZone.org, 270,875 people were registered as of March 18, including over 118,000 in Puerto Rico, 62,000 in Guadeloupe, 37,000 in Venezuela, 21,000 in Martinique, and 14,000 in Grenada. The jurisdiction of the British Virgin Islands activated 16% of its population with 4613 participants. The final number of participants was still being updated as not all participants registered on TsunamiZone.org.

92           The Start of Exercise ("Dummy") messages were issued by the PTWC. The Venezuela scenario simulated a tsunami generated by a magnitude 8.4 earthquake located adjacent to the northern coast of Venezuela with waves of almost 12 meters. The Northern Hispaniola

Scenario was based on a magnitude 8.7 earthquake with waves of almost 17 metres forecasted for the shores of Haiti and Dominican Republic. The start of exercise messages were disseminated mainly over the Global Telecommunication System and Email, while follow-up messages only through Email. Many countries also generated and disseminated their own domestic tsunami warning products for their areas of responsibility. This exercise also tested communications between the PTWC and Puerto Rico, US and British Virgin Islands in preparation for the upcoming transfer of tsunami domestic responsibility from the US NTWC (Alaska) to PTWC (Hawaii). Sirens, emails, emergency alert systems, text messages, media outlets, NOAA weather radio, and social media were used by many TWFP to further disseminate the messages. In addition to the communication tests, exercises were conducted at various additional levels of magnitudes and sophistication and included seminars, table top exercises, video/web conferencing and drills.

- 93 Through the exercise it has been possible to:
- Validate the issuance of tsunami products from the PTWC.
  - Validate the receipt and dissemination of tsunami products by TWFPs and NTWCs.
  - Continue with the exposure to enhanced PTWC products, which were fully implemented as of March 1, 2016.
  - Validate the readiness of the Caribbean and Adjacent Regions to respond to a local/regional source tsunami.
- 94 Feedback on the exercise was received through completed surveys by 38 TNCs/TWFPs which represented 32 Member States and 15 Territories.
- 95 USA congratulated the Task Team and all Member States on the successful exercise and great report. USA asked about how people were receiving the products and what was most useful. The results of the survey indicated that some of the visual products were not as useful as would be imagined, e.g. preference for the polygons over the deep ocean forecast. TNC requested more information and comments on this matter. Chair Hillebrandt-Andrade indicated that somehow people may be focused on their particular geography and that is why the polygons are more popular tools than some of the other visual products. That said she was not sure that the way the survey was written got to the heart of the issue about what products should be public.
- 96 Curacao joined the US congratulations to the Team. A question that has been raised is how the messages were received by TWFPs. Curacao was particularly interested in the GTS and how products were disseminated and received using these mechanisms. Chair Hillebrandt-Andrade reported that the dummy message went out well over GTS, but there was a problem with the dummy message on email and fax. While for the simulated messages they were sent by email as planned. Cuba indicated that the email is their preferred communication method.
- 97 Secretariat suggested communications matters pertaining to unscheduled and scheduled tests as well as exercises have been raised at several sessions but have not been worked in advance by any of the Working Groups. He suggested that WG3 should address these in advance to save time of delegates in plenary. Chair of WG3 Antonio Aguilar (Venezuela) indicated that the WG3 was going to address some of these dissemination questions in their discussions coming up.
- 98 **The ICG noted** the report of the Task Team.

#### 4. WORKING GROUP PROGRESS REPORTS

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

99 This agenda item was presented by Mr Jean Marie Saurel (France), Chair of Working Group 1 (WG1) with contributions from Sébastien Deroussi (France), vice-chair for sea-level network, Dan McNamara (USA), vice-chair for seismic network and Karl Feaux, invited expert for the GNSS network content.

100 Working Group 1 reported that regarding seismic monitoring, new data have been brought online from several networks as expected, like Costa Rica, Cuba and Panama. There are still ongoing plans for station installations and upgrades in the upcoming years and months (Dominican Republic, Venezuela, Honduras). CTWP continued to follow up the data availability and statistics. WG1 reported that 76% of the contributing stations have data archived at IRIS. Archival of data at IRIS is important because those data can then be used by scientists to improve the knowledge of earthquake hazards and tsunami hazards. The capabilities maps show that, if all the stations are working, the ICG goals are met. However, on the overall, only 60% of stations are providing data in a timely manner at any time for a variety of reasons. A map shows the impact of 40 % of the network being down randomly, which shows that some area with relatively low station density can be impacted and detection time then increased by as much as 80 seconds. Even if the goals have been reached, seismic networks still need to be densified in several regions.

101 Regarding sea-level network, four new stations were installed, for a total of 80 stations contributing mainly via the NOAA GOES satellite on five-minute slots and whose statistics have been followed by CTWP. The DART buoy network is again 100% operational. The count of installed sea-level stations in the region is still increasing, but we should be careful at maintaining the interest of the community for those stations and not end up with stations being brought down like happened twice in the past. A new capability map was produced that shows the improvement which resulted from stations installations in Panama/Colombia coasts, Yucatan (Mexico) and Jamaica regions. New sea-level stations are expected to be installed in the months and years to come.

102 Regarding GNSS networks, most of the updates have been presented by Karl Feaux from UNAVCO under item 3.4. above. There is already some 50 GNSS stations available in real-time, which is an emerging technology in order to improve the detection and assessment of large earthquakes.

103 Other activities of the WG1 included the participation in the regular webinar hosted by NOAA CTWP around sea-level and seismic network data availability, which is key in tracking stations changes and updates.

104 A scientific paper has been published in *Seismological Research Letter* by Dan McNamara, about the improvements made in the last ten years around seismic monitoring in the Caribbean region. McNamara, D.E., Christa von Hillebrandt-Andrade, Jean-Marie Saurel, V. Huerfano, L. Lynch (2016). 'Quantifying 10 years of Improved Earthquake Monitoring Performance in the Caribbean Region', *Seism. Res. Lett.*, 87, 1, 26-36. doi: 10.1785/0220150095 (<http://srl.geoscienceworld.org/content/87/1/26>).

105 The 5th volume of IOC Manuals and Guides N° 14 on 'Sea Level Measurement and Interpretation', focused on radar tide gauges will be published soon (IOC/2016/MG/14Vol.5).



106 Finally, future activities of the WG1 include workshop and training for sea-level and seismic network operators which need to be put in place, the latest one occurred two years and three years ago respectively.

107 The networks still need to be improved and open data exchange should be promoted. Wide data usage is useful for stations existence justifications and hence their maintenance.

108 Important work is needed around GNSS data promotion and GNSS stations requirements.

109 **The ICG noted** the report of Working Group 1 and **adopted** [Recommendation ICG/CARIBE-EWS-XI.2.](#)

#### 4.2. PROGRESS REPORT OF WORKING GROUP 2 ON HAZARD ASSESSMENT

110 This agenda item was introduced by Dr Alberto López (Puerto Rico, USA), Chair of Working Group 2 (WG2) and Silvia Chacon (Costa Rica), vice-chair WG2, who reported on three main action items that were recommended in previous ICG/CARIBE-EWS sessions: the definition of Caribbean Tsunami sources, a Bathymetry Inventory (second stage) and a Caribe Wave 2015 collaborative project.

111 With respect to the definition of Caribbean Tsunami sources, Dr Lopez reported that a sub-group of the WG2 specializing on tectonics of the Caribbean region worked during the Fall of 2015 to develop a comprehensive list of tectonically —induced tsunami sources for the Caribbean. The boundaries of the Caribbean plate were divided and assigned as follows: Northern/Northeastern: Alberto López-Venegas, Eastern: Valérie Clouard and Frédéric Dondin, Southeastern: Franck Audemard, Southwest and western: Silvia Chacón and Natalia Zamora. The results of the work of this subgroup were consulted with Carl Harbitz and Finn Løvholt (Norwegian geotechnical Institute). The study proved to be a fascinating collaborative work among colleagues. A poster summarizing the work of the group was presented at the Fall 2015 American Geophysical Union Annual Meeting under the title '[New Insights into the Active Deformation, Tectonic Evolution, and Hazard Mitigation of the Caribbean Plate and South America](#)'.

112 Dr Silvia Chacón-Barrantes (Costa Rica), member of the WG2 recalled the first stage of survey performed in 2014-2015 to quantify the existence of bathymetry, and tsunami inundation and evacuation maps of Member States. Twenty-six answers of that survey (76%) identified availability of bathymetric data, five of them as Nautical Charts and 13 of them as surveys. On availability of Tsunami Inundation Maps (TIMs) only three responses (8%) were positive and nearly 50% (18) of the answers indicated that TIMs are not available. A major gap for several Member States is the absence or the unavailability of bathymetry with the quality required for modelling tsunami inundation.

113 The second stage survey developed in 2016 sought to gauge interest of Member States in developing TIMs and Tsunami Evacuation Maps (TEMs). The survey was developed in January 2016 and launched on February 3<sup>rd</sup> as an online survey. The Secretariat sent an email to TNC's to fill the survey and WG2 members sent reminders to TWFP's as well. From the answers received it becomes clear that training is the preferred mean to build TEMs and TIMs. Given the interest of Member States it is proposed to organize a series of workshops for Caribbean Member States in the development of TIMs and TEMs. A proposal along the lines of the Tsunami Evacuation Maps, Plans Procedures (TEMPP) of the Pacific Tsunami Warning System (PWTS) was submitted to OFDA-USAID to sponsor these workshops and could be potentially funded. It is further known that resources from NCTR-PMEL in charge of modeling and tsunami map development would be available for 2017. Priority for training opportunities

under this framework would be based on available bathymetry data, vulnerability, exposure indices and population at risk of the Member States. It is suggested that a maximum of 10 countries would be chosen first, because this low number would guarantee a low instructor/student ratio.

114 With respect to the need for coastal bathymetry Mr Cesar Toro (IOCARIBE) indicated that there are other bodies working on bathymetry (i.e. GEBCO and IBCA) but one of the major challenges is to get detailed bathymetry for shallow waters due to unavailability or unwillingness to share it.

115 The **ICG noted** the report of Working Group 2 and **adopted** [Recommendation ICG/CARIBE-EWS-XI.3.](#)

#### 4.3. WORKING GROUP 3 ON TSUNAMI RELATED SERVICES

116 This agenda item was introduced by Mr Antonio Aguilar (Venezuela), Chair of the Working Group. Mr Aguilar, focused on progress and challenges of technology and communication platforms for alerts. Caribe Wave 2015 and 2016 provided an opportunity to test media and transmission platforms. The main observations are that for the dedicated channels of the World Meteorological Organization (WMO), the GTS and AISR (Aeronautical Information System Replacement) there are reports that the systems functioned smoothly in countries that use it regularly. Regarding the use of social networks based on widely available Internet, tests were made to evaluate its use and application for the transmission of alert messages and information exchange. Twitter, WhatsApp, Facebook, Hangout and Skype turned out to be the most accessible and stable. With respect to conventional telephone network, fax and cellular wireless networks a first conclusion is that these platforms are the most widely used throughout the Caribbean region for all people, for information on tsunamis and alerts, coupled extensive and disseminated availability of smartphones connected with Internet networks.

117 Mr Aguilar also reported on progress and challenges of protocols for end to end communication and dissemination of warnings. He indicated that there is agreement that there must be various types of information for each audience, pursuing certain goals. The information shared by researchers, emergency managers, the different levels of government, the armed forces and the general public are substantially different. At community level, people should acquire the ability to identify natural signs for a tsunami, and enable organizational plans and response at the local level to implement self-protection measures by themselves, in parallel to official channels and protocols.

118 He indicated that media continue to be an important channel for transmission of public information in the event of tsunamis and other threats. It is necessary then to promote training oriented to journalists, in order to have them as allies in case of tsunamis, but especially for information campaigns on self-protection measures and preparedness for this threat. For this reason, it is necessary to design short courses, diplomas and other measures to capture the attention of these professionals on the role to be played before, during and after a tsunami.

119 Mr Aguilar also reported that amateur radio volunteers consistently maintain networks of radio communications at national and international level in the HF bands: 2, 11, 20, 40 and 80 metres. During the last few years there has been an increased interest from this group of people to collaborate and play a leading role in the event of disasters, both in Venezuela and throughout the Caribbean region, demonstrating its importance in emergencies.

120 Curacao indicated the approach to diversified communication methods and sources should be done carefully because standardisation is a key feature of effective Early Warning

Systems. Mr Aguilar indicated these mechanisms are not alternate dissemination systems but it is about allowing the population to react in front of natural signs, then together with the traditional system the idea is to support traditional knowledge and communities for them to have sufficient power to recognise their threat.

121 PRSN inquired about the experience of Venezuela with reliability of commercial networks in using alternate communication methods including social media. Mr Aguilar responded that in Venezuela they integrated commercial cell phone companies to the process even if they were reluctant at the beginning.

122 Haiti inquired on how to access to the GTS network for agencies that are not meteorology services. Chair Ms Hillebrandt-Andrade indicated that this should be discussed with the meteorology agency and WMO.

123 The **ICG noted** the report of Working Group 3 and **adopted** [Recommendation ICG/CARIBE-EWS-XI.4.](#)

#### 4.4. PROGRESS REPORT OF WORKING GROUP 4 ON PUBLIC AWARENESS, EDUCATION AND RESILIENCE

124 This agenda item was introduced by Lt. Patrick Tyburn (France), Chair of Working Group 4 on Preparedness, Readiness and Resilience. Lt Tyburn reported that the WG4 did not meet during the intersessional period. The Group participated in the Task Team installed to review the terms of reference and business model of CTIC and in several meetings held to make sensitive the Permanent Delegates of Member States on CTIC's financial situation and to obtain their support to get a long term and secure financial contribution of UNESCO in the CTIC budget. WG4 also contributed in the preparation of Caribe Wave 16.

125 With respect to national implementation of tsunami awareness programmes, Mr Tyburn reported that in agreement with Recommendation ICG/CARIBE-EWS-X.6 Working Group 4 conducted a survey to evaluate Member States' national programmes alignment with the provisions of the [Tsunami Public Awareness and Educations Strategy for the Caribbean and Adjacent Regions](#) (IOC Technical Series, 107. 2013). The survey was included as part of the Caribe Wave 16 evaluation form and according to its outcomes Working Group 4 is proposing to define an Action Plan to accompany Member States in the implementation of tsunami awareness programmes.

126 The Chair of Working Group 4 also reported its participation at the TOWS-WG-IX meeting as member of the Inter-ICG Task Team on Disaster Management and Preparedness and the Group also contributed to the works of the Task Team on Tsunami Ready Recognition Programme.

127 The **ICG noted** the report of Working Group 4 and **adopted** [Recommendation ICG/CARIBE-EWS-XI.5.](#)

#### 5. SPECIAL INVITED LECTURES: COMMUNITY-BASED TSUNAMI WARNING SYSTEM

128 Under this agenda item, the Chairperson recalled [Recommendation ICG/CARIBE-EWS-IV.4](#), which urges Member States to consider the recommendations of the workshop on [Good Practices on Tsunami and Coastal Hazards Community Preparedness and Readiness in Central America and the Caribbean](#) held in Panama City, Panama, from 11 to 13 August 2008. In this respect, representatives of Colombia and St. Kitts and Nevis were invited to make a presentation with focus on the development of their community-based warning systems.



