Intergovernmental Oceanographic Commission
Reports of Governing and Major Subsidiary Bodies

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

Twenty-sixth Session

Honolulu, United States of America
22–24 April 2015

UNESCO

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

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

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Executive summary

The Twenty-sixth Session of the Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System (ICG/PTWS-XXVI) was held in Honolulu, Hawaii, United States of America, from 22 to 24 April 2015, chaired by the ICG/PTWS Chair, Dr Ken Gledhill (New Zealand). The meeting was attended by 106 participants from 28 countries, and 18 Observer organizations.

The **ICG approved** the continuity of the PTWC Enhanced Products for PTWS.

The **ICG confirmed** that the mechanism to address proposed changes to the PTWC Enhanced Products for PTWS is the intersessional Task Team on Enhancing Products and **reaffirmed** that any change to the products should be informed to all Member States by Circular Letter three months in advance of implementing the changes.

The **ICG decided** that to avoid misunderstandings the words “No threat” should be indicated for all countries with inundation below 0.3 metres, and the list of countries falling under this category should be removed from the message.

The **ICG agreed** that the Northwest Pacific Tsunami Advisory Center (NWPTAC) should proceed with its development of enhanced products for the North West Pacific.

The **ICG further agreed** to continue the Task Team on Enhanced Products under the Working Group on Tsunami Detection, Warning and Dissemination, to guide and provide feedback to NWPTAC regarding the enhanced products and requested the Task Team to provide a report on the recommendations and any implementations at ICG/PTWS-XXVII.

The **ICG also agreed** that any new products only be exercised in an experimental mode as they are developed and until they are approved for official use later by the ICG.

The **ICG agreed** to carry out a sixth and seventh Exercise Pacific Wave 16 and 17, coordinated by a Task Team on PacWave Exercises under the Steering Committee with Terms of References approved under Recommendation ICG/PTWS-XXVI.1.

The **ICG decided** to establish a Task Team on Evacuation Planning and Mapping to develop a new programme aimed at facilitating tsunami resilience through community preparedness, specifically through the preparation of tsunami evacuation maps and associated response plans for tsunami-vulnerable coastal communities, with Terms of References approved under Recommendation ICG/PTWS-XXVI.1

The **ICG accepted** Nicaragua’s offer to host and develop a Tsunami Advisory Centre for Central America (CATAC) under the guidance of the Regional Working Group on Tsunami Warning and Mitigation System on the Central American Pacific Coast, within the framework of ICG/PTWS, ICG/CARIBE-EWS and TOWS-WG, through Recommendation ICG/PTWS-XXVI.2.

The **ICG agreed** that ICG/PTWS organizes its effort on a more balanced report between warning systems, awareness and preparedness, and risk assessment, aligning its reporting against targets of the Sendai Framework for Disaster Risk Reduction 2015-2030 at the Third United Nations World Conference on Disaster Risk Reduction (WCDRR) which took place in March 2015 in Sendai, Japan.

The **ICG also agreed** that joint working groups and meetings with other regional organizations and programmes are organized as appropriate including with the Secretariat of

the Pacific Regional Environment Programme (SPREP), the Coordination Centre for the Prevention of Natural Disasters in Central America (CEPREDENAC) and others.

The **ICG decided** to constitute, under the Steering Committee, a Task Team to look into performance monitoring measures for Tsunami Service Providers (TSPs), National Tsunami Warning Centres (NTWCs), and national warning systems starting from the PTWS Medium-term Strategy 2014-2012 (IOC/2013/TS/108) established goals.

The **ICG further decided** to hold a mid-session joint meeting of Working Groups, Task Teams and the Steering Committee and to have four days ICG/PTWS sessions to allow sufficient time for discussion and decisions.

The **ICG agreed** that Member States be requested to reaffirm their commitment to enable the continued maintenance and enhancement of the PTWS, as indicated in Recommendation ICG/PTWS-XXVI.3.

The **ICG expressed its gratitude** to the Government of the United States of America for kindly hosting the Twenty-sixth Session of the ICG/PTWS in Honolulu, Hawaii.

The **ICG further expressed** its gratitude to the State of Hawaii Emergency Management Agency and Civil Defense for sharing their experience and strategies for working with the local communities to prepare for tsunamis.

The **ICG accepted with appreciation** the kind offers of France and Panama to host the Twenty-seventh Session of the ICG/PTWS in Tahiti or Panama City in 2017 and **requested** the Secretariat to follow up with both countries to confirm the details.

The **ICG elected** Ms Filomena Nelson (Samoa) as Chair, and Mr Tomoaki Ozaki (Japan), Dr Tatiana Ivelskaya (Russian Federation) and Mr Rick Bailey (Australia) as Vice-Chairs for the ICG/PTWS for the period May 2015–2017.

Résumé exécutif

La vingt-sixième session du Groupe intergouvernemental de coordination du Système d'alerte aux tsunamis et de mitigation dans le Pacifique (GIC/PTWS-XXVI) s'est tenue à Honolulu (Hawaii, États-Unis d'Amérique), du 22 au 24 avril 2015, sous la présidence du Président du GIC/PTWS, M. Ken Gledhill (Nouvelle-Zélande). Elle a rassemblé 106 participants de 28 pays, ainsi que 18 organisations présentes en qualité d'observateur.

Le GIC a approuvé la poursuite de l'élaboration de produits améliorés du PTWC pour le PTWS.

Le GIC a confirmé que l'Équipe spéciale intersessions pour l'amélioration des produits serait le mécanisme chargé d'étudier les changements proposés aux produits améliorés du PTWC pour le PTWS et **a réaffirmé** que tout changement apporté aux produits devait être communiqué à l'ensemble des États membres par lettre circulaire trois mois avant la mise en œuvre dudit changement.

Le GIC a décidé que, pour éviter tout malentendu, la mention « Risque nul » devrait être employée pour tous les pays dans lesquels l'inondation ne devrait pas dépasser 0,3 mètre, et que les pays entrant dans cette catégorie ne devraient pas figurer sur la liste des destinataires du message d'alerte.

Le GIC est convenu que le Centre consultatif sur les tsunamis dans le Pacifique Nord-Ouest (NWPTAC) devrait poursuivre la mise au point de produits améliorés pour le Pacifique Nord-Ouest.

Le GIC est convenu également de reconduire l'Équipe spéciale pour l'amélioration des produits dans le cadre du Groupe de travail sur la détection des tsunamis, l'alerte et la diffusion, en vue de donner au NWPTAC des orientations et un retour d'informations concernant les produits améliorés, et **a demandé** à l'Équipe spéciale de lui rendre compte, à sa 27e session, des recommandations et de toute mise en œuvre.

Le GIC est convenu en outre que tout nouveau produit ne serait appliqué qu'à titre expérimental pendant sa mise au point, jusqu'à ce qu'il soit ultérieurement approuvé pour une utilisation officielle.

Le GIC est convenu de réaliser un seizième et un dix-septième exercices PacWave (« Vague du Pacifique »), coordonnés par une équipe spéciale pour les exercices PacWave placée sous l'autorité du Comité directeur et dotée d'un mandat approuvé au titre de la recommandation Recommendation ICG/PTWS-XXVI.1.

Le GIC a décidé de créer une équipe spéciale pour les plans et cartes d'évacuation chargée de mettre en place un nouveau programme destiné à faciliter la résilience face aux tsunamis grâce à la préparation des communautés, en particulier par la réalisation de cartes d'évacuation en cas de tsunami et l'établissement de plans d'action correspondants à l'intention des communautés côtières vulnérables face à ces phénomènes. Cette équipe spéciale sera dotée d'un mandat approuvé au titre de la recommandation Recommendation ICG/PTWS-XXVI.1

Le GIC a accepté l'offre du Nicaragua, qui a proposé d'accueillir et de mettre en place un Centre consultatif sur les tsunamis en Amérique centrale (CATAC), sous la direction du Groupe de travail régional sur les systèmes d'alerte aux tsunamis et de mitigation sur la côte Pacifique de l'Amérique centrale, dans le cadre du GIC/PTWS, du GIC/CARIBE-EWS et du TOWS-WG, conformément à la recommandation Recommendation ICG/PTWS-XXVI.2.

Le GIC est convenu de s'efforcer de rendre compte de son action en assurant un meilleur équilibre entre les systèmes d'alerte, l'information et la préparation, et l'évaluation des risques, en alignant ses rapports sur les objectifs fixés dans le Cadre de Sendai pour la réduction des risques de catastrophe (2015-2030), adopté lors de la troisième Conférence mondiale des Nations Unies sur la réduction des risques de catastrophe (WCDRR) qui s'est tenue en mars 2015 à Sendai (Japon).

Le GIC est convenu également que des groupes de travail et réunions seront organisés conjointement, le cas échéant, avec d'autres organisations et programmes régionaux, notamment le Secrétariat du Programme régional océanien de l'environnement (PROE), le Centre de coordination pour la prévention des catastrophes naturelles en Amérique centrale (CEPREDENAC) et d'autres entités.

Le GIC a décidé de créer, sous l'égide du Comité directeur, une équipe spéciale chargée d'étudier les mesures de suivi des performances pour les prestataires de services relatifs aux tsunamis, les centres nationaux d'alerte aux tsunamis (NTWC) et les systèmes nationaux d'alerte, en commençant par les objectifs fixés dans la Stratégie à moyen terme du PTWS pour 2014-2021 (IOC/2013/TS/108).

Le GIC a également décidé d'organiser à la mi-session une réunion conjointe des groupes de travail, des équipes spéciales et du Comité directeur, et de tenir des sessions de quatre jours pour laisser suffisamment de temps aux discussions et à la prise de décisions.

Le GIC est convenu que les États membres seront invités à réaffirmer leur engagement à permettre le maintien et le renforcement continus du PTWS, comme indiqué dans la recommandation Recommendation ICG/PTWS-XXVI.3

Le GIC a remercié le Gouvernement des États-Unis d'Amérique d'avoir généreusement accueilli sa vingt-sixième session à Honolulu (Hawaii).

Le GIC a également remercié l'agence de gestion des situations d'urgence et de protection civile de l'État de Hawaii d'avoir fait part de son expérience et de ses stratégies en matière de collaboration avec les communautés locales pour la préparation aux tsunamis.

Le GIC a accepté avec gratitude les offres généreuses de la France et du Panama qui ont proposé d'organiser la vingt-septième session du GIC/PTWS à Tahiti ou à Panama en 2017 et **a demandé** au Secrétariat de rester en contact avec ces deux pays pour confirmer les détails.

Le GIC a élu Mme Filomena Nelson (Samoa) Présidente et M. Tomoaki Ozaki (Japon), Mme Tatiana Ivelskaya (Fédération de Russie) et M. Rick Bailey (Australie) Vice-Présidents du GIC/PTWS pour la période allant de mai 2015 à mai 2017.

Resumen dispositivo

La 26ª reunión del Grupo Intergubernamental de Coordinación del Sistema de Alerta contra los Tsunamis y Atenuación de sus Efectos en el Pacífico (ICG/PTWS-XXVI) tuvo lugar en Honolulú (Hawái, Estados Unidos de América) del 22 al 24 de abril de 2015 y estuvo presidida por el Presidente del ICG/PTWS, el Dr. Ken Gledhill (Nueva Zelandia). A la reunión asistieron 106 participantes de 28 países, así como 18 organizaciones observadoras.

El **ICG aprobó** la continuación de los productos mejorados del PTWC para el PTWS.

El **ICG confirmó** que el mecanismo para tratar las propuestas de cambios en los productos mejorados del PTWC para el PTWS era el Equipo de Trabajo sobre Perfeccionamiento de Productos, cuya labor se lleva a cabo durante el periodo entre reuniones, y **reafirmó** que cualquier cambio que se realizara en los productos debía notificarse a todos los Estados Miembros por medio de una circular tres meses antes de la aplicación de dicho cambio.

El **ICG decidió** que, para evitar malentendidos, debía indicarse la expresión “Sin peligro” para todos los países con un nivel de inundación inferior a 0,3 metros, y debía suprimirse del mensaje la lista de países correspondientes a esta categoría.

El **ICG acordó** que el Centro de Asesoramiento sobre los Tsunamis del Pacífico Noroccidental (NWPTAC) debía continuar elaborando productos mejorados para el Pacífico Noroccidental.

El **ICG acordó además** que el Equipo de Trabajo sobre Perfeccionamiento de Productos prosiguiera su labor bajo la supervisión del Grupo de Trabajo sobre Detección de Tsunamis, Alerta y Difusión para orientar y dar su opinión al NWPTAC sobre los productos mejorados, y pidió al Equipo de Trabajo que en la 27ª reunión del ICG/PTWS presentara un informe sobre las recomendaciones y su aplicación.

El **ICG acordó también** que los nuevos productos se pusieran en práctica solamente a título experimental a medida que se elaboraran y hasta que el ICG aprobara oficialmente su uso.

El **ICG acordó** llevar a cabo el ejercicio Pacific Wave por sexta y séptima ocasión (Pacific Wave 16 y Pacific Wave 17), bajo la coordinación de un Equipo de Trabajo sobre Ejercicios PacWave y la supervisión del Comité de Dirección, de conformidad con el mandato aprobado en virtud de la recomendación Recommendation ICG/PTWS-XXVI.1.

El **ICG decidió** crear un Equipo de Trabajo sobre Planificación y Elaboración de Mapas para la Evacuación en Caso de Tsunami, encargado de elaborar un nuevo programa para facilitar la resiliencia frente a los tsunamis mediante la preparación comunitaria, específicamente a través de la elaboración de mapas de evacuación en caso de tsunami y planes de respuesta conexos para comunidades costeras vulnerables a los tsunamis, de conformidad con el mandato aprobado en virtud de la recomendación Recommendation ICG/PTWS-XXVI.1

El **ICG aceptó** el ofrecimiento de Nicaragua de acoger y poner en marcha un Centro de Asesoramiento sobre los Tsunamis de América Central (CATAC), bajo la orientación del Grupo de Trabajo sobre el Sistema de Alerta contra los Tsunamis de la Costa del Pacífico de América Central y dentro del marco del ICG/PTWS, el ICG/CARIBE-EWS y el TOWS-WG, en virtud de la recomendación Recommendation ICG/PTWS-XXVI.2.

El **ICG acordó** que el ICG/PTWS organizara su labor para informar de manera más equilibrada sobre los sistemas de alerta, la sensibilización y la preparación y la evaluación de riesgos, ajustando la presentación de sus informes a los objetivos del Marco de Sendai para la Reducción del Riesgo de Desastres 2015-2030 definidos en la Tercera Conferencia Mundial de las Naciones Unidas sobre la Reducción del Riesgo de Desastres (CMRRD), que se celebró en marzo de 2015 en Sendai (Japón).

El **ICG acordó también** que se organizaran reuniones y grupos de trabajo conjuntos con otras organizaciones regionales, según proceda, entre ellas la Secretaría del Programa Regional del Medio Ambiente para el Pacífico (SPREP) y el Centro de Coordinación para la Prevención de los Desastres Naturales en América Central (CEPREDENAC).

El **ICG decidió** constituir un equipo de trabajo, dependiente del Comité de Dirección, encargado de analizar las medidas de supervisión del rendimiento relativas a los proveedores de servicios sobre tsunamis, los centros nacionales de alerta contra los tsunamis y los sistemas nacionales de alerta, sobre la base de los objetivos establecidos en la Estrategia a Plazo Medio del PTWS para 2014-2021 (IOC/2013/TS/108).

El **ICG decidió además** organizar una reunión conjunta de los grupos de trabajo, los equipos de trabajo y el Comité de Dirección en el ecuador del periodo entre reuniones y celebrar reuniones del ICG/PTWS de cuatro días de duración para disponer de tiempo suficiente para los debates y las decisiones.

El **ICG acordó** que se pidiera a los Estados Miembros que reafirmaran su compromiso de velar por que el PTWS se siguiera manteniendo y perfeccionando, como se indica en la Recommendation ICG/PTWS-XXVI.3

El **ICG expresó su agradecimiento** al Gobierno de los Estados Unidos de América por haber acogido amablemente la 26ª reunión del ICG/PTWS en Honolulú (Hawái).

El **ICG expresó además** su agradecimiento a la Agencia de Gestión de Emergencias y Protección Civil del Estado de Hawai por haber compartido su experiencia y sus estrategias en cuanto al trabajo con las comunidades locales para la preparación frente a los tsunamis.

El **ICG aceptó con reconocimiento** las amables propuestas de Francia y Panamá de acoger la 27ª reunión del ICG/PTWS en Tahití o en la ciudad de Panamá en 2017, y **pidió** a la Secretaría que mantuviera el contacto con ambos países para concretar los detalles.

El **ICG eligió** Presidenta del ICG/PTWS a la Sra. Filomena Nelson (Samoa) y Vicepresidentes al Sr. Tomoaki Ozaki (Japón), la Dra. Tatiana Ivelskaya (Federación de Rusia) y el Sr. Rick Bailey (Australia) para el periodo de mayo de 2015 a 2017.

Рабочее резюме

26-я сессия Межправительственной координационной группы по Системе оповещения о цунами и смягчения их последствий в Тихом океане (МКГ/СПЦТО-XXVI) состоялась в Гонолулу, Гавайи, Соединенные Штаты Америки, с 22 по 24 апреля 2015 г. под председательством председателя МКГ/СПЦТО д-ра Кена Гледхилла (Новая Зеландия). На сессию собралось 106 участников из 28 стран и 18 организаций-наблюдателей.

МКГ постановила продолжить деятельность по внедрению новых усовершенствованных продуктов Центра предупреждения о цунами в Тихом океане (ЦПЦТО) для СПЦТО.

МКГ подтвердила, что вопрос о предлагаемых изменениях в усовершенствованных продуктах ЦПЦТО для СПЦТО должен решаться в рамках межсессионной Специальной группы по усовершенствованным продуктам, и **подтвердила также**, что информация о любых изменениях в продуктах должна доводиться до сведения всех государств-членов циркулярным письмом не менее, чем за три месяца до введения в действие этих изменений.

МКГ постановила, что во избежание неправильного понимания сообщение «Угроза отсутствует» должно направляться всем странам с уровнем наводнения ниже 0,3 метра, а список подпадающих под эту категорию стран следует из сообщения изъять.

МКГ пришла к договоренности о том, что Консультативный центр по цунами для северо-западной части Тихого океана (NWPTAC) должен приступить к разработке усовершенствованных продуктов для северо-западной части Тихого океана.

МКГ также пришла к договоренности о сохранении в рамках рабочей группы по обнаружению, оповещению и распространению информации о цунами целевой группы по совершенствованию программ для предоставления NWPTAC руководящих указаний и информации об оценке в отношении усовершенствованных продуктов и предложила целевой группе представить доклад о рекомендациях и их реализации на 27-й сессии МКГ/СПЦТО.

МКГ далее пришла к договоренности о том, что любые новые продукты должны применяться исключительно в экспериментальной форме до тех пор, пока они не будут утверждены МКГ для официального использования.

МКГ постановила провести в 2016 г. и 2017 г. шестое и седьмое учение «Тихоокеанская волна», координируемое под руководством Руководящего комитета целевой группой по учениям «Тихоокеанская волна» с кругом ведения, утвержденным в рекомендации ICG/PTWS-XXVI.1.

МКГ постановила учредить целевую группу по планированию эвакуации и картирования с целью разработки новой программы, направленной на содействие обеспечению устойчивости к цунами посредством повышения готовности населения, в частности, путем подготовки маршрутов эвакуации при цунами и соответствующих планов реагирования для уязвимых от цунами сообществ в прибрежных зонах, с кругом ведения, утвержденным в рекомендации ICG/PTWS-XXVI.1.

МКГ приняла предложение Никарагуа создать и разместить у себя консультативный центр по цунами для Центральной Америки (CATAC) под руководством Региональной рабочей группы по системе оповещения о цунами и смягчению их последствий для

Тихоокеанского побережья Центральной Америки в рамках МКГ/СПЦТО, МКГ/КАРИБ-СРП и РГ-СПЦО в соответствии с рекомендацией ICG/PTWS-XXVI.2.

МКГ постановила, что в рамках своей деятельности МКГ/СПЦТО должна обеспечить более сбалансированное соотношение между системами оповещения, осведомленностью и подготовленностью и оценкой рисков, приведя свою отчетность в соответствие с целями Сендайской рамочной программы по уменьшению опасности бедствий на 2015-2030 гг., принятой в ходе третьей Всемирной конференции Организации Объединенных Наций по уменьшению опасности бедствий (ВКУОБ), состоявшейся в марте 2015 г. в Сендае, Япония.

МКГ также постановила, что заседания совместных рабочих групп и совещания с другими региональными организациями и программами должны проводиться по мере необходимости, в том числе с Секретариатом Тихоокеанской региональной программы в области окружающей среды (СПРЕП), Координационным центром по предотвращению стихийных бедствий в Центральной Америке (КЕПРЕДЕНАК) и другими структурами.

МКГ постановила учредить под руководством Руководящего комитета целевую группу для изучения мер по мониторингу деятельности провайдеров услуг по цунами (ПУЦ), национальных центров предупреждения о цунами (НЦПЦ) и национальных систем предупреждения на основе установленных в Среднесрочной стратегии СПЦТО 2014-2021 гг. целей (IOC/2013/TS/108).

МКГ далее постановила провести совместное межсессионное заседание рабочих групп, целевых групп и Руководящего комитета и проводить сессии МКГ/СПЦТО в течение четырех дней, с тем чтобы предоставить достаточное время для дискуссий и принятия решений.

МКГ постановила обратиться к государствам-членам с просьбой подтвердить свою приверженность и заинтересованность в целях обеспечения дальнейшего обслуживания и укрепления СПЦТО в соответствии с Рекомендацией МКГ/СПЦТО-XXVI.3

МКГ выразила свою благодарность правительству Соединенных Штатов Америки за любезное проведение двадцать шестой сессии МКГ/СПЦТО в Гонолулу, Гавайи.

МКГ также выразила свою благодарность Агентству по управлению чрезвычайными ситуациями и гражданской обороне штата Гавайи за обмен опытом и стратегиями работы с местными сообществами в области подготовки к цунами.

МКГ с признательностью приняла любезное предложение Франции и Панамы принять у себя двадцать седьмую сессии МКГ/СПЦТО на Таити или в Панаме в 2017 г. и **предложила** Секретариату провести консультации с обеими странами для согласования договоренностей.

МКГ избрала г-жу Филомену Нельсон (Самоа) ее председателем и г-на Томоаки Озаки (Япония), д-ра Татьяну Ивельскую (Российская Федерация) и г-на Рика Бейли (Австралия) заместителями председателя МКГ/СПЦТО на период с мая 2015 г. по 2017 г.

1. WELCOME AND OPENING OF SESSION

1 The master of ceremony Mr Ed Young (NOAA/NWS, USA) made a call of order that was followed by a traditional Hawaiian welcome ceremony. He then invited authorities to address the Plenary as follows:

2 Ms Laura Furgione, U.S. NOAA Deputy Assistant Administrator for Weather Services and Deputy Director, National Weather Service (NWS), congratulated the Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System (ICG/PTWS) for its anniversary and congratulated the Intergovernmental Oceanographic Commission (IOC) for coordinating a global tsunami warning system. She also welcomed and congratulated Ken Gledhill as Chair of the ICG/PTWS for his leadership and guidance. She noted that there is no place as Hawaii to celebrate the good work in protecting people of tsunamis and thanked all scientists and business people, including the Royal Hawaiian Hotel, for their contributions to make this meeting to happen. She concluded emphasizing that actionable and reliable measures to safe lives from impending hazards require a multi-stakeholder partnership, which for tsunami is well represented in the U.S. Delegation that includes agencies from across several agencies and services.

3 Mayor Kirk Caldwell from the City and County of Honolulu, State of Hawaii, addressed the plenary and shared that in 1975, when he felt a big earthquake, sirens for tsunami warning were off immediately and people evacuated promptly. By comparison the 1946 tsunami generated in the Aleutian Islands hit Hilo, destroyed the Hilo waterfront and killed 159 people in Hawaii, when there was no tsunami warning system in place. In 1960 for the Chilean earthquake and tsunami, there was a tsunami warning system in place but some did not take it seriously and 63 people died. In the past few years, the increased capabilities for observing and forecasting have make Hawaii a much safer place. But compared to these events, thinking out of the 2004 Indian Ocean tsunami it is an unbelievable disaster. To be prepared against such kind of disasters, the County and City of Hawaii is doing an incredible job with once a month sirens test, evacuation maps in all phone books, tsunami evacuation signs in lower lying areas. Now Hawaii is preparing for a worst case tsunami generated by a 9.3 Alaska earthquake. But bearing in mind the behaviour of some people in Hawaii for the March 2011 tsunami generated in Japan, it is clear that much more education is needed. That said, Hawaii is doing well and is ready to help other communities around the Pacific and in that framework, the ICG/PTWS is doing a very good job. He concluded wishing a safe and enjoyable stay.

4 The Chairman of the ICG/PTWS, Ken Gledhill (New Zealand), thanked the major for his very personal experience sharing, from his heart and soul. He declared the 26th session of the ICG/PTWS open.

2. ORGANIZATION OF THE SESSION

2.1 ADOPTION OF THE AGENDA

5 The Chairperson informed the Plenary that the agenda was prepared by the Secretariat and the Officers in consultation with the PTWS Steering Committee taking into account the Recommendations and instructions given at the Twenty-fifth Session of the ICG/PTWS (ICG/PTWS-XXV/3) held in Vladivostok, Russian Federation, from 9 to 11 September 2013, as well as the relevant parts of the IOC Rules of Procedure (IOC/INF/1166). He reported that agenda item 4.5 has been included on request by Nicaragua to discuss the establishment of a Central America Tsunami Advisory Centre (CATAC).

6 The PROVISIONAL AGENDA **was approved** as is.

2.2 DESIGNATION OF THE RAPPORTEUR(S)

7 The Chairperson informed Delegates that as per usual procedure a Rapporteur for the meeting needs to be appointed. He indicated that at the Fourth meeting of the Steering Committee held the 10 and 11 July 2014 in Honolulu, United States, the Chair was informed that USA and Chile may propose candidates for Rapporteur. USA proposed Nicolas Arcos (USA) and Chile proposed Nicolas Guzman (Chile). The Plenary accepted these nominations.

2.3 CONDUCT OF THE SESSION, TIMETABLE AND DOCUMENTATION

8 The Chairperson noted that interpretation is available in English and Spanish, kindly provided by the Government of Mexico through professional translators sent by the Secretariat of Mexican Navy (SEMAR).

9 He also noted that as customary, all the documentation is available in the website of the meeting, in English.

10 The Chairperson informed that to guide the Delegates an Annotated Provisional Agenda was provided, as document ICG/PTWS-XXVI/2 Prov (ANNEX I).

11 He informed the Plenary that in order to facilitate the proceedings of the meeting a revised timetable was prepared by the Secretariat in coordination with the Officers, the local organizing committee and the PTWS Steering Committee.

12 He noted that a deadline for nominations of candidates for Officers had been set to Wednesday, 22 April at 5 pm and a deadline for submission of Draft Recommendations through the Secretariat has been set to Thursday, 23 April at 6 pm.

13 He then proposed to the Plenary to constitute two statutory sessional groups that following nominations of Member States were composed as follows:

- Elections Commission: Chair Mr David Coetzee (New Zealand) with members from Colombia, China and France.

- Recommendations Committee: Chair Ms Jennifer Lewis (USA) with members from Australia, China, Japan, New Zealand and Samoa.

14 In order to smooth the work of the session and facilitate the generation of recommendations and agreements, the plenary set up three intrasessionnal Working Groups to address some of the major issues addressed at the meeting, as follows:

- PacWave: with Co-Chairs Dr Laura Kong (USA) and Mr Tomoe Ozaki (Japan) with members from Australia, France, Korea, New Zealand, the Russian Federation and PTWC.

- Central America – Pacific Coast: Chair Mr Wilfried Strauch (Nicaragua) with members from Honduras, Japan, Mexico, Panama and USA.

- Implementation Plan, Funding Strategy, and the Future: Chair Mr Rick Bailey (Australia) with members from Colombia, Cook Islands, China, Ecuador, France, New Zealand, Samoa and USA.

15 The Chairman indicated that due to limited time available the sessional Working Groups should meet outside the times of the plenary session and coordinate the booking of designated rooms with the Secretariat.

16 At this point, the Chairman asked Mr Rajendra Prasad, member of the IOC Secretariat, to inform the meeting about the forth-coming Election of Officers, and remind the ICG of the deadline for nominations by Member States, according to IOC Rules of Procedure. He reported that according to the rules, one Chair and three Vice-Chairs should be elected with candidatures accepted until EOB of the first day of the session, which is set for 5 pm on Wednesday, 22 April 2015.

17 With respect to the elections, Mr Gledhill indicated that per recommendation of the last session he was requested to assess if the current structure of three Vice-Chairs should be continued. At this point he indicated that, considering the workload and roles played by the Vice-Chairs, he suggests going back to a 2 Vice-Chairs structure.

18 The Chairperson requested that the time used to reporting is reduced as much as possible to concentrate on the exchange of views and decisions on policy matters. He asked Member States to deliver as much as possible national reports without PowerPoint presentations (PPTs), and the PPTs be provided to the Secretariat for posting to the website. As well, Member States were kindly asked to provide a written statement (5 to 10 lines) to the Secretariat for the report.

19 At this point, he offered the floor to the local host to provide logistic details about the welcome dinner and about the logistics for Working Groups (WGs) and Plenary.

20 Ms Cheryl Williams, Manager of the Royal Hawaiian Hotel, venue of the meeting, recalled that the most recent tsunami warnings to cause evacuations on the islands are the 27 February 2010 Earthquake in Chile, the 11 March 2011 Earthquake in Japan, and the 27 October 2012 Earthquake in British Columbia. The latest one on 2012 activated the tsunami emergency evacuation plan for the Royal Hawaiian Hotel as follows:

- Warning issued at 7 p.m.
- By 10:20 p.m. all guests and employees relocated to 30th floor at Sheraton Waikiki.
- At 1 a.m. all clear given by the state.
- What was forecast to be a 7’ wave was approximately 2.5’ in size.

21 She indicated that due to the high density of population in Waikiki it is difficult to move everyone to higher points of the island quickly-traffic congestion, hence the plan for a “Vertical Evacuation” within concrete buildings. The plan at the Royal Hawaiian Hotel will have guests on the lower floors moving to the 30th floor lounge next door. If time permits, they send their employees or associates home if they live in an inundation zone to prepare their homes and care for family, and they call in other workers who have been previously identified as essential and available for this type of potential disaster. She further indicated that all Guests and employees are evacuated vertically 30 minutes prior to wave arrival and the Royal Hawaiian Hotel is part of a network of hotels that have a messenger service to communicate with the city after impact to evaluate conditions and/or request assistance. With all these considerations, she expressed that ICG participants should feel very safe during the stay at the meeting venue.

22 The Chairman thanked Ms Williams for this very useful information.

23 The Chairperson indicated that the Session on 22 April will end at 5.30 pm, and a reception will follow.

24 The Chairperson opened the floor for comments from Delegates on the timetable. The timetable was approved with minor amendments proposed by the local host to accommodate logistical requirements.

3. REPORT ON INTERSESSIONAL ACTIVITIES

3.1. CHAIRMAN'S REPORT

25 The Chair presented his report for the intersessional period 2013 – 2015 (September 2013 to March 2015).

26 He indicated that this meeting is very significant, with several achievements that make all to be proud to be here. The International Tsunami Symposium to commemorate the 50th Anniversary of the Pacific Tsunami Warning and Mitigation System was held the 20 and 21 April 2015 in Hawaii, United States, just before the session, on top of recalling the history and achievements of 50 years, was instrumental in providing some guidance about the future.

27 One of the most significant achievements was the launching of the PTWC New Enhanced Products for PTWS, by using the best science available to inform the forecasting of tsunamis after an earthquake happens and improve with that the accuracy and content of tsunami bulletins.

28 The regional structure that was put in place in 2009 was instrumental in making the introduction of the Enhanced Products more effective through all the Member States.

29 An additional achievement was the global approach to tsunamis that has been taken through the IOC coordination. In this sense, the TOWS-WG that includes the ICGs, some other organisations and Inter-ICG Task Team Chairs has being effective in performing the important tasks of standardisation.

30 The Twenty-fifth Session of the ICG/PTWS held in Vladivostok, Russian Federation, from 9 to 11 September 2013, endorsed the Enhanced Products in 2013 and entrusted the Steering Committee to make sure the process ended with the launching on 1 October 2014.

31 The role of key persons in the launching and the associated training to make sure the Enhanced Products were understood and used, need to be highlighted, among them in particular Laura Kong from the International Tsunami Information Center (ITIC).

32 Several Working Groups continued working throughout the region, in the South China Sea, in the South East Pacific as well as in Central America. Several Task Teams met, for example the Task Team on Seismic Data Sharing in the South West Pacific. However, not all the Working Groups were as active as the above mentioned.

33 Chair Gledhill stressed that one of the really important things about the future is to use all the science and understanding we have about the tsunami phenomena to ensure all threatened communities have the evacuation maps required. To make sure that this happens, the PTWS needs to enhance its governance involving more representatives of the emergency management community.

34 Chairman Ken Gledhill thanked the PTWS Steering Committee that has been very supportive as well as the Secretariat. He thanked Mr Takeshi Koizumi (Japan) and Rear Admiral Patricio Carrasco (Chile). He expressed a special vote of thanks to the staff of the

warning centres and the International Tsunami Information Centre with whom he enjoyed close and productive working relationships: Laura Kong (ITIC), Charles McCreery (PTWC) and (as already acknowledged) Takeshi Koizumi (NWPTAC). He thanked as well Mike Angove (Tsunami Programme Manager for NOAA) and David Coetzee (New Zealand) for his continued support. He thanked USA for organizing and hosting the Symposium. The full text of his report is available in ANNEX III.

35 The **ICG noted** the report of the Chairman.

3.2. SECRETARIAT REPORT

36 The Technical Secretary for ICG/PTWS, Mr Bernardo Aliaga, presented the report of the Secretariat focusing on actions led or coordinated by the Secretariat during the intersessional period 2013 – 2015, including extrabudgetary funded projects.

37 He indicated that the Secretariat provided regular support to sub-regional groups, including to one meeting of the Working Group for the Central America Pacific Coast (Third meeting held in Nicaragua, Managua, the 29 and 30 September 2014, IOC/PTWS-WG-CA-III/3) and two meetings of the Working Group for the South China Sea Region (Third meeting held in Hong Kong, China, the 8 and 9 April 2014, ICG/PTWS-WG-SCS-III/3 REV; Fourth meeting held in Jakarta, Indonesia, the 11 and 12 February 2015, ICG/PTWS-WG-SCS-IV/3), as well as online support to the Working Group for the South East Pacific region.

38 Regular update of the Tsunami Warning Focal Point (TWFP) and Tsunami National Contact (TNC) database, and related frequent communications with the Northwest Pacific Tsunami Advisory Center (NWPTAC) and the Pacific Tsunami Warning Centre (PTWC) were performed over the period. Mr Aliaga reported that the most recent update including information about the National Tsunami Warning Centres (NTWCs) is an ongoing process.

39 Mr Aliaga reported that funding from contributions from China, Republic of Korea and New Zealand have been addressed to the IOC Special Account for activities of the PTWS. As well several PTWS training and workshops have been consistently supported by USA through the National Oceanic and Atmospheric Administration (NOAA) and the Office of Foreign Disaster Assistance the United States Agency for International Development (USAID/OFDA). With respect to extrabudgetary projects, he reported that a new project for Central America is under preparation.

40 Mr Rajendra Prasad, UNESCO/IOC staff based in Suva, Fiji, reported that he has been supporting countries of the South West Pacific, through specific trainings for Standard Operating Procedures (SOPs) with funding from NOAA, the WMO/USA Voluntary Cooperation Programme (VCP), and the Japan International Cooperation Agency (JICA). He reported that training on PTWS Enhanced Products is planned for the South West Pacific by the end of 2015. He indicated that together with the World Meteorological Organization (WMO), and the Intergovernmental Oceanographic Commission (IOC) of the United Nations Educational, Scientific and Cultural Organization (UNESCO) is trying to schedule tsunami related meetings or workshops back to back with the Tropical Cyclone Committee to save funds.

41 China expressed thanks for the excellent secretariat support provided by the Secretariat, in particular Mr Tony Elliot and Mr Bernardo Aliaga, in conducting the two meetings of the ICG/PTWS Regional Working Group on Tsunami Warning and Mitigation System for the South China Sea Region during the intersessional period.

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

3.3. REPORT FROM SYMPOSIUM: MAKING THE PACIFIC READY FOR THE TSUNAMI THREAT

43 The Chairman recalled the International Symposium commemorating the 50th Anniversary of the PTWS “Making the Pacific Ready for the Tsunami Threat”, held in Hawaii, United States, the 20 and 21 April 2015, that had the goal of identifying practical and tangible next steps, desirable partnerships, and necessary commitments needed to sustain and evolve the PTWS for the future. Dr Gledhill asked Dr Laura Kong, Chair of the Symposium Organizing Committee, to provide a summary of the Symposium.

44 The Chair of the Symposium Organizing Committee, Dr Laura Kong, ITIC Director, reported the outcomes of the International Tsunami Symposium Commemorating 50th Anniversary of the Pacific Tsunami Warning and Mitigation System. She explained that “Making the Pacific Ready for the Tsunami Threat” was organized by the IOC, IUGG, and USA and held the 20 and 21 April 2015 at the NOAA Inouye Regional Center, Ford Island, Oahu, Hawaii. Symposium meeting information and documents are posted to http://itic.ioc-unesco.org/index.php?option=com_content&view=article&id=1911:international-tsunami-symposium&catid=2153:its&Itemid=2596

45 She noted that altogether, 150 participants from 30 countries attended. Over 40 speakers representing 19 countries recounted the achievements of the last 50 years, stated and reviewed the current state of the System, and identified and recommended practical and tangible next steps, desirable partnerships, and necessary commitments needed to sustain and evolve the PTWS for the future. The goal of the Symposium was to “look back so we can look forward.” Sessions featured keynotes from long-standing countries, the history of the PTWS, and the PTWS Medium-Term Strategy (MTS) themes of Risk Assessment and Reduction, Event Detection, Warning, and Dissemination, and Awareness and Response. Thematic sessions consisted of speakers and panels representing decision-makers, planning and policy, science, warning, and/or emergency operations practitioners.

46 Dr Kong explained that in addition to the Plenary session, there were 33 posters and / or extended Abstracts submitted. A peer-reviewed Special Volume on the Pacific Tsunami Warning and Mitigation System: Past, Present, and Future is planned. During evening poster sessions, tours of the PTWC and ITIC spaces, a demonstration of tsunamis visuals projected in three-dimensions on the NOAA Science of the Sphere, and numerous tsunami event, awareness, and education videos were shown.

47 She highlighted that two products were specially produced for the PTWS 50th anniversary and briefed to the Symposium.

- A PTWS video “Tsunami Warning!” was produced by the ITIC, in collaboration with the USA and Chile. The video follows the tsunami warning chain after a M9.5 earthquake and tsunami off the northern coast of Chile. Highlighted are the PTWC enhanced products, and responses in Chile, Peru, Samoa, Hawaii, and Australia, Japan, Indonesia, and the Philippines. The video is available on the ITIC website, and the PTWC and UNESCO YouTube sites, as well as in hard disk.

- The ITIC and NGDC, along with many experts, published the PTWS Commemorative Historical Book, “Pacific Tsunami Warning System, A Half-Century of Protecting the Pacific, 1965-2015” recounting the establishment and evolution of the PTWS over the last 50 years. The book is available in hard copy to all Member States.

48 The USA, Chile, Japan, and Samoa provided keynote presentations on their systems, and shared lessons learned from their long experience in tsunami mitigation. The USA emphasized the importance of consistency in warnings for them to be effective, and the need to deliver warnings “through” the last mile. Chile stated that although the detection networks are vastly improved, because we cannot predict earthquakes, there is no fool proof early warning system and we therefore always need to be prepared. Japan recommended that to be sure for maximum public safety, it is wise to use the worst-case scenario wave forecast. Samoa recalled that tsunami awareness and preparedness efforts prior to their 2009 local tsunami saved many lives.

49 The Symposium closed with a ‘Pacific Town Hall Meeting.’ The PTWS Medium Term Strategy (MTS) foundational elements (interoperability, research, capacity building, funding and sustainability) were used as a starting point for interventions. The PTWS MTS and Implementation plan must always keep sight of and be integrated with the seven targets outlined in the WCDRR Sendai Framework for 2015-2030. Again, the importance and challenge of keeping public awareness was stated, as even in Japan this is an issue. Media can assist and Exercise Pacific Wave exercises are awareness opportunities. Including the disaster management sector is a priority to balance warning and response sector of the Intergovernmental Coordination Group, and may help with budget sustainability. It was noted that sustainability does not mean to maintain the status quo. To be sustainable, you have to keep developing. Research is still needed to improve warning response - the best-prepared country in the world (Japan) still lost 4% of people in the flooded zones. There are still analysis challenges as there are too many ‘false alarms.’ If the alarms are reduced, people will believe warnings and act. Detection and warning protocols for volcano and landslide tsunamis, and meteo-tsunamis, are still needed.

50 The Symposium closed with Mr Michael Angove, on behalf of the Symposium Committee thanking the Session Chairs, Speakers, Panelists, and participants for sharing and reflecting on 50 years of tsunami warning in the Pacific. The System has sustained itself thanks to the active coordination and cooperation of every country. Ms Furgione, as the U.S. host for the Symposium, thanked everyone for coming to commemorate the 50th Anniversary at NOAA’s new centre. She recognized and congratulated the Local Organizing Team led by Mr Ed Young (NWS Pacific Region) and Mr Brian Yanagi (ITIC) for its excellent work for the Symposium.

51 Philippines and Colombia as well as Cook Islands were supportive of the proposal of a renewed emphasis on getting evacuation zones and evacuation routes identified at each country. Philippines indicated that in several geographical areas they are confronted to both local and distant tsunamis.

52 Colombia indicated that a closer approach to the engineers’ community is necessary to address technically the issue of low lying populated areas.

53 New Zealand indicated that the ICG/PTWS needs champions on tsunami preparedness at national level, being those from the emergency response or preparedness fields.

54 Australia indicated that we do not have an even capability on tsunami response in all countries, including for local and distant tsunamis. Therefore, the ICG/PTWS needs to keep working on the system and while concentrating on community evacuation mapping it still needs to continue refining the entire regional system.

55 Tonga acknowledged the work that has been done to put the enhanced products in place that works pretty well, but are basically focused on the distant tsunamis. For local tsunamis that menace the Pacific Islands there is more cooperative work needed between

the disaster management and the scientific communities. An additional reason for the need of partnerships is that reaching out far located communities and islands is very expensive.

56 Vanuatu indicated they have data to contribute towards evacuation mapping in Vanuatu.

57 Ecuador thanked all organizers of the Symposium in particular NOAA. He suggested that it would be interesting to analyse the functioning of DART buoys and non-DART tsunameters. Knowing that new DART technologies are in development it would be interesting to analyse if these improvements could help on

58 USA indicated that it thanked Ecuador for raising this point and expressed that this group could play a role in terms of assuring that the best standards are used.

59 The full report of the Symposium is available as ANNEX V**.**

60 The ICG **noted** the report of the Symposium.

3.4. TOWS-WG REPORT

61 Under this agenda item, Mr Rick Bailey (Australia) informed to the Plenary that two meetings of the Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems (TOWS-WG) have been held in the intersessional period: the Seventh meeting of TOWS-WG held in Paris, France, the 12 and 13 February 2014 (IOC/TOWS-WG-VII), and the Eighth meeting of TOWS-WG held in Morioka, Japan, the 12 and 13 March 2015 (IOC/TOWS-WG-VIII). He summarised the main aspects of IOC/TOWS-WG-VII and IOC/TOWS-WG-VIII.

62 He recalled that the main objective of TOWS-WG is to advise the IOC Governing Bodies on coordinated development and implementation activities on warning and mitigation systems for tsunamis and other hazards related to sea level of common priority to all Intergovernmental Coordination Groups on Tsunami Warning and Mitigation Systems (ICGs/TWSs). Because of that, TOWS-WG reports directly to the IOC Assembly/Executive Council.

63 Mr Bailey indicated that the existing Inter-ICG Task Teams (TT), which have representation of all ICGs, including the ICG/PTWS, are the TT on Tsunami Watch Operations and the TT on Disaster Management and Preparedness, and a more recent TT on Hazard Assessment Related to Highest Potential Tsunami Source Areas. Some of the results of the work of these TTs include the Global Service Definition, which encompass among others, Areas of Service (AoS), Earthquake Zones (ESZs), reporting water levels, threat level definitions, and bulletin structures. From the collaborative work of the TTs in the framework of TOWS there has been also an effort in standardising terms. The result of it is that TOWS-WG is now the mechanism to oversee content changes of the *Tsunami Glossary* (IOC/2008/TS/85). It has also developed new definitions of National Tsunami Warning Centre (NTWC), Tsunami Warning Focal Point (TWFP), and Tsunami Service Provider (TSP).

64 Samoa commented that it is important to take into account at the global level the recommendations of the Sendai Framework for Disaster Risk Reduction 2015-2030 (A/CONF.224/L.2), in particular about the use of multi-hazard approach as the preferred framework for Early Warning Systems.

65 Mr Bailey responded that this is really important to keep aligned with the world initiatives and policies on disaster risk reduction commitments through the recent Third

United Nations World Conference on Disaster Risk reduction (WCDRR) which took place from 14 to 18 March 2015 in Sendai, Japan. He suggested that this aspect should be forwarded to TOWS-WG to make sure that the Intergovernmental Oceanographic Commission (IOC) and the Intergovernmental Coordination Groups (ICGs) do monitor and demonstrate that the tsunami programme is aligned and contribute to the targets agreed at the Third WCDRR.

66 The **ICG noted** the report on TOWS-WG.

3.5. WARNING & ADVISORY SERVICES REPORT

3.5.1. Pacific Tsunami Warning Centre (PTWC)

67 Dr Chip McCreery reported that the Pacific Tsunami Warning Centre (PTWC) monitors over 500 seismic stations and over 400 sea level stations around the world including dozens of DART buoys put in place by USA and several other Member States.

68 He indicated that PTWC responded to over 5000 global earthquakes that triggered PTWC seismic alarms in the period 2013-2015. It analysed and issued 581 global earthquakes with Mw greater than 5.5. It issued PTWS Tsunami Bulletins for 79 Pacific Earthquakes with Mw greater or equal than 6.5.

69 He referred in detail to the 1 April 2014 Northern Chile tsunami that had a magnitude of Mw 8.2. For this event, PTWC issued a bulletin within 8 minutes and cancelled at 4 hours and 56 minutes. There were run-ups greater than 3 metres with some damages but no casualties.

70 Another notable event happened in Guerrero, Mexico, with magnitude 7.2 Mw and with 0.43 metres measured on a costal gauge in Acapulco, with no damage or casualties. As well, a Mw 7.1 in the Eastern Pacific Rise that measured 0.47 metres in Easter Islands and 0.08 metres at San Felix Islands.

71 Mr Rabinovich (Russian Federation) commented that, as indicated by PTWC, the availability of more data is making that the statistics show more events in the last part of the century and beginning of this century. He asked about later wave arrivals for some events (with respect to predictions) and if current measurements are foreseen as part of the system. Mr McCreery indicated that later arriving waves from tsunamis has been observed in many tsunami events due to for example interferences. Currents are of interest for many countries including from USA but a dedicated observational system is not in place for that kind of measurements.

72 Mr Tony Song (NASA) commented that the National Aeronautics and Space Administration (NASA) is developing a GPS network for tsunami warning and noted that many countries do not share GPS stations data. For example, the Japan Meteorological Agency (JMA) has not access to the entire network of GPS stations available in Japan. He suggested that ICG/PTWS should make an effort to increase GPS data sharing.

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

3.5.2. Northwest Pacific Tsunami Advisory Center (NWPTAC)

74 Mr Tetsuyuki Ueyama, Scientific Officer from the Earthquake and Tsunami Observation Division of the Seismology and Volcanology Department of the Japan Meteorological Agency (JMA), presented the report of the Northwest Pacific Tsunami Advisory Center (NWPTAC).

75 He introduced that during the period of August 2013–March 2015, the centre issued advisories for 27 major events and has responded to 172 events in total since the commencement of its service in March 2005. NWPTAC conducts regular communication tests twice a year to examine the communications status on distributing messages. Since the last test conducted in January 2015, the test procedures has been improved, which led to positive outcomes such as a larger number of participating countries and more detailed feedback from them than for previous tests. However, it should be noted that 6 of 16 recipient countries were still unresponsive to the test. He stressed that NWPTAC would like to request participation of all countries concerned for the improved communications.

76 Federated States of Micronesia thanked JMA for the support provided and indicated that is seeking membership of UNESCO as soon as possible.

77 Korea confirmed that it received the communication tests from NWPTAC. It suggested that instead of 3 forecast points they would like to have 5 forecast points. Mr Ueyama indicated that this can be done through the Secretariat and PTWC.

78 PTWC asked Member States to keep the formal channel through IOC to update contact details to be more efficient.

79 Australia indicated that the group is very thankful of the support of USA and Japan to Member States. The Chairman endorsed the thanks to the Governments of USA and Japan, for their very effective support through PTWC and NWPTAC.

3.6. REPORT FROM THE INTERNATIONAL TSUNAMI INFORMATION CENTER (ITIC)

80 The Chair invited the Director of UNESCO/IOC's International Tsunami Information Center (ITIC), Dr Laura Kong to present her report.

81 Dr Laura Kong, Director of ITIC, provided an update on the activities of ITIC during the intersessional period. She reported on ITIC's staffing status and highlighted the main activities, which included updating and developing new tsunami outreach and awareness products, updating and distributing tsunami warning decision support tools, and training on the PTWC New Enhanced Products. Updated and new services, products, and outreach materials will be announced through the existing Tsunami Bulletin Board ((ptws_bb@infolist.nws.noaa.gov), and the newly-created list serve for Tsunami National Contact (ptws_tnc@infolist.nws.noaa.gov). She thanked the USA and Chile for supporting ITIC's operations and contributing to its services.

82 Between 2013 and 2015, the following awareness materials were updated: *Tsunami: the Great Waves* (IOC/BRO/2012/4), Tsunami Sources icosahedron Globe, and *Surviving a tsunami: lessons from Chile, Hawaii, and Japan, eyewitness accounts of the Pacific Ocean tsunami associated with the giant Chilean earthquake in 1960 and 2010* (IOC/BRO/2014/2) (adaption from USGS Circular 1218 to include the 2010 Chile tsunami). All materials are available in hard copy to Member States, as well as posted to the ITIC web site. She thanked the USA for supporting the development distribution of tsunami awareness materials, as well as the Tsunami Warning Decision Support Tools (TTT, Tide Tool), and training on the PTWC New Enhanced Products.

83 In 2015, in commemoration of the 50th anniversary of the PTWS, the ITIC produced an outreach video "Tsunami Warning!" (English, Spanish, French) distributed to ICG participants and available online at the ITIC website and IOC and PTWC YouTube sites. The video chronicles the tsunami warning chain for a M9.5 earthquake off Northern Chile as the PTWC quickly analyses seismic and sea level data, forecast tsunami wave heights, and

disseminates threat assessments to country National Tsunami Warning Centres. Woven into this fast-paced video are vignettes highlighting tsunami warning and emergency response actions by centres and communities starting immediately after the earthquake in Chile and Peru, and after receiving the PTWC alerts in Samoa and Hawaii, and in Australia, Japan, Indonesia, and the Philippines.

84 ITIC and the NOAA National Geophysical Data Center (NGDC), along with more than 80 experts, also published a historical book *Pacific Tsunami Warning System, A Half-Century of Protecting the Pacific, 1965-2015* (ISBN: 9780996257909), documenting the 50 year history and development of the PTWS (distributed to ICG and International Tsunami Symposium participants). The Book is a tribute to the men and women who dedicated their careers to saving lives from the tsunami hazard. Included are country and personal reflections, key tsunami events, PTWS history, science and technology, disaster management and tsunami preparedness, warning centres and organizations, and an outlook on the PTWS today and tomorrow.

85 She reported that 446 international scientists and tsunami professionals are subscribed to the Tsunami Bulletin Board. The ITIC Tsunami Newsletter, principally summarizing significant tsunami events and important Pacific tsunami-related meetings, has been distributed through 2013; due to costs, the ITIC will be moving to more electronic dissemination, and is asking each customer to confirm if hard copy is necessary. 2014 Newsletters will be mailed in July. She reported that the revision to the 1998 *Post-tsunami survey field guide,* first edition, was published in 2014, and is now renamed *International Tsunami Survey Team (ITST) Post-Tsunami Survey Field Guide*, second edition (IOC/2014/MG/37).

86 Per ITIC's Mandate and Functions (1977), ITIC continues to maintain a Library with historic documents, event data and reports. In editing the PTWS Historical Book, it was confirmed after exhaustive search to the IOC and Member States that the ITIC repository was nearly the only place holding many valuable one-of-a-kind records on the Pacific Tsunami Warning System.

87 Dr Kong reported that, in cooperation with UNESCO/IOC, ITIC conducted 20 1-week International Training Programmes (ITP), including the regional training on Strengthening Standard Operating Procedures for Tsunami Warning and the use of the ICG/PTWS PTWC New Enhanced Tsunami Products for South China Sea countries held in Beijing, China, from 16 to 20 December 2013, the regional training workshop on the PTWC Enhanced Products for Pacific Islands Countries held in Nadi, Fiji, from 22 to 24 May 2014, the regional training on ICG/PTWS Pacific Tsunami Warning Centre (PTWC) New Enhanced Tsunami Products for Latin American countries held in Guayaquil, Ecuador from 2 to 4 June 2014.

88 ITIC conducted one ITIC Training Programme - Hawaii (ITP-Hawaii), from 18 to 29 August 2014 in Honolulu, Hawaii, United States of America, attended by 14 countries. Dr Kong noted the high value and priority Member States have put in ITIC trainings, as evidenced in course evaluations and the 2013 ITIC Customer Satisfaction Survey. As such, re-iterating that ITIC's funding is limited, she strongly recommended that Member States include training costs in their own national budgets.

89 Dr Kong reported on progress on Action Items from the 2013 ITIC Customer Satisfaction survey (30 Member States responded). Regarding requests for training on practical TWC operations, the ITIC indicated that with its move to a larger office space at the NOAA IRC and co-location with PTWC, long-term working visits are now possible. As such, ITIC has re-started its Visiting Scientist (or Expert) Program. In 2014 and 2015, it has hosted 1-3 month visits by government officials and university graduate students from Japan and United Kingdom. PTWC has hosted 2 graduate students from Japan.

90 Regarding requests for training on tsunami modelling, the ITIC will include tsunami modelling training (in 2015, ComMIT in Central America) as part of its new course on Essential Tsunami Preparedness: Tsunami Plans, Maps, and Procedures (PMPs). The New Course is being led by the ITIC with PTWS WG 3, the IOC and Member State partners. A PTWS Task Team on Evacuation Planning and Mapping was formed to provide input with the ITIC Director as Chair.

91 Regarding requests for training through distance learning methods, the ITIC will evaluate feasibility through cooperation with the IODE Ocean Teacher Global Academy. To date, several of ITIC's courses are available. During the next intersessional period, ITIC will investigate online and offline teleconference, video and non-video, and computer-based learning methods with the goal of being able to make its trainings more widely available.

92 Australia requested that the list of activities that require funding including for ITIC activities be forwarded to the Sessional Committee that would be discussing about funding strategy and implementation plan.

93 Solomon Islands noted that the Voluntary Cooperation Programme (VCP) of WMO funded a training called Pacific International Training Desk that allows Met officers from South West Pacific Islands to receive training in Hawaii. He inquired if this could be expanded to include training on tsunami matter. Dr Kong indicated that there is only one day available for tsunami matters in the framework of this training. Ed Young (USA) indicated that there is a possibility of expanding a little the slot for tsunami in the Pacific Desk.

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

3.7. NATIONAL PROGRESS REPORTS

95 The Chair reminded the session that written reports have been requested in a standard format, and have been received in advance of the Session. They have been made available through the meeting website. He asked Delegates to make short statements focussed on key points of their National Reports that may have implications for the policy discussion.

96 Australia indicated that the Joint Australian Tsunami Warning Centre (JATWC) continues to develop its capabilities and in the upcoming period will continue to develop forecasting tools. The JATWC operates through two 24/7 hubs. The seismic detection and monitoring hub of the JATWC, based at Geosciences Australia (GA) in Canberra, automatically issues seismic solutions for potentially tsunamigenic earthquakes to the tsunami warning and sea level monitoring hub of the JATWC, based at the Bureau's National Operations Centre (BNOC) in Melbourne. For earthquakes of magnitude 6.5 and above, GA issues a manually assessed seismic solution to the Bureau via a dedicated high speed communications link. Australia has six deep ocean tsunami monitoring stations (tsunameters) deployed in locations to the NW (Indian Ocean), NE (Coral Sea) and SE (Tasman Sea). These are all DART^{TM}-derivative stations, including two Easy-To-Deploy (ETD) variants. Data from the buoys have been transmitted on the GTS in real time using the CREX/BUFR Template for Transmission of Sea Level Data from Tsunameters. As an interim measure, all stations also continue to report on the GTS in the legacy PMEL-developed coding format, used by U.S. operated DART stations. Data from these stations have also been made available in real time through the website of the U.S. National Data Buoy Centre (NDBC). In August 2014, both deep ocean tsunameters in the Coral Sea were replaced with ETD's as part of the scheduled maintenance program. In the Indian Ocean, one tsunameter had a mooring failure in July 2014 and a service mission is planned for July 2015. Both tsunameters in the Tasman Sea were until recently not reporting, however a return to service mission has now corrected the problems.

97 Canada indicated that there are 17 continuously operating water level stations capable of recording tsunamis on Canada's Pacific coast. Four are specifically for the tsunami warning system and there are 13 other Permanent Water Level Network (PWLN) stations. These stations are operated by the Canadian Hydrographic Service (CHS) of the Department of Fisheries and Oceans (DFO). The Geological Survey of Canada (GSC) of the Department of Natural Resources (NRCan) contributes real-time seismic data from 37 broadband seismographs stations to the PTWC and to the National Tsunami Warning Center of United States (US NTWC). Ocean Networks Canada at the University of Victoria (UVIC) has tsunami recording bottom pressure recorders and ocean bottom seismographs at nodes on its NEPTUNE 850 km fibre optic cable loop off the west coast of Canada. Data from these instruments are available continuously in real-time. Emergency Management of the province of British Columbia (EMBC) is the agency responsible for distributing tsunami warnings on Canada's Pacific coast and takes the lead in tsunami public education. EMBC regularly conducts Provincial Emergency Notification System tests with coastal stakeholders. In March 2014, EMBC participated in PACIFEX 2014, a cross-border tsunami training exercise involving, British Columbia, Alaska, Oregon, Washington, California and the U.S. NTWC.

98 Colombia reported that there have been several activities which have enabled progress and strengthened capacities for tsunami warning and mitigation in the Colombian coast. The National Technical Committee for Tsunami Warning (CTN) under the Colombian Ocean Commission (CCO), and consisting of more than 17 institutions is upgrading procedures in coordination with the National Plan for Tsunami Risk Management (PNGRT). A Colombia-Ecuador binational simulation that recreated the scenario of the 1979 tsunami that hit the area of Tumaco was organized, with 23,242 people evacuated from 204 institutions. Regarding seismic monitoring, continuous observations with satellite transmission from 54 seismic stations is available, 23 of which would provide relevant information to detect earthquakes that can generate tsunami. A network of accelerometers with 108 stations, 33 of them in time real and a network of 66 permanent and portable GPS, and complementary stations are shared with neighbouring countries. Additionally, Colombia began in 2015 an international project named "Strengthening the capacities of the country in areas of earthquakes, volcanoes and tsunamis" with the International Cooperation Agency of Japan (JICA) through the Science and Technology Research Partnership for Sustainable Development (SATREPS). With respect to sea level monitoring, the network of stations was strengthened with the installation of two gauges and one tsunami detection buoy in the Pacific. Work is in progress with NOAA for transmission of sea level stations data from both coasts through GOES and integration into the IOC Sea Level Monitoring Facility. Accordingly, Colombia would request that new forecast points of the Enhanced PTWC products include the location of its renewed sea level stations, 8 in the Pacific and 13 in the Caribbean. Regarding training courses, Colombia through the General Directorate of Maritime and Port Affairs (DIMAR) offers to host two trainings for the National System for Tsunami Detection and Evaluation in Bogota and expects that PTWS and CARIBE-EWS Member States could participate at them.

99 Chile recalled that its Tsunami Standard Operating Procedures identify the following roles: the Hydrographic and Oceanographic Service of the Chilean Navy (SHOA) identifies and characterizes tsunamigenic events. The criteria depends if it is a local or distant tsunami emergency. Then, the tsunami information is disseminated to NDMO (ONEMI), the Coast Guard (DIRECTEMAR), and the Chilean Navy using different communication systems, including alternative systems. The NDMO (ONEMI) acts on the information provided by SHOA and disseminates to government authorities and the community. Chile reported on the 1 April 2014 at 20:46 (local time), Mw 8.2, epicentre 19.8 ° S; 070.8 ° W. This earthquake generated a local tsunami with maximum amplitude of 2.1 metres. The 1 April earthquake occurred in the northern Chile "seismic gap". Historical records indicate a M 8.8 earthquake occurred within the seismic gap in 1877 in Iquique, which was preceded in the North by a M

8.8 earthquake in 1868 in Ilo, Peru. Chile highlighted that 2 new sea level stations are being installed, in Bucalemu and Bahia Gregorio, to make a total of 42 stations along the coast of Chile delivering data for tsunami warning purposes.