129 Staff of the [National Unit for Disaster Risk Management](#) (Unidad Nacional para la Gestion del Riesgo de Desastres – UNGRD) and from the [Colombian Geological Service](#) (Servicio Geologico de Colombia-SGC) presented respectively the 1st Binational Drill Colombia - Ecuador for earthquake and local tsunami in the border zone and the SATREPS (Science and Technology Research Partnership for Sustainable Development) project between Colombia and Japan.

130 First Bi-national Drill Colombia - Ecuador for earthquake and local tsunami in the border zone. Colombia has advanced actions of knowledge of the risk, reduction and preparation for the response concerning tsunami scenarios for the coasts in the Pacific Ocean and in the Caribbean Sea. It is known that Colombia has a major threat on the Pacific coast, for which its actions have been mainly directed.

131 The successful community experience, though it corresponds to the Pacific Ocean, strengthened the initiatives that are now planned to be implemented in the Caribbean. The experience corresponds to the First Bi-national Drill Colombia and Ecuador for earthquake and tsunami of nearby origin. The drill took place in February, 2014 in 10 municipalities of the south coast of Colombia, and had as main goal to strengthen the emergency response capability of disaster risk management systems of both Colombia and Ecuador. The drill implemented binational cooperation mechanisms and national strategies for disaster response to earthquake and local tsunami in the border zone.

132 During the exercise there were scenarios of flood, evacuation of victims by helicopter, prehospital attention, humanitarian assistance, community evacuation, and others. Colombia took as a goal the evacuation of 15,000 people but achieved as final result the evacuation of 23,242 people, which were above the initial expectations.

133 Lessons Learned:

- The development of response plans requires a strong involvement with communities who ultimately conduct the first response. Resilience is the key to success during the response phase.
- The need to improve mechanisms for warning dissemination was identified, given the specific characteristics of the region and the difficulties of telecommunications.
- Intervention in response preparedness, must also respond to installed physical capabilities to facilitate the implementation of priority response actions such as warning systems and tsunami signage.

134 Actions derived from the Lessons Learned:

- Seek technical assistance for developing specific emergency response strategies and a protocol for tsunami.
- Restructure the national coordination and telecommunications protocol for the tsunami alert system.
- Install emergency signage.
- To strengthen emergency telecommunications system through the Ministry of information and telecommunications technology.

135 SATREPS project: Application of state-of-the-art technologies to strengthen research and response to seismic, volcanic and tsunami events, and enhance risk management in

Colombia agreed upon among corresponding authorities of the Government of Colombia and Japan's International Cooperation Agency (JICA).

Colombian Counterpart Organizations:

- Colombian Geological Service – SGC
- National Unit for Disaster Risk Management - UNGRD
- General Maritime Directorate - DIMAR
- Instituto Distrital de Gestión de Riesgos y Cambio Climático - IDIGER
- Universidad Nacional de Colombia - UNAL
- Universidad de los Andes

136 Due to its location on the Northwestern corner of South America, where the Caribbean, Nazca and South American plates interact, Colombia is continuously affected by earthquakes, mainly in the Pacific coast and in the Andean and the Caribbean region. Most of the Colombian population is located in those regions. Moreover, volcanic activity originating from a series of active volcanoes, most of them located on the central mountain range, may affect seven departments of the country, where a large population and important infrastructure are located. Very large earthquakes (bigger than magnitude 8.0) and tsunamis have occurred along the Pacific coast, but there are records of some impacts on the Atlantic coast as well.

137 In response to the Tumaco earthquake in 1979 and its associated tsunami, which caused huge human and material losses on the Pacific coast; the earthquake in the same year, in the central part of Colombia, the earthquake of Popayan, in 1983, and the eruption of the volcano Nevado del Ruiz in 1985, with the tragedy of Armero, Chinchina and Honda where more than 25.000 people died, the Colombian government structured the National System for the Prevention and Attention of Disasters, recently ruled by the Law 1523 - 2012, which now is the National System of Disaster Risk Management – SNGRD, and the National Unit of Disaster Risk Management – UNGRD as the head and coordinator entity of the SNGRD. Institutions such as the Colombian Geological Service – SGC, General Maritime Directorate - DIMAR, Emergencies Attention and Prevention Fund of Bogota – IDIGER, Colombian Commission of the Ocean – CCO, all are part of the National System, as well as the Universities, such as the National University and Andes University. These institutions and universities have important roles in the research of natural phenomena, monitoring of seismic, volcanic and tsunami events and disaster risk management in Colombia.

138 Reducing the risk by natural phenomena has been a priority of the Colombian State, reason for which it has implemented programs such as the reduction of the vulnerability of natural disaster, financed with resources from the multilateral banks, whereby the UNGRD accompany the country's municipalities to formulate action plans and/or municipal plans of management of risk, in addition to this, the UNGRD has been anticipating investments in the country, mainly in the Pacific coast, considering their high social, physical, cultural, organizational, political and economic vulnerability. The SGC has modernized and expanded its network of monitoring seismic activity (Colombian Seismic Network - RSNC and Strong Motion Network - RNAC), volcanic activity (three volcano observatories at Manizales, Popayan and Pasto) and the geodynamic instrumentation using Global Navigation Satellite Systems Network (Geored), DIMAR is implementing the Tsunami Warning Centre, the CCO has coordinated the formulation of the National Tsunami Risk Management Plan, IDIGER coordinates and plans the actions of prevention of new risks to develop and existing risk mitigation and attention of threats in each of the strategic sectors of Bogota and the Universities National and the Andes with the geosciences and Engineering Departments respectively have been involved in research not only in the seismic characteristics of the events and damage estimations of structures during earthquakes in Bogota and Colombia, but also in the social aspects of risk management with the Centre of Studies for Disaster Prevention – CEPREVE,

which carried out a study on risk and crisis management in the hospital facilities of Tumaco on the Pacific coast of Colombia and its surroundings.

139 The overall goal of the SATREPS project is to improve the capacity of response and resilience of the communities that live in the influence zone of seismic, volcanic and tsunami activity in Colombia. The purpose is to strengthen the methodologies for monitoring, research and hazard evaluation associated with earthquakes, tsunamis and volcanic activity, as well as actions for prevention and risk mitigation.

140 The outputs of the project are:

- Strengthen the knowledge of the mechanism of occurrence of earthquake, tsunami and volcanic eruption.
- Networks for monitoring of earthquakes, GPS and volcanic activity are strengthened.
- Estimate the characteristics and impact of a possible mega-subduction earthquake in the Colombian Pacific and Caribbean regions, as well as earthquakes along active faults in Colombia with the potential risk for Bogota.
- Implement a system for forecast, estimation of the intensity and damage in real time and scenarios of earthquakes, which can affect to Bogota.
- Prepare plans for disaster mitigation due to tsunamis to cities and towns in the Pacific and Caribbean Colombian coasts.
- Early warning systems are improved, as well as the forecast of tsunamis in the country.
- Establish an effective system for the dissemination of information on earthquakes, tsunamis and volcanic activity in Colombia.

141 Brian Dyer from the Nevis Disaster Management Department presented the St. Kitts and Nevis Tsunami Ready Recognition Program Pilot Project.

142 He recalled that St. Kitts and Nevis is located in a seismic active zone with over 80% of the developments located in coastal areas and two historical events: on April 5<sup>th</sup> 1690 an earthquake of Mag 7.8 and a tsunami destroyed the capital city Jamestown on Nevis and on February 8<sup>th</sup> 1843 there was a major earthquake of a magnitude over 8.0, which gives an indication of a magnitude 8 earthquake every 100 years.

143 Following the Tsunami Ready Guidelines approved at the ICG/CARIBE-EWS-X, the first task was to define a Tsunami Hazard Zone. As no tsunami inundation modelling was available due to lack of bathymetry, ComMIT was run but results are of limited use, therefore a baseline tsunami zone was used (30 m height/1.6 km inland). Based on this baseline a Public Display of Tsunami Information was put in place. Tsunami Evacuation Maps and Public Education and Outreach materials were prepared and disseminated, including:

- Radio Program: From Danger to Safety
- Tsunami Smart Campaigns
- Jingles, Songs, Poetry, Drama,
- Puppetry
- Posters, Pamphlets
- Public Service Announcements (PSA's)
- Social Media
- Local Knowledge

144 Three Educational Outreach Activities per year have been organized and annual participation at the Caribe Wave Exercise will become a regular feature.

145 On the response side the following was put in place:

- Tsunami Response Plan
- EOC Operations
- Multiple Methods to Receive Tsunami Products from Tsunami Warning Centre/Tsunami Service Provider
- Multiple Methods to Disseminate Alerts to Public

146 Mr Dyers indicated that pending evaluation by the regional Tsunami Ready Board, St Kitts and Nevis expects to complete the requirement of the programme by October 2016.

147 Costa Rica inquired about the time required to complete the process. Mr Dyer indicated the process is still ongoing, it started in mid-2015 and is waiting for resources from the administration. Venezuela inquired if there is a legal basis for the educational tools developed in Saint Kitts and Nevis or is this a one-time effort and not sustainable. Mr Dyer responded that there is a work ongoing with the Ministry of Education to streamline Disaster Risk Reduction elements through the curricula. As well, public information and awareness includes schools as one of the beneficiaries of the activities.

148 Under this agenda item Ms Silvia Chacon (Costa Rica) on behalf of Dr Laura Kong Director, ITIC, presented the UNESCO–IOC/NOAA ITIC Pilot Course on Tsunami Evacuation Maps, Plans and Procedures (TEMPP). She reported that the TEMPP project will develop a course that covers the process of creating tsunami evacuation maps. Upon completion, the course and its methodologies will be formalized and offered widely, and published as part of the IOC Manuals and Guides series. A Course Development Team will work with ITIC to develop the Course. The PTWS Task Team on Evacuation Planning and Mapping will provide guidance to the ITIC and the Course Development Team. The Team will compile and incorporate best practices worldwide, and link existing materials and trainings on tsunami standard operating procedures and exercises. The course and process will build upon previous efforts to create a linked series of tsunami trainings.

149 The course will consider both cases where modeling is and is not available, demonstrate the application of different levels of tsunami modeling to construct inundation maps, work through the process of creating a community-owned evacuation map, with appropriate routing, safe area assembly, signage, and finally, use an exercise to test emergency response operational readiness of communities. Targeted trainees will include Tsunami National Contacts (TNCs) and Tsunami Warning Focal Points (TWFPs), other governmental institutions staff (local and national) and civil society organizations leaders. Tsunami modelling training will target physical scientists and oceanographers in governmental institutions and universities.

150 During the pilot phase, five training workshops will be organized over 1.5 years (2015-16) in one hosting country, starting with modelling and ending with a functional exercise. The final product will be in the form of an IOC Publication (expected in 2017). Simultaneous pilots in other countries are possible subject to funding availability.

151 Ms Chacon indicated that a pilot is being run in Honduras with the communities of Cedeno (Pacific) and Sambo Creek (Caribbean). TEMPP-1 (First course) on ComMIT Modelling took place on July 27-31, 2015 and included Inundation and evacuation mapping best practices and hazard and evacuation mapping tools. TEMPP-2 (Second course) on Tsunami Inundation Mapping for Evacuation took place on February 29 – March 3, 2016.

- 152 The direct outcomes for the host country include:
- communities that know what to do and where to go, and
  - country capability and tools to replicate the community evacuation map process elsewhere.

## 6. POLICY MATTERS

### 6.1. REPORT OF THE TASK TEAM ON TSUNAMI SERVICES

153 Chair Hillebrandt-Andrade introduced this topic recalling that according to Recommendation [ICG/CARIBE-EWS-II.3](#), the Group decided to establish a Caribbean Tsunami Warning Centre to be located in the region. She reminded that Recommendation [ICG/CARIBE-EWS-IV.5](#) approved the criteria for a Regional Tsunami Warning Centre as identified in the Working Group 1 report on Technical, logistical and administrative requirements of a Regional Tsunami Warning Centre for the Caribe EWS ([ICG/CARIBE-EWS-IV/13](#)) and the Ninth session of the ICG/CARIBE-EWS (ICG/CARIBE-EWS-IX) decided to create a Task Team to describe tsunami services as part of the Caribbean Tsunami Warning System, including the current capabilities, required information, products, and services and instructs it to propose a system model to serve as a guideline toward a fully functional Caribbean Tsunami Warning System. Upon the report of the Task Team, the [Tenth session of the ICG/CARIBE-EWS](#) through Recommendation ICG-CARIBE EWS-X.2, recommended that the Task Team pursues its work to further describe in detail the Services model.

154 Jean Marie Saurel (France) reported on the results of the work of the Task Team. He indicated that The Task Team worked by correspondence and through webinars (3) to produce a final consensual draft document on “Technical, logistical and administrative requirements of a Regional Tsunami Service Provider for the Caribe EWS” that was available for comments and for review by Member States as of February 2016, and published in the [ICG/CARIBE-EWS Eleventh](#) meeting website on 1<sup>st</sup> March 2016.

155 Mr Saurel summarised the main features of this draft document which includes the Regional Tsunami Service Providers (RTSP) requirements based on the Caribbean Tsunami Warning Centre (CTWC) logistical and technical requirements approved at the [4<sup>th</sup> session of the ICG/CARIBE EWS](#) in 2008, reflect and develop the tsunami service model adopted at the [Tenth session of the ICG/CARIBE-EWS](#) and includes key performance indicators.

156 Curacao and Venezuela intervened under this agenda item to request clarifications about the nature of communications issued by a RTSP that could reach communities. Mr Saurel clarified that in the case of the Caribbean public messages could only be text messages.

157 **The ICG approved** the Technical, logistical and administrative requirements of a Regional Tsunami Service Provider for the CARIBE-EWS including the proposed key performance indicators and goals described in [Annex IV](#).

### 6.2. EXERCISE CARIBE WAVE 17

158 The Chair recalled that at the Eighth 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](#)) held in Port of Spain, Trinidad and Tobago, from 29 April to 1 May 2013, the ICG decided to conduct Caribe Wave exercises on an annual basis and therefore an exercise is to be scheduled for 2017.

159 A proposal for Caribe Wave 17 to be held on Tuesday March 21<sup>st</sup>, 2017 starting at 14:00 UTC with three scenarios (South of Santiago de Cuba, Northern Antilles and East coast of Costa Rica) was presented by the Chair, Ms Christa Hillebrandt-Andrade on behalf of the Chair of the Task Team on Caribe Wave 16, Dr Elizabeth Vanacore (PRSN, USA). Following the presentation an intrasessional Working Group met, discussed the details of the proposal and reported afterwards to the plenary:

160 The Group discussed about the date proposed for the exercise. Costa Rica indicated the time for reporting between the exercise and the ICG session is very short. PRSN indicated that the date in March is aligned with the tsunami awareness week in the USA. Nicaragua indicated that the proposed date coincided with a national multi-hazard exercise which make it difficult, particularly because of its proximity to the holy week. PRSN also indicated that having multiple scenarios is very difficult for TSPs services. France indicated that the date proposed positively match the European Union Civil Protection Mechanism Rescue Exercise that is scheduled for March 22 – 23, 2017, and includes testing relief equipment and teams. Curacao indicated that the date should be kept outside the hurricane season, in March or April and make always in the same week if possible to create a general public awareness.

161 **The ICG adopted [Recommendation ICG/CARIBE-EWS-XI.6](#).**

### 6.3. REPORT OF THE TASK TEAM ON TSUNAMI RECOGNITION PROGRAMME

162 Chair Hillebrandt-Andrade recalled that at the Eighth 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](#)) was held in Port of Spain, Trinidad and Tobago, from 29 April to 1 May 2013, the ICG agreed to instruct Working Group 4 to establish a Task Team to develop a strategy or business proposal for a Performance Based Tsunami Recognition Programme. She indicated that through [Recommendation ICG/CARIBE-EWS-IX.1](#), and through [Recommendation ICG/CARIBE-EWS-IX.11](#) the ICG endorsed the continuation of the work of the Task Team on Performance Based Tsunami Recognition Programme and recommended continued implementation of the NWS NOAA-UNESCO/IOC TsunamiReady® pilot project to support the development and validation of the CARIBE-EWS Performance Based Tsunami Community Recognition Programme.

163 Ms Kerry Hinds (Barbados), Chair of the Task Team on Performance Based Tsunami Recognition Programme reported on the prioritised areas of work of the Task team during the intersessional period, which included the translation of the Guidelines, Capacity Building and Development, use and validation of Guidelines and dissemination and printing of the Guidelines, as well as discussing about the way forward. She indicated that English, French and Spanish versions of the Guidelines are completed and under revision by ICG/CARIBE native speakers of those languages. She also reported that a Dutch translation currently being done by Curacao. On Capacity Building and Development, she reported that St. Kitts and Nevis is working towards implementation of the Guidelines and the British Virgin Islands working towards renewal of its Tsunami Ready recognition.

164 An intersessional group discussed about this agenda item and supported the continuation of the Task Team and the requirement for Working Group3 and Working Group 4 to develop complementary tools for the Tsunami Recognition Programme.

165 France indicated the need for communities to be assessed about the status of their preparedness, with visits carried out by the ICG to make sure they continue working in between renewal periods as defined in the guidelines (three years). Colombia, Venezuela and Mexico indicated their support to this request for regular visits.

166 Chair Ms Hillebrandt-Andrade recalled that the guidelines establish a three-year recognition that would need to be renewed at the request of the community. She further recalled that for countries or territories to be considered for recognition there is a Regional Board. For communities within a Member State to be recognised there must be a national board at each Member State that coordinates with IOC ICG/CARIBE-EWS to receive the recognition. See [Recommendation ICG/CARIBE-EWS-XI.5](#).

#### 6.4. TSUNAMI THREAT FROM VOLCANIC ACTIVITY: LESSONS LEARNT FROM THE KICK 'EM JENNY EVENT IN JULY 2015

167 Ms Hillebrandt-Andrade indicated that this agenda item was suggested to provide a forum to discuss volcanic unrest of at Kick'em-Jenny during the week of 13th July 2015, and discuss the response by emergency management and public services, in particular with respect to the potential tsunami threat. Unfortunately, it was not possible to produce a report as initially envisaged by the Officers. She indicated that at this stage it would not be possible to address the matter in depth and suggested to postpone it for the next meeting making sure that the [Seismic Research Centre](#) SRC of the University of West Indies is invited to attend the session and a separate report is available for the ICG.

168 France indicated they have not yet finalised their national internal report on this but will make it available as soon as finalized. They recalled that PTWC issued a message that was difficult for TWFPs in France to interpret and use it for emergency management.

169 PTWC reported that there were many inquiries coming on about the unrest that it prompted to issue a message, even if there is no procedure available for that. With the limited available information, the message was issued with the understanding of the limitations.

170 PRSN suggested that perhaps a mechanism of coordination between PTWC and the Volcano Observatories should be explored.

171 Colombia suggested that the ICG Working Groups could help defining the borders of the problem, addressing the different parts of it, i.e. Working Group 1 for observing systems, special needs in terms of seismic monitoring, Working Group 2 for hazard assessment including for volume of displacement that could trigger a tsunami. Landslides and debris flows could occur with or without volcanic eruption. Chair Hillebrandt-Andrade added that Working Group 3 could work on what type of products should be produced for volcanic activity in relation with tsunamis.

172 USA inquired about the convenience of issuing a message from the Tsunami Service Provider for these cases. France argued that it probably introduces some degree of confusion given the current status of knowledge.

173 Curacao recalled that SRC issued several information messages and then this triggered a message from PTWC and that was useful for Curacao to issue its own information product to the public. So, in that case not issuing a bulletin could have created more speculation. For Curacao the ICG/CARIBE EWS is the platform to discuss and come up with a guidance on what would be done if this happens again.

174 France commented that the issue with volcanos is, as Colombia pointed out, that the higher the volcanic activity is the higher the tsunami threat could be. But it is very difficult to measure it. It seems that there are not quick techniques available to help measure rapidly the volume of pyroclastic materials involved and its implication for tsunami forecasting.



175 PRSN commented that the arrival time is the first information requested by users, and  
the second question is the height of the wave. The recommendation could be for Working  
Group 2 to do some estimations and provide forecasting with different scenarios.

176 Colombia suggested that this is a good example on the need for this Group to work out  
the communication between the provider and the users, both should have the same  
understanding on the technical language of the bulletin, and understand the uncertainties and  
complexities for this kind of event. The challenge is therefore how to improve for next time.

177 Venezuela agreed that the ICG should have a message and have the capabilities at  
national level for reading, interpreting the messages and produce information products for  
national purposes.

178 Nicaragua commented that the issue is very complex and every country that has this  
threat need to study in detail and understand its mechanisms because they are not equal one  
to the other.

179 **The ICG decided** to establish a Task Team on Volcanic Sources under the  
Chairmanship of Mr Paul Martens (Sint Maarten, Kingdom of Netherlands).

## 7. PROGRAMME AND BUDGET FOR 2016-2017

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

181 He provided details about the spending of the regular budget available in 2014-2015  
used mainly to support the ICG coordination work including the meetings of its Working Groups  
and Task Teams and reported also on the spending plans for the available regular budget for  
2016–2017.

182 Mr Aliaga also provided information on extra budgetary funding, in particular on the  
approval of two funding proposals to ECHO for activities on tsunami preparedness in San  
Cristobal, Dominican Republic, and Haiti. Both proposals were elaborated in partnership with  
other agencies.

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

## 8. NEXT SESSION

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

184 The Chairperson recalled that, at the Tenth Session of ICG/CARIBE-EWS, Costa Rica  
announced that they will consider hosting the Twelfth Session.

185 The representative of Costa Rica reiterated the offer to host the Twelfth Session of the  
ICG/CARIBE-EWS in Costa Rica, in April 2017.

186 **The ICG decided** to accept the offer of Costa Rica to host the Twelfth Session of the  
ICG/CARIBE-EWS in April 2017.



## 8.2. TARGET DATE FOR ICG/CARIBE EWS-XIII

187 The Group was requested by the Chairperson to decide on a target date for the  
Thirteenth Session of the ICG/CARIBE-EWS, and eventual offers from Member States to host  
it.

188 Curacao indicated that it hosted the Seventh session in 2012 and if the Member States  
agree it could start the work to host the Thirteenth session in Curacao in 2018.

189 Mexico indicated it would be very much interested in hosting the Fourteenth session in  
Mexico in 2019 with previous authorisation of national authorities.

190 USA recognised the willingness of Puerto Rico to host the Thirteenth session in 2018  
but it would not be able to confirm offering it due to matters that were not resolved ahead of  
this session.

191 **The ICG acknowledged** the offer of Curacao to host the Thirteenth Session in 2018.

## 9. OFFICERS ELECTIONS

192 The Intergovernmental Coordination Group for the Tsunami and Other Coastal Hazards  
Warning System for the Caribbean and Adjacent Regions (ICG/CARIBE EWS), was requested  
to elect one Chairperson and three Vice-chairpersons to act as Officers of the ICG for the two-  
year intersessional period (2016–2018).

193 The Chairman of the Intrasessional Elections Committee, Mr Albert Martis from  
Curacao, addressed the Session and introduced this agenda item. He informed attending  
Delegates that elections should follow the established IOC Rules of Procedure and briefly  
reviewed procedure to be followed.

194 Mr Cesar Toro, IOC-UNESCO Secretary for the IOCARIBE Subcommission verified  
that all nominations were received within the timeframe established (Tuesday April 5 at  
18.00 hrs.) and informed the Session.

195 Following nominations were received:

- Ms Christa von Hillebrandt-Andrade (USA) as Chairperson seconded by United Kingdom and St. Maarten
- Mr Paul Maarten (Sint Maarten) as Vice-Chairperson seconded by United Kingdom and France
- Mr Gérard Metayer (Haiti) as Vice-Chairperson seconded by France and Sint Maarten
- Mr Milton Gabriel Puentes (Colombia) seconded by Costa Rica and USA.

196 The Chairman of the Elections Committee extended his appreciation for the members  
of the Board for their excellent work.

197 Considering that Ms Christa von Hillebrandt-Andrade was proposed as Chairperson for  
the ICG, and this period would represent her third term, a recommendation to extend the  
number of terms for reelection “on an exceptional basis and in the interest of the Commission”  
with reference to the “Guidelines for Establishment of IOC Subsidiary Bodies”, was proposed.

198 **The ICG approved** this recommendation.

199 The Chairman of the Elections Committee reported that one nomination for the Chair was received and three nominations have been received for the existing three Vice-chair positions by the Secretariat. Ms Christa von Hillebrandt-Andrade (United States) was re-elected by acclamation as Chairperson for the period 2016–2018. Mr Paul Maarten (Sint Maarten, Kingdom of Netherlands), Mr Gérard Metayer (Haiti) and Mr Milton Gabriel Puentes (Colombia) were elected as Vice-chairs of the ICG/CARIBE-EWS for the period 2016–2018 by acclamation. (Rule 38.2).

200 The Chair of the Nominations Committee congratulated elected officers and thanked their efforts and time dedicated to the work dedicated to the ICG.

201 Barbados, British Virgin Islands, United States, France, Venezuela and Haiti congratulated the new Board of Officers and recognized the special dedication of Ms Von Hillebrandt-Andrade.

202 The Chairperson acknowledged with thanks the confidence and trust received by the of the ICG for her reelection.

## 10. ANY OTHER BUSINESS

203 At the proposal of the Officers the Chair Ms Hillebrandt-Andrade recalled that the [current Implementation Plan runs from 2013 to 2017](#) and that it would be advisable to start working on the next Implementation Plan.

204 Vice-chair Milton Puentes (Colombia) indicated that according to recommendations approved at this meeting and previous meetings this Group needs to have a sort of road-map to achieve the defined goals with planned resources. In the Implementation Plan we should include the issue of including other coastal hazards than tsunami and how to improve communications mechanisms. The invitation is then to develop together with Member States an Action Plan interesting enough to sell the idea to our countries and to IOC about the importance of the ICG to secure the lives and assets of coastal populations in the Caribbean.

205 Curacao inquired if there is a mechanism to report back from each country on how much of the Implementation Plan is being implemented not only at country level but at community level. Chair Hillebrandt-Andrade indicated that gap analysis can proceed from the evaluation of the current Implementation Plan, and then each country report on the status at community level.

206 Mr Aliaga, Technical Secretary reminded delegates that the planning mechanism should stand for six years instead of five, to match the biennium programming process of UNESCO and IOC, that is the new Implementation Plan should cover the period 2018–2023. He suggested defining focused and strategic indicators, and use Tsunami Ready recognition as an objective indicator for communities.

207 Chair Christa Hillebrandt-Andrade commented that considering the main ICG CARIBE-EWS objectives, particularly “to promote the establishment and further development of national tsunami and other coastal hazards warning and mitigation capacities in accordance with standard protocols and methods”; as well, and considering that IOC and IOCARIBE has been developing IOCARIBE-GOOS; and also that WMO is implementing in the context of the JCOMM workplan other initiatives for other coastal hazards mainly coastal inundation as a result of hurricane activity, it would be advisable to establish a “Group of Experts” (GoE) for advising the ICG/CARIBE-EWS on the work and implementation plan for enhancing the warning system by including other coastal hazards. UK strongly supported the idea.

208           **The ICG requested** the Technical Secretary to draft Terms of Reference for a Group of Experts (GoE) to advise the ICG/CARIBE-EWS on the work and implementation plan required to enhance the warning system by including other coastal hazards. **The ICG further decided** to request the Technical Secretary to deliver the draft Terms of Reference to the Officers for their consideration and for review at the Twelfth session of the ICG/CARIBE-EWS.

## 11.    **ADOPTION OF DECISIONS AND RECOMMENDATIONS**

209           Based on the reports of the Working Groups and discussions at the Plenary Sessions, the ICG adopted six Recommendations.

210           **The ICG decided** the following Chairpersons for Working Groups:

- Working Group 1 on Monitoring and Detection Systems:
  - Chair: Jean-Marie Saurel (France, 2013-),
  - Vice-Chair (Seismology): Dan McNamara (USA, 2015-),
  - Vice-Chair (Sea Level): Marcelino Hernandez (Cuba, 2016-)
- Working Group 2 on Hazard Assessment:
  - Chair: Silvia Chacon (Costa Rica, 2016-)
  - Vice-Chair: Alberto Lopez, (PRSN, USA, 2016-)
- Working Group 3 on Tsunami Related Services:
  - Chair: Antonio Aguilar (Venezuela, 2014-),
  - Vice-Chair (Technology and communications platform for alerts): Chip McCreery, PTWC (USA 2016-),
  - Vice-Chair (Protocols for end to end communication and dissemination of warnings): Wilfredo Ramos (USA, 2016-)
- Working Group 4 on Preparedness, Readiness and Resilience:
  - Chair: Patrick Tyburn (France, 2014-),
  - Vice-Chair (Resilience): Susan Hodge (Anguilla (U.K.), 2014-),
  - Vice-Chair (Public Awareness): [vacant]

211           **The ICG decided** on the continuation or establishment of the following Task Teams:

- Task Team Performance Based Recognition Programme
  - Chair: Kerry Hinds (Barbados, 2013-).
- Task Team Caribe Wave 17
  - Chair: Patrick Tyburn (France, 2016-)
- Task Team Volcanic Sources
  - Chair: Paul Martens, (St Maarten, Kingdom of Netherlands, 2016-)

## 12.    **CLOSE OF THE SESSION**

212           The Chair Ms Christa Hillebrandt-Andrade recognised the services of audio/translation and extended the recognition to the Government of Colombia, highlighted the commitment and contributions of all agencies participating in the National System of Disaster Risk Management

– SNGRD, and in particular thanked to Rear Admiral Juan Manuel Soltau Ospina for the excellent hosting and leadership.

213           Mr Vladimir Ryabinin, Executive Secretary of IOC, sent his warm thanks to Ms Christa Hillebrandt-Andrade, for her leadership, enthusiasm, and good results of her work.

214           The Chair thanked IOC's strategic support and leadership.

215           Rear Admiral Juan Manuel Soltau on behalf of the Government of Colombia thanked all the participants and hoped to get them back for tourism to beautiful Cartagena, and congratulated the newly elected and re-elected officers, as well as all participants for the sound discussions and quality of the recommendations.