100 China reported that the National Marine Environmental Forecasting Centre (NMEFC) of State Oceanic Administration (SOA) is responsible for operating the tsunami warning and mitigation system in China. NMEFC operates 24 hours a day, 7 days a week, identifies and characterizes events that may generate tsunamis. Besides earthquake sources from CEA (Alternative Energies and Atomic Energy Commission), PTWC and NWPTAC, NMEFC received GSN, IRIS data stream and adopted SeiscomP3 and Antelope to detect earthquakes in the global and regional field. So far, 25 coastal seismic stations have been installed by SOA to detect earthquakes that may trigger local tsunamis. In 2014, NMEFC worked closely with the China Meteorological Administration (CMA) to promote the sharing of 5 tidal gauge data in the South China Sea (SCS) region, which are now transmitted through GTS. SOA made efforts to re-deploy its tsunami buoy and keep it in stable service since June 2014. The sharing of tsunami buoy data is scheduled for 2015. Efforts were always made and will be ongoing in coordinating with CEA to promote the seismic data sharing. China also reported that a programme on “Tsunami hazard, vulnerability and risk assessment”, particularly for some seriously vulnerable areas was conducted in China since 2012. In Zhejiang Province, there were 9 coastal counties that have completed tsunami risk assessment with evacuation maps being developed. In April 2014, Third Meeting of the ICG/PTWS Regional Working Group on Tsunami Warning and Mitigation in the South China Sea Region (ICG/PTWS-WG-SCS/III) held in Hong Kong, China, the 8 and 9 April 2014 and the First Meeting of the ICG/PTWS Task Team on Establishment of the South China Sea Tsunami Advisory Centre (SCSTAC) held the 7 April 2014 in China was hosted by HKO, China. China also joined the 4th SCS Working Group Meeting hosted by BMKG, Indonesia in February 2015. The operational requirements and available observational resources for the SCSTAC were identified, and the performance indicators, as well as draft plan on operational products were discussed. In addition, NMEFC was seeking tight links with NOAA agencies including PTWC, ITIC and PMEL in 2014, for technical consultation on the establishment of the SCSTAC.

101 Ecuador indicated that it has now an Oceanic Monitoring Centre of much better capacity than before. This centre has replaced the previous centre in INOCAR. Special studies about the configuration of Galapagos and the complex effect of tsunamis in this area are under development. Ecuador will also cooperate with Central America considering the experience of the 2012 tsunami.

102 Federated States of Micronesia reported that they have 5 sea level stations with 3 of them in Marshall Islands. It receives warnings and tsunami information from PTWC. They do have TideTool kit installed by PTWC/ITIC and typhoon information is received from the Joint Typhon Warning Center (JTWC) in Honolulu.

103 France reported that this ICG/PTWS-XXVI session is attended for the first time by one representative of New Caledonia, a French Territory with a large autonomy and its own government. The Civil Defence (Disaster Management Office - DMO) was transferred from France to the local government on 1 January 2014 (with new director and new staff), with the creation of the DSCGR (Direction de la Sécurité Civile et de la Gestion des Risques de la Nouvelle-Calédonie). New Caledonia is not a UNESCO member and as such is represented by France at the PTWS. The list of TWFPs (phone and emails) has been updated with 3 new TWFPs added for New Caledonia: the local DMO (DSCGR), the MRCC (Maritime Rescue Coordination Center), and the French Security zone Headquarters. It should be noticed that as in French Polynesia, Meteorological services are not involved in the tsunami warning system, but they can receive messages via GTS. In 2014, the TWFPs have been trained to the use of the PTWC Enhanced Products. New Caledonia participated in the Exercise Pacific

Wave 15 held from 2 to 6 February 2015 (IOC/2015/TS/117 VOL.1, VOL.2.) using the Tonga Earthquake scenario It was reported that New Caledonia uses 2 means of threat assessment: IRD (and PTWC and USGS) seismic detection messages, used directly as a first mean of threat assessment; and PTWC Enhanced Products (especially kmz files).

104 New Caledonia also relies on data from 5 local tide gauges, 3 on the main land, one in Maré and one in Lifou. Data is sent to the IOC Sea Level Monitoring Facility. Threat levels for various events in each coastline area are partially documented but improvements in the accuracy of threat assessment are necessary. Educational programmes for the population have been implemented, and the population in the most exposed areas are well aware of the risk, and the procedures to follow in case of an event.

105 From 2013 to 2015, the Centre polynésien de prévention des tsunamis has implemented modern forecast tools through two fast earthquakes focal mechanism computation methods (W_Phase and PDFM2) completed by two different tsunami numerical modeling: amplification law and nested grids. These methods were performed the first time in real-time during the 1 April 2014 event. The forecast results were very similar to the recorded data.

106 One additional new tide gage has been installed in French Polynesia.

107 Concerning the downstream part of the French Polynesia tsunami warning system, 166 sirens are presently installed , and most of the islands of the 4 archipelagos are equipped (Marquesas: 25; Society: 80; Austral: 17; Tuamotu-Gambier: 44). The sirens can be remotely triggered through INMARSAT from the Civil Protection located in Papeete (Tahiti), with several modes: (i) the whole Territory, (ii) by archipelago, (iii) by island; (iv) each siren separately (for the tests). A part of the sirens network is self-powered by solar panel and batteries and the totality of the network will be self-powered in solar energy within 2 or 3 years.

108 Honduras reported that this is the first time it participates at an ICG/PTWS session. They indicated that through the Comisión Permanente de Emergencias (COPECO) Honduras has executed tsunami drills and seismic and sea level monitoring reinforcements.

109 Indonesia reported on the Indonesia Tsunami Early Warning System of the Indonesian Agency for Meteorological, Climatological and Geophysics (InaTEWS/BMKG), which started operation in November 2008.

110 In the area of observing systems, Indonesia has currently 164 broadband stations, 238 accelerograph stations, and 35 existing siren networks with 13 on planning. Fifty-eight sea level stations and 2 DART buoys are available, both in the Indian Ocean, with two more DART buoys to be installed in 2015. BMKG is also a Tsunami Service Provider (TSP) for the Indian Ocean region, together with India and Australia. There are 28 Indian Ocean rim countries that could receive tsunami warning messages from these three TSPs. Since March 2013, the TSP scheme was fully operational and had taken over the service from the Japan Meteorological Agency (JMA) and the PTWC (USA). Tsunami warning products include: earthquake parameters (magnitude, location, earthquake time, and source mechanism), and tsunami warning (warning segment and status, estimated arrival time of tsunami, observed tsunami arrival time and height, tsunami warning cancellation). The tsunami warning level was categorized into major warning, warning and advisory. The system disseminated tsunami warnings within 5 minutes after the earthquake.

111 Japan reported about future technical improvement and international cooperation. JMA will upgrade its system named Earthquake Phenomena Observation System (EPOS) by March 2016. The new system will introduce an innovative offshore sea-level data

assimilation method for local tsunamis, referred to as the tsunami Forecasting based on Inversion for initial sea-Surface Height (tFISH), developed by the Meteorological Research Institute (MRI) of JMA. To take use of tFISH effectively, JMA plans to collect data from two seafloor pressure meter networks referred to as S-net and DONET, to be installed by the National Research Institute for Earth Science and Disaster Prevention (NIED) and the Japan Agency for Marine-Earth Science and Technology (JAMSTEC), respectively. With regard to the cooperation with countries overseas, JMA has been joining some programmes such as the Science and Technology Research Partnership for Sustainable Development (SATREPS) and the International Institute of Seismology and Earthquake Engineering (IISEE) trainings implemented by the Japan Science and Technology Agency (JST), the Japan International Cooperation Agency (JICA) and other organizations. In addition, as part of JICA's Technical Cooperation Projects, JMA dispatched experts to several countries such as Republic of Ecuador, aiming at supporting their efforts to establish national tsunami warning systems.

112 Malaysia reported on their worst case scenarios for the Philippines trench, Sulu Sea and Sulawesi Sea, all of a magnitude 9.0 with very important tsunami heights expected in local areas. They reporter a total of 53 sirens for warning dissemination and two recovery centres under planning including one in Saba.

113 Mexico reported that its Tsunami Warning Centre (CAT) has three years of existence, and has taken advantage of the integrated services from diverse institutions in order to form a Tsunami Warning System. In these 3 years, it has been able to form a principal centre with response capabilities for tsunamis warnings in just 7 minutes after the seismic event. While trying to improve the response time, the Tsunami Warning Centre is developing systems which will automate the information process stage in order to reduce the response time to 5 or 6 minutes. Since this Centre is located in Mexico City, which is a seismic zone, Mexico created a mobile Tsunami Warning Centre to be used if the main centre needs to be evacuated. For the future Mexico is also planning to establish a Tsunami Warning Centre in a non-seismic zone to reinforce the continuity of the main operations centre, possibly in Veracruz.

114 Nicaragua reported that the Instituto Nicaragüense de Estudios Territoriales (INETER), a governmental institution which is the largest geosciences institution in Central America with 400 co-workers, 40 of them in the Geophysical Department identifies tsunamigenic events. The seismic activity is monitored by the seismic data centre at INETER (24x7, 2 watch persons) using online data from 88 stations in Nicaragua, around 100 stations from other countries in Central America and around other 200 stations worldwide. Data processing is carried out by a number of SeisComP3 systems. The Operation Centre of Civil Defense and SINAPRED have a graphical client of INETER´s SeisComP3 which presents in real time the graphical (Epicentral Map) and alphanumeric information of the occurring seismic events. First seismic event characterizations should be available within 1 minute for events in Nicaragua. Tsunami warning should be declared within 5 minutes

115 INETER communicates the tsunami information to the the Presidency of Nicaragua, the National System of Disaster Prevention (SINAPRED), and the Centre of Operations of the Civil Defence of Nicaragua. The President of Nicaragua decides about the declaration of the emergency. SINAPRED informs all related parts of the national disaster prevention system about the emergency and coordinates their efforts to mitigate the impact to the population and infrastructure. Civil Defence activates the 60 automatic sirens on the Pacific Coast, communicates the emergency to the Army of Nicaragua and coordinates the efforts for the evacuation of the population under risk. Civil Defence also monitors via INTERNET the results of PTWC, NEIC, seismic data centres in Central America. If the communication to INETER and/or Presidency fails (e.g. due to the impact of the earthquake) and they became

aware about a possible tsunami thread they would emit tsunami warning to the population by their own decision observing the thresholds defined in the national tsunami protocols.

116 In Nicaragua, tsunami information is disseminated by means of 60 automatic sirens to alarm the population on the coast line, radio communication to local authorities and natural leaders on the coast, electronic mail and SMS to national, regional and local authorities and national mass media as radio and television.

117 INETER identifies also distant tsunamigenic events. The seismic activity is monitored by the seismic data centre at INETER (24x7, 2 watch persons). First seismic event characterizations should be available within 5-15 minute for remote events in the Pacific Ocean. Information about a possible tsunami emergency should be declared within 5 minutes after knowing of the tsunami generic event.

118 The known strongest tsunami which affected the Pacific coast of Nicaragua occurred on 1 September 1992, and was caused by a magnitude 7.7 earthquake. It was a slow earthquake with very low seismic intensities. Hundred and seventy (170) persons were killed and there was extended destructions of infrastructure along the entire coast. Maximum run-up heights were nearly 10 metres. In general, the entire Pacific coast had run-up heights of around 3 to 4 metres. Only 20 years later, the 26 August 2012, occurred again a slow earthquake with a magnitude of 7.3 off shore of the Gulf of Fonseca, between Nicaragua and El Salvador. It caused waves which affected with run-up heights of around 5 metres very locally an area in the northern part of the Nicaraguan coast Pacific coast and also an area on the coast of El Salvador. Both areas are very sparsely populated. People were affected but not harmed. The low seismic intensities and the low magnitudes originally computed by INETER and NEIC caused some confusion. As soon PTWC transmitted a corrected magnitude based on distant seismic stations, a tsunami warning was emitted but with an internal procedure transmitting the messages only to military and local administration officials on the coast, the population was not informed. If there had been detected a wave occurrence in a larger settlement a full warning would have been emitted. Tsunami warnings were transmitted to the public the 5 September 2012 due to a magnitude 7.4 earthquake on the Nicoya Peninsula, Costa Rica and a 7.3 earthquake on the Pacific coast of Guatemala. The 13 October 2014, a magnitude 7.2 earthquake led to the emission of a tsunami warning for the Nicaragua Pacific coast.

119 With respect to INETER's Seismic Network, in June 2014, 25 new accelerometer stations were installed around Managua and in larger cities near the Pacific coast of Nicaragua. The seismic network counts now with 88 seismic stations. All stations are digital and are transmitted in real time to the data centre. In 2015, the installation of at least 20 new seismic stations is planned. The number of stations data of which are received in real time from the other Central American countries has considerable increased: 10 from Guatemala, 10 from Honduras, 15 from El Salvador, 50 from Costa Rica, 3 from Panama. INETER has acquired 30 high precision GPS and is planning to use them as permanent GPS stations for volcano and tsunami warning. Some GPS will be used as mobile equipment for a large number of geodetic sites for tectonic and volcanic monitoring. Considerable upgrades of the seismic data acquisition and processing system were carried out in 2014 and 2015. The automatic SeisComP3 system was extended to guarantee redundancy of data processing. The software is now running on new servers.

120 The number of staff being present in the 24x7 shift at INETER was increased to 2 persons. There is a total number of 13 persons working 24x7. In case of an emergency, additional staff rushes to the centre to help with data processing and communication. INETER together with the National University (UNAN) is carrying out, since November 2014, an extensive programme to capacitate scientific personnel in seismology. A number of 30 young geophysicists and electronics/informatics engineers from INETER´s existing

permanent staff, from other institutions, and from a group of temporary contracted young scientists are trained in a postgraduate course on the UNAN. The duration of the course is 9 months with 2 days per week. The professors of the course are doctors in seismology from Nicaragua and Cuba. It is the intention to integrate some the best students of the course in the monitoring and early warning system of INETER. An INETER scientist is studying 2014-2015 in Japan for a Master´s degree on tsunami mitigation. For the period 2015-2016, another two young scientist from INETER will study on seismology and tsunami mitigation in Japan. Additionally, INETER staff participated in capacitation courses of the PTWS and CARIBE-EWS on tsunami warning, and the PTWC Enhanced Products, in Hawaii and Mexico.

121 Nicaragua as the Chair of the Regional Working Group for Central America (WG-CA) took the lead for the improvement of tsunami warning in the region. Three meetings of the WG-CA were organized with the help of IOC. In the Third meeting of the Regional Working Group for Central America, held in Managua, Nicaragua, the 29 and 30 September 2014 (IOC/PTWS-WG-CA-III/3), representatives from all Central American countries of the scientific institutions responsible for tsunami warning and civil protection institutions responsible for mitigation measures decided to support the proposal of Nicaragua to establish at INETER, Nicaragua, a regional Tsunami Warning Centre. Furthermore, they decided to support the proposal of Nicaragua to form a common regional seismic network to aid tsunami warning and other applications for earthquake information and early warning.

122 Panama indicated that this is the first time that Panama is participating with a delegation at a meeting of the ICG/PTWS. It has created a National Tsunami Committee composed of governmental and non-governmental institutions interested in the issue of tsunamis. Panama is very interested in tsunami early warning and mitigation of tsunami effects; therefore, its delegation to this meeting is composed of the Director of the National Civil Protection System, the Director of Hydrometeorology, the Maritime Authority of Panama (AMP), the Director of the Panama Fire Department and the Director of the Institute of Geosciences at the University of Panama. SINAPROC (Sistema Nacional de Protección Civil) created an office in charge of Tsunamis that has to do with community preparedness and evacuation plans in case of Tsunamis.

123 Panama has a network of 11 seismic broadband stations and 50 short period stations that broadcast in real time. Signals are received on 3 records centres, one in the Panama Canal Authority, the second at the University of Panama, and a third one to the West of the country near the border with Costa Rica. Seismic data is shared with networks of Costa Rica and Colombia. SeisComp3 is used for analysis of data and the automatic detection programme. Data from two tide gauge located on the Caribbean coast of the country are available through the IOC Sea Level Monitoring Facility. At the end of May, three new tide gauges will be installed in the Gulf of Chiriqui, to the South West of Panama. The Delegate of Panama indicated the country's willingness to share seismic and sea level data for tsunami warning purposes.

124 Staff of the Institute of Geosciences at the University of Panama has participated in the workshop seminars sponsored by ITIC in Chile, Mexico and Ecuador. As well, in the last two years, Panama has participated in Exercise Pacific Wave 13 (IOC/2013/TS/106 Vol.1 & Vol.2.) and 15 (IOC/2015/TS/117 Vol.1, Vol.2.), and Exercise Caribe Wave/Lantex 14 (IOC/2013/TS/109 Vol.1) and 15 (IOC/2014/TS/118 Vol.1) in the Caribbean.

125 Republic of Korea indicated that it does not have records of tsunamis in the Korean Peninsula, and reported on the installation of one new seismometer and 4 new sea level stations. They expect to install 40 new stations by the end of 2015.

126 Samoa thanked ITIC, PTWC and IOC for the support provided that has enabled tsunami warning capabilities in Samoa. Samoa reported that seismic and sea level as well as siren stations are in operation in the island and awareness and exercises activities take place regularly.

127 The Solomon Islands Joint Tsunami Warning Centre which comprises of the National Disaster Management Office, Solomon Islands Meteorological Service and the Seismology Department acknowledged all the services and assistance provided by the Pacific Tsunami Warning Centre (PTWC/NOAA), the Japanese Meteorological Agency (JMA), the International Tsunami Information Center (ITIC), the Australian Bureau of Meteorology (BoM) and Joint Australian Warning Centre and IOC/UNESCO. It reported that a SOP for Tsunami Early Warning has been developed with technical assistance from BoM, a Threat Analysis Model has been developed and is currently operational with technical assistance provided by BoM and funded by the Department of Foreign Affairs and Trade (DFAT) of the Australian Agency for International Development (Ausaid). Solomon Islands have a continued record of participation at PacWave exercises and an annual National Tsunami Exercise (Aelan Wav). Future activities planned for 2015 and onwards include a Review and finalization of the Tsunami SOP to include the new enhanced products from PTWC and JMA, the review/verification of the performance of the Tsunami Threat Analysis Model, the establishment of an Automated Early Warning Dissemination System, the expansion of seismic Network with establishment of 4 new broadband seismic station, the establishment and formalization of the National Joint Tsunami Warning Centre and the development of a training and awareness programme. Some gaps and challenges ahead are the need for continuous training for Met Service and NDMO officers on tsunamis and the lack of bathymetry data to do proper inundation map especially for populated urban areas.

128 Timor Leste indicated that they have SOP and risk assessment completed with a multi-hazard early warning system that also covers tsunami in place.

129 Vanuatu reported on the post-event assessment of the Panama 6 Mw Earthquake and Tsunami of 20 February 2015. According to eyewitness water receded 8 - 10 minutes after the main shock (eyewitnesses at Cave beach, Liro Nessa) with cobbles rattles then soon after roaring sound. Most people in the village heard roaring sound and the tsunami event involved 3 waves, the first 10-12 minutes after main shock, the second much bigger than the first wave 8-10 minutes after the first wave and the last wave 10 minutes after. Generally, most people headed inland and uphill but in fear of landslides.

130 USA thanked all countries that were able to attend this session of the ICG/PTWS even in the aftermath of national disasters like in the case of Vanuatu. USA continues to support the free and open exchange of information and, in that sense, the high number of observing sensors available to PTWC is very important. That said the importance of maintaining the observing sensors is a matter that continues to be addressed on a permanent basis to secure these systems are always available. USA has make progress on the science side, in particular on the bridge between modelling and forecasting and in that all the credit is with NOAA Pacific Marine Environmental Laboratory (PMEL). On preparedness and awareness, TsunamiReady is amazingly successful, and USA is willing to make this accessible. A very senior representative of the Federal Emergency Management Agency (FEMA) present to this session is a clear indication of the higher importance the Government of USA assigns to the tsunami work including through the international arena. USA thanked to Chairman Ken Gledhill personally and congratulated him for his outstanding leadership

3.8. WORKING GROUP REPORTS

131 Dr Vasily Titov, Chair of the Working Group on Tsunami Risk Assessment and Reduction reported that the Group has not met in the intersessional period. While there are

several initiatives on hazard assessment there is no consensus on the methodologies. The Group should at least look and list all the different methodologies available relying on existing efforts on risk assessment including through the TOWS-WG Inter-ICG Task Team on Hazard Assessment Related to Highest Potential Tsunami Source Areas (meeting planned at IUGG Assembly in June), the National Hazard Assessment efforts: 2nd update on U.S. National Tsunami Hazard Assessment & ASCE maps, the IUGG Working Groups on defining standards and the IOC/AUSAID/SPC/SOPAC Training Web-based Community Model (ComMIT). He recalled that over 60 participants from 13 nations of the South West Pacific participated and were trained and certified on tsunami modelling tools use through the IOC/AUSAID/SPC/SOPAC Training. Dr Titov indicated that ComMIT has cumulated thanks to several trainings an extensive set of grids provided by the participants which covers a big part of the world. He indicated that IOC and ITIC with USAID funding are proposing to develop a pilot project to use ComMIT

132 In response to an inquiry from Australia, Mr Titov indicated that the proposed pilot initiative is also using the experiences of the Indian Ocean Tsunami Warning and Mitigation System (IOTWS), in particular the Risk Assessment Guidelines.

133 Russian Federation indicated that Probabilistic Tsunami Hazard Assessment (PTHA) is very important. It recalled that the International Union of Geodesy and Geophysics (IUGG) initiated in 1990 a Global Seismic Hazard Assessment that produced Global Seismic Maps, which were contradicted by earthquakes that happened while the maps were produced. The lesson to be learnt is that the emphasis should be put in the methodology rather than in the products itself.

134 A brief exchange took place in plenary about the Terms of Reference of the Working Group on Tsunami Risk Assessment and Reduction and of its two Task Teams. There was consensus that the Task Teams under this Working Group have become redundant and that the most important job to be performed by the Working Group is to relate the hazard assessments with the evacuation maps. Mr Coetzee, Chair of the Working Group on Disaster Management and Preparedness, supported this idea and reported that this is being linked with its Working Group.

135 Mr Rick Bailey, Chair of the Working Group on Tsunami Detection, Warning and Dissemination, reported that the Group has not met in the intersessional period. However, all of its Task Teams met and developed a very productive work for the PTWS. He described the existing seismic and sea level monitoring status and gaps, highlighting that although large number of seismic stations is available, some problems with data sharing (including latency) still persist. He indicated that the IOC Sea Level Monitoring Facility has been very effective and has access to more data in real-time than is available on the GTS. He suggested that it would greatly benefit TSPs, who access data via the GTS as primary 24/7 access, if the extra data could also be placed on the GTS by the IOC Sea Level Monitoring Facility. He recalled the TOWS developed indicators of Performance monitoring for Earthquake detection and Threat Assessment. Then he recalled the ToRs, chairmanship and activities of the following Task Teams under this Working Group: Enhancing Products, Warning Dissemination, PacWave 15 and Seismic Data Sharing in the SW Pacific.

136 Recommendations put forward to the ICG/PTWS by the Working Group included its renewal with modified Terms of Reference and greater emphasis on performance monitoring, that the Task Team on Enhancing Products continue for at least one more ICG/PTWS intersessional period with its currently Terms of Reference, that the Task Team on Seismic Data Sharing in the South West Pacific continue for at least one more inter-sessional period with modified Terms of Reference. Also that the Task Team on Warning Dissemination be reconstituted as a Task Team under Working Group 2 on Tsunami Detection, Warning and Dissemination, assisted by ITIC and that each PTWS Regional Working Group designate an

expert from among Members within each region to assist in the work of the Task Team Warning Dissemination, focused on building early warning system capacity in their respective jurisdictions.

137 Japan and Solomon Islands supported the continuation of the Task Team on Enhanced Products.

138 Dr Eddie Bernard (Observer) inquired about the meaning of the Target factor of 2 for Accuracy of tsunami amplitude forecasts, in the listed Threat Assessment Performance monitoring elements. Mr Bailey responded that it relates to the expected performance of TSPs, that the actual amplitude of the measured tsunami cannot be more than twice the forecasted amplitude.

139 Mr David Coetzee, Chair of the Working Group on Disaster Management and Preparedness, recalled the membership of the Working Group and its revised ToRs. Then he reported on the main activities of WG3 including the participation in the TOWS-WG Task Team on Disaster Management, and cooperation with other ICGs including SOP trainings in the Caribbean. He indicated that training and awareness related activities have been consistent with the guidance provided by PTWS. Planned activities for the upcoming inter sessional period are very much aligned with the recommendations of the TOWS-WG Task Teams, and include finalising the SOP manual, consider adoption of a Performance Based Recognition Program, and continued support to Enhanced Products and training including through the ITIC Training Programme (ITP).

140 The most relevant recommendation of the Working Group on Disaster Preparedness that link with the Working Group on Hazard Assessment and Risk Reduction is to develop a PTWS ITIC New Training Course on Essential Tsunami Preparedness: Evacuation plans, Maps and Procedures. Ms Julie Leonard (USA) introduced the proposal. The goal of the course is to produce reliable tsunami evacuation maps working with communities and governmental agencies, linking a series of training workshops on Evacuation Planning, Evacuation Map Development (inundation modelling and map creation), Tsunami Warning & Emergency Response SOPs, and conducting tsunami exercises (including evacuation). The course should be globally applicable, with standardized tools and methodologies and once developed, it should replicate as Train-the-Trainers. The course would be developed under ITIC lead, in collaboration with New Zealand, UNESCO/IOC, PTWS Working Groups and other partners. A Pilot Course using 'real' communities (produce evacuation map) is envisaged in Central America, where after each training delivery; a feedback mechanism to adapt and improve would be put in place. At the end of the process, the intent is to publish an IOC Manual and Guides on Evacuation Plans, Maps, and Procedures.

141 On a final remark, Mr Coetzee recalled that the Steering Committee recommends that after the implementation of the PTWS Enhanced Products the next focus should be on preparedness, which synergises with the call from the 50th Anniversary Symposium to address the balance focus. To that end, according to Mr Coetzee, the Working Group on Disaster Management and Preparedness needs active and enthusiastic participation by Member States, and the right people for the right job.

142 Philippines as well as Samoa supported the proposal for a PTWS ITIC New Training Course on Essential Tsunami Preparedness: Evacuation plans, Maps and Procedures and indicated its readiness to host pilot applications in their countries. Dr Laura Kong (ITIC) indicated that the Indian Ocean Tsunami Information Centre (IOTIC) has also indicated its willingness to host a pilot application in the Indian Ocean. Both Philippines and IOTIC have indicated funding is available to support it.

143 Mr Wilfried Strauch (Nicaragua) on behalf of Ms Angelica Munoz (Nicaragua), Chair of the Regional Working Group on Tsunami Warning and Mitigation System on the Central American Pacific Coast, briefly reported on the background of recent developments of the tsunami early warning systems in Central America. He indicated that only two countries (El Salvador and Nicaragua) have National Tsunami Warning Centres (NTWCs), and Costa Rica in initial phase. He reported that at the Third meeting of the Regional Working Group for Central America, held in Managua, Nicaragua, the 29 and 30 September 2014 (IOC/PTWS-WG-CA-III/3), the Group decided to support the efforts and progress of Nicaragua for the establishment of a Tsunami Warning Center of Central America (CATAC) under the ICG/PTWS and ICG/CARIBE-EWS. The Group also decided to support the proposal of Nicaragua for the establishment of a Regional Seismic Network to improve rapid information on strong earthquakes, tsunami warning support at regional level, enabling the seismic early warning and preparedness in a database. In follow up of this decision, the Group has recently obtained the support from CEPREDENAC and SICA, and is securing support from national relevant scientific institutions towards CATAC.

144 Lt. Nicolas Guzman (Chile) on behalf of Lt. Cmd. Carlos Zuniga (Chile), Chair of the Regional Working Group on Tsunami Warning and Mitigation System in the South East Pacific Region (SRATPS), reported that the Group continues to be very active in terms of data sharing, regular communications tests and also in the area of training through the Diploma “Tsunami in the South American coast of the Pacific Ocean: scientific bases, threat and vulnerability”. In the intersessional period, the Group organised the First Regional Tsunami Warning Exercise using SRATPS platform between the NTWCs of the Southeast Pacific (Chile, Colombia, Ecuador and Peru). As well, the Oceanographic and Hydrographic Service of the Chilean Navy (SHOA) hosted two internships about tsunamis, tide gauges and DART buoys experience, to technicians from Ecuador and Colombia. Other international cooperation activities in the region included a MOU (Memorandum of Understanding) between NDMO´s from Colombia (Unidad Nacional para la Gestión del Riesgo de Desastres, NGRD) and Ecuador (Secretaría Nacional de Gestión de Riesgos), in order to improve the capacities of both countries. The Group recommended continuing with its current Terms of Reference.

145 Ms Filomena Nelson (Samoa), Chair of the Regional Working Group on Tsunami Warning and Mitigation System in the South West Pacific Region, reported on key activities including on risk assessment and reduction, warning detection and dissemination and tsunami awareness and response. On Warning, detection and dissemination she reported that a regional data sharing strategy was recently endorsed by the TT on Seismic Data Sharing in the framework of the Oceania Regional Seismic NETwork (ORSNET). ORSNET is a regional mechanism initiated and led by Vanuatu and New Caledonia with financial assistance by France. Solomon Islands and Samoa recently joined this network while other member states with seismic monitoring capability were encouraged to join this platform. All Pacific Island countries (PICs) have been urged to provide information on their National Seismic Networks including Metadata to the ORSNET Regional Seismic Network, currently hosted at the Institut de Recherche pour le Developpement (IRD) in New Caledonia. PICs are also encouraged to register their seismic network metadata with FDSN (http://www.fdsn.org/forms/netcode_perm.htm).

146 She also reported that sirens activated by radio frequency and phone call have been installed in Samoa, Tonga, Cook Islands and Tokelau. As well, a number of countries have review their SOPs and developed threshold tables with the assistance from the Secretariat of the Pacific Community (SPC) and the New Zealand Ministry of Civil Defence & Emergency Management to guide warning and warning dissemination. She indicated that 18 Member States of the South West Pacific participated in the Exercise Pacific Wave 15 (PacWave 15). Ms Nelson indicated that planned activities include training on operations for Meteorological and Emergency Management staff as well as modernisation of observation infrastructure.

She provided detailed information about the status of Tsunami Warning System at each Member States and informed that the Group may meet again at the Pacific Meteorological Council (PMC) and Ministerial Meeting from 20 to 23 July 2015 hosted by Tonga. Another possible venue for meeting members of the Group would be at the Disaster Reduction Management Platform in mid-2016 most possibly in Suva, Fiji. The Group recommended continuing with its current Terms of Reference.

147 Responding to a question from Australia, Ms Nelson indicated that some countries are looking into joint activities of Disaster Management and Meteorological Services, particularly those that do not have Geohazard units or departments. That is the case for Samoa and Tonga.