216           The meeting closed at 18:00 hrs on 7 April 2016.

ANNEX I

**AGENDA**

**1. WELCOME AND OPENING**

- 1.1. MS CHRISTA VON HILLEBRANDT, ICG/CARIBE-EWS CHAIR
- 1.2. MR CESAR TORO, HEAD OF THE IOCARIBE OFFICE ON BEHALF OF THE INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION OF UNESCO
- 1.3. REAR ADMIRAL JUAN MANUEL SOLTAU, EXECUTIVE SECRETARY OF THE COLOMBIAN OCEAN COMMISSION

**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 CENTRE (CTIC)
- 3.4. REPORTS FROM UN AND NON-UN ORGANISATIONS
- 3.5. STATUS OF OTHER ICGs
- 3.6. NATIONAL PROGRESS REPORTS
- 3.7. INTERIM ADVISORY SERVICES REPORT (PTWC)
- 3.8. REPORT OF CARIBE WAVE 2016

**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. SPECIAL INVITED LECTURES:  
COMMUNITY-BASED TSUNAMI WARNING SYSTEM**

- 5.1. *COLOMBIA'S ACTIONS FOR TSUNAMI RISK MANAGEMENT*
- 5.2. *HONDURAS TSUNAMI EVACUATION MAPPING AND PLANNING*
- 5.3. *ST KITTS AND NEVIS TSUNAMI READY PILOT*

**6. POLICY MATTERS**

- 6.1. REPORT OF THE TASK TEAM ON TSUNAMI SERVICES MODEL
- 6.2. EXERCISE CARIBE WAVE 2017
- 6.3. REPORT OF THE TASK TEAM ON TSUNAMI RECOGNITION PROGRAMME

- 6.4. TSUNAMI THREAT FROM VOLCANIC ACTIVITY: LESSONS LEARNT FROM THE KICK 'EM JENNY EVENT ON JULY 2015

**7. PROGRAMME AND BUDGET FOR 2016–2017 (UPDATE)**

**8. NEXT SESSIONS**

- 8.1. CONFIRMATION OF DATE AND PLACE OF ICG/CARIBE EWS-XII
- 8.2. TARGET DATE FOR ICG/CARIBE EWS-XIII

**9. OFFICER'S ELECTION**

**10. ANY OTHER BUSINESS**

**11. ADOPTION OF DECISIONS AND RECOMMENDATIONS**

**12. CLOSE OF THE SESSION**



## ANNEX II

### RECOMMENDATIONS

#### Recommendation ICG/CARIBE-EWS-XI.1

##### **Caribbean Tsunami Information Centre (CTIC)**

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

**Acknowledging** the contribution of Barbados to host CTIC,

**Recognizing** CTIC's essential function in the region and its potential to attract funding for preparedness projects,

**Noting** the report of the Task Team on CTIC Terms of Reference and Business Model,

**Reiterating** the concern that the CTIC, despite its essential function in the region, is not able to continue to function without sustained core funding,

**Accepts** changes in the Terms of Reference of CTIC as proposed by the CTIC Task Team and included as Appendix I,

**Broadens** the scope of the CTIC to include other coastal hazards and put more emphasis on community preparedness,

**Extends** the duration of the Task Team on CTIC Terms of Reference and Business model until the 12<sup>th</sup> session of the ICG/CARIBE EWS to work on a 5-year strategic plan and a sustainability plan,

**Strongly recommends** that the Financial Committee of the IOC considers in their discussions about the programme and budget 2018-2021 (Draft 39C/5) the reinforcement of the CTIC including through core staffing as part of the implementation of the UNESCO Action Plan for Small Island Developing States (SIDS).

### Appendix 1

#### **CTIC Purpose**

1. Monitor the effectiveness of the tsunami warning system and recommend improvements.
2. Bring to regional and national stakeholders knowledge on tsunami warning systems, and on how to become active participants in the activities of the ICG/CARIBE EWS;
3. Assist national stakeholders in the establishment of warning and mitigation systems, and the improvement of tsunami preparedness for all through the implementation of comprehensive mitigation programmes in risk assessment, warning guidance and emergency response, and education and awareness
4. Acting in future as a technical resource for strengthening both the technical and institutional aspects of the ICG/CARIBE EWS, in addition to fostering research and its application to prevent loss of life and minimize damage to property.
5. Act as an information resource providing for the development, publication, and distribution of educational and preparedness materials on tsunamis and tsunami hazards; and
6. Act as an information resource on tsunami events, cooperating with the World Data Centre for Solid Earth Geophysics and the ITIC in collecting and making available through appropriate channels all records pertaining to tsunami events, and assisting

national authorities in making investigations of all aspects of major tsunamis, including the development of standard survey procedures for such investigations.

7. Support Member States in the preparation and conduction of regional and national exercise in cooperation with the Caribbean Tsunami Warning programme (CTWP).

#### **CTIC Functions**

- **Monitor the performance and effectiveness of the regional and national tsunami warning activities and seek the cooperation of all stakeholders in improving the system. Activities may include to:**
  - Maintain close familiarity with the operations and needs of the designated regional Tsunami Warning Centre (TWC), and work closely with the regional TWC to assist as needed with warning operations improvements.
  - Maintain communications with the designated contacts and focal points for the ICG/CARIBE EWS, and as appropriate, national Tsunami Warning Centres, and National Disaster Management Offices.
- **Serve as an information resource for the availability of technical information required for an effective tsunami warning system. Cooperate with experts to ensure that knowledge of new technology applicable to the warning system is made available to all participants. Activities may include to:**
  - Provide, or arrange for, consultative services to stakeholders wishing to develop or improve their warning system capability, and liaison services between international, regional and national stakeholders for planning and development of warning systems;
  - Conduct, or arrange for, assessments of existing facilities and the recommendation of improvements, in such areas as instrument standardization, operational scientific evaluation and interpretation, and real-time communications;
  - Initiate, coordinate, or conduct technical training programmes, workshops, and seminars, dealing with all aspects of tsunami warning and preparedness, taking advantage of national, regional, and international experts to provide and share experiences;
- **Serve as an information resource for the availability of educational, preparedness, and other awareness materials required for an effective tsunami warning and mitigation system. As needed, activities may include to:**
  - Initiate and foster the development and distribution of materials in the local language and context in partnership with national and local agencies and civil society organizations;
  - Initiate and implement national and community level awareness programmes, as are appropriate, for the effective delivery of awareness information in partnership with community stakeholders;
  - Encourage and assist as requested in the development of national social awareness materials for events and institutions, such as museums, memorial events, sign boards and other tsunami event memorials or materials, informative roadside signage or exhibits which remember the damaging aspects of past tsunamis
  - Encourage the posting of hazard, evacuation, or other interpretative signage to increase public awareness for effective and timely tsunami warning response
  - Disseminate, or arrange for, regular reports on tsunami warning and mitigation activities from regional and national stakeholders (such as newsletters and/or bulletins)
  - Disseminate, or arrange for, regular reports on tsunami warning and mitigation activities from regional and national stakeholders (such as newsletters and/or bulletins)

## **CTIC Board**

### **Role of the CTIC Board:**

Provide oversight for the operations and activities of the CTIC

### **Responsibilities of the CTIC Board:**

- Provide strategic guidance to ensure the sustainable management, and operations of the CTIC, including the mobilization of resources;
- Provide overall oversight for the implementation of the CTIC Work Plan activities and production of materials
- Conduct periodic monitoring of the implementation of CTIC activities through the review and approval of quarterly progress reports submitted by the CTIC Director
- Ensuring that the financial control and audit mechanisms of the CTIC are executed in accordance with the applicable UNESCO or host country rules as indicated in the host agreement;
- Provide input into annual work plans, budgets and implementation schedules for CTIC activities prior to ratification by the ICG/CARIBE EWS

### **Composition of CTIC Board:**

Board should reflect the multi-lingual nature and geographical spread of the ICG/CARIBE EWS.

### **Core Members:**

- Chair, ICG/CARIBE EWS
- Representative, IOC/UNESCO
- Representative, CTIC Host Government
- Representatives of ICG/CARIBE EWS Member States, one of which should be the Chairperson (or designate) of Working Group IV.

### **Observers:**

- Representative, CTIC Board meetings host country
- Director, CTWC, (Manager, Caribbean Tsunami Warning Program pending the establishment of the CTWC), UNDP Barbados and OECS
- Representatives (2), donor agencies
- Representatives (2), partner agencies

### **CTIC Board Secretariat:**

- Director, CTIC

### **Membership:**

- Membership by representatives will be on both permanent and rotational bases
- Membership representatives Member States nominated by Member State for a term of two years, renewable for a second term

## Recommendation ICG/CARIBE-EWS-XI.2

### **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 on Monitoring and Detection Systems, Warning Guidance and having reviewed the status of the observational data availability in the Caribbean and Adjacent Regions,

**Acknowledging** that the Member States need to support the operations of their national and local seismic, sea level and GNSS networks so they can continue to sustain and improve the quality and timeliness of the data delivery for optimal tsunami services,

**Recognizing** the efforts of the COCONet and TlalocNet projects to deploy continuous GNSS networks around the Caribbean, some of them with real-time high-rate data distribution, the installation of three GNSS data centres in the region and the installation or upgrade of four sea level stations,

**Recognizing** the improvements made in recent years for seismic and sea level monitoring around the Caribbean can be useful for other purposes such as Earthquake Early Warning, quickly felt earthquakes assessments, sudden changes in sea level and public information, encourages open distribution of those real-time data,

**Further recognizing** the ongoing efforts and developments made toward the use of GNSS products in real-time for timely threat level assessment,

**Having encouraged** the use of continuous real-time high rate GNSS measurements for high magnitude earthquakes rapid detection and improved Tsunami Early Warning,

**Also recognizing** that a strong need exists in the region for workshops with regional network operators on the evaluation of the calibration and accuracy of seismic and sea-level data and meta-data, and on the technical daily operations of sea-level stations,

**Recommends** that Working Group 1 drafts minimal requirements for high-rate, real-time GNSS stations and data format standards in coordination with relevant bodies; and that Working Group 1 promotes real-time GNSS stations installation in the Caribbean and Adjacent Regions;

**Also recommends** that WG1 conduct a review of seismic station calibration and related metadata in order to guarantee their accuracy and reliability for magnitude and focal mechanism determination;

**Requests** the Caribbean Tsunami Warning Program to collect existing sea level data availability and latency statistics, to continue producing up to date maps and data availability reports based on current sea-level and seismic stations contributing to the CARIBE-EWS, and to provide appropriate tools for online archival and sharing of those documents;

**Also requests** that WG1 and Caribbean Tsunami Warning Program evaluate the feasibility of a common protocol and associated software for real-time continuous internet based sea-level data exchange (not GTS) as a redundant communication link;

**Further requests** the Caribbean Tsunami Warning Program prepare a sea-level stations best practices manual including levelling and calibration that can be used by the Member States and operators of sea level stations;

**Encourages** each Member State to support, share and contribute science and technology advances in the fields of tsunami monitoring (including but not only HF radars, real-time GNSS computation, cabled sea-bed seismometers and tsunameters, strong-motion accelerometers, real-time and robust data sharing);

**Further recommends** working Group 1 to define minimum meta-data for sea-level stations using existing International Standards such as IODE, GLOSS, and JCOMM to establish minimum latency criteria for sea-level network performance assessment;

**Requests** working Group 1 in coordination with UNAVCO and NASA conduct a performance and sensitivity analysis on the actual available real-time GNSS stations in order to identify the reinforcement needs in the region to reach necessary network density in support of tsunami threat level assessment;

**Suggests** that the ICG identify volcano observatories as the primary entities responsible for determining the potential of a volcano induced tsunami threat. Volcano observatories should work with the PTWC to determine the appropriate types of threat information products for volcano observatories would make available to emergency managers to convey this threat potential. Should the PTWC detect a volcano-induced tsunami, forecast bulletins will be issued in accordance with established procedures, independent of source;

**Decides** that the Pacific Tsunami Warning Center be henceforth referred to as a CARIBE-EWS Tsunami Service Provider (TSP), removing the term "Interim". This recommendation is based on PTWC meeting the criteria established in the CARIBE-EWS Tsunami Service Model, and successful operational performance in support of CARIBE-EWS in a TSP role.

### Recommendation ICG/CARIBE-EWS-XI.3

#### **Tsunami Hazard Assessment**

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

**Acknowledging** that a list of tsunami sources from tectonic origin has been made by members of the Working Group 2 and presented at the Fall 2015 American Geophysical Union annual meeting, and **considering** that other sources from non-seismic origin could also affect the Caribbean basin,

**Recognising** a survey was carried out to quantify the status, format, quality and availability of bathymetry data, as well as to learn about the existence of tsunami inundation and evacuation maps to gauge which member states are interested in learning how to develop their own maps, **and noting** that 93% of Member States who participated in the survey showed interest in receiving assistance for the generation of tsunami inundation and evacuation maps,

**Acknowledging** that a pilot-project known as Tsunami Evacuation Maps, Plans Procedures (TEMPP) is currently on-going for Central America that came as a recommendation from the Pacific Tsunami Warning System (PTWS), with the International Tsunami Information Center (ITIC) as coordinator,

**Also acknowledging** that Member States have different levels of available products of tsunami preparedness (modelling, inundation maps, evacuation maps, etc.), **and noting** that funds to organize a series of workshops to generate tsunami preparedness products might not be possible to cover the needs in its entirety,

**Considering** recommendations from the [9th session of Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems \(TOWS-WG\)](#),

**Requests** Working Group 2 to examine for implementation modifications of Greens Law for tsunami wave forecasting for the Caribbean and Adjacent Regions;

**Also considering** the Kick'em Jenny volcanic crisis of 2015,

**Acknowledging** benchmark exercises exist for tsunami numerical models, which provide guides to test and compare different models, and the importance of validating and verifying tsunami numerical models to avoid preparedness measures be based on unrealistic estimates,

**Noting** the existence of tsunami numerical models which have not been benchmarked,

**Also noting** that NOAA's tsunami source modeling tool –TWEB, though not operational, provides helpful information that can be used by the TWFPs and NTWCs to produce more detailed coastal tsunami forecasts through inundation modeling,

**Decides** that Working Group 2 and Member States perform tsunami numerical simulations from sources that were included in the list presented by members of the Working Group 2 at the [Fall 2015 American Geophysical Union annual meeting](#), **and further decides** expanding the list of sources for the Caribbean to include those sources from non-seismic origin;

**Decides** that a series of workshops similar to the Tsunami Evacuation Maps, Plans Procedures (TEMPP) be organized for ICG/CARIBE-EWS Member States requiring training in tsunami simulations and development of tsunami inundation and evacuation maps;

**Recommends** categorisation of Member States into groups who have similar tsunami products available (i.e. group together states with tsunami inundation maps but no evacuation maps);

**Further recommends** that the above identified Member States be divided by geographic location and/ or language;

**Recommends** Working Group 2 to submit a proposal to USAID and other donors with the goal of obtaining funding to organize a series of workshops similar to TEMPP;

**Recommends** that a group of experts in tsunami modelling from Working Group 2 stands available to provide assistance to Member States related on tsunami modelling and development of tsunami inundation maps, and explore examples such as IODE or other similar IOC programmes that could help in the training effort;

**Recommends** to establish an ICG/CARIBE-EWS Task Team to identify the procedures to follow for volcanic crises;

**Noting** Recommendation ICG/CARIBE-EWS-IX.3, **further recommends** that in case a Member State is considering bathymetry data collection surveys, the survey should be programed following the above recommendation, particularly in accordance to coastal geomorphology. Member States can consult Working Group 2 for assistance in defining recommended resolution for specific locations;

**Recommends** Member States to employ validated and verified tsunami numerical models;

**Recommends** that NOAA proceeds with development of TWEB with operational capability delivered through the CTWP for CARIBE-EWS Member States as soon as feasible.



#### Recommendation ICG/CARIBE-EWS-XI.4

##### **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),

**Recalling** that at the Ninth Session of the Intergovernmental Coordination Group for the Tsunami and other Coastal Hazards Warning System for the Caribbean and Adjacent Regions (ICG/CARIBE-EWS-IX) held in St. Thomas, United States of America, 13–15 May 2014, approved new terms of reference for Working Group 3 through Recommendation ICG/CARIBE-EWS-IX.4,

**Recognising** that a wide range of new communications systems are available,

**Notes** that multiple existing communications pathways of the Tsunami Service Providers (TSPs) should be operational and used by National Tsunami Warning Centres (NTWCs) and Tsunami Warning Focal Points (TWFPs) to ensure receipt of messages;

**Encourages** countries to make the best use of new communications technology to deliver information in real time, allowing the rapid exchange of scientific data and information for assessment of tsunamis, to facilitate the work of emergency response agencies;

**Invites** Member States to explore the effective and appropriate use and monitoring of social media networks and other media to disseminate educational, public awareness, community preparedness messages and materials, and to rapidly deliver emergency alerts;

**Encourages** Member States to include organisations such as the amateur radio user community to help spread emergency alerts;

**Suggests** that Member States promote and encourage tsunami awareness training for journalists and other representatives of the media who can play a key part in dissemination of information to communities about tsunamis, in terms of preparation, response, and risk reduction;

**Recommends** that Member States establish mechanisms to assess the effectiveness of alert dissemination from National Tsunami Warning Centres (NTWCs) to coastal towns and communities, in order to identify any difficulties and to produce solutions.

#### Recommendation ICG/CARIBE-EWS-XI.5

##### **Public Awareness, Education and Resilience**

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** that according to the outcomes of the survey conducted to evaluate the national implementation of the tsunami awareness programmes in alignment with the provisions of the [Tsunami Public Awareness and Educations Strategy for the Caribbean and Adjacent Regions](#) (PAE) IOC Technical Series No.107, 52.94% of the Member States consider the PAE strategy framework useful, 55.88% have not yet realised its implementation and furthermore that 88,57% asked for training on how to conduct this implementation,

**Taking into account** the needs for tsunami preparedness, monitoring and response to tsunami hazard along the coastal regions and that the *Tsunami Ready* Community Performance Based Tsunami Recognition Programme for the Caribbean and Adjacent Regions to be followed by Member States within the Caribbean and Adjacent Regions were adopted through the Recommendation ICG/CARIBE EWS-X.6,

**Recognizing** the important role of the *Tsunami Ready* Community Performance Based Tsunami Recognition Programme for the Caribbean and Adjacent Regions in building community, territorial and country resilience for tsunami and other coastal hazards in the various Member States,

**Requests** Working Group 4 to elaborate, in collaboration with CTIC, a training action to assist Member States in the implementation of their national Tsunami Public Awareness and Education programme;

**Decides** that the Task Team continue its work on supporting the work of the Working Group 4 and the Caribbean Tsunami Information Center (CTIC) and Caribbean Tsunami Warning Programme (CTWP) as required by the ICG;

**Further decides** the continued piloting of the approved guidelines for the *Tsunami Ready* Community Performance Based Tsunami Recognition Programme for the Caribbean and Adjacent Regions;

**Further recommends** that Member States and donor agencies support pilot projects under the *Tsunami Ready* Community Performance Based Tsunami Recognition Programme for the Caribbean and Adjacent Regions;

**Requests** that Working Group 4 through CTIC and the CTWP promotes the *Tsunami Ready* Community Performance Based Tsunami Recognition Programme for the Caribbean and Adjacent Regions through a targeted public awareness and education campaign to commence during the inter-sessional period;

**Encourages** all Member States during the inter-sessional period to select and inform on the communities to be targeted to participate and receive Tsunami Ready recognition by 2026;

**Further encourages** all Member States to identify Points of Contact for the *Tsunami Ready* Community Performance Based Tsunami Recognition Programme for the Caribbean and Adjacent Regions for the corresponding coordination and as a prerequisite for the local implementation of it;

**Recommends** the Task Team on the *Tsunami Ready* Community Performance Based Tsunami Recognition Programme for the Caribbean and Adjacent Regions to consider the proposed logo developed by Colombia in support of the implementation of the Programme;

**Re-emphasises** the need for Working Group 3 to develop, in accordance with Recommendation ICG/CARIBE-EWS-X.6, a regional Tsunami Media Guide and produce a resource guide on communication and technologies for use by communities in the reception and dissemination of tsunami alerts, as well as Working Group 4 to develop the guideline on how to plan and conduct community tsunami exercises as well as the guidelines for the public display of tsunami information in support of the guideline requirements;

**Considers** the outcomes and the delivery of the Tsunami Evacuation Mapping and Planning Procedures process in the CARIBE-EWS in support of the implementation of the *Tsunami Ready* Community Performance Based Tsunami Recognition Programme for the Caribbean and Adjacent Regions.

Recommendation ICG/CARIBE-EWS-XI.6

**Exercise Caribe Wave 17**

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** Recommendation ICG/CARIBE-EWS XI.4,

**Recognizes** the success of the Caribe Wave 16 exercise in advancing tsunami readiness in the region and congratulates the organizers, Member States and over 330,000 participants for the conduct of what has become the largest international tsunami 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 exercise;

**Decides** that Caribe Wave 17 will have three scenarios, a Santiago de Cuba, Costa-Rica based on the Limon earthquake 1991 and a North-eastern Antilles based on the 1843 event. This last scenario will be used for the European Union Civil Protection Mechanism Rescue Exercise that is scheduled for March 22-23, 2017.

**Also decides** that all scenarios start at the same time, with one dummy message at the time of the earthquake, 1400 UTC, and the 1<sup>st</sup> message for each of the three scenarios 5 minutes later, 1405 UTC;

**Proposes** that each Member States selects one scenario and that PTWC only send simulated products for the selected scenario to the primary TWFP and NTWC of that Member State;

**Further decides** that the exercise takes place on Tuesday March 21, 2017 and commences at 1400 UTC;

**Recommends** the timetable and benchmarks proposed by the Task Team on Caribe Wave 16 and that webinars follow the same or similar process as with previous exercises;

**Further recommends** that the registration process be kept at [www.tsunamizone.org](http://www.tsunamizone.org) and **appreciates** the support of the US National Tsunami Hazard Mitigation Program to this site;

**Additionally recommends** that a survey similar to previous exercises be conducted as part of the Caribe Wave 2017 exercise;

**Encourages** Member States to convene a national tsunami preparedness week including the Caribe Wave Exercise 17;

**Suggests** the following possible exercise scenarios for 2018 and 2019:

**Caribe Wave 18:**

- a. Puerto Rico event as part of the 100-year anniversary of the 1918 tsunami

**Caribe Wave 19:**

- a. Jamaica 1906
- and/or
- b. Kick 'em Jenny

**Decides** to establish a Caribe Wave 17 Task Team modelled after past Caribe Wave Task Teams.

ANNEX III

**OPENING SPEECH**

Ms Christa von Hillebrandt  
on the occasion of the Eleventh Session of the ICG/CARIBE-EWS  
Cartagena de Indias, Colombia, 5-7 April 2015

Me uno en el saludo protocolar en especial al Contra Almirante Juan Manuel Soltau Espinal, Presidente de la Comisión Colombiana del Océano y anfitrión de nuestra reunión y agradecer la invitación y la hospitalidad de Colombia en esta onceava reunión del CARIBE EWS. También un saludo especial a todos los Delegados de los países miembros que han hecho prioridad participar en esta sesión, muchos, aunque desde muy cerca han viajado hasta días para llegar aquí.

Hace un poco más de 10 años nos reunimos por primera vez en Barbados, llenamos un auditorio en la sede de la UNESCO. Los pocos aquí presentes que estaban en esa reunión han de recordar la energía y muestras de compromiso hacia la creación del sistema, y también el poco conocimiento que había de tsunamis y los procesos de la UNESCO en general. Pero gracias al compromiso de todos los estados miembros, la UNESCO y COI y países y organizaciones donantes, aunque no tengamos la cantidad de participantes como en esa primera reunión, que no cabe la menor duda que hoy los 48 países y territorios de nuestra región tienen su sistema de alerta de tsunami y en menor o mayor grado están listos para responder cuando el próximo tsunami azote nuestra región.

Esto no lo digo, porque lo pienso, sino porque lo comprobamos una vez más y de manera más contundente que nunca en el Ejercicio Caribe Wave 16 hace menos de un mes. En este ejercicio participaron sobre 270,000 personas desde Bermuda hasta Brasil, personas e instituciones a lo largo y ancho de la Antillas y desde México pasando por América Central hasta los países del Norte de Sur América. Sin duda ha sido el ejercicio internacional de tsunamis más grande del mundo.

Y como comentaba el Dr. Charles McCreery, el Director del Centro de Alerta de Tsunamis del Pacífico, nuestro aun proveedor de servicios de tsunamis en uno de los webinars preparativos para CARIBE WAVE, es impresionante pero también imprescindible esta participación tan masiva. En los pasados 500 años han ocurrido unos 75 tsunamis que han costado la vida de casi 4,500 personas. Aunque el número de muertes es significativo, más de lo que han muerto en Alaska y todo el Noreste Atlántico donde llevan décadas con un sistema de alerta es más preocupante aún si consideramos que el más reciente gran tsunami en nuestra región ocurrió en el 1946, cuando había muy poco desarrollo en las costas y el boom turístico justamente estaba por empezar. A pesar de esta realidad, los tsunamis no ocurren con mucha frecuencia, mucho menos que en el Pacífico, por lo que es muy fácil olvidarse o dejar para “mañana” la planificación. Pero, sabemos, y lo vivimos en sangre propia, lo que pasa cuando dejamos para mañana el alistarnos y prepararnos para los desastres, ocurren tragedias como la de Haití del 2010, cuyas cicatrices aun surcan las almas, las ciudades y el paisaje de este país caribeño. Así la importancia de CARIBE WAVE, no permitiendo que los tsunamis vuelvan a ser el “Peligro Olvidado”.

Pero no solo hemos madurado en cuanto a nuestra organización y capacidad de movilización de gobiernos y comunidades en ejercicios como Caribe Wave, también hemos reducido a menos de cinco minutos el tiempo toma detectar y reportar sobre un terremoto significativo, en vez de 3 horas ya no debe tardar más de 5 a 30 minutos confirmar un tsunami con nuestra red mareográfica. También ya se ha empezado a encaminar el programa Tsunami Ready bajo el cual CARIBE EWS y UNESCO reconocerán comunidades que han tomado los 10 pasos mínimos de alistamiento. Este programa del Caribe está sirviendo de modelo para el Pacífico, el Mediterráneo y el Océano Índico. En esta reunión, también a tenor con la Plataforma de Sendai de Reducción de Riesgos por Desastres, estaremos considerando el

Modelo de Servicios de Tsunamis que pone la comunidad en el Centro, no al final de la secuencia de toma de decisiones.

Ciertamente hemos avanzado mucho desde esa reunión del 2006 en Barbados. ¿que toca ahora? Ahora que hemos completado la fase de implementación entramos con pies firmes en la etapa de mantenimiento y consolidación. Como con cualquier nave, sabemos que esta labor es muy necesaria, pero también restante. Todos quieren estar presente y cubrir la noticia cuando se lanza el barco y este hace su viaje inaugural, pero una vez que ya ha hecho sus recorridos y hay que pintar, reparar motores, reemplazar piezas, entrenar la nueva tripulación, integrar nueva tecnología... la operación se puede volver cuesta arriba.

Igualmente nosotros tenemos el reto en el CARIBE EWS de mantener nuestra “nave” alerta y lista, de que se mantengan las estaciones sísmicas y mareográficas, se adelanten los mapas de amenaza, se mejoren comunicaciones, se den adiestramientos y se siga educando y concientizando. Esto requiere recursos económicos. Todo este trabajo de mantenimiento lo hacemos reconociendo que no todos los países están al mismo nivel con sus sistemas y hay aun componentes del sistema que necesitan un refuerzo urgente y que el CTIC necesita urgentemente de un financiamiento sostenible, para que no tenga que cerrarse como ha ocurrido desde comienzos de este año y que no podamos contar con su directora en esta reunión.

Uno de los asuntos que quisiera traer a su atención y que tengamos en cuenta son algunos de los siguientes elementos pues entiendo que son críticos para la sustentabilidad del CARIBE EWS, y quizás en el pasado por estar enfocados en los elementos propios del sistema de tsunamis no le hemos dado tanto énfasis. Primeramente, necesitamos como representantes del sistema de tsunamis en nuestros países fortalecer nuestras relaciones con los representantes de nuestros países ante la COI y la UNESCO. En mis oportunidades de representar al CARIBE EWS en Paris, he tenido la oportunidad de reunirme con las delegaciones de estados miembros y he podido ver que cuando ellos se sensibilizan se convierten en voces fuertes y potencialmente muy efectivas para que la COI y la UNESCO designen los recursos necesarios. Segundo, debemos reconocer el rol y dar especial atención a los SIDS (Pequeños Estados Insulares en Desarrollo) que representan 17 de los estados miembros del CARIBE EWS y es un área de enfoque especial para la COI. Tercero y por último, efectivamente hemos construido una plataforma de observación y acción que tiene muchas otras aplicaciones y fortalecerían programas para otras amenazas costeras que están en la mira y la atención de nuestros países, organizaciones y potenciales donantes, específicamente los ciclones y cambio climático. Por lo tanto, para el CTIC y otros componentes en necesidad de recursos, una estrategia para allegar los fondos que necesitamos es atender estratégicamente el asunto de “otras amenazas costeras” en nuestro título. Yo no estuve en la reunión de México donde se dieron los primeros pasos para la creación de nuestro sistema, pero entiendo que tuvieron mucha visión los participantes cuando decidieron que el enfoque no debería ser solo los tsunamis, pero incluir otras amenazas costeras, especialmente aquellas relacionados a cambios en el nivel del mar.

Después de 4 años en la presidencia, me siento muy orgullosa y complacida de lo que hemos podido lograr juntos, de que hemos identificado lo que nos une para construir una base sólida sobre el cual el CARIBE EWS seguirá creciendo. Sé que queda mucho trabajo pendiente. En esta reunión tomaremos decisiones importantes que definirán mejor nuestro sistema de alerta de tsunamis y otras amenazas costeras, incluyendo la elección y designación de los y las líderes de esta próxima fase... Muchas gracias a todos y todas que han aportado desde nuestro establecimiento hace un poco más de 10 años, gracias Colombia y Cartagena en particular por recibirnos y gracias sobre todo por su confianza. Espero no haberles defraudado y con esa pasión reconocida por el colega Albert Martis en Curacao en el 2012 les digo, manos a la obra, para atrás, ni para coger impulso.