148 Mr Hing-yim Mok, Chair of the Regional Working Group on Tsunami Warning and Mitigation System in the South China Sea Region, reported that the Group met twice in the intersessional period, at the Fourth meeting of the Regional Working Group on Tsunami Warning and Mitigation System for the South China Sea Region (ICG/PTWS-WG-SCS/IV) that was held in Jakarta, Indonesia, the 11 and 12 February 2015, and at the Third meeting of the WG-SCS held in Hong Kong, China, the 8 and 9 April 2014 (ICG/PTWS-SCS-WG/III).On Hazard Assessment he reported progress through a survey for the inventory of past papers relevant to tsunamigenic zone identification, tsunami hazard assessment, and paleotsunami surveys that was conducted by IOC and China, and through a review of the past papers that was conducted and presented by China. On Hazard Assessment, the Group decided to organize a Technical/Experts meeting on earthquake and tsunami hazard in the South China Sea Region with the purpose of reviewing the historical earthquakes and tsunamis in the region, and determine potential sources and probability of occurrence of future events for hazard assessment and risk reduction in the South China Sea Region. This meeting will be hosted by China in 2015. On observational systems, an inventory of seismic and sea level monitoring stations in the South China Sea Region was built based on contributions from PTWC, IOC Secretariat and China, showing that the number of sea-level stations in the region has increased. The Group decided in this region to establish a network of seismic and sea level operators, with contact points identified by each of the Member States to coordinate the completion of the list of seismic and sea level monitoring stations available for tsunami monitoring in the South China Sea Region, and to work towards enhancement of coverage and performance of these networks. It also decided to identify the gaps and discuss the prioritization of additional seismic and sea level stations in the region. On the working of the Task Team on the Establishment of the South China Sea Tsunami Advisory Center (SCTAC), he reported that Performance Indicators (PI) of the SCSTAC were proposed and accepted by Working Group, noting some of them are still open. As well, a draft plan on text and graphical tsunami advisory products was proposed and comments from Task Team members were collected. The Task Team will finalize the definition of tsunami advisory products for presenting them to the next Working Group meeting scheduled in the Philippines in 2016. The Group recommended continuing with its current Terms of Reference.

149 China congratulated Mr Mok and expressed that it is pleased to see that the establishment of SCSTAC is becoming a reality. It indicated that JMA and PTWC and ITIC support to the establishment of SCSTAC is welcome. Japan indicated it continues to support the establishment of SCSTAC.

3.9. STATUS OF PROGRESS IN OTHER ICGs

150 Mr Francois Schindele, former Chairman 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), reported on behalf of Dr Ahmet Yalciner, Chair of the ICG/NEAMTWS. He recalled the major tsunamigenic earthquakes in

North-Eastern Atlantic and Mediterranean and described the effects of the most recent generated off Alger in 2003 and impacting in Spain (Baleares), Alger and France. He reported that over 130 sea level stations are reporting data in real time and the number is increasing. Under the ICG/NEAMTWS, seven National Tsunami Warning Centres (NTWCs) have been established, and 5 of them are operating in France, Greece, Italy, Portugal and Turkey, with Israel and Morocco in process. These same five countries are candidate Tsunami Service Providers (France, Greece, Italy, Portugal and Turkey). A series of exercises have been organised by NEAMTWS including Exercise NEAMWave 12 (IOC/2012/TS/103 Vol.1 & Vol.2) with 4 scenarios prepared and disseminated by (IPMA (Portugal), CENALT (France), NOA (Greece) and KOERI (Turkey) and Exercise NEAMWave 14 (IOC/2014/TS/114 Vol.1 & Vol.2) with 4 scenarios prepared and disseminated by the same centres. Mr Schindele indicated that the Tsunami Information Centre for the North-Eastern Atlantic, the Mediterranean and Connected Seas (NEAMTIC) has produced multi-lingual information and educational products, collected good practices on prevention and preparedness and is the repository of ICG/NEAMTWS documents and information.

151 The Russian Federation reminded that in the European region there have been meteo-tsunamis in Croatia and Turkey.

152 Mr Rick Bailey (Australia), former Chairman of the Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System (ICG/IOTWS), reported on behalf of Dr Srinivas Kumar, current Chair of the ICG/IOTWS. He reminded that 10 years have passed from the 2004 Indian Ocean tsunami. At that time, tsunami risk was considered low in the Indian Ocean, there were very limited seismic observations to detect, very limited real-time sea level observations to verify, no tsunami warning system to forecast, no national tsunami warning contact points to inform and the community was unaware and not prepared. Ten years after and following an unprecedented international coordination effort, the region can show now a series of achievement on risk assessment including the development of guidelines, improved sea level and seismic observing systems, and the launching in 2011 of the Interoperable "System of Systems" with Tsunami Service Providers (TSPs) hosted by India, Indonesia and Australia that deliver tsunami threat forecast information via Registered User web sites for National Tsunami Warning Centres (NTWCs) and Tsunami Warning Focal Points (TWFPs) around the Indian Ocean . This system of systems works under the sovereignty principle to avoid conflicting information and to ensure appropriate response. Under this principle: national tsunami warnings should only be issued by the recognised national authority. Other achievements include a dedicated work in the area of public awareness and community preparedness. As well every 6 months a test of communications takes place and wide-basin exercises have taken place in 2009, 2011 and 2014 with the next one scheduled in 2016 that is expected to be coordinated with the Pacific. Mr Bailey provided detailed information about the Key Performance Indicators (KPIs) that help to measure and monitor performance of TSPs. He further reported that an Indian Ocean International Conference to Commemorate 10th Anniversary of the Indian Ocean Tsunami was hosted the 24 and 25 November 2014, in Jakarta, Indonesia. Mr Bailey indicated that we always must be ready for the next tsunami, and for that the challenge is to sustain the achievements, address gaps, and increase the focus on community awareness and preparedness.

153 Ms Christa von Hillebrandt-Andrade, Chair of the ICG/CARIBE-EWS, on behalf of the 48 Member States and Territories and Observer Organizations, congratulated the PTWS on the occasion of its 50th anniversary. She mentioned that the activities and programmes of the PTWS have also helped guide the organization of the CARIBE-EWS. The Caribbean and adjacent regions covers the smallest area of the regional tsunami warning systems but includes 48 Countries and Territories, including 7 Member States in common with PTWS from Mexico to Colombia, for which continued cooperation would be mutually beneficial. Ms Hillebrandt-Andrade recalled that before 2004 the region tried to establish a Tsunami

Warning System, but received very little support. However, after the Indian Ocean tsunami which affected a region that has the same frequency of tsunamis as the Caribbean, the governments of the world recommended the establishment of the Intergovernmental Coordination Group for the Tsunami and other Coastal Hazards Warning System for the Caribbean and Adjacent Regions (ICG/CARIBE-EWS) within the Intergovernmental Oceanographic Commission of UNESCO in 2005.

154 She reported significant advances in seismic, sea level and GPS monitoring supported by regular capacity building actions through remote and in person trainings. She informed the Plenary that the Caribbean will also go through a transition period from the current text products to the enhanced tsunami products of the PTWC. Ms Hillebrandt indicated that the recent Exercise Caribe Wave/Lantex 15 (IOC/2014/TS/118 Vol.1) held the 25 March 2015, which had for the first time a participation rate of 100% of the Member States and Territories, involved over 200,000 participants. She also highlighted the fact that the ICG/CARIBE-EWS is developing a Performance Based Community Recognition Programme modelled after TsunamiReady™. The U.S. TsunamiReady™ combined with an international Pilot Recognition Programme organized in the framework of the ICG/CARIBE-EWS has recognized 49 coastal communities for their commitment to preparedness, mitigation and response. Ms Hillebrandt-Andrade recommended that the PTWS and CARIBE-EWS continue to collaborate in areas of joint interest, especially where there are common Member States for optimization and strengthening of the regional and global tsunami warning system.

155 In response to a question from the Russian Federation Ms Hillebrandt-Andrade indicated that that the accuracy of the fatalities accounted for tsunamis in the Caribbean is based on data from the U.S. National Centers for Environmental Information (NCEI, former NGDC), which is not fully accurate for the Caribbean but is the only available data.

3.10. REPORTS FROM UN AND NON UN ORGANIZATIONS

156 Dr Rhett Butler, Director of the Hawaii Institute of Geophysics and Planetology (HIGP), reported that from 2011 a Joint Task Force (JTF) of three United Nations agencies — the International Telecommunication Union (ITU), the World Meteorological Organization (WMO), and the Intergovernmental Oceanographic Commission of UNESCO (UNESCO/IOC) — in collaboration with the telecommunications industry, governments and the international scientific community have pursued a course to integrate scientific sensors into new, SMART SubSea Cable Systems. Industry is already beginning to progress towards the JTF's goal, with press releases announcing the potential integration of sensor systems into new commercial cable systems in their planning stages.

157 The scientific and societal reasons for the project are compelling. Tsunamis have the potential to threaten many of the world's coastal communities within minutes or hours of a large seismic event. Reliable, robust tsunami-warning systems will save lives and property. A relatively straightforward complement of instrumentation — accelerometers, high-resolution pressure gauges, thermometers — will answer many of the basic science and societal needs as well as provide for the monitoring of the physical state-of-health of the cable system itself. Technological advances have made it possible to integrate basic sensors with repeaters on submarine telecommunication cables at intervals of about 50-70 km. The JTF strongly endorses the SMART cable concept and welcomes participation to ensure that humanity benefits from its realization. The science and societal case for the benefits of SMART cables is posted at ITU: www.itu.int/en/ITU-T/climatechange/task-force-sc/

158 Mr Butler recommended the recognition and endorsement of the SMART Subsea Cable Systems Initiative and a proactive action of nations to approach the World Bank to fund development of capabilities in this area.

159 In response to an inquiry from USA, Mr Butler indicated that the cost of the project is in the order of USD 15 Million.

160 Dr Walter Mooney from USGS/NEIC provided a report on the activities and history of the U.S. Geological Survey National Earthquake Information Center (NEIC). He indicated that due to the evolving need for post-earthquake information products the seismology community has moved from a response on a timescale of hours to days, to hours and then one of minutes. To do this, it had to both improve the quality and speed of the products it was already generating, and also internalize many of the products that were previously generated by the academic community. This gives NEIC the ability to provide a complete situational awareness to those groups that respond to earthquakes directly, who put boots on the ground in an affected region and need to know, quickly, what tools they need and where they will be most effective. With the example of the northern Chile seismic gap, he detailed the variety of tools in the seismologists toolbox that they can use to address these questions including Earthquake Relocations (to reveal detailed relative relationships), Finite Fault Modelling (source processes of largest events), Regional Moment Tensors (faulting mechanisms of aftershocks) and Coulomb Stress Transfer analyses (How EQs respond to stress loading - and what hazard remains). He indicated that given that significant sections of the northern Chile subduction zone have not ruptured in almost 150 years, it is likely that future megathrust earthquakes will occur south and potentially north of the 2014 Iquique sequence.

161 Ms Paula Dunbar from the NOAA National Centers for Environmental Information (NOAA/NCEI) indicated that the NCEI, formerly the National Geophysical Data Center (NGDC), and co-located World Data Service (WDS) for Geophysics continue to provide archive, data management, and access to global tsunami data including global tsunami event data, damage photos, raw and processed water Level data from NOAA observational networks, and development of digital elevation models (DEMs). NCEI now provides online event summaries for recent significant tsunami events that provide easy access to all the data related to a tsunami.

162 Ms Katrin Hafner, GSN Programme Manager reported on the Global Seismographic Network (GSN). The Global Seismographic Network (GSN) is a 153 station global network of state-of-the-art seismic observatories distributed worldwide and operated by the Incorporated Research Institutions for Seismology (IRIS) and the U.S. Geological Survey (USGS), with funding from the National Science Foundation (NSF) and the USGS. The GSN has operated since 1988 and provides valuable long-term observations of Earth processes as well as observations of infrequent but exceptional events such as great earthquakes. This network is designed to provide robust, uniform, high-quality, very broadband, high-dynamic-range recording. The stations have very broadband instruments that record from a period of many thousands of seconds up to at least 20 Hz, and use a combination of very high gain (weak motion) and low gain (strong motion) sensors to record on scale over a wide range of shaking. Continuous data are delivered in real time and the data are archived with their metadata.

163 The GSN plays a vital role in tsunami warning. Tsunami warning Centres (TWC's) base their initial warning strictly on seismic data analysis because seismic waves propagate over 20 times faster than a tsunami travels. High quality recordings of earthquakes provide early warning and location, and can be used to characterize the tsunamigenic potential of the event. The National Tsunami Warning Centre uses a large number of GSN stations in its real-time analyses. Out of 652 stations, it uses 65 USGS and 36 IRIS stations. GSN stations are important in these analyses, as they provide coverage where data from other networks are sparse, particularly in oceanic regions.

164 The IRIS DMC archives continuous seismological waveforms and other data for 150 GSN stations, USGS networks, 66 networks of the International Federation of Digital Seismograph Networks (FDSN) and 39 non-FDSN international networks. Data archived at the DMC are freely and openly accessible to all at:

http://ds.iris.edu/ds/nodes/dmc/data/types/waveform-data/. Contributions of waveform data (in SEED format) from newly installed broadband stations are encouraged.

165 Dr Jerome Aucan (France) on behalf of Dr Mark Merrifield, Director of the University of Hawaii Sea Level Center (UHSLC), provided a report on the contributions of UHSLC to the PTWS sea level observing network. He recalled that UHSLC has collaborated with PTWC on real-time water level stations in the Pacific since the early 1980s. Currently UHSLC assists with operations and maintenance of ~80 stations globally, 30 stations in the Pacific, and maintains data archive of high frequency data from UHSLC stations. It also supports water level stations capable of monitoring sea level (GLOSS programme) as well as tsunami monitoring. He reported that 1 minute data averages are transmitted at 5 minute intervals, except for the stations of Christmas, Kanton, Manila, Davao and Hiva O'a (15 min intervals), and Legaspi (12 min), using satellites (GOES W, GOES E, JMA, MET 7) and has recently obtained the approval from JMA for 5 minute intervals. He indicated that there are upgrades planned at Manila, Davao, and Legaspi.

4. POLICY MATTERS

4.1. IMPLEMENTATION REPORT OF PTWC ENHANCED PRODUCTS FOR PTWS

166 The Chairman, Ken Gledhill, introduced this agenda item by recalling that through Recommendation ICG/PTWS-XXIII.1 a Task Team on Enhancing Tsunami Warning Products was established, under the Chairmanship of Dr Charles McCreery, and that after its guidance and his leadership, and with the ITIC-led training, the PTWC enhanced products for PTWS are operational from 1 October 2014. He requested Dr McCreery to present his report.

167 Dr McCreery gave his report on the status of the enhanced products for the PTWS. He noted that the new products had been implemented the 1 October 2014, fully replacing the former products. Since that time, Tsunami Information Statements had been issued for 19 events and Tsunami Threat Messages had been issued for 3 events. He also described some suggested changes to the new products that had been received from Member States based on this early experience.

168 In the initial public threat message that is not based upon a numerical forecast, countries having coasts within a certain distance of the earthquake epicentre are advised of a potential tsunami threat. For reference, estimated tsunami arrival times are listed for places within 6 hours tsunami travel time even if they are not in the potential threat area. Several Member States had said this information had been misunderstood by some as meaning those places also had a potential threat. The Group agreed that estimated arrival times should only be given in the public message for areas initially named with a potential threat.

169 An initial numerical tsunami forecast is produced by PTWC about 20-30 minutes after the earthquake based upon a determination of the earthquake's focal mechanism. For speed, this initial forecast is not made for the entire Pacific but is limited to only a small region around the epicentre. PTWC's initial forecast products are then issued based on this first forecast for nearby areas. A slower but much wider forecast is then made, and an updated set of products issued. In the public message for both sets of products, areas with forecast amplitudes less than 0.3 m are listed. For smaller events, this list might include all

Member States except the one or two places close to the epicentre with a higher-level threat. While this small-wave category was intended to show that those areas had no significant threat, several Member States noted that it had been misinterpreted to mean all those places might have up to a 0.3 m-amplitude tsunami that was a threat. The Group agreed that this amplitude category should be eliminated in the public message and be replaced with appropriate language indicating that all other areas have no tsunami threat.

170 The PTWC Director also pointed out a few changes to the enhanced products and procedures that had been made unilaterally by PTWC since the last ICG to remedy issues that had come to light as the products were fielded. One was that the initial numerical forecast, instead of being made for the entire Pacific, is now made only for the region immediately surrounding the earthquake. This forecast and its set of products can be produced about 15 minutes sooner than ones for the whole Pacific. Since the nearest places are where impacts are soonest and largest, it is critical to get forecast information to them as quickly as possible rather than wait for the basin-wide forecast to complete. Another change was the production of 12 regional coastal amplitude forecast maps to accompany the Pacific-wide map. These regional maps make it possible to more easily and quickly see particular coasts and their forecast values in greater detail. Lastly, email distribution of the enhanced products is now being done using a commercial service. PTWC's own email server proved to be too slow in sending out the large-size emails to multiple addresses.

171 Dr McCreery indicated that the User's guide for the Pacific Tsunami Warning Center: enhanced products for the Pacific Tsunami Warning System (IOC/2013/TS/105 Rev.3) would need to be updated to take into account the changes above that are already implemented. On the way forward, he suggested that Member States review the feedback on Enhanced Products received after the Exercise PacWave 15 and through the Task Team on Enhancing Products the need for further changes and improvements is reported to the ICG.

172 Australia, Cook Islands, Chile, Federated States of Micronesia, France, Mexico, Philippines, Samoa, USA and Mr Rajendra Prasad (Secretariat) intervened under this agenda item.

173 The ICG **confirmed** that the mechanism to address proposed changes to the PTWC Enhanced Products for PTWS is the inter-sessional Task Team on Enhancing Products and **reaffirmed** that any change to the products should be informed by Circular Letter to all Member States three months in advance of implementing the changes.

174 The ICG **decided** that to avoid misunderstandings the words "No threat" should be indicated for all countries with inundation below 0.3 metres, and the list of countries falling under this category should be removed from the message.

175 While a discussion over the issue of public versus not public messages took place the **ICG agreed** to review it again at the next ICG.

4.2. ICG/PTWS IMPLEMENTATION PLAN AND FUNDING STRATEGY

176 The Chair will recall Recommendation ICG/PTWS-XXIV.1 that requested the Steering Committee to Develop a Strategy for funding PTWS activities. He also recalled that a revised version of the Implementation Plan has not been published from the last session.

177 Rick Bailey (Australia), Chair of the Sessional Working Group on Implementation Plan, Funding Strategy, and the Future, reported that the Implementation Plan has not been updated for some time, without major consequence.

178 The Group suggested to replace the Implementation Plan with a PTWS Status Report at each ICG compiled with input from all Working Groups, including information from National Reports providing required information and include also performance measured against ICG agreed performance indicators/targets

179 The Group suggested as well that ICG Decisions, Recommendations, Requests, and Action Plans for all ICG Working Groups and Task Teams do address any issues, gaps and identified enhancements, including implementation needs.

180 The **ICG approved** Recommendation ICG/PTWS-XXVI.1

4.3. ENHANCING PTWS
TSUNAMI WARNING PRODUCTS

181 The Chair introduced this agenda item by recalling that through Recommendation ICG/PTWS-XXIII.1 a Task Team on Enhancing Tsunami Warning Products was established, under the Chairship of Dr Charles McCreery, PTWC Director, and later renamed to a Task Team on Enhanced Products.

182 Chair Dr Gledhill recalled that in the pursuit of improving PTWS tsunami warning products, Japan announced at the 47th Session of IOC Executive Council (IOC/EC-XLVII) held from 1 to 4 July 2014, Paris, France, that the Northwest Pacific Tsunami Advisory Centre (NWPTAC) would also be preparing new products based on the requirements of the recipient countries. Following this announcement, during the Fourth meeting of the PTWS Steering Committee (SC) held Honolulu, United States, the 10 and 11 July 2014, it was discussed a proposed timeline for the NWPTAC to develop and introduce Enhanced NWPTAC Products, targeting 2018 for its complete transition.

183 Mr Tomoaki Ozaki (Japan), on behalf of the Task Team on Enhanced Products, introduced a proposal to the ICG/PTWS on NWPTAC Enhanced Products for PTWS that is attached in full under ANNEX IV.

184 Australia and Philippines intervened under this agenda item. Australia indicated that this is again a tremendous improvement for the PTWS that is proposed by NWPTAC. It suggested that the evaluation process is as comprehensive as possible, including the results of the national warning centres. Philippines requested additional forecast points for its territory.

185 France intervened under this agenda item to showcase a new operational method for estimating tsunami height that uses a modified Green's law. This method is very rapid (# 5 minutes) because the tsunami modelling is computed only in deep ocean, and it does not use nested grids for propagation the tsunami from deep sea to the shore; thus instead of this last step, a transfer function (the modified Green's law) is applied to calculate the tsunami amplitude near the shore.

186 Basically, the seismic source parameters are calculated using the PDFM2 method (Clément & Reymond, 2014) and the WPHASE method. Both methods are executed over the SEISCOMP system, which is the main engine of detection, and acquisition in real time of the seismic data. Both methods provide two independent estimations of the seismic moment tensors and focal geometry in 30 minutes (for WPHASE) and 45 minutes (for PDFM2), and the worst case scenario is retained for safety reasons.

187 Once the seismic sources parameters are determined, the numerical modelling of the tsunami in deep ocean are executed; this last process only takes about 5 minutes of computation time. After that, the distribution of the maximum amplitudes near the shore are

calculated from the tsunami amplitudes in deep ocean using a modified Green's law (Jamelot & Reymond, 2015), inspired from the original work of (Reymond et al., 2012):

$$x_1 = x_2 \, (H_2/H_1)^{(1/4)} \, [1 + \alpha \, (H_{MAX} - H_1)/H_{MAX}]$$

with: HMAX = 50 m, H1 ≤ 5m

H2 and H1 are the depth in deep ocean, and close to the shore respectively.

x2 and x1 are the amplitudes (zero- crest) in deep ocean, and the shore respectively.

188 In this relation, the α coefficient is estimated to have the best fit between the tsunamis amplitudes recorded and the calculated ones.

189 Notice that this method will not take into account the particular case of resonance effects of a bay or a harbour that depends on the period of the tsunami, because the period of tsunami is ignored.

190 The results obtained with the MERIT method using a dataset of 22 tsunamis recorded during the last 22 years, give an accurate estimation of the tsunami amplitude within a factor 2.

191 It is presently applied operationally in the tsunami warning centre of French Polynesia for estimating the level of warning in function of the tsunami height expected (instead of a threshold of magnitude).

192 USA thanked France for the excellent work and indicated that this could be used to improve the current PTWC products. PTWC indicated that they will start collaborations with the team of Papeete (France), in the framework of the WG2 Task Team on Enhanced Products.

193 The ICG **approved** the continuity of the PTWC Enhanced Products for PTWS.

194 The ICG **agreed** that NWPTAC should proceed with its development of enhanced products for the North West Pacific.

195 The ICG **further agreed** to continue the Task Team on Enhanced Products under the Working Group on Tsunami Detection, Warning and Dissemination, to guide and provide feedback to NWPTAC regarding the enhanced products and requested the Task Team to provide a report on the recommendations and any implementations at ICG/PTWS-XXVII.

196 The **ICG also agreed** that any new products only be exercised in an experimental mode as they are developed and until they are approved for official use later by the ICG.

4.4. REPORT OF EXERCISE PACIFIC WAVE 15

197 The Chairman requested Ms Jo Guard (New Zealand), Co-Chair of the PacWave 15 Task Team to present its report.

198 Ms Guard referred to document IOC Technical Series, 117 and reported that the Exercise Pacific Wave 15 (PacWave 15) is the fifth Pacific-wide drill in a regular schedule of Pacific exercises. PacWave 15 evaluated the new enhanced tsunami products of the Pacific Tsunami Warning Centre (PTWC), which started the 1 October 2014.

199 The new enhanced products provide guidance on the levels of threat along coastal segments using real-time tsunami wave forecasts, and are expected to greatly reduce the number of areas that have previously been unnecessarily warned.

200 A total of 41 countries (including six sub-national entities) participated in the exercise. A strong majority of responding countries expressed a positive view of the planning and conduct of PacWave 15. Exercise objectives were exercised, evaluated and reported, thus enabling PTWS recommendations and lessons learned to be formulated. PacWave 15 provided valuable feedback from countries on the newly introduced PTWC enhanced products. PacWave 15 reinforced the integration of PTWC enhanced products in their country decision-making processes, and in their Standard Operating Procedures (SOPs).

201 Countries overwhelmingly found the new procedures and forecast products timely, clear and useful. Countries generally understood the PTWC enhanced products and viewed them as adding important advice to guide them in providing more accurate national warnings. The text product was viewed as the most useful enhanced product.

202 Although all countries have now implemented the Enhanced Products into their national processes and procedures, there is still a need for continued training and exercising. Indications of improvements to the new products were seen as development in country technological abilities.

203 The findings from PacWave 15 are as follows:

- An overwhelming majority of respondents ranked the text message as the most useful product, followed by the forecast polygon map. Moderately useful products were the coastal amplitude forecast map, energy forecast map, and forecast polygon table. The coastal KMZ file was ranked the least useful product.

- The majority of respondents agreed that the format and content of PTWC enhanced products were clear and easy to understand. Some suggestions for improvements were made.

- The majority of respondents indicated the National Tsunami Warning Centres (NTWCs) and National Disaster Management Offices (NDMOs) understand the content of the enhanced products.

- The majority of respondents indicated the information in the enhanced products, in particular the earthquake parameters, estimated arrival times and forecast wave amplitudes, assisted with their decision-making.

- The majority of respondents indicated that the current resolution quality of the graphical products in acceptable, but acknowledged that the resolution of these products is poor when zoomed in. The majority of respondents also indicated that they would have the internet bandwidth to receive higher resolution images, but some would have to request the provision of greater internet bandwidth for this.

- All respondents indicated that the NTWC/NDMO knows its specific response role in the event of a tsunami and the majority of respondents agreed that the NTWC/NDMO has an activation and response process in place for when tsunami warnings are received.

- The majority of respondents used national tsunami experts to help assess the tsunami threat messages received. Most of the respondents had arrangements in place to assemble these experts before the exercise.

- Half of respondents indicated that tsunami-related curriculum programmes are in place of all levels of education. The comments revealed that many respondents did have some programmes in place, though not for all educational levels.

- Overall, respondents indicated that stakeholder agencies now have a better understanding of their goals, responsibilities and roles in tsunami emergencies.

204 The following recommendations are made:

- Tsunami Warning Focal Point (TWFP) contact information needs to be 100% accurate, 100% of the time. Reference action is made to IOC Circular Letter 2563 "Updating information on National Tsunami Warning Centres (NTWC) and Tsunami Warning Focal Points (TWFP) for the PTWS region according to new definitions"

- Countries need sufficient time to fully prepare for the PacWave exercises. The IOC should announce future PacWave activities at least six months prior to the exercise, and distribute the exercise manual at least three months prior. Tsunami Service Providers should make available tsunami products at least one month prior to the exercise.

- Thirty-five percent of responding countries do not have tsunami evacuation maps, hampering a community to plan for response. Preparedness efforts should be supported at highest priority. All at-risk communities should have evacuation maps.

- Thirty-five percent of the responding countries do not conduct routine tsunami exercises, relying upon IOC PacWave Exercises that occur every two years. Effective response readiness requires more frequent exercises. Countries are encouraged to conduct annual tsunami exercises, starting with small, controllable coastal school drills.

- Past PacWave exercises have been conducted in controlled, moderately-paced timelines as Table Top exercises. Many countries are ready to exercise realistic responses. Future exercises should be conducted in real time, initially during daytime working hours with full staffing during normal duty hours, and later, simulating the presence of minimal staff during night-time or weekend hours.

205 Ms Guard then reported on the recommendations of the sessional Working Group on PacWave. The Group recommended conducting two exercises in the intersessional period, in 2016 and in 2017, with the objective of providing enough opportunities to test the NWPTAC Enhanced Products prior to implementation. They suggested holding:

- PacWave 16 as a regional exercise for the 16 countries that receive NWPTAC products, with a format of Table-top exercise recommended.

- PacWave 17, as a Pacific-wide exercise with all PTWS Member States, encouraging additional activities over and above Table-top exercise.

206 The Group also suggested that the Exercise, Symposium and ICG meeting take place at dates to be set in advance to assist with country planning, and provide sufficient time for reporting. They suggested organizing both PacWave 16 and PacWave 17 in the month of February.

207 Australia, Colombia, Mexico, Philippines, Samoa and the Chair ICG/CARIBE-EWS, Ms Hillebrandt Andrade, intervened under this agenda item, to congratulate the Task Team for its work, to support the recommendations on 6 months in advance notice of the exercises,

minimum three months in advance for distribution of the Manual and sub-regional coordination of the exercises.

4.5. CENTRAL AMERICA TSUNAMI WARNING CENTRE (CATAC)

208 Dr Gledhill reported that within the framework of the Regional Working Group on Tsunami Warning and Mitigation System on the Central American Pacific Coast, its Member States have conducted consultations over a proposal of Nicaragua to establish and host a Central America Tsunami Warning Centre (CATAC).

209 Mr Wilfried Strauch (Nicaragua) reported that Nicaragua has offered to host CATAC and has consulted with a number of institutions in the Central America region including with Civil Protection organizations and with Seismic and Geophysical centres of the region. He indicated that a Draft recommendation was presented to them and approved for forwarding to the Twenty-sixth session of the ICG/PTWS.

210 A sessional Working Group on Central America–Pacific Coast chaired by Mr Wilfried Strauch (Nicaragua) discussed the proposal, including several technical details and agreed to forward the recommendation to the Plenary.

211 Mexico, Panama and Honduras expressed support for the proposal and indicated that CATAC should contribute to improve the sharing of information among the countries of Central America and should help to improve the forecast capabilities of PTWC. Honduras indicated that the exchange of data with Mexico and also with Ecuador could also be improved through CATAC.

212 In response to queries from the Chair Dr Gledhill and from USA, Mr Strauch (Nicaragua) indicated that the exact way of operation of CATAC still needs to be defined. It should however fit into the ICG/PTWS framework with special attention to Central America, by developing faster products if possible. CATAC will supply its messages in Spanish and will deliver messages to both national scientific and technical organisations as well as Civil Defence agencies.

213 The **ICG approved** Recommendation ICG/PTWS-XXVI.2

4.6. PRIORITIES FOR NEXT FIVE YEARS

214 Dr Ken Gledhill indicated that following the introduction of PTWC Enhanced Products for PTWS in 2014, and with the proposed NWPTAC timeline for the introduction of NWPTAC enhanced products for PTWS in 2018, there is already a clear priority for PTWS in that area. Furthermore, with the improved usefulness of the products, Member States are encouraged to prioritise preparedness as high priority, and especially for all hazard-prone communities to have tsunami evacuation maps. Other priorities are the more effective engagement with PTWS of the emergency management community, and that advances in science and the availability of the Enhanced Products lead to better life-safety outcomes.

215 The Chairman also recalled the report under agenda item 3.3 on the outcomes of the International Symposium *Making the Pacific Ready for the Tsunami Threat*, held the 20 and 21 April 2015, that had the goal of identifying practical and tangible next steps, desirable partnerships, and necessary commitments needed to sustain and evolve the PTWS for the future.