5 de Abril de 2016

## ANNEX IV

### TECHNICAL, LOGISTICAL AND ADMINISTRATIVE REQUIREMENTS OF A REGIONAL TSUNAMI SERVICE PROVIDER FOR THE CARIBE-EWS

#### EXECUTIVE SUMMARY

One of the main action items of the UNESCO-IOC ICG/CARIBE-EWS is the establishment of a fully functional Tsunami Warning System for the Caribbean and Adjacent Regions (CTWS). At its tenth session in Philipsburg, Sint Maarten, the ICG adopted a Tsunami Service Model (Figure 1). Following this model, the Regional Tsunami Service Provider (RTSP) will replace the interim service being provided by the Pacific Tsunami Warning Center to the Region. At ICG-X, the Tsunami Service Model Task Team was instructed to prepare documents describing the various elements of the Tsunami Service Model for the Caribbean and Adjacent Regions, taking into account the discussions at ICG-X, the relevant recommendations from TOWS-WG and considering the work and documentation provided for other Tsunami Warning Systems on defining these operational requirements. This document describes the RTSP, one of the main components of the Tsunami Service Model.

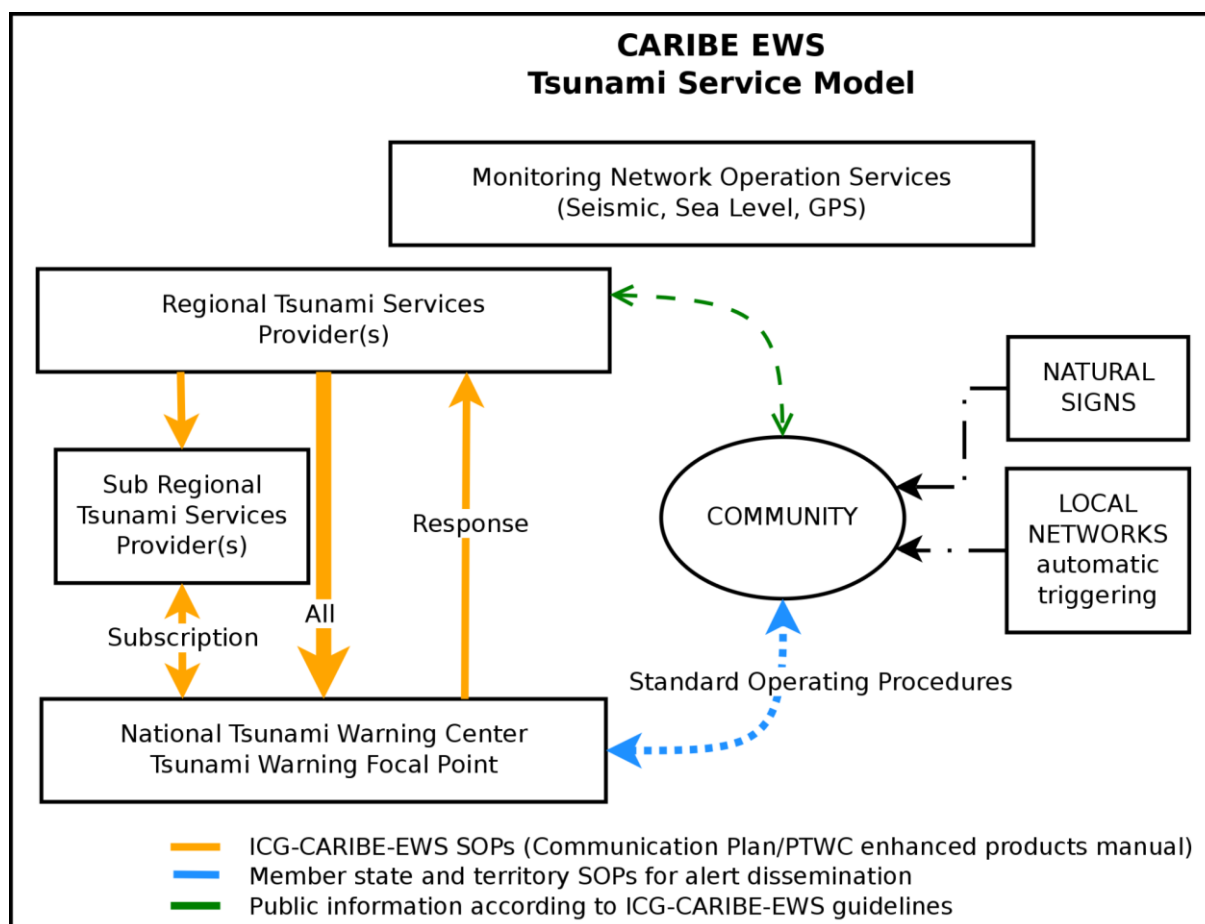


Figure 1. ICG CARIBE-EWS Tsunami Service Model (ICG-X 2015).

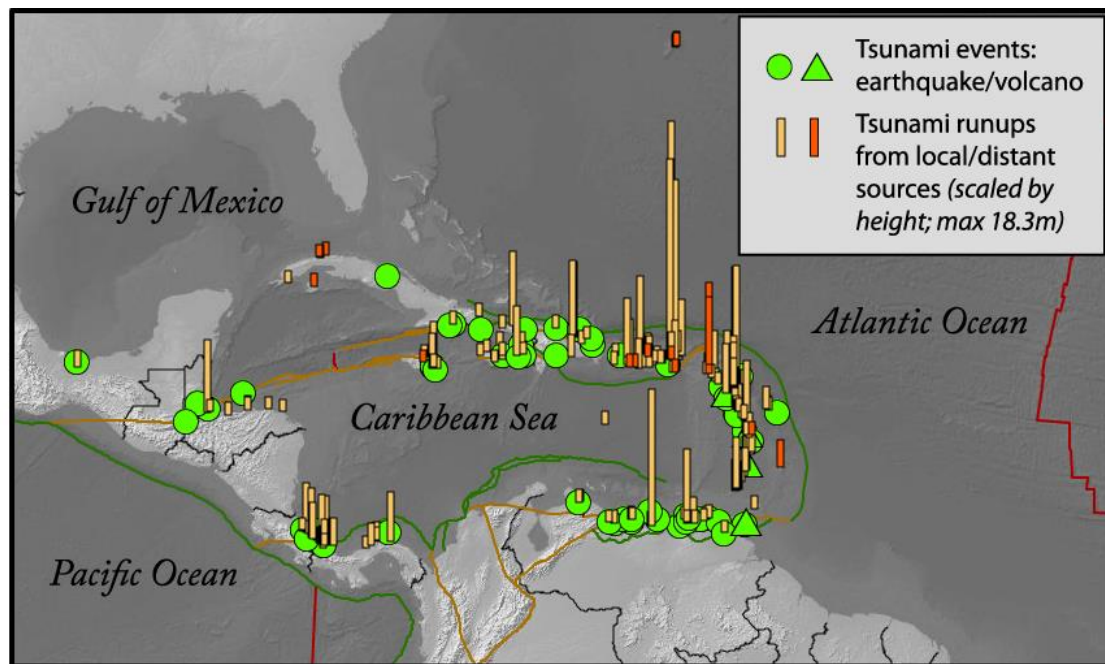
#### INTRODUCTION

A **Tsunami** is a series of waves generated by a displacement of the water column by an undersea earthquake, volcanic eruption, landslide or meteor impact. Offshore earthquakes are by far the most common cause of tsunamis. In deep waters they can travel as fast as



500 miles per hour, equivalent to the speed of a commercial jet. When the tsunami approaches the coast, its speed decreases drastically as well as the distance between the waves, causing its height to increase up to dozens of feet with the potential of causing extensive destruction and loss of lives.

History and ongoing research confirms the very high risk of the Caribbean coasts to tsunamis (Figure 2). The most significant source is a local earthquake, although tsunamis from volcanic eruptions and regional and distant earthquakes and submarine landslides also threaten the low lying coastal areas. With growing populations, increasing tourism, and concentration of infrastructure along vulnerable coastlines, events of similar proportions to those which have occurred historically carry a very high level of risk and must be anticipated and addressed (von Hillebrandt, 2013).



**Figure 2. Maps of historical tsunamis in the Caribbean basin and their relative source (von Hillebrandt-Andrade, Christa, 2013. *Minimizing Caribbean Tsunami Risk, Science, Vol. 341*pp. 966-968).**

For tsunami prone areas, the IOC tsunami experience has shown a Tsunami Service Provider (TSP) and accompanying Tsunami Information Centres (TIC) working closely with the national authorities to be essential and critical organizational components for the successful operation of a Tsunami Warning System (TWS).

Since 2005, the PTWC has agreed to provide an interim tsunami advisory information service to the Caribbean and adjacent regions. Since June 2007, the US National Tsunami Warning Center (US-NTWC, previously known as the West Coast and Alaska Tsunami Warning Center) has been providing interim tsunami warning service for Puerto Rico and the US and British Virgin Islands. To cover the needs of the Caribbean, the ICG/CARIBE-EWS II and III had recommended that a Caribbean Tsunami Warning Centre must be established by 2010. This recommendation has been superseded by a Regional Tsunami Service Provider (RTSP) within the context of the Tsunami Service Model recommended by ICG -X.

## MISSION

The RTSP will provide timely and effective tsunami threat assessments (and based on those assessments will disseminate regional tsunami services products to) for all ICG/CARIBE-EWS Member States.

## DUTIES

The RTSP will monitor the Caribbean and adjacent regions for tsunamis threat and inform its customers and partners of potentially tsunamigenic events and the associated tsunami threat. The authoritative tsunami warning agency (Tsunami Warning Focal Point (TWFP) and/or National Tsunami Warning Center (NTWC)) for each Member State is designated its government and has the fundamental responsibility for public safety in a tsunami emergency. The authority for issuing tsunami warning instructions to the public resides with this agency and not with RTSP.

In order to fulfill its mission, the RTSP responsibilities will encompass the following:

1. Acquire in real time the seismic data from as many seismic stations as possible and necessary to meet the detection thresholds. These data are to be provided by the global, regional, sub regional, national and local seismic networks.
2. Monitor the seismic data streams to locate and analyze earthquakes to determine the tsunami threat for the area of coverage (AOC) of the ICG/CARIBE-EWS.
3. Establish cooperation with other TWC, TWS's and TSP's, (e.g. PTWC/S, NEAMTWS) particularly for the monitoring of teleseismic tsunamis that could affect the ICG/CARIBE-EWS's AOC.
4. Monitor coastal and ocean (DART buoys) sea level data around the Caribbean and Adjacent Areas and integrate into tsunami evaluation procedures and products.
5. Compute the estimated arrival times (ETA's) and amplitudes of the tsunamis for coastal point of interests designated by ICG/CARIBE-EWS.
6. Disseminate Tsunami products (information statements, tsunami threat levels), including to all TWFP and/or NTWC designated by the Member States, according to the ICG/CARIBE-EWS recommendations.
7. Monitor the observational data that is received to ascertain that it meets the specifications established by the ICG/CARIBE-EWS.
8. Evaluate and develop new technologies (software, hardware, algorithm ...) to improve tsunami monitoring and tsunami services. Cooperate with international research groups on tsunami science.
9. Coordinate data and products with NTWCs in the region and other tsunami service providers.
10. Coordinate with international data centres to maintain historical tsunami databases for the Caribbean.
11. Develop, maintain and update the necessary documentation, including Tsunami Products Users Guide.
12. Develop IT processes and systems, including security measures, necessary to carry out responsibilities 24/7.
13. Maintain communication links (including scheduled and unscheduled tests) with Tsunami Warning Focal Points and National Tsunami Warning Centres.

14. Prepare summary reports (including timelines) on tsunami communication tests and whenever a tsunami related event occurs.
15. Prepare annual report on RTSP activities for CARIBE-EWS, including key performance indicators (Table 4).

## OPERATIONAL REQUIREMENTS

The key operational components of the Regional Tsunami Service Provider (RTSP) are to provide real-time monitoring, information on potential tsunami events, timely decision making and dissemination of tsunami products, as agreed by the ICG/CARIBE-EWS.

The operational requirements can be divided into technical and logistical requirements.

### **Technical Requirements**

#### **Earth Data Observations**

*Observational data (including seismic and sea level) from international, regional, national and local networks*

The RTSP must have access to as many global, regional, sub-regional, national, local and their own seismic and sea level stations (see table 1 and table 2 for, respectively, seismic and sea-level stations requirements) in order to detect earthquakes and confirm and forecast potential tsunamis. Mechanisms and procedures need to be developed to also detect and inform the Member States on tsunamis caused by non-seismic sources, such as landslides and volcanic eruptions.

The rapid detection and characterization of tsunami-generating earthquakes provides the first indication of a potential tsunami in an end-to-end tsunami warning system. All earthquakes will be processed and the result disseminated according to ICG/CARIBE-EWS thresholds. Standardized seismic location, magnitude and depth parameters should be disseminated within 5 minutes.

Initial seismic-based tsunami threat level information is subsequently refined by the detection of tsunami-generated changes in sea level, measured by coastal tide gages and buoys.

#### **Data and Information Requirements**

##### *Telecommunications methods and connections*

Several telecommunications connections are required to collect real-time data needed to detect earthquakes and tsunamis and to collaborate with other centres and disseminate critical products messages to its customers and clients. Some data, especially seismic and sea level data from international networks, is available in real time through the internet and satellite downlinks.

To obtain seismic data in a timely fashion RTSP will use Internet, dedicated circuits and/or regional VSAT methods. For sea level data, the RTSP will need to use international communication methods like GOES or Global Telecommunications System (GTS) of the World Meteorological Organization's (WMO), and Internet. The RTSP should also acquire, in the most effective and efficient way, real-time earthquake and tsunami information released by other tsunami service providers and international, regional and local earthquake observatories, such as the U.S. Geological Survey (USGS) National Earthquake Information Center (NEIC), the PTWC, and NTWCs. Information could be acquired through faxes, Internet web sites, the

GTS, and other alternate public and non-public information sources. In all cases, the communications programmes will be continually maintained and upgraded by an Information Technology Officer (ITO) on the centre staff. They must be continually tested to make sure they will be performing as needed during actual events. When tests indicate a failure, the problem should be resolved as quickly as possible as the next event can occur at any time.

### **Tsunami threat level System Decision Support**

#### *Development, adaptation and/or upgrade of Tsunami forecast models*

The forecast of whether a tsunami has or has not been generated from a seismic event, and the refinement of the forecast by additional observational data (including seismic and sea level) processing and analysis requires the incorporation of observational data from the communications channels into an integration and analysis subsystem. A decision-making subsystem that is composed of useful aids to the operational watch stander is needed to assist making quick decisions on the issuance of tsunami products. This may be an automated system or one that is an interactive human-machine mix.

#### *System to assess the potential impact of the tsunami*

This is contemplated as a tsunami forecast subsystem that should have an appropriate historical database and a forecast system to estimate arrival times and wave heights at coastal locations.