216 Rick Bailey (Australia), Chair of the Sessional Working Group on The Future, Implementation Plan and Budget reported under this agenda item. He indicated that the

sessional group recommended an initial planning horizon of 4 years, i.e. two intersessional periods, which should use indicators expressed as a number of Member State (MS) and PTWS goals, including targets. It further recommended that all goals and targets are for coastal communities at risk of a tsunami threat and those goals and targets may vary for Member States and communities depending on the Local or Distant Tsunami threats. Further, goals and targets should be mapped to inform the WCDRR Sendai Framework 2015-2030 and associated national commitments.

217 Mr Bailey indicated that the proposal of the Group is to review and report progress against targets at next ICG/PTWS-XXVII meeting, revising targets as appropriate for the following intersessional period, and reporting to ICG/PTWS-XXVII.

218 The Group further suggested that the ICG/PTWS organises its work on a 50/50 effort between: a) warning systems; and b) awareness/preparedness. That Regional Disaster Management representatives are invited as observers to ICG/PTWS Steering Committee, and relevant WGs and TTs and that joint Working Groups and meetings with other regional organizations/programmes are organised as appropriate (e.g. SPREP). It also recommended that the ICG and Member States consider reporting against targets defined in the UN-WCDRR Sendai Framework for 2015-2030.

219 The sessional group proposed some goals and targets in the area of Preparedness, Awareness and Threat Information.

220 New Zealand and Samoa intervened under this agenda item to comment on the proposed mechanism and goals.

221 The ICG **agreed** that PTWS organizes its effort on a more balanced report between warning systems, awareness and preparedness, and risk assessment, aligning its reporting against targets of the UN-WCDRR Sendai Framework for 2015–2030.

222 The ICG **also agreed** that joint Working Groups and meetings with other regional organizations and programmes are organized as appropriate including with the Secretariat of the Pacific Regional Environment Programme (SPREP), Coordination Centre for the Prevention of Natural Disasters in Central America (CEPREDENAC) and others.

223 The ICG **decided** to constitute, under the Steering Committee, a Task Team to look into performance monitoring measures for TSPs, NTWCs and overall national PTWS warning systems starting from the PTWS Medium-term Strategy (IOC/2013/TS/108) established goals.

224 The ICG **further decided** to hold mid-session joint meeting of Working Groups, Task Teams and the Steering Committee and to have four days ICG/PTWS sessions to allow sufficient time for discussion and decisions.

5. PROGRAMME AND BUDGET FOR 2016–2017

225 This agenda item was only informational. On behalf of the Secretariat, Mr Bernardo Aliaga, Technical Secretary of the ICG/PTWS, reported on the resources assigned from the UNESCO regular budget to the work of the Tsunami Unit of the IOC. He indicated that for the biennium 2016-2017 a slight increase in the regular budget may also impact positively in the resources available for the ICG/PTWS.

6. NEXT SESSION

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

226 The Chair invited interventions from Member States on the subject.

227 France expressed that is considering organising the next session in 2017 in Tahiti. Considering the season occupation of hotels France proposes to host the Twenty-seventh session of the ICG/PTWS in September/October 2017.

228 Panama proposed also to host the next session, which will also celebrate the expansion of the Panama Channel. The representative of Panama indicated that formal notes from highest level would be sent to the Secretariat shortly.

229 The ICG **agreed** to request the Secretariat to follow up with France and Panama their offers to host the Twenty-seventh session of the ICG/PTWS, and help the Steering Committee to take a decision on this matter.

6.2. TARGET DATE FOR ICG/PTWS-XXVIII

230 The **ICG decided** to schedule its Twenty-eighth session in 2019.

7. ELECTIONS OF OFFICERS

231 The Chair handed over this part of the Meeting to the Chair of the Elections Commission, Mr David Coetzee (New Zealand).

232 Mr Coetzee recalled that the Election of Officers of the ICG/PTWS was announced with the Invitation in Circular Letter 2566 providing the required forms. Open for nominations were the positions of one Chair and three Vice-Chairs. The deadline for nominations was set in Circular Letter 2566 and confirmed in the adopted Annotated Agenda as Wednesday, 22 April 2015, at 5 p.m. local time Hawaii. Nominations were received by the Secretariat before the deadline for all open Officers positions. Each nomination was duly dated, timed and signed by the Secretariat.

233 The Elections Committee, composed of China, Colombia, France, Japan and New Zealand, chaired by Mr David Coetzee, met on Thursday, 23 April at 08:30. It duly scrutinized the nomination papers. Two nominations were received for the position of Chair and three nominations were received for the Vice-Chair positions. On inspection, one of the nomination forms for Chair was found to be incomplete. Upon explanation by the Secretariat it was understood this was due to a misunderstanding that occurred in the process of seconding. The Elections Committee deliberated and decided that as the error could not wholly be ascribed to the nominating country, and recommended to the ICG/PTWS Plenary that nominations should be re-opened for a limited time window on Thursday 23 April 2015. The ICG/PTWS agreed to this recommendation, and on closing of the nomination window, the Elections Committee again scrutinized all nominations received by the Secretariat. At this point, the Election Committee was informed by the Secretariat that one nomination for the position of chair had been withdrawn. The remaining nominations were considered complete, correct and in the required form and format.

234 The remaining nominations were one nomination for Chair and three nominations for Vice-Chair.

235 The Elections Committee noted that at ICG/PTWS-XXV the Chair of the ICG/PTWS was requested to comment to ICG/PTWS-XXVI, in his report on the success or otherwise of

the experiment to elect three Vice-Chairs, and that the Chair of ICG/PTWS-XXVI subsequently suggested in his report that the number of Vice-Chairs should return to two, as per the ICG's Terms of Reference (ToRs). However, the Committee also noted that IOC Circular Letter 2566 invited for nominations for three Vice-Chairs. The Elections Committee therefore recommends that the invitation for nominations for three Vice-Chairs as indicated in Circular Letter 2566 be honoured for the next inter-sessional period, **and that the ICG returns to two Vice-Chairs at its next session** (ICG/PTWS-XXVII), recognizing the current Chair's recommendation.

236 Against the above recommendation, the Elections Committee reports that there is only one nominee for each position and therefore there is no need for voting to take place.

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

- Chair: Ms Filomena Nelson (Samoa)
- Vice-Chair: Mr Tomoaki Ozaki (Japan)
- Vice-Chair: Mr Rick Bailey (Australia)
- Vice-Chair: Dr Tatiana Ivelskya (Russian Federation)

8. RECOMMITMENT TO PTWS: SHORT STATEMENTS FROM MEMBER STATES

238 Dr Gledhill recalled that in its message to the International Symposium commemorating the 50th Anniversary of the PTWS *Making the Pacific Ready for the Tsunami Threat*, the IOC Executive Secretary, Vladimir Ryabinin, recalled that successful work with governments is necessary to make sure that this system is sustained into the future. Mindful of this the Steering Committee suggested that under this agenda item Member States have an opportunity to reaffirm its commitment with the PTWS.

239 Vice-Chair Rear Admiral Patricio Carrasco (Chile) expressed that the Steering Committee discussed this matter and Chile in particular was keen in seeing a reconfirmation of the Member States to the system. He indicated that in the modern world the membership to a given service is usually paid. This is completely exceptional that a system like the PTWS with the very high level of products and services provided is on free subscription.

240 Cook Islands, Chile, New Zealand, Samoa, Solomon Islands and the United States of America intervened under this agenda item.

241 The **ICG agreed** that Member States be requested to reaffirm their commitment to enable the continued maintenance and enhancement of the PTWS.

242 The **ICG approved** Recommendation ICG/PTWS-XXVI.3.

9. ANY OTHER BUSINESS

243 No other business was discussed.

10. ADOPTION OF DECISIONS AND RECOMMENDATIONS

244 The ICG debated in Plenary and approved three recommendations as included under ANNEX II

11. CLOSURE

245 The session was closed at 6 pm on 22 April 2015.

ANNEX I

PROVISIONAL AGENDA

1. WELCOME AND OPENING OF SESSION

2. ORGANIZATION OF THE SESSION

2.1 ADOPTION OF AGENDA

2.2 DESIGNATION OF THE RAPPORTEUR

2.3 CONDUCT OF THE SESSION, TIMETABLE AND DOCUMENTATION

3. REPORT ON INTERSESSIONAL ACTIVITIES

3.1 CHAIRMAN'S REPORT

3.2 SECRETARIAT REPORT

3.3 REPORT FROM SYMPOSIUM: MAKING THE PACIFIC READY FOR THE TSUNAMI THREAT

3.4 WARNING & ADVISORY SERVICES REPORT

3.4.1 PTWC

3.4.2 NWPTAC

3.5 ITIC'S REPORT

3.6 NATIONAL PROGRESS REPORTS

3.7 WORKING GROUP REPORTS

3.8 STATUS OF PROGRESS IN OTHER ICGs

3.9 REPORTS FROM UN AND NON UN ORGANISATIONS

4. POLICY MATTERS

4.1 IMPLEMENTATION REPORT OF PTWC ENHANCED PRODUCTS FOR PTWS (Recommendation PTWS XXV.2)

4.2 ICG/PTWS IMPLEMENTATION PLAN AND FUNDING STRATEGY

4.3 ENHANCING PTWS TSUNAMI WARNING PRODUCTS

4.4 REPORT OF PACIFIC WAVE EXERCISE 2015 `
(Recommendation PTWS XXV.1)

4.5 CENTRAL AMERICA TSUNAMI WARNING CENTRE (CATAC)

4.6 PRIORITIES FOR NEXT FIVE YEARS

5. PROGRAMME AND BUDGET FOR 2016–2017

6. NEXT SESSION

6.1 CONFIRMATION OF DATE AND PLACE OF ICG/PTWS-XXVII

6.2 TARGET DATE FOR ICG/PTWS-XXVIII

7. ELECTIONS OF OFFICERS

8. RECOMMITMENT TO PTWS: SHORT STATEMENTS FROM MEMBER STATES

9. ANY OTHER BUSINESS

10. ADOPTION OF DECISIONS AND RECOMMENDATIONS

11. CLOSURE

ANNEX II

ADOPTED RECOMMENDATIONS

Recommendation ICG/PTWS-XXVI.1

ICG/PTWS Governance

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

Noting and **considering** the outcomes of the International Tsunami Symposium Commemorating the 50th Anniversary of the Pacific Tsunami Warning and Mitigation System "Making the Pacific Ready for the Tsunami Threat" (20–21, April 2015, Honolulu, Hawaii, USA),

Expresses gratitude to NOAA, IUGG and IOC of UNESCO for re-vitalising the partnership between the scientific community, emergency managers and operational tsunami warning centres;

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

Reaffirming that the Pacific Tsunami Warning and Mitigation System (PTWS) will be a coordinated network of national systems and capacities, and will be part of a global network of early-warning systems for all ocean-related hazards,

Notes the outcomes from the Third United Nations World Conference on Disaster Risk Reduction Risk (UN WCDRR), Sendai, Japan, 14–18 March 2015, and the resulting government commitments to the Sendai Framework for Disaster Risk Reduction 2015–2030;

Reaffirming further that each Member State has the sovereign responsibility to issue warnings within its respective territories,

Noting with appreciation the tsunami forecasting products provided for the Member States of the PTWS by the PTWC hosted by the USA and the NWPTAC hosted by Japan, and guidance materials by the ITIC,

Recalling the Mauritius Declaration adopted at the Intergovernmental Coordination Meeting held at Grand Baie, 14–16 April 2005 to openly share and exchange tsunami-relevant real-time observational data in accordance with the UNESCO/IOC Oceanographic Data Exchange Policy,

Recalling Decision IOC-XXVII/Dec.5.2.2 which decided to continue the TOWS-WG for the next intersessional period with the existing terms of reference and membership, and accepted the report of TOWS-WG and its recommendation of continuing the Inter-ICG Task Teams on Disaster Management and Preparedness, Hazard Assessment Related to Highest Potential Tsunami Source Areas, and Tsunami Watch Operations for the next intersessional period, with the same membership and Terms of Reference,

Having reviewed the progress made in the implementation of the PTWS since the 25th Session of the ICG/PTWS,

Having considered the reports of:

- Working Group 1 on Tsunami Risk Assessment and Reduction
- Working Group 2 on Tsunami Detection, Warning and Dissemination
- Working Group 3 on Disaster Management and Response
- WG2 Task Team on Warning Dissemination
- WG2 Task Team on PacWave 15
- WG2 Task Team on Enhancing Products
- WG2 Task Team on Seismic Data Sharing in the South West Pacific
- Regional Working Group on Tsunami Warning and Mitigation System in the Central American Pacific Coast
- Regional Working Group on Tsunami Warning and Mitigation System in the South East Pacific Region
- Regional Working Group on Tsunami Warning and Mitigation System in the South West Pacific Region
- Regional Working Group on Tsunami Warning and Mitigation System in the South China Sea Region
- 4th Meeting of the PTWS Steering Committee, Honolulu, Hawaii, USA, July 2014
- 8th Meeting of the TOWS-WG and its Task Teams, Morioka, Japan, March 2015
- North West Pacific Tsunami Advisory Center (NWPTAC)
- Pacific Tsunami Warning Center (PTWC)
- International Tsunami Information Center (ITIC)
- Chairman's Report
- Reports of the ICG/IOTWS, ICG/NEAMTWS, ICG/CARIBE-EWS,

Recognizing the importance of inclusion of emergency managers to help re-orient the ICG/PTWS to focus on the last mile of the end-to-end tsunami warning and mitigation system,

Encourages Member States to include representation of Disaster Management Organizations (DMOs) and/or relevant social scientists in their delegations to the ICG and relevant inter-sessional Working Groups;

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

Encourages voluntary contributions to support Budget and Programme activities recommended by the ICG/PTWS either directly or through the IOC Special Account set up for the PTWS as well as in-kind and extrabudgetary contributions, in particular for training with regards to the new Enhanced Products;

Encourages Member States to nominate members for the three technical Working Groups;

Recognizing the limited capacity of many Member States of the PTWS in (i) tsunami risk assessment and reduction; (ii) tsunami detection, warning and dissemination; and (iii) tsunami awareness and response,

Encourages Member States, donors and development partners to re-commit to investing in resources to sustain and enhance national tsunami warning and mitigation systems;

Requests Member States to promptly inform the Secretariat of all changes to their Tsunami National Contacts (TNCs), National Tsunami Warning Centres (NTWCs), and Tsunami Warning Focal Points (TWFPs) through official channels;

Noting the importance of seismic data for timely and accurate determination of tsunami threats by TSPs, **requests** Member States to provide all relevant seismic data in real-time to the TSPs and international seismic data centres and to ensure station calibration and metadata are kept up to date;

Noting the importance of clarifying the earthquake and tsunami potential in the Pacific Ocean region, **encourages** Member States to acquire and share new datasets such as GNSS, seismic and other geological data;

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

Decides to:

1. Reconstitute WG1 under the name of Tsunami Hazard Assessment with Terms-of-Reference as attached in Appendix to Recommendation ICG/PTWS-XXVI.1, Chair Mr Vasily Titov (USA), Vice-Chair Mr Francois Schindelé (France);

2. Dissolve the WG1 Task Team on Tsunami Risk Assessment after completion of its activity report and recommendations and publication as an IOC report;

3. Dissolve the WG1 Task Team on Tsunami Modelling Hazard Assessment Task Team and merge with WG1 on Tsunami Hazard Assessment;

4. Continue WG2 Tsunami Detection, Warning and Dissemination; Chair Mr Ken Gledhill (New Zealand) and Vice-Chair Mr Dan Jaksa (Australia); with revised Terms of Reference as attached in Appendix to Recommendation ICG/PTWS-XXVI.1;

5. Dissolve WG2 Task Team on Warning Dissemination: and merge into WG2 Tsunami Detection, Warning and Dissemination;

6. Continue WG2 Task Team on Enhancing Products, Chair Mr Charles McCreery (USA), Vice Chair Mr Tomoaki Ozaki (Japan) with same Terms of Reference as attached in Appendix to Recommendation ICG/PTWS-XXVI.1;

7. Continue WG2 Task Team on Seismic Data Sharing in the South West Pacific Co-Chairs Ms Esline Garaebiti Bule (Vanuatu) and Mr Pierre Lebellegard (France) with revised Terms of Reference as attached in Appendix to Recommendation ICG/PTWS-XXVI.1;

8. Reconstitute WG3 under the name of Disaster Management, Preparedness and Risk Reduction, Chair Mr David Coetzee (New Zealand) and Vice Chair Ms Julie Leonard (USA) with revised Terms-of-Reference as attached in Appendix to Recommendation ICG/PTWS-XXVI.1;

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

    - Regional Working Group on Tsunami Warning and Mitigation System on the Central American Pacific Coast, Chair Ms Angelica Munoz (Nicaragua) and

vice-chair Mr Dolan Castro (Honduras) with revised Terms of Reference as attached in Appendix to Recommendation ICG/PTWS-XXVI.1;

- Regional Working Group on Tsunami Warning and Mitigation System in the South East Pacific Region; Chair Mr Humberto Gomez (Ecuador) and Vice-Chair Ms Mary Rengifo (Colombia);

- Regional Working Group on Tsunami Warning and Mitigation System in the South West Pacific Region; Chair Mr Ofa Fa'anunu (Tonga).and vice-chair Ms Esline Garaebiti (Vanuatu);

- Regional Working Group on Tsunami Warning and Mitigation System in the South China Sea Region; Chair Mr Mok Hing-yim (China) and Vice-Chair Mr Nguyen Hong Phuong (Vietnam);

- Task Team of the Regional Working Group on Tsunami Warning and Mitigation in the South China Sea Region on Establishment of a South China Sea Tsunami Advisory Center, Chair Mr Ye Yuan (China), Vice Chair Mr Wandono (Indonesia);

10. Continue the PTWS Steering Committee with same Terms-of-Reference as attached in Appendix to Recommendation ICG/PTWS-XXVI.1;

11. Establish a Task Team on PacWave Exercises under the Steering Committee, Co-Chairs Ms Jo Guard (New Zealand), Ms Laura Kong (USA) and Mr Tomoaki Ozaki (Japan) with Terms of Reference as attached in Appendix to Recommendation ICG/PTWS-XXVI.1;

Requests Member States to participate more actively in the activities of the re-constituted Working Group 3 on Disaster Management, Preparedness and Risk Reduction, with specific emphasis on the involvement of social scientists and disaster managers;

Decides to continue to disseminate a communication test message from the PTWC once a month on the same day and at the same time every month and two random unannounced tests annually to the PTWS Member State TWFPs;

Decides to conduct training workshops on hazard assessment organised by WG1 Tsunami Hazard Assessment in coordination with IUGG to enhance collaboration between the operational and research communities, as recommended by the TOWS-WG, subject to extra-budgetary funding support being identified;

Decides to hold joint inter-sessional meetings of Working Groups (1, 2, and 3), Task Teams and the Steering Committee, and to revert to four-day ICG meetings to allow sufficient time for discussion and decisions;

Decides to replace the current Implementation Plan with a PTWS Status Report prepared by the Steering Committee for presentation and review at each session of the ICG/PTWS, with the Action Plans of the Working Groups and Task Teams being informed by the Decisions, Recommendations and Action Plans of the ICG/PTWS to address any issues, gaps and identified enhancements identified by the PTWS Status Report;

Decides to have a balanced effort of the ICG/PTWS across: a) risk and hazard assessment; b) warning systems; and c) awareness and preparedness, taking into consideration Member States reporting and targets of the UN WCDRR Sendai Framework 2015–2030;

Encourages the participation of regional Disaster Management Organisations as Observers on the ICG/PTWS Steering Committee and relevant Working Groups and Task Teams where appropriate, as well as joint working groups and meetings with other regional organisations/programmes as appropriate;

Decides to establish a Task Team on Future Goals and Performance Monitoring with Terms of Reference attached, reporting to the Steering Committee and chaired by ICG/PTWS Vice-Chairman Mr Rick Bailey;

Decides to establish a Task Team on Evacuation Planning and Mapping with Terms of Reference in Appendix to Recommendation ICG/PTWS-XXVI.1, reporting to the Steering Committee and chaired by Ms Laura Kong (ITIC);

Adopts the guidelines for ICGs and their WGs and TTs, developed by TOWS-WG and its TTs, to help ICG activities focused on facilitating national implementation and enhanced regional capability and capacity;

Instructs the WG2 Tsunami Detection, Warning & Dissemination and its Task Team on Enhancing Products to review changes to TSPs products and **requests** the IOC Secretariat to provide Circular Notices on Planned Changes to PTWS TSPs Products to TNCs and TWFPs three months in advance of operational implementation;

Requests the Executive Secretary to:

1. Write to the Member States annually requesting updates to TNC, NTWC and TWFP contact details, and advise them of the procedures for updating contact details,

2. Circulate a template for national report prior to each session of the ICG/PTWS;

Expresses its gratitude to the Government of the United States of America for kindly hosting the 26th Session of the ICG/PTWS in Honolulu, Hawaii; and

Further expresses its gratitude to the State of Hawaii Emergency Management and Civil Defense for sharing their experience and strategies for working with the local communities to prepare for tsunamis;

Accepts with appreciation the kind offers of France and Panama to host the 27th Session of the ICG/PTWS in Tahiti or Panama City in 2017 and requests the Secretariat to follow up with both countries to confirm the details.

Financial Implications: None

Appendix to Recommendation ICG/PTWS-XXVI.1

Terms of Reference

Working Group 1:
Tsunami Hazard Assessment

1. Work toward developing standards for tsunami hazard assessment model products and methodology to ensure model products interoperability and consistency for use in hazard assessment and forecast application.

2. Work with IUGG and other scientific bodies to review and report on existing methods for tsunami hazard assessments. Develop recommendations for IUGG and other scientific bodies on science gaps in hazard assessment capability.

3. Explore procedures for use of coastal inundation models, including appropriate requirements for bathymetry.

4. Liaise with Working Groups from the other ocean basins, as well as other working groups within ICG/PTWS to coordinate and ensure use of data and new model forecast products for improvements and new development of hazard assessment and tsunami forecast models.

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

Terms of Reference

Working Group 2:
Tsunami Detection, Warning and Dissemination

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

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

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

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

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

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

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

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

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

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

Terms of Reference

Task Team on PacWave Exercises

1. Design and carry out a sixth and seventh Exercise Pacific Wave 2016 and 2017 with the following characteristics:

- Two exercises shall be conducted to support the development of improved tsunami procedures and products by the Northwest Pacific Tsunami Advisory of the Northwest Pacific Tsunami Advisory Center (NWPTAC) enhanced products.

- The exercises are an effective and important way to increase readiness and raise awareness, and especially communities at risk need to be prepared for the next tsunami.

- Exercise Pacific Wave 2016 (PacWave16) will:

    - Take place in the first quarter of 2016, preferably in February

    - Be conducted as a regional exercise involving the sixteen countries that receive the NWPTAC products

    - Be conducted as a table top exercise.

- Exercise Pacific Wave 2017 (PacWave17) will:

    - Take place in the first quarter of 2017, preferably in February

    - Be conducted as a Pacific-wide exercise involving all PTWS countries as part of the regular bi-annual Pacific Wave exercise conducted since 2006

    - Be conducted to include exercise activities over and above a table top exercise. Possible exercise variations include:

        — conduct in real time during the daytime working hours with full staffing, or simulating minimal staff during night time or weekend hours

        — joint exercises involving neighbouring countries organized through the PTWS Regional Working Groups.

- The exercise objectives and dates of the exercises will be finalized by the PTWS Steering Committee.

- The exercise scenarios will be a multi-scenario exercise consisting of major tsunamis originating in various seismic zones of the Pacific to complement previous scenarios in other places.

- The exercise shall be announced by the IOC to Member States at least 180 days in advance of the exercise date.

- The exercise manual including instructions to Member States regarding their participation and the evaluation instrument be prepared with content and structure similar to what was prepared for previous Pacific-wide exercises, but taking into account lessons learned and any need to collect additional information.

- The exercise manual will be distributed by the IOC to Member States at least 90 days in advance of the exercise date. The manual should include instructions to Member States regarding the exercise conduct and the evaluation instrument.

- Participating Member States be asked to complete and return the evaluation instrument no more than 21 days following the exercise.

2. Advise countries as requested on the scenarios, design and conduct of national tsunami exercises, in coordination with the Task Team on Enhancing Products.

3. Prepare the Summary Report for each exercise, compiling a list of recommendations on the NWPTAC enhanced products and the list of actions from the findings for consideration by the ICG/PTWS-XXVII.

4. Members from the ICG/PTWS Member States, Task Team co-chairs: Laura Kong (ITIC), Jo Guard (New Zealand), Tomoaki Ozaki (Japan).

Terms of Reference

WG2 Task Team
on Enhancing Products

1. Review the capabilities and plans of the international TWCs with respect to their operational products and product dissemination for the PTWS.

2. Gather feedback from Member States regarding international TWC current and planned product content, format, and dissemination.

3. Consider best practices based on social science as well as the experiences of the Member States.

4. Consider the global harmonization of tsunami warning products and terminology.

5. Develop recommendations to improve current products and /or develop new products.

Terms of Reference

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

1. Advocate seismic data sharing in the region.

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

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

Members nominated by Member States and territories of the Secretariat of the Pacific Community (SPC).

Terms of Reference

Working Group 3:
Disaster Management, Preparedness and Risk Reduction

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

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

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

4. Develop and promote best practice preparedness material, programmes and assessment tools.

5. Develop and promote best practice tsunami risk reduction material, programmes and assessment tools.

6. Support the ITIC of the ICG;

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

Terms of Reference

Working Group for the Central American Pacific Coast

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

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

3. To implement a regional communications and warning plan.

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

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

Terms of Reference

Working Group for the South East Pacific Region

1. To identify current gaps on the warning and mitigation capabilities of countries in the South East Pacific Region based upon the lessons learned from the last tsunami

events. Understand and prioritize the new requirements from countries in the Southeast Pacific Region for the tsunami warning and mitigation services, and group them under the three central pillars of the Medium Term Strategy 2009–2013.

2. To organize the working plan and structure of the South East Pacific Region taking into account the three central pillars of the Medium Term Strategy 2009–2013.

3. To promote and facilitate tsunami hazard and risk studies in the region, through the active participation of appropriate national delegates from Member States, in the Working Group 1: Tsunami Risk Assessment and Reduction.

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

5. To improve the education programmes with a regional criteria based on the regional social, cultural and economic reality, through the active participation of appropriate national delegates from Member States, in the Working Group 3 Disaster Management and Preparedness.

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

7. To promote and facilitate the creation of in-region trainers in order to meet the regional needs of training.

The Group will be composed of representatives nominated by the Member States of Colombia, Ecuador, Peru and Chile, with a Chair and a Vice-Chair from each country rotating every two years.

Terms of Reference

Working Group for the South West Pacific Region

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

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

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

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

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

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

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

8. To work in cooperation with PTWS Working Group 3, especially on activities which strengthen country capacity in tsunami emergency response.

The Group to be comprised of representatives from Member States and territories of the Secretariat of the Pacific Community (SPC) as members and observers with Chair and Vice Chair to be elected by the members of the Working Group and endorsed by the ICG/PTWS.

Terms of Reference

Working Group for the South China Sea Region

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

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

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

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

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

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

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

Terms of Reference

South China Sea Sub-Regional WG Task Team on Establishment of a SCS Tsunami Advisory Center

1. Develop capability guidelines and performance indicators for the SCSTAC.

2. Explore ways for facilitating the sharing and exchange of data and relevant information necessary for the establishment of the SCSTAC.

3. Consult with National Tsunami Warning Focal Points of the SCS region to determine appropriate requirements for Tsunami service/products.

4. Develop the SOP and the contents of tsunami advisory products for the SCSTAC.

5. Identify potential resource requirements for the establishment of the SCSTAC.

6. Keep contact with PTWC and NWPTAC (JMA) for technical guidance and assistance.

7. Membership:

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

Terms of Reference

Steering Committee

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

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

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

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

Terms of Reference

Task Team on Future Goals and Performance Monitoring

1. Through consultation with relevant stakeholders, develop goals and targets for the ICG/PTWS for the next two inter-sessional periods.

2. Develop a list of priority activities and resources requirements to help address the identified goals.

3. Develop metrics for monitoring the performance of the ICG/PTWS TSPs, NTWCs, overall national and PTWS risk and hazard assessment activities, warning system components, community awareness and preparedness related activities, to measure the status against requirements and assist with obtaining resources for continued improvement.

4. Develop an outline for the PTWS Status Report.

5. Review and revise National Report template for Member States in order to collect required information and determine performance metrics for the PTWS Status Report.

Members consisting of the Working Group Chairs, a rep from ITIC and invited experts as observers as appropriate, reporting to the Steering Committee and chaired by ICG/PTWS Vice-Chairman Rick Bailey.

Terms of Reference

Task Team on Evacuation Planning and Mapping

1. Develop a new programme aimed at facilitating tsunami resilience through community preparedness, specifically through the preparation of tsunami evacuation maps and associated response plans for tsunami-vulnerable coastal communities. Programme globally applicable and utilizing standardized tools and methodologies where they exist.

2. Take advantage of existing resources, the new programme should link existing training workshops, such that modules cover:
   - Evacuation Planning
   - Evacuation Map Development (inundation modelling and map creation)
   - Tsunami Warning & Emergency Response SOPs
   - Conducting Tsunami Exercises (including evacuation)

3. Compile and take into consideration best practices worldwide.

4. Conduct a Pilot(s) using 'real' communities to produce an evacuation map.

5. After each training delivery, develop feedback mechanisms that will adapt and lead to improvements in the next course delivery.

6. Produce an IOC Manual and Guide on Evacuation Plans, Maps, and Procedures.

Membership to include experts in Warning, Modelling, Disaster Management, Community Preparedness, Education and Outreach, reporting to the Steering Committee and chaired by Ms Laura Kong (ITIC).

Recommendation ICG/PTWS-XXVI.2

Tsunami Advisory Centre for Central America (CATAC)

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

Recalling that the Intergovernmental Oceanographic Commission (IOC) adopted Resolution EC-XLI.6, for Member States around regional seas, as appropriate, actively promote the development, establishment and sustained operation of national and sub-regional Tsunami Warning and Mitigation Systems within the framework of the ICG/PTWS,

Remembering that the six countries of Central America and the Coordination Centre for the Prevention of Natural Disasters in Central America (CEPREDENAC) during a meeting held in Managua, Nicaragua on 3 September 2003 decided to start the process for a Regional Tsunami Warning System, and requested IOC/ITSU assistance for its development,

Further remembering that PTWS in its session XIX decided to assist the Central American countries in this process and established the Regional Working Group on Tsunami Warning and Mitigation System on the Central American Pacific Coast (WG-CA) for this purpose,

Further recalling that the ICG/PTWS-XXV.1 recommended to determine whether El Salvador or Nicaragua (or both countries in cooperation) could establish an interim Tsunami Warning Centre for disseminating warnings to all Central American countries and the Implementation of a Technical Committee for the development of a Regional Tsunami Warning and Mitigation Systems,

Recognizing that Nicaragua, El Salvador and Costa Rica, already operate National Tsunami Warning Systems,

Acknowledging that there have been considerable improvements in Central America regarding the capabilities applicable to the requirements of a regional tsunami warning system as real time seismic data exchange between the countries, automatic seismic data processing, availability of sea level data, tsunami hazard mapping and training of personnel,

Having considered the reports of the following meetings:

- The First meeting of the ICG/PTWS-WG-CA, held in Managua, Nicaragua, 04-06 November 2009,
- The Second meeting of the ICG/PTWS-WG-CA, held in San Salvador, El Salvador, 28-30 September 2011
- The Third meeting of the ICG/PTWS-WG-CA, held in Managua, Nicaragua, 29-30 September 2014,

Noting the efforts for the establishment of a Central American Regional Seismic Network as documented in the Third meeting of the ICG/PTWS-WG-CA,

Further noting that the Centre for the Coordination of the Prevention of Natural Disasters in Central America (Spanish: Centro de Coordinación para la Prevención de los Desastres Naturales en América Central, or CEPREDENAC) is the corresponding agency for disaster prevention within the Central American Integration System (Spanish: Sistema de Integración Centroamericana, or SICA),

Also noting the decision of the council of representatives of CEPREDENAC in their meeting on February 6, 2015, “to recognize within the priorities of CEPREDENAC the development of the Tsunami Advisory Centre for Central America (Spanish: Centro de Alerta de Tsunamis en America Central, or CATAC) and the creation of a Regional Seismic Network to be established in the Republic of Nicaragua and elevate to SICA”,

Having considered the presentation of Nicaragua at PTWS-XXVI on the proposed development of CATAC to cover both the coasts of the Pacific and Caribbean within the framework of PTWS and CARIBE–EWS,

Noting the report of the UNESCO IOC/TOWS-WG-VI and VII and its recommendations for harmonized tsunami services, products and terminologies,

Noting with appreciation that PTWC is providing tsunami services for Central America,

Reaffirms its commitment to establish a sub-regional Tsunami Warning and Mitigation System for the Central American region within the framework of the ICG/PTWS and TOWS;

Decides further to establish within WG-CA a CATAC Task Team, with Terms of Reference attached as Appendix I;

In addition, **recognizing** the remarkable advances of Nicaragua in its National Tsunami Warning and Mitigation System and **noting** the offer of Nicaragua to host and develop the CATAC at the Instituto Nicaraguense de Estudios Territoriales (INETER) in Managua, Nicaragua,

Accepts Nicaragua's offer to host and develop the CATAC under the guidance of the WG-CA within the framework of ICG/PTWS, ICG/CARIBE-EWS and TOWS-WG;

Noting the proposed CATAC will provide services to both the Pacific and Caribbean coasts of Central America, requests the Secretariat to share this recommendation with the ICG/CARIBE-EWS for their consideration at their 10th session in May 2015,

Encourages members of the WG-CA to actively participate in and contribute to the establishment of the sub-regional Tsunami Warning and Mitigation System within the framework of the ICG/PTWS and TOWS;

Invites other countries outside the Central American region to provide appropriate support to develop the sub-regional Tsunami Warning and Mitigation System within the framework of ICG/PTWS and TOWS;

Further decides to organize an inter-sessional meeting of the WG-CA in mid-2015;

Financial implications: None

Appendix I to Recommendation ICG/PTWS-XXVI.2

Terms of Reference

Central America Sub-Regional WG Task Team
on the Establishment of a Tsunami Advisory Center
for Central America (TT - CATAC).

Purpose: To assist the Central American Working Group in the establishment of the CATAC until it has the ability to provide operational service.
Mandate: Under the guidance of the ICG/PTWS-WG-CA, the task team shall strengthen coordination and cooperation among the CA countries to establish the CATAC:

- Develop capability guidelines and performance indicators for the CATAC.
- Explore ways for facilitating the sharing and exchange of data and relevant information necessary for the establishment of the CATAC.
- Consult with National Tsunami Warning Focal Points, National Tsunami Warning Centres and Tsunami National Contacts of the Central American region to determine appropriate requirements for tsunami services.
- Develop the SOP and the contents of tsunami services for the CATAC.
- Identify potential resource requirements for the establishment of the CATAC.

- Keep contact with PTWC and NWPTAC (JMA) for technical guidance and assistance.

Membership: Representatives from the Member States **of Central America and adjacent regions** and invited experts; representatives of PTWC and NWPTAC (JMA), ITIC and CTWP; with Chairperson and vice Chairperson to be elected.

Modus operandi: The task team will work mainly by correspondence and virtual meetings and prepare reports for the WG-CA meetings.

Recommendation ICG/PTWS-XXVI.3

Re-Commitment to PTWS

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

Recalling that in his message to the International Symposium commemorating the 50th Anniversary of the PTWS Making the Pacific Ready for the Tsunami Threat, the IOC Executive Secretary recalled that successful participation and commitment by governments is necessary to ensure that the PTWS is sustained into the future,

Noting that this Session of the ICG/PTWS agree that Member States be requested to reaffirm their commitment to enable the continued maintenance and enhancement of the PTWS,

Requests the IOC Executive Secretary to send a letter in 2015 to the National Contact and the IOC representative of each Member State that will contain the following:

1. Noting the 50th anniversary celebration of the PTWS,

2. Acknowledging the indispensable role and contribution by the United States of America and Japan in the maintenance of the System,

3. Recognizing that the contribution of the United States of America and Japan requires supplementation by other Member States for the System to maintain its momentum and to grow,

4. Noting the outcome of the ICG/PTWS-XXVI session with regards to its future focus, including the holistic focus on hazard assessment, warning, preparedness and disaster management,

5. Inviting Member States to reaffirm their commitment towards the maintenance and enhancement of the PTWS through active participation, sharing and contribution.

Requests the Secretariat to draft this letter for approval by the Steering Committee.

ANNEX III

**REPORT OF THE CHAIR
TO ICG/PTWS-XXVI**

INTRODUCTION

The significance of this ICG/PTWS session cannot have escaped anyone! This year is our 50th anniversary and our first meeting since the introduction of the PTWC Enhanced Products – the use of forecast models to establish threat levels to inform the actions of Member States. I am very proud to be your chair (albeit the outgoing chair) for this significant occasion. We have already enjoyed two superb days of celebration at the symposium preceding this meeting. We have heard about the history of our tsunami system, including how it came into being, considered the current state of the system and tsunami science, but more importantly, we continue to look to the future – how can we be even more effective? Lives are still being lost to tsunami, and it must be our aim to at least minimise, if not eliminate, loss of life.

When we last met at ICG/PTWS-XXV in Vladivostok, Russian Federation in September 2013 we endorsed the PTWC Enhanced Products with a suggested transition date of 1 October 2014. The final stop/go decision was left to the Steering Committee. Your Steering Committee checked on progress when we met in Hawaii in July 2014 before giving the final go ahead for the changeover. I consider the introduction of the Enhanced Products to be the most significant change during my two terms as PTWS chair. We will look back and confirm this as a significant turning point in the 50 year history of our organisation.

The move to the Enhanced Products demonstrates the effectiveness of the governance structure introduced at ICG/PTWS-XXIII (Apia, Samoa) and endorsed at ICG/PTWS-XXIV (Beijing, China). Because of the complexity of the Pacific Ocean region, PTWS has a structure based on both Regional and Technical Working Groups. A Steering Committee comprising the Officers, Working Group chairs and representatives from the tsunami warning and information centres is charged with overseeing and continuing the activities of the group during the intersessional period.

HARMONISATION WITH OTHER ICGS

For much of our history (~40 years) PTWS was the only tsunami warning system. Following the Indian Ocean tsunami of 26 December 2004, the IOC established three other systems – for the Indian Ocean, Caribbean, and the North-eastern Atlantic and Mediterranean. PTWS has had an important role helping these “new” systems in their formative years. PTWC and JMA provided interim services to some of these regions as they developed. But now they are celebrating their first decade and harmonisation between the tsunami systems is becoming increasingly important. This includes active participation in TOWS (the overall IOC coordination group) and its Task Teams. In my role as PTWS Chair I have attended the TOWS meetings and our Working Group 3 chair, David Coetzee, chairs one of the TOWS Task Teams. The TOWS Task Teams are a key mechanism for ensuring harmonisation between the ICGs and are carrying out work which does not need to be duplicated by each ICG. For example, a TOWS Task Team is considering “Highest Potential Tsunami Source Areas”, drawing on work from the Global Earth Model project on the characterisation of (potentially tsunamigenic) large subduction zone earthquakes. As the Pacific is the largest ocean on the planet, this work has obvious relevance for us as we strive to understand the tsunami risk.

TOWS last met in Morioka, Japan just a month ago. The chairs of all four ICGs then took part in activities organised by JMA as part of the third World Conference on Disaster Risk

Reduction in Sendai, Japan. Although PTWS is the older sibling in the tsunami world, it does not mean we cannot learn from what other ICGs are doing. For example, we should consider adopting the more quantitative measures of our performance being developed by other ICG and some of the huge variety of public education initiatives now available.

ENHANCED PRODUCTS AND PacWave'15

A key focus since ICG/PTWS-XXIV has been the deployment of the PTWC Enhanced Products for tsunami threat assessment based on tsunami forecast models and pre-defined coastal zones. Since the introduction of the Enhanced Products on 1 October 2014 there have been very few tsunami events. The Enhanced Products formed the basis for PacWave'15 in early February this year – we will hear the results of the evaluation of the exercise during this meeting. Exercises are vital to the success of our core objective to save lives. Exercises are time consuming for all involved but have been an important tool for refining the Enhanced Products, testing our Standard Operating Procedures, as well as fulfilling our preparedness objectives. The introduction of the PTWC Enhanced Products has been a huge undertaking not just by PTWC, but the whole U.S. tsunami programme, a range of aid agencies in multiple countries (too many to list in this report), and a range of dedicated individuals (again too many to list in this report). Member States gave full support to the process and the training and exercises which formed a part of the testing and refinement of the products. Thank you all!

ONGOING ACTIVITIES

The Steering Committee met in July 2014 in Hawaii to review the progress with the training and exercise programmes, the development of Enhanced Products and to chart activities leading up to ICG/PTWS-XXVI, including the organisation of the symposium and other activities to commemorate the 50th anniversary such as the book and short video.

Since the ICG/PTWS-XXV session, Regional Working Group meetings and activities have continued in all sub-regions, and I look forward to hearing the outcomes at this meeting. Work has continued on the planning for the establishment of a tsunami advisory centre for the South China Sea (SCS) region. Progress has been made towards this goal during two Regional Working Group meetings (Hong Kong, China, April 2014; Jakarta, Indonesia, February 2015). Meetings of the Task Team formed at ICG/PTWS-XXV to plan for the new advisory centre were held in conjunction with both Working Group meetings. The Working Group is progressing work on a seismo-tectonic study in the South China Sea region (with a technical workshop planned for later this year), an inventory of seismic and sea level stations in the region, including real-time data sharing mechanisms, and development of plans to produce/adapt educational materials tailored for the region. I look forward to hearing reports on progress during this ICG.

The Working Group for Central America met in September 2014 for the second time since 2011, and will present a proposal for a regional centre in Nicaragua to this ICG. It is also impressive to observe the cooperation between the members of the Working Group for the South East Pacific. Chile, Ecuador, Peru and Colombia participated in the first Regional Tsunami Warning Exercise using SRATPS (a platform for exchanging bulletins between NTWCs in the Southeast Pacific), are involved in joint training and education activities, and are carrying out very regular communications testing using a variety of channels, including satellite telephones.

A large number of training and consultation workshops have taken place, many focusing on standard operating procedures and the Enhanced Products for tsunami threat assessment. Key funders of the training were the U.S. and Japan, with many other donors contributing (as indicated above). For example, after the threat of tsunami was dramatically demonstrated by

the Great East Japan Tsunami, Japan provided increased support (via JICA) to several Member States in Central America, South America, South East Asia and the South West Pacific.

Additionally, several technical Task Teams have met, and Member States have continued tsunami hazard and risk assessment work progressing the goals of the PTWS Strategic Plan. I personally attended a meeting of the Task Team on data sharing in the Southwest Pacific which included the launch of the Oceania Regional Seismograph Network (ORSNET) in Port Vila, Vanuatu. ORSNET is a regional initiative to enable data sharing for hazard warning in the region with Vanuatu, New Caledonia, Tonga, Fiji, Samoa, Solomon Islands and PNG currently actively involved. Importantly, it is providing data which fills gaps in PTWC coverage in the region.

Many challenges still face the PTWS including ensuring the continued development of the Enhanced Products (for both PTWC and NWPTAC) and their uptake by Member States, and securing enough funding to enable ongoing operational training. One of our key challenges is maintaining the current high levels of public tsunami awareness over the long term. Although I am delighted with the progress made during the intersessional period, I wish to sound a note of warning. Although the governance structure of PTWS is working very well, the real work goes on within Working Groups and Task Teams and this work is being done by teams with few members. I ask that Member States consider how they can contribute and nominate members to the Working Groups and Task Teams, when requested, who will contribute strongly. There are a large number of Task Teams, but few are as active as they need to be if we are to make good progress. It may be time to consolidate the work within the Working Groups rather that continuing to create even more Task Teams.

PTWS FUTURE DIRECTIONS

What are the next priorities for PTWS now we have successfully introduced the Enhanced Products? One priority is for similar products to be introduced by the NWPTAC and we will hear more about that at this meeting. There is also a pressing need for PTWS to engage more effectively with the emergency management community. We must move “mitigation” from being a silent part of PTWS and encourage active participation of more emergency managers in our system. I consider our highest priority is to ensure that advances in science and the availability of the Enhanced products lead to better life-safety outcomes. Here I am talking about using the best science available to inform evacuation zone and route planning so that communities can react effectively when tsunamis occur. The best outcomes will occur when communities have a “culture of evacuation”, a philosophy espoused by the new mayor of Otsuchi, a small seaside city destroyed by the 2011 Great East Japan Tsunami which I visited last month with the TOWS team. So the challenge is to implement a programme aimed at ensuring every community at risk has full evacuation plans socialised at the community level and informed by the best physical and social science. We should adopt that outcome as our challenge for the next five years!

ACKNOWLEDGEMENTS

The PTWS Officers and members of the Steering Committee have worked very hard to ensure we have continued to make progress on the PTWS Strategic Plan objectives. I would like to express my sincere appreciation to all colleagues and friends who have supported my job as chair of the ICG/PTWS since 2011. I thank members of the IOC Tsunami Secretariat for their support. Although he is not with us, I would like to place on record my appreciation of the dedication and support provided to myself and PTWS by Takeshi Koizumi from JMA, Japan during his two terms as vice-chair which coincided with my terms as chair. Likewise, I thank Admiral Patricio Carrasco who has been a supportive vice-chair during my time as PTWS chair.

I wish to express a special vote of thanks to the staff of the warning centres and the International Tsunami Information Centre - I have enjoyed close and productive working relationships with Laura Kong (ITIC), Charles McCreery (PTWC) and (as already acknowledged) Takeshi Koizumi (NWPTAC). The hosting of the warning and information centres by Japan and the U.S. is crucial for the success of PTWS and on behalf of all Member States I thank them. The transition to the Enhanced Products was supported strongly by the U.S. tsunami programme manager, Mike Angove – thank you Mike. My fellow New Zealander on the Steering Committee, David Coetzee has provided continuing help and support, without which my task would have been much harder.

After our bi-yearly ICG, we are required to report orally to the IOC Executive Council or General Assembly. Last year for various reasons I could not undertake the reporting trip, and this was done for us by Commander Enrique Silva from Chile. I would like to thank him for undertaking this task on my behalf and vice-chair Admiral Patricio Carrasco for arranging for him to do so. I understand Member State representatives attending the Executive Council were very supportive of the activities of all ICGs and commented favourably on the progress we are making with the enhanced tsunami alerting products.

Finally, I would like to thank our hosts, the United States of America, for the invitation to join them in Hawaii to celebrate our 50th anniversary. I must make special mention of the amazing hard work and dedication of Laura Kong and her team – they have brought us the symposium, the video and the commemorative book. The U.S. hosting of the symposium and this session of ICG/PTWS is greatly appreciated!

Ken Gledhill
Chair, ICG/PTWS
Director, New Zealand GeoNet,
Department Head, Geohazards Monitoring
GNS Science, New Zealand
20 April 2015

ANNEX IV

REPORT OF TASK TEAM ON ENHANCED PRODUCTS

Tomoaki OZAKI (TNC of Japan)
on behalf of the Task Team

Summary Report and Recommendations
of the PTWS Task Team on Enhanced Products

1. INTRODUCTION

During the Twenty-third session of the ICG/PTWS in February 2009, the group formulated Recommendation ICG/PTWS-XXIII.1 (see Annex III to the Report on ICG/PTWS-XXIII) that established a Task Team on Enhanced Products under Working Group on Detection, Warning and Dissemination (WG2) to review current capabilities, obtain customer feedback, consider best practices, and develop recommendations to improve existing or create new products, and improve dissemination for more effective, functional, and timely delivery.

After years of discussions by the Task Team and dedicated efforts by PTWC, the IOC Secretariat, through IOC Circular Letter No 2535 dated 4 September 2014, announced the start of issuance of PTWC Enhanced Products for the Pacific Tsunami Warning and Mitigation System (PTWS) on 1st October 2014.

In the pursuit of improving PTWS tsunami warning products, Japan announced at the IOC Executive Council in July 2014, that the Northwest Pacific Tsunami Advisory Centre (NWPTAC) would also be preparing new products based on the requirements of the recipient countries. Following this announcement, Mr Takeshi Koizumi presented on behalf of Japan Meteorological Agency (JMA), on the occasion of the 4th Meeting of the PTWS Steering Committee (SC) in July 2014, a proposed timeline for the NWPTAC to develop and introduce Enhanced NWPTAC Products, targeting 2018 for its complete transition. The PTWS SC agreed about the proposed course of action by NWPTAC and recommended JMA to continue the process of developing NWPTAC Enhanced Products for PTWS.

Pursuant to the agreement of PTWS SC and considering the potential impact of the NWPTAC Enhanced Products in the emergency operation of National Tsunami Warning Centres (NTWCs), JMA conducted a questionnaire survey in cooperation with the IOC Secretariat (see IOC Circular Letter No 2568 dated 3 February 2015), seeking to gather the views of countries in the region on this process. The survey revealed there is a recipient countries' demand for graphical products as part of the enhancement.

In light of the survey outcome, this Report presents a proposal to the ICG/PTWS on NWPTAC Enhanced Products for PTWS (ICG/PTWS-XXVI Agenda item 4.3).

2. BACKGROUND

The successful launch of PTWC Enhanced Products demonstrated a mature capacity of Member States to utilise the advanced graphical products. This encouraged JMA to consider providing NWPTAC Enhanced Products including similar graphical information, as shown in appendix A, to meet the user requirements. Considering the issuance of graphical products will require elaborate tsunami forecast, JMA plans to add real-time simulation technique to the existing database driven forecast.

On the other hand, taking into account the concise and easy-to-understand nature of conventional text messages which include forecasted heights at selected but individual Forecast Points (FPs), JMA recognizes it is still indispensable to provide them to the recipient countries. Therefore, JMA plans to issue both existing texts and graphics.

It should be also noted that the NWPTAC products are issued only in support of ICG/PTWS and meant for national authorities in each country in NWPTAC's Area of Service, which are responsible for the determination of domestic alert level. In this regard, graphical products should be exclusive for the national authorities to avoid unexpected confusion of the public.

Moreover, JMA will add/modify FPs, for which forecast and observed data are reported in NWPTAC products, in line with those for PTWC products. Appendix B presents proposed change of NWPTAC FPs list.

JMA expects the NWPTAC Enhanced Products will contribute to tsunami disaster mitigation within the Northwest Pacific region.

3. TASK TEAM RECOMMENDATIONS

Considering the foregoing discussion, the Task Team on Enhanced Products makes six recommendations on the NWPTAC improvements:

1. *NWPTAC will, in accordance with the course of action agreed by the PTWS SC, begin issuing enhanced products that consist of an initial text message based on pre-established tsunami database, and the following text messages accompanied by graphics based on real-time simulation technique.*

2. *NWPTAC basically will not change contents of the text messages in order to keep them compact and avoid overloading of recipient countries.*

3. *NWPTAC will disseminate graphical products exclusively for national authorities of recipient countries.*

4. *NWPTAC will harmonize Forecast Points for the NWPTAC Enhanced Products with those for the PTWC Enhanced Products.*

5. *NWPTAC will set an experimental products phase before the final changeover, with a view to sufficient feedback opportunity and training on the new products*.

6. *The Task Team on Enhanced Products will provide NWPTAC with guidance during the inter-sessional period regarding details on the development, implementation, and evaluation of the products.*

4. IMPLEMENTATION DETAILS

Details of the proposed enhancement of NWPTAC products are provided in the outline below.

a. Text products
   - Forecast method
     - Tsunami forecast database (the first message, without graphics)
     - Real-time simulation (the second message or later, with graphics)
   - Contents (basically no change from current format)

- Hypocentral parameters (origin time, location, magnitude)
- Tsunamigenic potential
- Coastal blocks
- Forecast amplitude and arrival time
- Observed amplitude and arrival time

- Public or private
  - GTS, FAX and E-mail – private

b. Graphical Products (Maps)

- Forecast method
  - Real-time simulation (along with the second message or later)
- Contents
  - Deep-Ocean tsunami amplitude forecast map
  - Tsunami travel time map
  - Coastal tsunami amplitude forecast map
- Public or private
  - E-mail – private

5. IMPLEMENTATION TIMELINE

The following timeline is proposed for the coordinated implementation of NWPTAC Enhanced Products:

<u>April 2015: ICG/PTWS XXVI in Honolulu, United States of America</u>

Report under item 4.3, ENHANCING PTWS TSUNAMI WARNING PRODUCTS

- Task Team on Enhanced Products to propose the implementation plan for the NWPTAC Enhanced Products under item 4.3, ENHANCING PTWS TSUNAMI WARNING PRODUCTS.
- Member States to make discussion and approve or request changes.
- If approved, NWPTAC to begin preparing for experimental products for the use during PacWave 16.
- ICG/PTWS XXVI to PacWave 16
- NWPTAC to continue preparing for PacWave 16

<u>February 2016 (TBC): PacWave 16– the beginning of Experimental Products Phase</u>

- NWPTAC to issue experimental NWPTAC Enhanced Products
- Feedback from PacWave 16 to be used to evaluate enhanced products and identify necessary modification.

<u>PacWave 16 to the Meeting of the Task Team on Enhanced Products</u>

- Recipient countries to comment and evaluate the experimental products through PacWave 16 evaluation questionnaire.

- September 2016 (TBC): the Task Team Meeting

- Task Team to analyse the Evaluation Questionnaire responses from recipient countries.

- NWPTAC to provide a report on its implementation issues and feedback for new products.

- Task Team to recommend modification of the experimental products where necessary based on the evaluation.

- Task Team to plan another PacWave (desk top) exercise using NWPTAC experimental products before official changeover. This exercise will aim at finalising the new PTWC products and procedures.

The Task Team Meeting to the PacWave 17

- NWPTAC to accordingly modify experimental products for operations.

February 2017 (TBC): PacWave 17 (desk top)

- NWPTAC to issue modified experimental products

- Feedback from PacWave 17 to be used to finalise enhanced products.

PacWave 17 to ICG/PTWS-XXVII

- Recipient countries to comment and evaluate the experimental products through PacWave 17 evaluation questionnaire.

- NWPTAC to draft the User's Guide for the NWPTAC Enhanced Products for the PTWS for approval by ICG/PTWS.

September 2017 (TBC): ICG/PTWS-XXVII – the end of Experimental Products Phase

- Task Team to report the analysis of the Evaluation Questionnaire responses from Recipient Countries.

- NWPTAC to report the final proposal on enhanced products and the User's Guide.

- ICG/PTWS to endorse the finalised NWPTAC Enhanced Products, implementation date and User's Guide.

ICG/PTWS-XXVII to the final changeover

- NWPTAC to implement parallel issuance of existing and enhanced products.

October 2018 (TBC): The final changeover

- NWPTAC to cease to provide existing products.