### **Equipment and Maintenance Requirements**

At a minimum, the RTSP maintenance program will consist of computer hardware and software maintenance. This includes local area network and communications hardware and software maintenance and upgrades. Technicians may also be called upon to maintain physical plant systems such as backup generators, telephone systems, etc.

### **Logistical Requirements**

#### **Tsunami Service Products**

In order to take advantage of existing international resources and the experiences of the Pacific and other Tsunami Service Providers and to maintain already established standard parameters and formats, the RTSP will issue tsunami products according to the ICG/CARIBE-EWS Users Guide (previously known as communications plan)<sup>3</sup>:

**Tsunami Threat:** A Tsunami Threat will be issued by the RTSP when there is a threat for a potential tsunami that may produce strong currents or waves dangerous to those in or near the water. Coastal regions historically prone to damage due to strong currents induced by tsunamis are at the greatest risk. The threat may continue for several hours after the arrival of the initial wave, and different threat levels (wave heights) can be assigned to different areas.

**Information Statement:** An Information Statement will be issued to inform emergency management officials and the public that an earthquake has occurred. In most cases, Information Statements are issued to indicate there is no threat of a destructive tsunami affecting the RTSP's AOC and to prevent unnecessary evacuations, as the earthquake may have been felt in coastal areas. An Information Statement may, in appropriate situations, caution about the possibility of destructive local tsunamis. Information Statements may be reissued with additional information, though normally these messages are not updated. However, a Tsunami Threat message may be issued for the area, if necessary, after analysis and/or updated information becomes available.

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<sup>3</sup> Adapted from the Tsunami Warning Center Reference Guide, USAID and WCATWC

Product Content: Tsunami bulletins or statements will be issued by the RTSP, when an earthquake with the magnitude 6.0 or greater occurs or when an event cause concern about tsunami potential. The products should contain:

**Earthquake Information:**

Origin time (UTC), Coordinates (latitude and longitude) of the epicenter, Location (name of geographical area), Magnitude (M) and Depth.

**Tsunami Information:**

- 1) Evaluation of tsunamigenic potential based on the empirical relationship between magnitude of earthquake and generation/non-generation of tsunami in the CARIBE-EWS AOC basin.
- 2) Estimated tsunami travel times to reach the respective coasts in the CARIBE-EWS AOC (only when a tsunami threat is issued). This is best handled by specifying forecast points that are well known to emergency managers and the population.
- 3) Tsunami impact information whenever available.

For non-seismic potential tsunami events, a situation assessment and tsunami threat evaluation will be provided, based on available information.

All these products have to be subject to the World Meteorological Organization, IOC, TOWS or any other ICG-approved standards. The geographic region has been defined by the ICG.

**Dissemination and Notification**

Since a comprehensive information dissemination program is critical to an effective tsunami warning system the RTSP will ensure that all the officially designated CARIBE EWS Tsunami Warning Focal Points and National Tsunami Warning Centers are sent at no cost the products thru the established communications methods. The products will also be sent to the SRTSP's. The entire dissemination system, from the RTSP to the NTWC/TWFP's and SRTSP's, should be tested on a routine basis with scheduled and unscheduled tests. Dissemination processes should take advantage of all technologies available to the RTSP and be automated as much as possible to decrease the time required to issue products and improve efficiency in providing threat levels. There should be redundant communications paths to ensure receipt of critical data and complete dissemination of all tsunami products. GTS should be used for the dissemination of the text products, as well as any other alternatives for disseminating information, including graphical products, to the established RTSP bulletin recipients, including, but not limited to:

- Email
- Telephonic faxes
- Web pages, web-based technology (public products only)
- TCP/IP Protocols
- Satellite-based communication systems

The RTSP will monitor the Caribbean and Atlantic Basins for seismic events and tsunamis and inform and advise the institutions designated by the Member States. However, the authoritative tsunami warning agency (e.g. Tsunami Warning Focal Point, National Tsunami Warning Centre) for each country, territory or administrative area is designated by its central government or administrative head and has the fundamental responsibility for public safety in a tsunami emergency. The authority for issuing tsunami warning and instructions to the public resides with this agency and not with RTSP.

The RTSP should collect from each NTWC and/or TWFP an acknowledgement and the response taken locally to the Tsunami Threat bulletins.

In addition to the official products issued to the TWFP's, NTWC's and SRTSP's, the RTSP will also establish mechanisms to disseminate public products according to the recommendations of the CARIBE-EWS using, but not limited to:

- Web sites;
- Social Media.

### **Community Connections**

Local preparedness and commitment is the key for the CARIBE-EWS success, including the RTSP, because ultimately, warning systems will be judged on their ability to reach people in the at risk areas and to lead them safely inland or to higher ground before the first tsunami waves hit. The goal and focus of the RTSP outreach should be to ensure the understanding of their operational responsibilities among its stakeholders. During actual tsunami events, the RTSP should have a person designated to coordinate media response. The RTSP should also support training and guidance to NTWC/TWFP's representatives, respond to media requests, organize news conferences, coordinate briefings and tours at the RTSP, develop informational materials, assist with briefings of government officials. All these activities need to be coordinated with the CTIC and CTWP.

### **Administrative Requirements**

The administrative requirements refer to the organizational capacity requirements of the RTSP. The RTSP will require the resources necessary to conduct 24/7 operations as well as maintain all the data streams, computers, computer programs and communications needed to fulfill its mission. It has to be sustainable with the political will and adequate funding to ensure sustainability well into the future. This must be clearly stated by the hosting Member State.

It should be physically and technologically accessible to the scientific and hazard management community of the ICG/CARIBE-EWS. No political restrictions should apply. This must be clearly stated by the hosting Member State.

The RTSP should maintain up-to-date documentation including a user's guide, standard operating procedures and agreements with partners. The list of TWFP, NTWC, and SRTSP provided through UNESCO/IOC should be reviewed frequently to secure its performance under emergency conditions. Finally, the goal for the RTSP should be to maintain or exceed the capability and interoperability requirements as defined by the IOC and the ICG/CARIBE-EWS.

### **Staffing Requirements**

In addition to staffing around-the-clock operational shifts, additional resources are needed for staff training and conducting or integrating research into RTSP operations. This is the only way to ensure that a RTSP keeps pace with advances in technology and science. To meet its full mission, the RTSP requires several critical positions to ensure that all necessary functions are accomplished. Positions include, but are not limited to: administrative, scientific, information and communication and technical personnel. Given the multilingual environment, the staff should be able to communicate in English and at least one more of the Caribbean official languages (Spanish, French, Dutch). The staff should be available to travel to all the ICG/CARIBE-EWS Member States.

### **Documentation Requirements**

To be effective, the RTSP should have documentation that clearly states the centre's mandate, authority, and relationship to other government agencies. Equally important are references that document the centre's concept of operations, standard operating procedures, and agreements with partners and as requested by ICG/CARIBE-EWS.

RTSP Concept of Operations (CONOPS): this is a high-level document for decision makers and describes the system and how it functions in general terms. It should identify who is



involved and clearly define their roles and responsibilities. It should be maintained by the RTSP.

**Operations Manual:** this document details how the RTSP works to carry out its roles and responsibilities. The manual should be designed as an instruction manual to be used by the duty people at the centre. It should include information on emergency management plans and standard operating procedures (SOP), such as criteria for action, data streams, communications links, analysis software, messaging software, notification and dissemination methods, and general troubleshooting. It should be maintained by the RTSP. SOPs can be defined as:

- A set of written instructions describing routine, or repetitive, activities conducted by an organization. The instructions are stakeholder agreed-upon steps that will be used in coordinating the Who, What, When, Where, and How during an event.
- A mechanism for operating effective and reliable warning systems and disaster management systems. The RTSP SOPs must be linked at all levels from international to national and local warning institutions.

SOPs will include data processing, analysis and tsunami product dissemination procedures. SOPs also should facilitate good decision-making by describing in detail the actions taken by an agency to carry out its responsibilities, as defined in the system's Concept of Operations (CONOPS) document. The existence and use of SOPs are especially essential for rapid, efficient tsunami response since tsunamis are rapid-onset disasters with little time to prepare. Because of this, all responses need to be preplanned, well-practiced, and automatically enacted to minimize loss of life through quick notification.

**Users Guide:** this guide should contain general information for customers on tsunamis and the tsunami forecast procedures, and the criteria for action, along with sample messages and products (text messages, maps, tables). It should include a general description of that centre's system: seismic data, sea level data, RTSP message dissemination, public safety actions, and public responses. It should also include guidance on what the user or customer can expect from the tsunami service provider, including how to interpret messages for action, definitions of terms, and what to do when threat levels are issued. This document is formally agreed upon by Member States at ICG/CARIBE EWS meetings.

**NTWC/TWFP/SRTSP Stakeholder Contacts:** this document generally comprises contacts responsible for overall tsunami warning operations:

- These are Tsunami Warning Focal Points and/or National Tsunami Warning Centres for 24/7 action on tsunami emergencies,
- ICG Tsunami National Contacts (TNC) responsible for coordination,
- Sub Regional Tsunami Service Providers.

It is the responsibility of the IOC ICG/CARIBE-EWS Technical Secretary to maintain this list of designations by the Member States. It is the responsibility of the Member States to report any changes in designations and contact information on Tsunami National Contacts, Tsunami Warning Focal Points and Alternates to the IOC ICG/CARIBE-EWS secretary.

**Tsunami Emergency Response Plans (TERP):** RTSP must create and customize written Tsunami Emergency Response Plans to meet their specific needs. The documents form the basis on which to conduct routine drills to ensure response procedures can be effectively enacted by a 24/7 duty staff. These can range from stakeholder familiarization workshops, agency and multiagency drills, tabletop scenario exercises, and functional communications tests, to full-scale response agency field deployment exercises, which may or may not include

public evacuations. Documents and drills also ensure the consistency of actions as duty staff may turn over several times between actual tsunami events.

### **Capability and Interoperability Requirements of the RTSP**

The RTSP needs to be interoperable within the basin and with other RTSPs, with the end goal being a fully interoperable tsunami warning system for the globe. RTSP should comply with the requirements which are based upon years of PTWC, JMA and NTCWC experiences, and those edited by TOWS-WG working group:

1. Use the community standards magnitude scales (e.g. Mwp, moment magnitude from p waves)
2. Have the ability to determine rapid focal mechanisms and magnitudes using seismic data or other emergent vetted technologies.
3. Have real time access to pertinent data (e.g., sea-level, seismic, GNSS) to detect earthquakes and tsunamis and disseminate the corresponding products within 5 minutes of event detection time that could impact the AOC of CARIBE-EWS.
4. Maintain, have access to pre-computed tsunami models and/or run tsunami forecasts for the CARIBE-EWS AOC.
5. Be able to determine which Member State in the CARIBE-EWS AOC might be affected by a tsunami, and the threat level, based on standardized or otherwise agreed upon thresholds (earthquake magnitude and wave heights).
6. Revise their forecasts in light of additional seismic and sea level data or other data, e.g. GNSS.
7. Provide products in standardized format in accordance with global practices as approved by the ICG/CARIBE-EWS.
8. Transmit products on the GTS and e-mail in a timely manner, and have backup dissemination paths in place and tested.
9. Provide NTCWCs, TWFPs and SRTSPs with estimated tsunami arrival times within five minutes of the event origin time and forecasted wave heights within 30 minutes of the event origin time.
10. Provide NTCWCs, TWFPs and SRTSPs access to all RTSP products.
11. Coordinate with other relevant RTSPs when issuing products.
12. Coordinate end of threat messages with NTCWCs, TWFPs and SRTSPs.

### **RTSP Key Performance Indicators**

The RTSP will work with the Caribbean NTCWCs and TWFPs to quantify its performance indicators (see table 3 for metrics targets). An annual report, as well as post event studies will be submitted by RTSP to the ICG/CARIBE-EWS. The RTSP performance indicators may include:

1. Elapsed time from earthquake or other trigger to issuance of tsunami products.
2. Accuracy of initial earthquake parameters (location, depth, magnitude) compared to the final solution from a reference agency.
3. Elapsed time to report tsunami wave heights, in the case that a tsunami is generated
4. Elapsed time to tsunami forecast.
5. Accuracy of tsunami forecast compared to in situ measurements in the case that a tsunami is generated.
6. Elapsed time to end of threat message in the event of no tsunami.

7. Reliability of RTSP office (power, computers, communications, 24/7 operations).
8. Metrics on communication tests.
9. Data availability (e.g. sea-level, seismic).
10. Up to date software and technology.

**Table 1: Recommended Minimum and Optimal Requirements for Seismic Stations contributing data to the Caribbean Tsunami Warning System as agreed on the Meeting of Regional Seismic Network Operators of the Caribbean Basin Seismic Agencies (RSNO2), 25-29 February 2008 (revised from the list of criteria determined by Working Group I: Monitoring and Detection Systems, Warning Guidance), considering modifications approved at ICG-X.**

CHARACTERISTICS	Primary network		Secondary network	
	Minimum req.	Optimal req.	Minimum req.	Optimal req.
Sensor type	Broadband	Broadband, accelerometer, continuous GPS	Short period	Broadband, accelerometer, continuous GPS
Station type	3 component	3 component	Vertical component	3 component
Accuracy of Location of Sensor	< 10m, horizontal < 10m, elevation	< 10m, horizontal < 10m, elevation	< 100m, horizontal < 20m, elevation	< 10m, horizontal < 10m, elevation
Calibration	Full response known to 10%	Full response known to 10%	System gain known to 10%	Full response known to 10%
Seismometer sampling rate	20 sps	20 sps	20 sps	20 sps
Seismometer frequency range (flat response)	0.1 – 60 sec	0.02 – 240 sec	Free period ≤ 2Hz	0.02 – 240 sec
Seismometer self noise	≤ 5 db below NLNM 0.1 – 10 Hz	≤ 10 db below NLNM 0.1 – 10 Hz	10 db above NLNM above 1 Hz	≤ 10 db below NLNM 0.1 – 10 Hz
Dynamic range	≥136 db	≥136 db	≥126 db	≥136 db
Absolute Timing Accuracy	<10ms	<10ms	<10ms	<10ms
Delay in Transmission to TWC	< 30 sec latency	< 30 sec latency	< 1 min latency	< 30 sec latency
Timely Data Availability	> 95%	> 95%	> 75%	> 90%
Data transmission protocol	Compatible with TWC	Low latency compatible with TWC	Compatible with TWC	Compatible with TWC
Data transmission	Cont / real-time	Cont / real-time	Cont / real-time	Cont / real-time
Communications	VSAT / Internet	VSAT / Internet secured transmission	Internet	VSAT / Internet
Infrastructure	Seismic vault	Thermally shielded vault	-	Seismic vault
Reliability	Problem investigation in less than 10 working days.		-	-
Energy autonomy	> 48 hours of autonomy (batteries backup)		-	-

**Table 2. Criteria and standards for the sitting, sensors, leveling procedures, data processing and other factors for sea level stations in the Caribbean, as approved by ICG-X**