APPENDIX A

NWPTAC GRAPHICAL PRODUCTS

1. DEEP-OCEAN TSUNAMI AMPLITUDE FORECAST

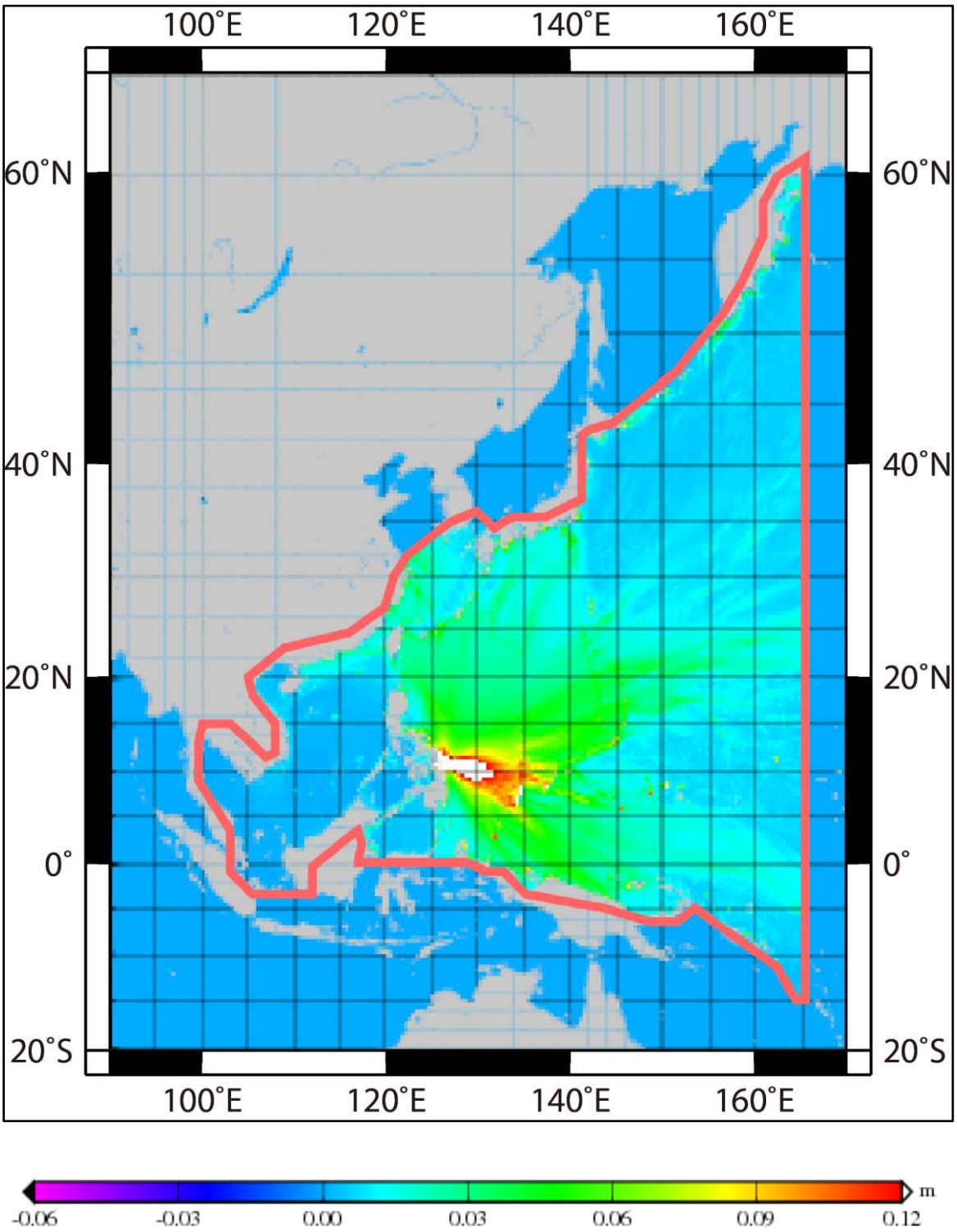

Image IV-1. Deep ocean tsunami amplitude forecast

2. TSUNAMI TRAVEL TIME MAP

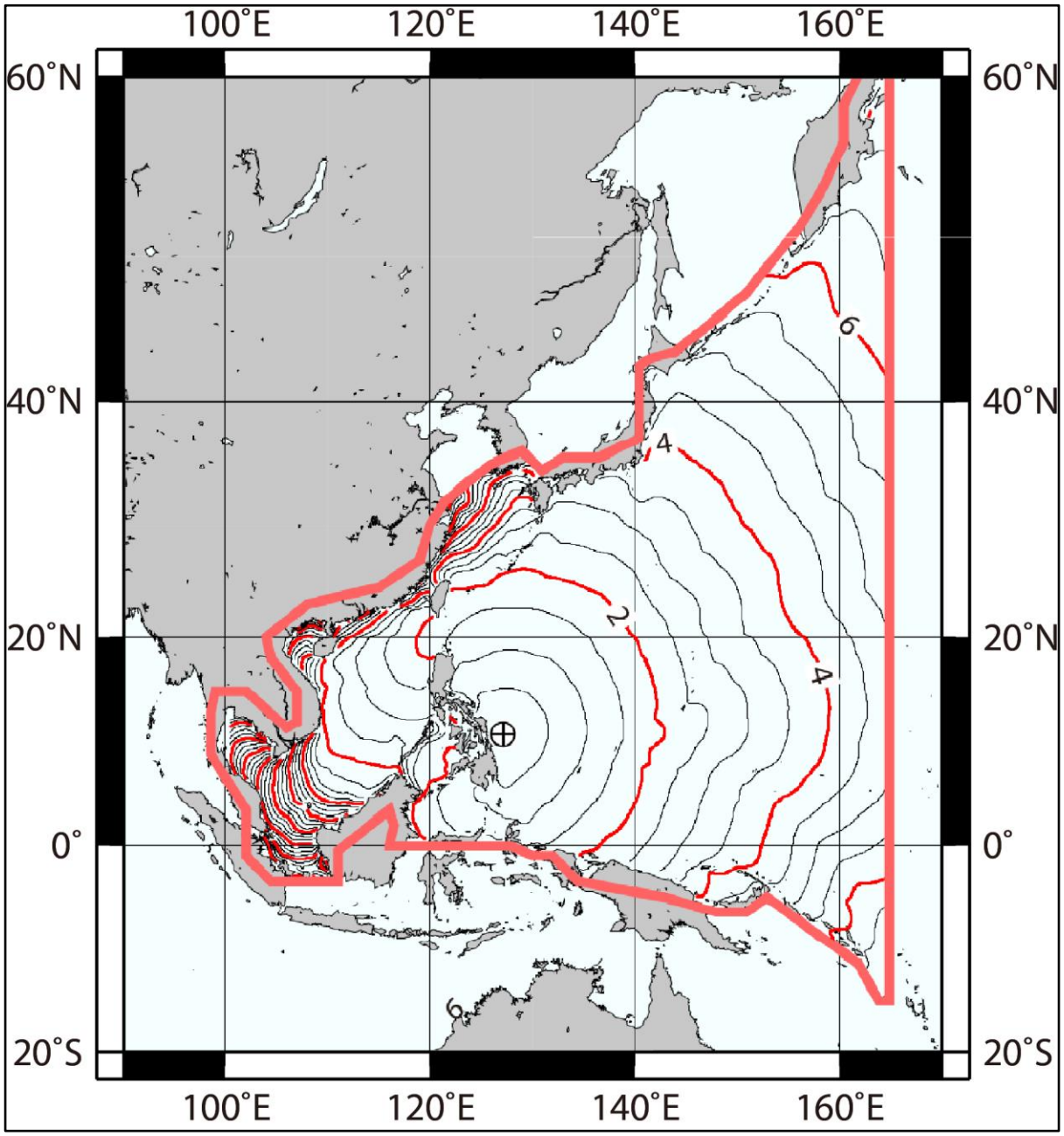

Image IV-2. Tsunami travel time map

3. COASTAL TSUNAMI AMPLITUDE FORECAST

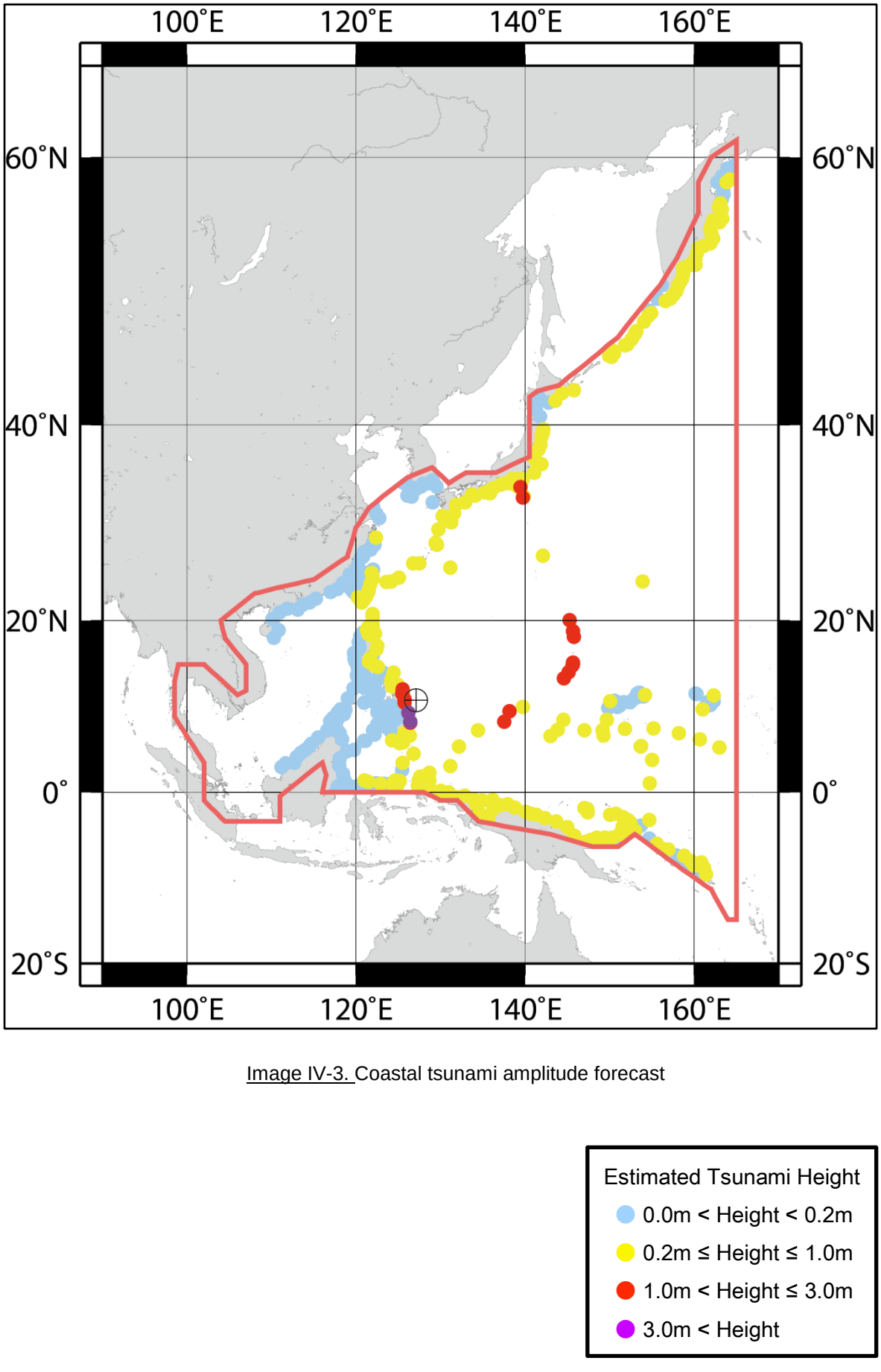

Image IV-3. Coastal tsunami amplitude forecast

APPENDIX B

PROPOSED LIST OF FORECAST POINTS

COASTAL BLOCK	FORECAST POINT	LATITUDE	LONGITUDE
EAST COASTS OF KAMCHATKA PENINSULA	UST_KAMCHATSK	56.1N	162.6E
EAST COASTS OF KAMCHATKA PENINSULA	PETROPAVLOVSK_K	53.2N	159.6E
EAST COASTS OF KAMCHATKA PENINSULA	OSTROV_KARAGINSKIY	58.8N	164.5E
KURIL ISLANDS	SEVERO_KURILSK	50.8N	156.1E
KURIL ISLANDS	URUP_IS.	46.1N	150.5E
SOUTH COASTS OF KOREAN PENINSULA	BUSAN	35.1N	129.1E
SOUTH COASTS OF KOREAN PENINSULA	NOHWA	34.2N	126.6E
SOUTH COASTS OF KOREAN PENINSULA	SEOGWIPO	33.2N	126.5E
SOUTH COASTS OF KOREAN PENINSULA	CHEJU_ISLAND	33.5N	127.0E
TAIWAN	HUALIEN	24.0N	121.6E
TAIWAN	CHILUNG	25.2N	121.8E
TAIWAN	TAITUNG	22.7N	121.2E
TAIWAN	KAOHSIUNG	22.5N	120.3E
TAIWAN	HOMEL	24.2N	120.4E
EAST COASTS OF PHILIPPINES	BASCO	20.4N	122.0E
EAST COASTS OF PHILIPPINES	PALANAN	17.2N	122.6E
EAST COASTS OF PHILIPPINES	LEGASPI	13.2N	123.8E
EAST COASTS OF PHILIPPINES	LAOANG	12.6N	125.0E
EAST COASTS OF PHILIPPINES	MADRID	09.2N	126.0E
EAST COASTS OF PHILIPPINES	DAVAO	06.9N	125.7E
NORTH COASTS OF IRIAN JAYA	BEREBERE	02.5N	128.7E
NORTH COASTS OF IRIAN JAYA	PATANI	00.4N	128.8E
NORTH COASTS OF IRIAN JAYA	SORONG	00.8S	131.1E
NORTH COASTS OF IRIAN JAYA	MANOKWARI	00.8S	134.2E
NORTH COASTS OF IRIAN JAYA	WARSA	00.6S	135.8E
NORTH COASTS OF IRIAN JAYA	JAYAPURA	02.4S	140.8E
NORTH COASTS OF IRIAN JAYA	GEME	4.6N	126.8E
NORTH COASTS OF PAPUA	VANIMO	02.6S	141.3E

COASTAL BLOCK	FORECAST POINT	LATITUDE	LONGITUDE
NEW GUINEA			
NORTH COASTS OF PAPUA NEW GUINEA	WEWAK	03.5S	143.7E
NORTH COASTS OF PAPUA NEW GUINEA	MADANG	05.2S	145.8E
NORTH COASTS OF PAPUA NEW GUINEA	MANUS_IS.	02.0S	147.5E
NORTH COASTS OF PAPUA NEW GUINEA	RABAUL	04.2S	152.3E
NORTH COASTS OF PAPUA NEW GUINEA	KAVIENG	02.5S	150.7E
NORTH COASTS OF PAPUA NEW GUINEA	KIMBE	05.6S	150.2E
NORTH COASTS OF PAPUA NEW GUINEA	KIETA	06.1S	155.6E
NORTH COASTS OF PAPUA NEW GUINEA	AMUN	6.0S	154.7E
NORTH COASTS OF PAPUA NEW GUINEA	ULAMONA	5.0S	151.3E
MARIANA ISLANDS	GUAM	13.4N	144.7E
MARIANA ISLANDS	SAIPAN	15.3N	145.8E
PALAU	MALAKAL	07.3N	134.5E
MICRONESIA	YAP_IS.	09.5N	138.1E
MICRONESIA	CHUUK_IS.	07.4N	151.8E
MICRONESIA	POHNPEI_IS.	07.0N	158.2E
MICRONESIA	KOSRAE_IS.	05.5N	163.0E
MARSHALL ISLANDS	ENIWETOK	11.4N	162.3E
NORTH COASTS OF SOLOMON ISLANDS	PANGGOE	06.9S	157.2E
NORTH COASTS OF SOLOMON ISLANDS	AUKI	08.8S	160.6E
NORTH COASTS OF SOLOMON ISLANDS	KIRAKIRA	10.4S	161.9E
NORTH COASTS OF SOLOMON ISLANDS	GHATERE	7.8S	159.2E
SOLOMON SEA	MUNDA	08.4S	157.2E
SOLOMON SEA	HONIARA	09.3S	160.0E
SOLOMON SEA	FALAMAE	7.4S	155.6E
Coastal Block	Forecast Point	Latitude	Longitude
COASTS OF EAST CHINA SEA	SHANGHAI	31.2N	122.3E
COASTS OF EAST CHINA SEA	WENZHOU	27.8N	121.2E
COASTS OF SOUTH CHINA SEA	HONG_KONG	22.3N	114.2E
COASTS OF SOUTH CHINA SEA	SANYA	18.2N	109.5E
COASTS OF SOUTH CHINA SEA	QUANZHOU	24.8N	118.8E
COASTS OF SOUTH CHINA SEA	HAINAN_ISLAND	18.8N	110.5E
COASTS OF GULF OF TONKIN	VINH	18.6N	105.7E
EAST COASTS OF INDO CHINA	QUI_NHON	13.7N	109.2E

COASTAL BLOCK	FORECAST POINT	LATITUDE	LONGITUDE
PENINSULA			
EAST COASTS OF INDO CHINA PENINSULA	BAC_LIEU	09.3N	105.8E
GULF OF THAILAND	PRACHUAP_KHIRI_KHAN	11.8N	099.8E
GULF OF THAILAND	SIHANOUKVILLE	10.6N	103.6E
GULF OF THAILAND	NAKHON_SI_THAMMARAT	08.4N	100.0E
GULF OF THAILAND	PATTAYA	12.8N	100.9E
NORTHWEST COASTS OF KALIMANTAN	MUARA	05.0N	115.1E
NORTHWEST COASTS OF KALIMANTAN	BINTULU	03.2N	113.0E
NORTHWEST COASTS OF KALIMANTAN	KOTA_KINABALU	6.0N	116.0E
WEST COASTS OF PHILIPPINES	LAOAG	18.2N	120.6E
WEST COASTS OF PHILIPPINES	SAN_FERNANDO	16.6N	120.3E
WEST COASTS OF PHILIPPINES	MANILA	14.6N	121.0E
SULU SEA	ILOILO	10.7N	122.5E
SULU SEA	PUERTO_PRINCESA	09.8N	118.8E
SULU SEA	SANDAKAN	05.9N	118.1E
SULU SEA	LAHAD_DATU	4.9N	118.4E
EAST COASTS OF MALAY PENINSULA	KUARA_TERENGGANU	05.3N	103.2E
EAST COASTS OF MALAY PENINSULA	SINGAPORE	01.3N	103.9E
CELEBES SEA	ZAMBOANGA	06.9N	122.1E
CELEBES SEA	MAIMBUNG	5.9N	121.0E
CELEBES SEA	COTABUTO_CITY	7.3N	124.2E
CELEBES SEA	TARAKAN	03.3N	117.6E
CELEBES SEA	MANADO	01.6N	124.9E
CELEBES SEA	TOLITOLI	01.1N	120.8E
CELEBES SEA	TABUKAN_TENGAH	3.6N	125.6E
NATUNA SEA	SINGKAWANG	01.0N	109.0E
NATUNA SEA	PANGKALPINANG	02.1S	106.1E
NATUNA SEA	KUALA_INDRAGIRI	0.5S	103.8E
NATUNA SEA	KEPULAUAN_RIAU	4.0N	108.5E

Table IV-1.Poposed list of forecast points

Note: Green rows represent additional FPs to the current list
Note: Orange cells represent modifications from the current list

ANNEX V

INTERNATIONAL TSUNAMI SYMPOSIUM COMMEMORATING THE 50TH ANNIVERSARY OF THE PACIFIC TSUNAMI WARNING AND MITIGATION SYSTEM

Making the Pacific Ready for the Tsunami Threat
20-21 April 2015
NOAA Inouye Regional Center,
Ford Island, Oahu, Hawaii

Organized by the Intergovernmental Oceanographic Commission (IOC) of UNESCO, International Union of Geodesy and Geophysics (IUGG), and the Government of the United States of America

SUMMARY REPORT

The Symposium commemorated the 50th anniversary of the International Tsunami Warning System in the Pacific. Altogether, 150 participants from 30 countries attended. The establishment of the ITSU/PTWS in 1965 was an amazing achievement demonstrating great foresight and true international cooperation. Additionally, PTWS Member State contributions to the formation and development of the tsunami warning capability globally after the 2004 Indian Ocean tsunami were foundational for its success. Over 40 speakers representing 19 countries recounted the achievements of the last 50 years, stated and reviewed the current state of the System, and identified and recommended practical and tangible next steps, desirable partnerships, and necessary commitments needed to sustain and evolve the PTWS for the future. The goal of the Symposium was to “look back so we can look forward.” Sessions featured keynotes from long-standing countries, the history of the PTWS, and the PTWS Medium-Term Strategy (MTS) themes of Risk Assessment and Reduction, Event Detection, Warning, and Dissemination, and Awareness and Response. Thematic sessions consisted of speakers and panels representing decision-makers, planning and policy, science, warning, and/or emergency operations practitioners. Panel discussions sought to address the themes in a holistic and interdisciplinary manner. In addition to the Plenary session, there were 33 posters and / or extended Abstracts submitted. Participants were invited to submit papers to be published as part of a peer-reviewed Special Volume on the Pacific Tsunami Warning and Mitigation System: Past, Present, and Future. During the evening poster sessions, tours of the PTWC and ITIC spaces, a demonstration of tsunamis visuals projected in three-dimensions on the NOAA Science of the Sphere, and numerous tsunami event, awareness, and education videos were shown.

Symposium meeting documents are posted to
http://itic.ioc-unesco.org/index.php?option=com_content&view=article&id=1911:international-tsunami-symposium&catid=2153:its&Itemid=2596

Mr Brian Yanagi (ITIC), as emcee, welcomed everyone to the NOAA Inouye Regional Center, which was newly moved into in early 2014. It is home to all NOAA Line Offices in Hawaii, including the offices of the PTWC and the ITIC on the third floor, and the National Weather Service Pacific Region Headquarters on the second floor.

During the Opening Session, Dr Vladimir Ryabinin welcomed the Group by video, expressing his regrets that he could not attend in person due to commitments in Paris for the UNESCO Board meetings. He acknowledged the very important job warning systems have in protecting millions of people on coasts globally, and commended Member States for their energy, devotion, and professionalism, noting that it is that combination of expertise and energy that moves this world forward. Dr Yutaka Michida of Japan, IOC Vice-President,

Dr Vasily Titov, Chair, International Union of Geodesy and Geophysics (IUGG) Tsunami Commission, Dr Ken Gledhill of New Zealand, Chair, Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System (ICG/PTWS), Lt General Anthony G. Crutchfield, U.S. Army, Deputy Commander, United States Pacific Command (USPACOM), and Brigadier General Arthur J. Logan, Adjutant General, Hawaii Department of Defence and Director, Hawaii Emergency Management Agency (HI-EMA), then welcomed participants.

PTWS Historical Keynotes from Long-standing Countries

The Session began with the debut of the PTWS video "Tsunami Warning!" produced by the ITIC, in collaboration with the USA and Chile. The fast-paced video follows the tsunami warning chain in countries around the Pacific as they respond to a M9.5 earthquake and tsunami off the northern coast of Chile. The video chronicles PTWC as staff quickly analyses seismic and sea level data, forecasts tsunami wave heights, and disseminates threat assessments to country National Tsunami Warning Centres. Vignettes highlight actions by centres and communities starting immediately after the earthquake in Chile and Peru, and after receiving the PTWC alerts in Samoa and Hawaii, and in Australia, Japan, Indonesia, and the Philippines.

Following the video, the USA, Chile, Japan, and Samoa provided keynote presentations on their systems, and shared lessons learned from their long experience in mitigating against tsunamis. Ms Laura Furgione (USA National Weather Service) spoke on the vision of a WeatherReady (184 TsunamiReady communities as of 2015) nation with a ready, responsive, and resilient society; she emphasized the importance of consistency in warnings for them to be effective, and the need to deliver warnings "through" the last mile. Whereas there were 4 DART systems in 2004, there are now 60, and the new generation of DARTs can be placed closer to the earthquake zone for earlier tsunami detection. Rear Adm Patricio Carrasco (Chile SHOA) spoke on the evolution since 1965 of Chile's El Sistema Nacional de Alarma de Maremotos (SNAM), and its good performance for the 1 April 2014 earthquake and tsunami. There are 40 real-time sea level stations and 2 DARTs. He emphasized that although the detection networks are vastly improved, because we cannot predict earthquakes, there is no fool proof early warning system and we therefore always need to be prepared. Mr Yasuo Sekita (JMA) noted that Japan's system started in 1949. The lesson learned from the 2011 Great East Japan Earthquake and Tsunami was that though JMA responded optimally to issue the warning in three minutes, the forecast was based on an underestimated earthquake magnitude. To be sure for maximum public safety, it is recommended to instead use the worst case scenario wave forecast – that change in procedures was implemented in March 2013. He also noted that JMA operations continued despite strong shaking, and attributed this ability to the regular exercises and drills that are part of the required duty. Ms Filomena Nelson (Samoa NDMO) related that tsunami awareness and preparedness efforts (evacuation procedures and drills) prior to the 29 September 2009 local tsunami saved many lives. The tsunami affected 18% of the population and the $104 million in damage was 20% of their GDP. Since the tsunami, with donor assistance, they've improved their detection, monitoring, warning, and alerting capabilities, and are implementing disaster risk reduction programmes for tsunami, cyclone, and other hazards.

History and milestones in the development of the Tsunami Warning System (TWS) in the Pacific, ITSU to PTWS, 1960-2015

The Session was chaired by Fred Stephenson (former Canada TNC, ITSU Chair 2006-2007). Dr Iouri Oliounine (ITSU Technical Secretary, 1982-2002) provided a historical keynote recalling highlights from his tenure. These were followed by summaries by Fred Stephenson for 1960-1985, Francois Schindele (France TNC, ITSU Chair, 1999-2005) for

1985-2005, and Masahiro Yamamoto (retired Senior Tsunami Advisor, UNESCO IOC Tsunami Unit (2005-2012), and Director, Earthquake and Tsunami Observations Division, Seismology and Volcanology Department, JMA (2004-2005)), for 2005-2015. Paula Dunbar of NOAA's National Geophysical Data Center, closed the session with a summary of the PTWS Commemorative Historical Book, "Pacific Tsunami Warning System, A Half-Century of Protecting the Pacific, 1965-2015" that was edited by ITIC and NGDC. The following is a combined summary from all speakers.

After the devastating tsunamis of 1960 and 1964, an international tsunami warning system was established, building on the foundation of existing national systems in Hawaii, USA, Japan and Kamchatka, Russian Federation. Fortunately, the USA took a leadership role and offered to host the new international TWS in Hawaii, and to host the services of ITIC, with the general mandate of mitigating the effects of tsunamis throughout the Pacific.

Initially, the Group had only six members and the first decades were challenging. Even with the best available seismographs, tide gauges and communication systems, the Pacific's large geographic area made it nearly impossible to monitor completely. There were too few instruments, and the times needed to collect seismic and water level information, and to disseminate warnings and watches, were too great for most events. The Pacific Basin the Ring of Fire is a very large ring. Slowly the number of Member States grew, and with it the number of seismic and water level stations. By the mid-1980s, new digital instruments and computers, satellite communications, numerical models and the internet reduced the time needed to collect data and disseminate warnings and watches. The western and southwest Pacific regions still presented challenges to the PTWS. The ITIC developed training programmes and educational material produced a Newsletter and established a visiting scientists program. "A Guide for a Post-Tsunami Survey" was produced, and the Group developed for the first time the ITSU Master Plan to ensure that resources for the improvement of the international TWS were most effectively utilized.

During the first 25 years of the PTWS, there weren't a large number of destructive tsunamis, most being only locally destructive and all of these tsunamis were 'normal' in their behaviour. By 1990, the PTWS was finally starting to solidify and build a reliable, robust, and timely warning system. New tools, like the TREMORS system, and the MOST tsunami model were helping in this regard.

After 1990, the frequency of destructive earthquakes increased and there were more "abnormal" tsunamis; slow earthquakes in Nicaragua (1992) and Peru (1996), and earthquakes with tsunami wave heights much larger than expected in Indonesia (1992, 2006). These tsunami earthquakes are challenging for the Tsunami Warning Systems and for emergency response planners. Fortunately, these are the events that most interest the tsunami research community. Their investigations result in findings that feed back to the operational warning and mitigation communities and contribute to improved understanding and procedures.

On December 26, 2004 when the Sumatra earthquake occurred, the PTWS was able to calculate the earthquake magnitude and destructive potential. But unfortunately, the PTWC had no official contact information for countries in the Indian Ocean. If they had that information, warnings could have been issued that would have saved many lives – altogether, 230,000 perished in Indonesia, 14 other countries in the Indian Ocean. In the aftermath, the PTWC and JMA provided tsunami watch information for the Indian Ocean region until their own TWS become operational in 2013. The IOC took the lead in establishing warning systems in the Indian Ocean, the Caribbean Sea, and the North Atlantic and Mediterranean Sea. The ICG/PTWS community provided much support in the creation of these new TWSs. Directors of the ITIC, PTWC, and JMA TWC, and the NOAA NWS provided their expertise and support, as did the officers of the ICG/PTWS.

Fifty years after the PTWS's humble beginning, the PTWC now receives real-time data from > 500 seismic stations, > 500 sea level stations and 60 DART buoys. Automated systems determine an earthquake's epicentre, magnitude and depth, and numerical models simulate the tsunami's propagation and estimate coastal impact. Alerts are sent within 10 minutes of the earthquake. The ICG/PTWS encompasses 46 Member States of the Pacific and its marginal seas.

The ICG/PTWS and ITIC continue to work to strengthen every country's TWS, to densify monitoring networks, develop better tools for tsunami detection and decision support, to support capacity building and training, to quality control and improve the historical database, to develop new education material, and to interact with the other TWSs and emergency management organizations. There is no standing still.

If that small group of people who attended the first Working Group meeting in Honolulu in April 1965 could have been with us this week, their impressions would have been very un Spock-like. They would likely stand up, exchange 'high-fives' and say "well done."

For recommendations for the next 5-10 years, the Historical Session speakers stated:

1. All members of the PTWS should be active participants. It should not be left it to the Group Chair to do the bulk of the work. The Vice-Chairs, Task Teams and other members all have contributions to make. Every Member State Tsunami National Contact and Tsunami Warning Focal Point should contribute by being a champion of the PTWS programme in their country.

Thematic Session 1: Hazard and Risk – Identification and Risk Reduction

Understanding tsunami risk has two components: hazard assessment (specifying tsunami sources and their wave height potential along the coast), and risk assessment (estimating likelihood of tsunami effects to coasts in terms of human impacts or physical damages). The aim is to know where the at-risk areas are and how a tsunami could affect those areas. Risk and hazard assessment are conducted utilizing the latest scientific tools and available tsunami data. Understanding tsunami risk is fundamental for planning effective tsunami warnings. It is also required for disaster risk reduction activities that reduce the impact and community exposure to tsunami threats.

The Session was chaired by Dr Eddie Bernard, Scientist Emeritus, NOAA Pacific Marine Environmental Laboratory. Expert topical talks were given by Dr Kenji Satake (University of Tokyo) on Gigantic Earthquakes and Tsunamis, Dr Viacheslav Gusiakov (Novosibirsk Tsunami Laboratory, Russian Academy of Sciences) on Tsunami Hazard Assessment and Risk, Gary Y.K. Chock (U.S. ASCE -7 Tsunami Loads and Effects Subcommittee) on Tsunami Provisions in the International Building Code, and Doug Mayne (Vice Director, Hawaii Emergency Management Agency) on Hawaii tsunami preparedness. Panelists included Dr Garry Rogers (Geological Survey of Canada), Dr Hansjürgen Meyer (Colombia Corporación OSSO), and Prof Karl Kim (University of Hawaii). They provided thoughts on how to responsibly link science, uncertainty, and public policy to ensure simple understanding of risk, and meaningful implementation of programmes that make countries safer from the tsunami threat, and adaptations needed to meet varying risk levels and community capacities.

Dr Satake described successes and challenges in tsunami warning for giant earthquakes and tsunamis. Forecasting of far-field tsunamis through seismic waveform analysis, tsunami monitoring, and travel times and wave height estimation is relatively good. In contrast, uncertainty continues for near-field tsunamis where quick estimates of earthquake size and tsunami potential can be misleading (underestimate). He noted the continuing challenge of

detecting ‘tsunami earthquakes’ in real-time, and progress, such as in Japan, in determining the possible maximum earthquake size for different locations, which can then be used for worst case scenario evacuation planning.

Dr Gusiakov summarized historical tsunamis, noting that 20% (452) occurred between 1965 and 2015, including two trans-oceanic mega-tsunamis (2004, 2011) and five tsunami earthquakes. Trans-oceanic tsunamis from M9 subduction earthquakes contribute the most to the overall tsunami hazard (< 1% of events responsible for >50% of fatalities), producing the highest run-ups (> 10m) over long stretches of coastline (~1000 km). The M9 value looks to be the threshold for generating trans-oceanic tsunamis.

Mr Chock described the U.S. effort to include national standards in engineering design for tsunami effects (ASCE 7-16 Standard, Chapter 6–Tsunami Loads and Effects). The Standard will be published in March 2016, and the Tsunami Provisions referenced in the International Building Code in 2018. Tsunami-resilient engineering design involves tsunami modelling for expected flooding heights, probabilistic tsunami hazard analysis for the scenario, and coastal, hydraulic, structural, and geotechnical engineering loading calculations to achieve structural reliability for buildings.

Mr Mayne emphasized the importance of preparedness at the community level – we must ensure the public is educated and understands the threat, and then knows about warnings and responding. April is Tsunami Awareness Month in Hawaii, and for schools, it is required to conduct tsunami evacuation drills. HI-EMA sponsors the Hawaii Hazards Awareness and Resilience Programme (HHARP) as a community-based and -driven all-hazards empowerment programme that citizen champions can lead to build resilience in their community through preparedness. Support is especially focused on those communities that might become isolated after a disaster.

During the Panel Discussion, Dr Gary Rogers noted that communicating science and risk in simple, non-jargon terms continues to be the biggest challenge, but if done, people can become champions; explanations in the local context and lexicon, with lots of local pictures that people can relate to are very helpful. Dr Meyer indicated that Colombia’s two coasts are diverse and long, making their efforts more difficult. He stressed the importance of the PTWS in its coordinating role and PTWC for its steady alerting for decades as factors that have helped his country to sustain momentum over the years. Dr Kim spoke of the need to take an all hazard approach, and consider how different hazards, including human-induced, affect the same place and location. To better manage risk takes planning and land use zoning, which are often difficult. One way easy way to manage risk is to build more capacity through training, especially down to community level, which is the aim of the U.S. National Disaster Preparedness Training Center of the University of Hawaii.

Further discussion from the audience focused on mega events, and how to best quantify what they are (maximum size, maximum probability), how often they recur, and where. The challenge continues into how to effectively communicate the science so the public understands, as this then shapes the implementation of policy.

Dr Bernard summarized that there are still a number of scientific questions to answer, and reminded the Plenary that tsunamis are a flooding hazard. For Theme 1, the summary Session statements were:

1. Establish standards for flooding products such as evacuation maps, building codes, preparedness programs, etc. to serve as international guidelines. These standards require technical expertise that could be drawn from the IUGG Tsunami Commission, and others.

2. Build capacity to apply these standards in tsunami threatened countries to ensure public safety and global consistency. Capacity could be built using UNESCO/IOC partners and other educational partners throughout the world.

Thematic Session 2: Warning and Forecast: Detection, Warning and Dissemination

An effective tsunami warning system involves the rapid detection and quantification of the tsunami source; forecasting and verification of wave propagation and identification of likely threatened areas; and dissemination of information about the threat to enable communities to respond. These topics should be addressed within national, regional, and ocean-wide contexts. National warning systems are the most crucial part in the entire end-to-end system for both local and distant source tsunamis due to their national responsibility for alerting communities at risk and for urging or ordering immediate evacuation. Local source tsunami warning requires data and techniques that rapidly warn people in minutes, complemented by continuous public education efforts to immediately react to the natural tsunami warning signs. This Theme was divided into Sub-Themes on 1. Tsunami Warning Operations and 2. Warnings – The Last Mile.

Sub-Theme 1: Tsunami Warning Operations

The Session was chaired Dr Laura Kong, Director, ITIC. Expert topical talks were given by Dr Charles McCreery (Director, PTWC) on Tsunami Warning, Dr Dominique Reymond (Director, Polynésien de Prévention des Tsunamis (CPPT)) on Real-time Earthquake Source Characterization, Dr Vasily Titov (NOAA PMEL) on Tsunami Forecasting, and Tomoaki Ozaki (Senior Coordinator for International Earthquake and Tsunami Information, JMA) on Japan Local Tsunami Warning. Panelists included Prof Yuichi Ono (Tohoku University), Cdr Juan Ramon Sans Aguilar (Director, Mexican Tsunami Warning Center), and ‘Ofa Fa‘anunu (Director, Tonga Meteorological Services). They provided thoughts on the adequacy of the present core seismic and sea level observing networks, and analysis methodologies, whether instrument-determined local tsunami warnings possible and practical, and what level of accuracy is necessary, and how quickly should a forecast be made, to be useful to the different stakeholders (government, non-government, private sector, public, special populations).

Dr McCreery provided a historical overview noting it used to take an hour to get a warning issued, but now with > 500 seismic stations to monitor earthquakes and > 500 sea level stations to monitor tsunamis, warnings can be issued in a few minutes. While arrival times for distant tsunami can be determined well, maximum impact and duration is much harder, and it is not known where the next big one will occur - models are used to estimate propagation and inundation, but the results depend on the tsunami source. The W-phase Centroid Moment Tensor now takes only ~20 minutes to compute, and gives the earthquake source, and this is used to forecast the tsunami coastal inundation. New sensing techniques utilizing GPS, undersea cables, and remote sensing show promise, and alerting methods (CAP, mobile phone broadcasting) are becoming better (faster, reliable). He stated that ensuring sustainability and promoting active coordination are important for the future of the PTWS.

Dr Reymond spoke on real-time earthquake monitoring for tsunami warning, noting that if the earthquake source characteristics are wrong, then the tsunami modelling results will be wrong, and the forecast may under- or over-estimate. 78% of the Pacific’s deadly tsunamis were generated by earthquakes, so it is important to monitor and analyse them for tsunami warning. Centres utilize automated processes to rapidly locate and size the earthquake, and invert seismograms for source information. In the first 10s of minutes, the earthquake’s location, magnitude (using P waves is quickest, but great or slow earthquakes have significant energy at long periods), fault dynamics and geometry are determined. The biggest

unknown is in estimating the earthquake's fault dimensions – high-frequency GPS looks promising for providing direct ground displacement without saturation.

Dr Titov continued the warning centre process discussion by focusing on challenges in tsunami wave forecasting – of the trade-off between forecast speed and accuracy. The goal is the flooding impact, but it depends on the source and it may take several iterations (and time) to obtain an accurate forecast. He summarized by giving a forecast timeline: 1. Source determined (taking 3-15 min); 2. Tsunami propagates (taking 1-5 min); 3. Tsunami inundates (taking 10-15 min); 4. Tsunami observed (taking 20-120 min); and 5. Cycle repeats. Currently, it takes ~30 min for a forecast, and accuracy is ~70%. Dr Titov stated that the flooding forecast must be available in < 15 min to be practical. To achieve this, DARTs need to be placed closer to the source for faster observations, and there must be good near-shore bathymetry and topography for accurate forecasts.

Mr Ozaki provided lessons learned based on the performance of Japan's local tsunami warning system. Warnings should be announced quickly, and be as simple as possible. While there are > 270 seismic stations, > 100,000 scenarios in the tsunami simulation database, and JMA can issue a warning within two minutes of the earthquake, there is unavoidable uncertainty in earthquake characteristics calculated in the early minutes – thus, JMA assumes the worst case scenario for the first message. Even so, people should leave immediately and evacuate when they feel strong, or unusually long but weak earthquake shaking. To be simple, JMA uses pre-determined messages, where the warnings are linked to actions, and these have been socialized to the public.

During the Panel, Dr Ono emphasized that there is No Perfect System - people make mistakes. Everyone should react on their own to warnings, rather than over-depend on TWC warnings. He called for people-centered multi-hazard warning systems and stressed the importance of evacuation drills. Land-use planning and structural mitigation (vertical refuges) help reduce losses. Changes in policy are successful when data and statistics are used to support the change. Mr Fa'anunu described the situation in Tonga since 2004, and the challenges they had during the 2009 tsunami in issuing the alert, which eventually was issued but ~3:30 hours late. It has improved with Fiji - Tonga seismic data sharing, better SOPs, and increased awareness so people know what immediately do. However, he called for improved placement of DARTs to better help Samoa, Tonga, and Fiji, inundation modelling to facilitate planning, and more training for operational staff. Cmdr Ramon summarized warnings in Mexico. There has been no major event in 200 years, but they have a local threat 30 km offshore and people need to respond in 4-7 minutes. Automation will reduce processing time. The speed of the alert is important, but accuracy is also important so people know how far to go.

Further discussion from the audience called attention to the importance of Theme 3 on public education and community preparedness, so people know when to act immediately independent of a tsunami warning. Mr Ozaki reminded that early, tsunami warnings are very important to alert people, but if the forecast is an under-estimate, it may prevent evacuation so it is a difficult situation.

Dr Kong summarized that there has been tremendous progress made over the last 20 years, with several keystone tsunamis contributing to milestone improvements in detection and analysis. The following summary Session statements are:

1. Warning safely for distant tsunamis has been achieved. Warning for local tsunamis is the biggest challenge for the future. There are promising technologies on the horizon.

2. For local tsunamis

- There are competing requirements for speed and accuracy, but right now we cannot do both. Presently, we need more time to characterize the earthquake source (location, magnitude, fault rupture) and to forecast the wave height and inundation.

- Announce quickly and use simple, actionable messages. People should not wait for the warning (may not come, may be late) – evacuate immediately if you feel the earthquake.

- To be useful, an accurate forecast needs to be available within 15 minutes. Currently, it takes ~30 min or more. Improvements in network density and computation speed are needed, as well as good coastal bathymetry/topography.

3. The reality is that there is no single perfect warning. Knowing the earthquake and the tsunami's reaction are still inexact, so we need to invest in awareness. Technology (tsunami warning) and preparedness must work together to save lives.

Sub-Theme 2: Warnings - The Last Mile

The Session was chaired by Bernardo Aliaga, IOC PTWS Technical Secretary. Expert topical talks were given by Edward Young (Deputy Director, NOAA NWS Pacific Region) on Warning Communications and Technologies, and by Loti Yate (Director, Solomon Islands National Disaster Management Office) on Warning the Last Mile. Panelists included Dr Rene Solidum (Director, PHIVOLCS), Lcl Frederic Tournay (Director, Haut-Commissariat de la République en Polynésie Française), and Dr Ye Yuan (Director, Tsunami Warning Division, China National Marine Environmental Forecasting Center). They provided thoughts on information flow challenges in communicating threat and actionable safety information to the different stakeholders in the warning chain, and what the key investments countries can make to ensure 'Last Mile' warnings are more robust and effective.

Mr Young emphasized diversity as important for successfully warning different customers. He covered satellite-based global technologies such as the WMO GTS, EMWIN, LRIT, GEONETcast, and RAPIDcast, mobile technologies such as cellular SMS and broadcast, and the Chatty Beetle, HF and VHF radios, especially in the Pacific Islands, and role of social media such as Twitter in assisting in the communication of warnings. He noted the importance of authoritative information and the challenges to ensure non-confusing, accurate warnings through the different communication media.

Mr Yates stated the Solomons Islands has 992 islands, and many earthquakes and local tsunamis (20 in 1926–2013, with 4 catastrophic; 1960 and 2011 far-field), and thus a big challenge in warning everyone. They use multiple media, such as radio, TV, HF radio, phone/fax/internet (only 10% in urban center); cellular SMS developing. Telecommunications infrastructure and service will improve in time, but in the meantime, Island Wave annual exercises, along with aggressive awareness and preparedness programmes, have to be their focused efforts.

During the Panel, Dr Solidum shared the Philippines' strategy which centered on community-based early warning. In the Philippines, tsunamis can occur on either side of the country, with 40 events in the last 400 years. Their major challenge is how to disseminate warnings to all their islands – they cannot, so communities need run their own Community Tsunami Early Warning System (monitoring) and be educated on how to respond to warnings. The education sector is also key. Lcl. Tournay emphasized time, and for this, SMS messaging is useful. In the future, with location information automatically embedded, it could be used to expertly show the fastest way to the safe zone. Training is very important for response.

Dr Yuan noted that successful warning is much more than science and technology - it requires warning centre coordination with different stakeholders with different responsibilities. In some nations, convincing authorities that there is a tsunami hazard is a big challenge. A best practice in China is to make sure fishermen are equipped with GPS and SMS so they can be kept informed.

From the audience, Cook Islands requested that the RANET PTWC SMS text messages be reinstated. Mr Young responded that it is pending, but will be reinstated. Dr Solidum requested the ITIC to provide simulations to use in community preparedness training. ITIC noted the existing scenarios from the Pacific Wave exercise, and will update them to use the latest PTWC formats, and inform PTWS TNCs on their availability.

Mr Aliaga summarized with the following Session statements:

1. A diverse set of technologies is required for warning dissemination to ensure communications are reliable and redundant.

2. The PTWS has countries with isolated communities or remote islands that are difficult to reach with timely warnings. Satellite, or radio technologies, that are simple are needed.

3. Technology cannot be the only solution. Communication of information, including warnings, requires multi-stakeholder responsibility.

4. Training is key to getting information from the upstream to the vulnerable communities. All parts of the warning chain should have SOPs that are exercised regularly.

Thematic Session 3: Awareness and Response

Preparedness, Emergency Planning and Response, and Post-Disaster Response

It is essential that tsunami-vulnerable communities are made aware of the effects of and how to respond through simple, cost-effective, and culturally sensitive awareness programmes that utilize all-available communication and media mechanisms. Emergency management authorities need plans, standard operating procedures and arrangements to enable effective response management and evacuations. Ensuring the safe action in harbours and ports during tsunamis requires pre-planning. Exercises are essential to maintain operational readiness and test warning systems, and should be conducted on a regular basis. Engagement of non-governmental organizations (NGOs), the private sector, and community representatives as partners is critical component in post-disaster response and for sustaining preparedness and reducing risk throughout the disaster management cycle.

The Session was chaired by David Coetzee, Manager, Capability & Operations, New Zealand Ministry of Civil Defence and Emergency Management. Keynote talks were provided by Mylene Villegas, Chief, GDAPD, PHIVOLCS) on Community Education and Awareness, Vinnie Atofau, Jr (Manager, TEMCO, American Samoa) on Tsunami Emergency Response and Evacuation, Kevin Miller (Earthquake and Tsunami Program, California Office of Emergency Management) on Boat Harbours and Shipping Ports during Tsunamis, and Julie Leonard (USAID Office of Foreign Disaster Assistance, Latin America and the Caribbean Office) on Post-Event Response, Relief, and Recovery and Humanitarian Assistance. Panelists included Rick Bailey (Head, Tsunami Warning & Ocean Services, Australia BOM), Dr Wilfried Strauch (INETER, Nicaragua), and Dr Sun-Cheon Park (Korea Meteorological Administration (KMA)). They provided thoughts on Awareness and Response challenges, or successes, and how communities can be more involved in tsunami risk mitigation.

Ms Villegas emphasized that when there is a local threat, communities need to be prepared to respond themselves. This statement was common in all Thematic Sessions. The PHIVOLCS national system is well established, including research and social aspects. They work with communities, which are at different levels of awareness and use their own local language dialect, to develop their response plans. Community tsunami early warning monitoring and alert systems are being piloted.

Mr Atofau recounted that before the 2009 tsunami, there was only minimal tsunami preparedness. Now, with U.S. National Tsunami Hazard Mitigation Program (NTHMP) and FEMA support, they have been able to conduct inundation modelling, create evacuation maps, signage, deploy sirens, and put response plans in place. The ASDHS and NWS Pago Pago work closely together during warnings, and as partners in outreach and preparedness. American Samoa was recognized as TsunamiReady in 2012.

Mr Miller described the U.S. NTHMP as a State and Federal partnership, with the State emergency management agencies leading preparedness. The Tsunami Maritime Safety Planning effort seeks to implement a consistent national policy for maritime evacuation. Each harbour is using scenarios to estimate damaging currents, plan vessel traffic control in and out of harbours, and port re-opening issues. Proposed minimum offshore evacuation depths for ocean-going vessels for local and distant sources are 30 and 100 fathoms, respectively.

Ms Leonard summarized the role and process by which USAID, and by analogy other aid agencies, become involved in responding. The disaster must exceed the country's capacity to respond and the affected country must request, or will accept assistance. For OFDA, a field-based DART works with a Washington-based RMT (EOC) to organize response using an Incident Command System structure. Partners are the national and local government, and the affected community, as well as other international response organizations.

During the Panel, Mr Bailey, who chaired the ICG/IOTWS, stated that the last mile is the most important mile - a community must know what to do. Needs are common for all oceans. In the Indian Ocean 10th Anniversary Conference (November 2014), highlighted needs were risk assessment, education and training, Tsunami Information Centre's important role, preparedness, exercises and drills, and response. For the PTWS, suggested priorities are to 1. Establish Key Performance Indicators (KPIs); 2. Undertake capacity assessments; 3. Evaluate PTWS performance and progress from baseline; and 4. Encourage and enable countries to continually assess themselves using a common standard. Dr Strauch shared that while the 1992 Nicaragua tsunami killed, the slow earthquake was not felt so authorities needed to be persuaded that tsunamis are a threat. It has taken a lot of help from donors and the government to establish a national tsunami warning system and begin the regional CATAC. Dr Park noted that awareness had declined because the last tsunami that affected South Korea was in 1993. KMA has used tsunami exercise and education programmes to sustain awareness. She also emphasized that warnings and awareness must reach tourists and foreigners, recalling that her countries had 12 deaths and eight missing in the 2004 Indian Ocean tsunami.

From the audience discussion, it was emphasized that media needs to be educated and engaged in all steps (mitigation, preparedness, warning, response, recovery). Media may benefit more if guidelines and information kits are available. During the event, it is critical that media be given (and then report) accurate information. A focus should also be on community-based programmes – reference was made to the IOC workshop, 'Best Practice on Tsunami and Coastal Hazards Community Preparedness and Readiness in Central America and the Caribbean' (2008, WR 241) as an example of activities that will help all countries prepare.

Mr Coetzee summarized with the following Session statements:

- The PTWS consider that the heretofore 'Last Mile' should really be called the 'First Kilometer'. In the real world, the 'first in the line of fire' is the community. Thus, have we been focusing on the wrong end of the System?

- Response actions (SOPs) need to use a time perspective to plan effective warnings. For successful warning, what do communities need (and when) so that they respond correctly?

- The PTWS needs to involve more emergency managers. Then, it will be in a better position to truly set the most important priorities, and then seek and allocate resources accordingly.

Summary Session: Looking to the Future

The Session, chaired by Dr Yutaka Michida (Japan, IOC Vice-President, TOWS-WG Chair), articulated the requirements and commitments needed to sustain and evolve the PTWS to continue to protect the lives and property throughout the Pacific Region. The Thematic Session chairs for the Session on PTWS History, Hazard and Risk, Warning Operations, Warnings–Last Mile, Awareness and Response (Fred Stephenson, Dr Eddie Bernard, Dr Laura Kong, Bernardo Aliaga, David Coetzee) summarized pertinent issues, challenges, and recommendations raised in their sessions as key PTWS priorities for the next 5 -10 years (see above), and this was followed by remarks from the ICG/PTWS Chair Dr Ken Gledhill.

In his speech, the ICG/PTWS Chair recommended the following PTWS Priorities:

1. The PTWS, based on its experience, can and should play a strong role in the establishment of standards and the global harmonization tsunami services.

2. The PTWS warning services are moving from concentrating on tele-tsunamis to addressing local tsunamis. This is challenging but very important. The trade-offs of time versus accuracy for successful warning were presented by the Tsunami Warning Operations speakers, and summarized by the Session Chair. They identified a "Heisenberg's uncertainty principle for tsunami", which is that the faster a earthquake magnitude (or wave forecast) is estimated, the less precise the solutions will be, or vice versa.

3. The PTWS is a complete system with life-safety as its driving goal, and we cannot ignore any component of the system. "We are only as effective as our weakest link." Therefore, key strategic Pillar priorities should be:

    - Pillar 1: Understanding mega earthquakes. Where can they happen? What will be the impacts?

    - Pillar 2: Improving and realizing new tsunami detection and characterization tools, such as

        - Real time GPS and strong motion techniques
        - Using submarine cables
        - Remote sensing techniques

    - Pillar 3: There is a long list of "to dos" to implement and sustain including:

        - Preparedness, Public alerting, Exercising, Training
        - Last mile issues (or is that first mile?)

- The importance of “natural warning signs” and how this information is conveyed
- Sustainability of the high public awareness following recent events

4. Over the last five years we have concentrated on the Enhanced Products – using the best available science to inform alerting. This includes threat-based forecast models delivered in a variety of forms. My priority vision for the next five years is to ensure that the advances made in science that led to the availability of the Enhanced Products now lead to better life-safety outcomes. Specifically, this means that we need to use the best science available to inform evacuation zone, route and planning and procedures so that communities can react effectively when tsunamis occur. The best outcomes will happen when communities have a “culture of evacuation”, a philosophy espoused by the new mayor of Otsuchi, a small seaside city destroyed by the 2011 Great East Japan. So, the priority challenge is to implement a programme aimed at ensuring every community at risk has full evacuation plans socialised at the community level and informed by the best physical and social science. This is the outcome the PTWS should adopt as its challenge for the next five years.

5. Achieving this challenge will require changes in the governance of PTWS to ensure better balance in representation through the increased participation of the emergency management community.

<u>Pacific Town Hall Meeting:</u>

The Symposium closed with a ‘Pacific Town Hall Meeting.’ Representatives of the United Nations, Science, Warning Centres and Disaster Management Offices, Risk Reduction agencies, Post-Disaster Response and Recovery, Regional Organizations, Financing, and Member States dialogued on effective Disaster Risk Reduction drawing on lessons learned from recent tsunami disasters, and other natural hazard disasters, and the importance of adaptation in building greater resiliency. Discussions centered on the PTWS Medium Term Strategy (MTS) foundational elements, which are:

- Interoperability: Free, open and functional exchange of tsunami information
- Research: Enhanced understanding and improved technologies and techniques
- Capacity Building: Training, technology and knowledge transfer
- Funding and Sustainability: Resources to sustain an effective PTWS

Noted interventions were:

- Again, the importance and challenge of keeping public awareness, as even in Japan this is an issue. Media can assist in this activity. Media can be positive and negative but are always important. Exercise Pacific Wave exercises, which are conducted every two years, should also be used as public awareness opportunities.
- Again, improving the balance of warning and response for the Intergovernmental Coordination Group is a priority for truly saving lives. Including the disaster management sector is also important for ensuring budget sustainability.
- The PTWS MTS and Implementation plan must always keep sight of and be integrated with the seven targets outlined in the WCDRR 2015–2030 Sendai Framework.

- Sustainability does not mean to maintain the status quo. To be sustainable, you have to keep developing. There is still much to be improved - the best-prepared country in the world (Japan) still lost 4% of people in the flooded zones. Even with the best warning system and well-informed evacuation protocols, the human factor means that you may never get to 0% fatalities if you rely on people to evacuate when warned. Therefore, innovative solutions and research are still needed.
- There are still analysis challenges as there are too many 'false alarms.' If the alarms are reduced, people will believe warnings and act. Additionally, detection and warning protocols and criteria for other tsunami sources are needed, such as from volcanoes, landslides, and meteo-tsunamis.
- Integration of data, services, information in real-time needs to be in the forefront for the future.

Closing

At the closing, Mr Michael Angove, on behalf of the Symposium Committee (Angove (US Tsunami National Contact), Rear Adm Patricio Carrasco (Chile, PTWS Vice-Chair), David Coetzee (NZ, PTWS Disaster Management and Preparedness WG Chair), Dr Ken Gledhill (NZ, PTWS Chair), Dr Laura Kong (ITIC Director), Dr Vasily Titov (USA, IUGG Tsunami Commission President, PTWS Tsunami Hazard Assessment WG Chair), thanked the Session Chairs, Speakers, Panelists, and participants for sharing and reflecting on 50 years of tsunami warning in the Pacific. He reiterated that the System has sustained itself thanks to the active coordination and cooperation of every country, and as the U.S. Tsunami National Contact, is looking forward to working with everyone to continue to progress over the next half-century.

Ms Furgione, as the U.S. host for the Symposium, thanked everyone for coming to commemorate the 50th Anniversary at NOAA's new center. She recognized and congratulated the Local Organizing Team led by Mr Ed Young (NWS PR) and Mr Brian Yanagi (ITIC) for its excellent work for the Symposium.

ANNEX VI

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ANNEX VII

LIST OF DOCUMENTS

Working Documents

Agenda item	Code	Title
2.1	ICG/PTWS-XXVI/1Prov	Provisional Agenda
2.3	ICG/PTWS-XXVI/1Add prov	Provisional Timetable
3.1	ICG/PTWS-XXVI/9	PTWS Chair Report
3.3	ICG/PTWS-XXVI/39	Making the Pacific Ready for the Tsunami Threat
3.4	ICG/PTWS-XXVI/40	Global TWS Coordination & Harmonisation
3.5.1	ICG/PTWS-XXVI/41	PTWC Warning and Advisory Services Report
3.5.2	ICG/PTWS-XXVI/10	ICG/PTWS-XXVI-NWPTAC Report 2015
3.7	ICG/PTWS-XXVI/11	National Report Solomon Islands 2015
3.7	ICG/PTWS-XXVI/12	National Report Malaysia 2015
3.7	ICG/PTWS-XXVI/13	National Report Costa Rica 2015
3.7	ICG/PTWS-XXVI/14	National Report Chile 2015
3.7	ICG/PTWS-XXVI/15	National Report Ecuador 2015
3.7	ICG/PTWS-XXVI/16	National Report Canada 2015
3.7	ICG/PTWS-XXVI/17	National Report Nicaragua
3.7	ICG/PTWS-XXVI/18	National Reports Template
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3.7	ICG/PTWS-XXVI/26	National Report Australia 2015
3.7	ICG/PTWS-XXVI/27	National Report Colombia 2015
3.7	ICG/PTWS-XXVI/28	National Report Japan 2015
3.7	ICG/PTWS-XXVI/29	National Report Mexico 2015
3.7	ICG/PTWS-XXVI/30	National Report Indonesia 2015
3.8	ICG/PTWS-WG-SCS-IV/3	Fourth meeting of the Regional Working Group on Tsunami Warning and Mitigation System for the South China Sea Region (SCS-WG)
3.8	IOC/PTWS-WG-CA-III/3	Tercera Reunión del Grupo de Trabajo para América Central del Grupo Intergubernamental de Coordinación del Sistema de Alerta contra los Tsunamis y Atenuación de sus Efectos en el Pacífico (ICG/PTWS)
3.8	ICG/PTWS-XXVI/31	Report WG3 ICG/PTWS-XXVI
3.8	ICG/PTWS-XXVI/32	Fact Sheet PTWS Working Groups and Task Teams 2014
3.8	ICG/PTWS-XXVI/33	Regional Working Group South West Pacific_2015
4.3	ICG/PTWS-XXVI/34	Task Team Report - NWPTAC Enhanced Products
4.4	IOC/2015/TS/117	Exercise Pacific Wave 15. A Pacific-wide Tsunami Warning and Enhanced Products Exercise, 2-6 February 2015
4.5	ICG/PTWS-XXVI/35	Acta 1a Sesión del Consejo de Representantes de CEPREDENAC -1
4.5	ICG/PTWS-XXVI/36	INETER Proyecto de creación de CATAC
7	ICG/PTWS-XXVI/37	Election of Officers Form

10	ICG/PTWS-XXVI/38	Recommendation CATAC ICG/PTWS-XXVI (draft 20150413)

Background Documents

Code	Title
CL 2563	Updating information on NTWC and TWFPs for the PTWS region according to new definitions
CL 2566	Invitation to the 26th session of the ICG/PTWS, Honolulu, Hawaii, United States of America, 22–24 April 2015
ICG/PTWS-XXV/3	Twenty-fifth Session of the Intergovernmental Coordination Group for the Pacific Ocean Tsunami Warning and Mitigation System Vladivostok, Russian Federation; 2013
IOC/2013/TS/108	Medium-term strategy: Pacific Tsunami Warning and Mitigation System (PTWS MTS), 2014-2021

ANNEX VIII

LIST OF ACRONYMS

AMP	Maritime Authority of Panama
AoS	Areas of Service
BNOC	Bureau's National Operations Centre
CATAC	Central America Tsunami Advisory Centre
CCO	Colombian Ocean Commission
CEA	Alternative Energies and Atomic Energy Commission
CEPREDENAC	Coordination Centre for the Prevention of Natural Disasters in Central America
CHS	Canadian Hydrographic Service
CMA	China Meteorological Administration
COPECO	Comisión Permanente de Emergencias
CTN	National Technical Committee for Tsunami Warning
DEMS	digital elevation models
DFAT	Department of Foreign Affairs and Trade
DFO	Department of Fisheries and Oceans
DIRECTEMAR	Dirección General del Territorio Marítimo y Marina Mercante
DMO	Disaster Management Office
EMBC	Emergency Management of the province of British Columbia
EPOS	Earthquake Phenomena Observation System
ESZs	Earthquake Zones
FDSN	Federation of Digital Seismograph Networks
FEMA	Federal Emergency Management Agency
GA	Geosciences Australia
GSC	Geological Survey of Canada
GSN	Global Seismographic Network
HIGP	Hawaii Institute of Geophysics and Planetology

ICG/IOTWS	Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System (
ICG/NEAMTWS	Intergovernmental Coordination Group for the Tsunami Early Warning and Mitigation System in the North-Eastern Atlantic, the Mediterranean and Connected Seas (),
ICG/PTWS	Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System ()
IISEE	International Institute of Seismology and Earthquake Engineering
InaTEWS/BMKG	Indonesia Tsunami Early Warning System of the Indonesian Agency for Meteorological, Climatological and Geophysics
INETER	Instituto Nicaragüense de Estudios Territoriales
INOCAR	Joint Typhon Warning Center
IOC	Intergovernmental Oceanographic Commission
IOTIC	Indian Ocean Tsunami Information Center
IRIS	Incorporated Research Institutions for Seismology
ITIC	International Tsunami Information Center
ITP	International Training Programmes
ITST	International Tsunami Survey Team
ITU	International Telecommunication Union
IUGG	International Union of Geodesy and Geophysics
JAMSTEC	Japan Agency for Marine-Earth Science and Technology
JATWC	Joint Australian Tsunami Warning Centre
JICA	the Japan International Cooperation Agency
JMA	Japan Meteorological Agency
JST	Japan Science and Technology Agency
JTF	Joint Task Force
JTWC	Joint Typhon Warning Center
MRCC	Maritime Rescue Coordination Center
MRI	Meteorological Research Institute
MTS	Medium-Term Strategy

NASA	National Aeronautics and Space Administration
NCEI	National Centers for Environmental Information
NDBC	National Data Buoy Centre
NEIC	National Earthquake Information Center
NGDC	NOAA National Geophysical Data Center
NGRD	Unidad Nacional para la Gestión del Riesgo de Desastres
NIED	National Research Institute for Earth Science and Disaster Prevention
NOAA	National Oceanic and Atmospheric Administration
NRCan	Department of Natural Resources
NSF	National Science Foundation
NTWC	National Tsunami Warning Centres
NWPTAC	Northwest Pacific Tsunami Advisory Center
NWS	National Weather Service
OFDA	Office of Foreign Disaster Assistance
ONEMI	Oficina Nacional de Emergencia del Ministerio del Interior y Seguridad Pública
ORSNET	Oceania Regional Seismic NETwork
PICs	Pacific Island countries
PMC	Pacific Meteorological Council
PMEL	NOAA Pacific Marine Environmental Laboratory
PTHA	Probabilistic Tsunami Hazard Assessment
PTWC	Pacific Tsunami Warning Center
PWLN	Permanent Water Level Network
SATREPS	Science and Technology Research Partnership for Sustainable Development
SCS	South China Sea
SCSTAC	South China Sea Tsunami Advisory Center
SEMAR	Secretariat of Mexican Navy
SHOA	Servicio Hidrográfico y Oceanográfico de la Armada de Chile

SINAPRED	National System of Disaster Prevention (SINAPRED
SINAPROC	Sistema Nacional de Protección Civil
SOP	Standard Operating Procedures
SPC	Secretariat of the Pacific Community
SPREP	Secretariat of the Pacific Regional Environment Programme
TNC	Tsunami National Contact
TOWS-WG	Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems
TSP	Tsunami Service Provider
TT	Task Team
TWFP	Tsunami Warning Focal Point
UHSLC	Director of the University of Hawaii Sea Level Center
UNAN	the National University
UNESCO	United Nations Educational, Scientific and Cultural Organization
US NTWC	National Tsunami Warning Center of United States
USAID	United States Agency for International Development
USGS	U.S. Geological Survey
UVIC	University of Victoria
VCP	Voluntary Cooperation Programme
WCDRR	World Conference on Disaster Risk reduction
WDS	World Data Service
WG	Working Group
WG-CA	Working Group for Central America
WMO	World Meteorological Organization

In this Series *Languages*

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

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

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

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

151.	Twenty-fourth Session of the Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System, Beijing, China, 24–27 May 2011 (*Executive Summary in E, F, S & R included)	E*
152.	Twenty-first Session of the IOC Committee on International Oceanographic Data and Information Exchange, Liège, Belgium, 23–26 March 2011 (*Executive Summary available separately in E, F, S & R)	E*
153.	Eighth Session of the IOC Sub-Commission for the Western Pacific (WESTPAC-VIII), Bali, Indonesia, 10–13 May 2010 (*Executive Summary available separately in E, F, S & R)	E*
154.	Tenth IOC Intergovernmental Panel on Harmful Algal Blooms, Paris, France, 12–14 April 2011 (* Executive Summary available separately in E, F, S & R)	E*
155.	Forty-fifth Session of the Executive Council, Paris, 26–28 June 2012 (* Decisions available in E, F, S & R)	E*
156.	Seventh Session of the Intergovernmental Coordination Group for the Tsunami and other Coastal Hazards Warning System for the Caribbean Sea and Adjacent Regions, Willemstad, Curacao, 2–4 April 2012 (*Executive Summary available in E, F, S & R)	E*
157.	Eleventh Session of the IOC Sub-Commission for the Caribbean and Adjacent Regions (IOCARIBE), Miami, USA, 17–20 May 2011 (*Executive Summary available separately in E & S)	E, S*
158.	Eight Session of the Intergovernmental Coordination Group for the Tsunami and Other Coastal Hazards Warning System for the Caribbean and Adjacent Regions (ICG/CARIBE EWS-VIII), Trinidad & Tobago, 29 April–1 May 2013 (*Executive Summary available in E, F, S & R)	E*
159.	Twenty-seventh Session of the Assembly, Paris, 26 June–5 July 2013 and Forty-sixth Session of the Executive Council, Paris, 25 June 2013	E, F, R, S
160.	Twenty-fifth Session of the Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System (ICG/PTWS), Vladivostok, Russian Federation, 9–11 September 2013 (*Executive Summary in E, F & R)	E*
161.	Ninth Session of the Intergovernmental Coordination Group for the Tsunami and Other Coastal Hazards Warning System for the Caribbean and Adjacent Regions, US Virgin Islands, 13-15 May 2014 (*Executive Summary available in E, F, S & R)	E*
162.	Forty-seventh Session of the Executive Council, Paris, 1–4 July 2014 (* Decisions available in E, F, S & R)	E*
163.	Ninth Session of the IOC Sub-Commission of the Western Pacific (WESTPAC-IX), Busan, Republic of Korea, 9–12 May 2012	E
164.	Eleventh Session of the Intergovernmental Coordination Group for the Tsunami Early Warning and Mitigation System in the North Eastern Atlantic, the Mediterranean and Connected Seas, 12–14 November 2014, Nicosia, Cyprus (*Executive Summary available in E, F, S & R)	E*
165.	Twenty-sixth Session of the Intergovernmental Coordination Group for the for the Pacific Tsunami Warning and Mitigation System (ICG/PTWS-XXVI), Hawaii, USA, 22–24 April 2015 (*Executive Summary available in E, F, S & R)	E*