CHARACTERISTICS	MINIMUM REQUIREMENTS	OPTIMAL REQUIREMENTS
Number of sensors with different technology	1	> 2
Transmitted sampling rate	< 1 min	< 15 sec
Recorded sampling rate	< 1 min	< 1 sec
Measurement accuracy	< 5 cm	< 2 cm
Maximum dynamic range	-	3 m above and below high/low tides
Data stored on site	-	yes
GTS transmission interval	< 15 min	< 5 min
GTS transmission redundancy	-	Data redundancy (ex : 10 minutes of data each 5 minutes)
Geodesic benchmarks	5 within few hundred meters	> 5 within few hundred metres + 1 on a national leveling network
Leveling periodicity	2 / year during first 2 years. Then each years	Idem + continuous GPS
Backup power autonomy	1 day	> 5 days
Timing accuracy	1 minute	Second or better (GPS)
Auxiliary sensors	-	Barometric pressure, wind ...
Station electronics altitude	-	> 5m
Continuous GPS specifications	-	< 30s sampling rate
Availability on VLIZ web site	yes	yes
Sensor drifts	-	No drifts

Table 3. **Key performance indicators**

<b>Performance Indicator</b>	<b>Description</b>	<b>Target value</b>
Reaction time	Time from the earthquake to the issuance of the first bulletin or from wave detection for non-seismic source events	< 5 minutes
Earthquake location	Difference between initial location and final authoritative location estimation	< 10km
Earthquake magnitude	Difference between initial magnitude estimation and final authoritative magnitude estimation	< 0.5
Earthquake depth	Difference between initial depth estimation and final authoritative depth estimation	< 10% of final depth or <5 km,
Tsunami forecast time	Time from the earthquake to the issuance of the first tsunami wave height forecasts	< 30 minutes
Accuracy of tsunami forecast	Difference between initial tsunami wave heights forecasts and measurements	< 15% of measurements or < 0.3m
Reliability of RTSP facility and tsunami services	Down time of the tsunami services due to any cause (power outage, communication problems, major observational data outage)	< 1 hour consecutive and < 1 day over the year
Up to date software	From time of latest update publication or ICG recommendation	< 1 year

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## Acronyms

AOC	Area of Coverage
CONOPS	Concept of Operations
CTIC	Caribbean Tsunami Information Centre
RTSP	Regional Tsunami Service Provider
SRTSP	Sub-Regional Tsunami Service Provider
IOC	Intergovernmental Oceanographic Commission
NTWC	National Tsunami Warning Center
PTWC	Richard H. Hagemeyer Pacific Tsunami Warning Center
RTWC	Regional Tsunami Warning Centre
TERP	Tsunami Emergency Response Plan
TNC	Tsunami National Contact
CTWP	Caribbean Tsunami Warning Program
TWFP	Tsunami Warning Focal Point
TWS	Tsunami Warning System
TOWS-WG	Working Group on Tsunamis and Other Hazards related to Sea-Level Warning and Mitigation Systems

## Appendix 1.

Brief example of staff positions for the RTSP's (taken from Tsunami Warning Center Reference Guide. Printed in Bangkok, Thailand U.S. IOTWS Document No. 26-IOTWS-07. Supported by United States Agency for International Development, NOAA and partners, Bangkok, Thailand.

### **RTSP Director/Deputy Director**

The Director manages and provides oversight of the day-to-day operations at the centre. All operational systems, procedures, and products must be kept in operational status, and staff must be trained in proper response actions. Additional responsibilities include overseeing operational research, development of integrated computer and ocean modeling systems, community outreach and preparedness activities and maintenance of equipment necessary to support the tsunami warning system. The director is responsible for providing supervision and leadership to the TWC staff. The Director supervises the scientific staff that responds to

potentially tsunamigenic events and must be an expert in tsunami warning communications, real-time seismic analysis, tsunami dynamics, and tsunami history and forecasting.

### **Science Officer**

The primary focus of the Science Officer is to ensure the scientific integrity of the products and services provided to the public by the centre, to lead or participate in joint research projects and developmental efforts and to implement new techniques and processes to the operational systems. Major duties include technology transfer/development activities, evaluation and improvement activities and serves on shift duty.

### **Warning Coordination Officer**

The Warning Coordination Officer (WCO) plans, designs, executes and evaluates the overall preparedness programs. The WCO serves as the principal interface between the centre and the users of tsunami bulletins. The WCO should be responsible for planning, coordinating and carrying out the centre's area wide public awareness and tsunami readiness program, this would be in close collaboration with the CTIC. The WCO also leads and coordinates staff outreach efforts and provides direction, guidance, instructions and assistance to the staff regarding centre operational procedures. The WCO may also perform shift duty.

### **Operational Watch Stander**

The Watch Stander must be able to make all observation, calculation, and interpretations using all available geophysical, oceanographic, and geographic data, obtained by diverse methods of communications, to locate and earthquake, determine its magnitude, evaluate its potential threat and issue with follow up, a tsunami product. The WS answers questions about geophysical events. The WS conducts applied research in Tsunami warning and forecasting systems. The WS will interact with participants of the CARIBE-EWS and is expected to be familiar with all its components.

### **Information and Communications Technology Officer**

The Information and Communications Technology Officer analyzes and performs work necessary to plan, design, develop, acquire, document, test, implement, integrate, maintain or modify systems for solving problems or accomplishing centre work process by using computers. Assists in maintaining and enhancing the real-time seismic and sea level operational software. Does computer programming and software maintenance of the communication systems. Responsible for computer security.

### **Administrative Assistant**

The Administrative Assistant performs a wide range of administrative functions for the staff management team including technical aspects of all administrative programs and activities for the office related to budget, funds control, purchasing, procurement requests, contract monitoring, property, vehicles, travel, training, personnel actions items, attendance, mail, office supplies and equipment, among others.



ANNEX V

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## ANNEX VI

### LIST OF ACRONYMS

<b>BME</b>	Bureau of Mines and Energy
<b>CATAC</b>	Central America Tsunami Advisory Centre
<b>CDEMA</b>	Caribbean Disaster Emergency Management Agency
<b>CENAI</b>	National Centre of Seismic Research
<b>CFIDP</b>	Coastal Inundation Forecasting Demonstration Project
<b>CISN</b>	California Integrated Seismic Network
<b>CNE</b>	National Emergency Commission
<b>COCONet</b>	Continuously Operating Caribbean GPS Observational Network
<b>CODOMAR</b>	Centre for Maritime Data Observation and Operations
<b>CTIC</b>	Caribbean Tsunami Information Centre
<b>CTSP</b>	Candidate Tsunami Service Providers
<b>CTWP</b>	Caribbean Tsunami Warning Program
<b>DEM</b>	Department of Emergency Management of Barbados
<b>DIMAR</b>	General Directorate of Maritime and Port Affairs of Colombia
<b>ECHO</b>	European Commission's Humanitarian Aid Office
<b>EMIZA</b>	French West Indies Emergency Management Organization
<b>ESF</b>	Emergency Support Functions
<b>ETAs</b>	Estimated Time of Arrival
<b>FUNVISIS</b>	Venezuelan Foundation of Seismological Research
<b>GEF</b>	Global Environment Facility
<b>GLOSS</b>	Global Sea-Level Observing System
<b>ICG</b>	Intergovernmental Coordination Group
<b>ICG/CARIBE-EWS</b>	Intergovernmental Coordination Group for the Tsunami and other Coastal Hazards Warning System for the Caribbean and Adjacent Regions
<b>ICG/NEAMTWS</b>	Intergovernmental Coordination Group for the Tsunami Early Warning and Mitigation System in the North Eastern Atlantic, the Mediterranean and Connected Seas



<b>ICG/PTWS</b>	Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System
<b>INETER</b>	Instituto Nicaragüense de Estudios Territoriales
<b>IOC</b>	Intergovernmental Oceanographic Commission
<b>IOCARIBE</b>	IOC Sub-Commission for the Caribbean and Adjacent Regions
<b>IRC</b>	Inouye Regional Center
<b>ITIC</b>	International Tsunami Information Center
<b>JICA</b>	Japan International Cooperation Agency
<b>KNMI</b>	Royal Netherlands Meteorological Institute
<b>NASA</b>	National Aeronautics and Space Administration
<b>NEIC</b>	National Earthquake Information Center
<b>NMHEWS</b>	National Multi Hazard Early Warning System
<b>NOAA</b>	National Oceanic and Atmospheric Administration
<b>NTWS</b>	National Tsunami Warning System
<b>NWS</b>	National Weather Service
<b>ORSEC</b>	Organization of the Civil Security Response
<b>PREMA</b>	Puerto Rico Emergency Management Agency
<b>PRSN</b>	Puerto Rico Seismic Network
<b>PTWC</b>	Pacific Tsunami Warning Center
<b>RTSPs</b>	Regional Tsunami Service Providers
<b>SATREPS</b>	Science and Technology Research Partnership for Sustainable Development
<b>SEMANAH</b>	Navigation and Maritime Service of Haiti
<b>SGC</b>	National Geological Service of Colombia
<b>SIDS</b>	Small Island Developing State
<b>SINAMOT</b>	Sistema Nacional de Monitoreo de Tsunamis
<b>SINAPRED</b>	National System of Disaster Prevention
<b>SNGDR</b>	Sistema Nacional de Gestión de Riesgo
<b>SRC</b>	University of the West Indies Seismic Research Centre

<b>SRTSPs</b>	Sub-Regional Tsunami Service Providers
<b>TEMS</b>	Tsunami Evacuation Maps
<b>TIMs</b>	Tsunami Inundation Maps
<b>TLALOCNet</b>	Trans-boundary, Land and Atmosphere Long-term Observational and Collaborative Network
<b>TNC</b>	Tsunami National Contact
<b>TOWS-WG</b>	Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems
<b>TWFP</b>	Tsunami Warning Focal Point
<b>UNDP</b>	United Nations Development Programme
<b>UNESCO</b>	United Nations Educational, Scientific and Cultural Organization
<b>US NTWC</b>	US National Tsunami Warning Center
<b>WCDRR</b>	World Conference on Disaster Risk Reduction
<b>WMO</b>	World Meteorological Organization

In this Series	Languages
<b>Reports of Governing and Major Subsidiary Bodies</b> , which was initiated at the beginning of 1984, the reports of the following meetings have already been issued:	
1. Eleventh Session of the Working Committee on international Oceanographic Data Exchange	E, F, S, R
2. Seventeenth Session of the Executive Council	E, F, S, R, Ar
3. Fourth Session of the Working Committee for Training, Education and Mutual Assistance	E, F, S, R
4. Fifth Session of the Working Committee for the Global Investigation of Pollution in the Marine Environment	E, F, S, R
5. First Session of the IOC Sub-Commission for the Caribbean and Adjacent Regions	E, F, S
6. Third Session of the <i>ad hoc</i> Task team to Study the Implications, for the Commission, of the UN Convention on the Law of the Sea and the New Ocean Regime	E, F, S, R
7. First Session of the Programme Group on Ocean Processes and Climate	E, F, S, R
8. Eighteenth Session of the Executive Council	E, F, S, R, Ar
9. Thirteenth Session of the Assembly	E, F, S, R, Ar
10. Tenth Session of the International Co-ordination Group for the Tsunami Warning System in the Pacific	
11. Nineteenth Session of the Executive Council, Paris, 1986	E, F, S, R, Ar
12. Sixth Session of the IOC Scientific Committee for the Global Investigation of Pollution in the Marine Environment	E, F, S
13. Twelfth Session of the IOC Working Committee on International Oceanographic Data Exchange	E, F, S, R
14. Second Session of the IOC Sub-Commission for the Caribbean and Adjacent Regions, Havana, 1986	E, F, S
15. First Session of the IOC Regional Committee for the Central Eastern Atlantic, Praia, 1987	E, F, S
16. Second Session of the IOC Programme Group on Ocean Processes and Climate	E, F, S
17. Twentieth Session of the Executive Council, Paris, 1987	E, F, S, R, Ar
18. Fourteenth Session of the Assembly, Paris, 1987	E, F, S, R, Ar
19. Fifth Session of the IOC Regional Committee for the Southern Ocean	E, F, S, R
20. Eleventh Session of the International Co-ordination Group for the Tsunami Warning System in the Pacific, Beijing, 1987	E, F, S, R
21. Second Session of the IOC Regional Committee for the Co-operative Investigation in the North and Central Western Indian Ocean, Arusha, 1987	E, F
22. Fourth Session of the IOC Regional Committee for the Western Pacific, Bangkok, 1987	E only
23. Twenty-first Session of the Executive Council, Paris, 1988	E, F, S, R
24. Twenty-second Session of the Executive Council, Paris, 1989	E, F, S, R
25. Fifteenth Session of the Assembly, Paris, 1989	E, F, S, R
26. Third Session of the IOC Committee on Ocean Processes and Climate, Paris, 1989	E, F, S, R
27. Twelfth Session of the International Co-ordination Group for the Tsunami Warning System in the Pacific, Novosibirski, 1989	E, F, S, R
28. Third Session of the Sub-Commission for the Caribbean and Adjacent Regions, Caracas, 1989	E, S
29. First Session of the IOC Sub-Commission for the Western Pacific, Hangzhou, 1990	E only
30. Fifth Session of the IOC Regional Committee for the Western Pacific, Hangzhou, 1990	E only
31. Twenty-third Session of the Executive Council, Paris, 1990	E, F, S, R
32. Thirteenth Session of the IOC Committee on International Oceanographic Data and Information Exchange, New York, 1990	E only
33. Seventh Session of the IOC Committee for the Global Investigation of Pollution in the Marine Environment, Paris, 1991	E, F, S, R
34. Fifth Session of the IOC Committee for Training, Education and Mutual Assistance in Marine Sciences, Paris, 1991	E, F, S, R
35. Fourth Session of the IOC Committee on Ocean Processes and Climate, Paris, 1991	E, F, S, R
36. Twenty-fourth Session of the Executive Council, Paris, 1991	E, F, S, R
37. Sixteenth Session of the Assembly, Paris, 1991	E, F, S, R, Ar
38. Thirteenth Session of the International Co-ordination Group for the Tsunami Warning System in the Pacific, Baja California, 1991	E, F, S, R
39. Second Session of the IOC-WMO Intergovernmental WOCE Panel, Paris, 1992	E only
40. Twenty-fifth Session of the Executive Council, Paris, 1992	E, F, S, R
41. Fifth Session of the IOC Committee on Ocean Processes and Climate, Paris, 1992	E, F, S, R
42. Second Session of the IOC Regional Committee for the Central Eastern Atlantic, Lagos, 1990	E, F
43. First Session of the Joint IOC-UNEP Intergovernmental Panel for the Global Investigation of Pollution in the Marine Environment, Paris, 1992	E, F, S, R
44. First Session of the IOC-FAO Intergovernmental Panel on Harmful Algal Blooms, Paris, 1992	E, F, S
45. Fourteenth Session of the IOC Committee on International Oceanographic Data and Information Exchange, Paris, 1992	E, F, S, R
46. Third Session of the IOC Regional Committee for the Co-operative Investigation in the North and Central Western Indian Ocean, Vascoas, 1992	E, F
47. Second Session of the IOC Sub-Commission for the Western Pacific, Bangkok, 1993	E only
48. Fourth Session of the IOC Sub-Commission 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, Papete, 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 (IOPCARIBE), 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 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*