Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems (TOWS-WG)

Eleventh Meeting
Paris, France
16–17 February 2018
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This document contains the executive summary in English, French, Spanish and Russian.
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Executive Summary

The Eleventh Meeting of the Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems (TOWS-WG-XI) was held in Paris, France, on 16-17 February 2018 under the Chairmanship of Mr Alexander Postnov (IOC Vice-Chair). The meeting evaluated progress in actions and decisions taken by the Governing Bodies through IOC-XXV/Dec. 7.2.

The Group recognized the success of the symposium Advances in Tsunami Warning to Enhance Community Responses (12–14 February 2018, Paris, France) (hereafter “the Symposium”) in identifying the current status and future directions to improve operational tsunami warnings and community resilience.

The Group recognized the physical, economic and social impact of the recent 2017 Hurricane Season and other Natural Disasters in the Caribbean region.

The Group noted the decision by the UN General Assembly, as part of the Omnibus Resolution for Oceans and the law of the sea (A/RES/72/73), to “proclaim the United Nations Decade of Ocean Science for Sustainable Development for the 10-year period beginning on 1 January 2021, and called upon the Intergovernmental Oceanographic Commission to prepare an implementation plan for the Decade in consultation with Member States, UN Bodies, and relevant stakeholder”.

The Group reviewed reports by the IOC Intergovernmental Coordination Groups (ICG) as well as its own Task Teams on Disaster Management and Preparedness and Watch Operations.

The Group noted with satisfaction the progress made during the intersessional period, including:

- Two exercises carried out (CARIBEWave 2017, NEAMWAVE 17) and regular communication tests performed;
- Progress in sharing the results of Tsunami exercises and communication tests with World Meteorological Organization (WMO);
- Increased number of sea level stations in North-eastern Atlantic and Mediterranean region to ensure reinstatement of monitoring, detection, communication and warning capacity;
- The publication of the document Plans and Procedures for Tsunami Warning and Emergency Management (IOC Manuals and Guides, 76);
- The adaptation and piloting of the CARIBE-EWS Tsunami Ready community based performance recognition programme in the Pacific and Indian Ocean;
- The completion of the educational strategy to address buoy vandalism and the contribution of the ICGs towards it.

The Group recommended the Executive Council to encourage Member States:

- to increase and sustain technical and financial support of the tsunami and other coastal hazards warning systems in their respective regions considering the significant impacts of these hazards on lives and livelihoods in coastal communities;
- to further promote tsunami awareness in communities and among authorities through communication and tsunami wave exercises, training, information, and community preparedness and recognition programmes;
• to densify sea level networks and seismic network particularly nearby tsunamigenic sources;
• to support the rehabilitation and enhancement of the sensing, communication and warning infrastructure to insure readiness from future events in Caribbean;
• to consider the recommendations from the Symposium contained in the summary statement.

**The Group recommended** the Executive Council to instruct ICGs:

• to advocate World Tsunami Awareness Day among Member States and advise them of the availability of material from the United Nations Office for Disaster Risk Reduction (UNISDR) in this regard, and share activities and materials with UNISDR and Tsunami Information Centres;
• to recommend Tsunami Service Providers and National Tsunami Warning Centres to continue populating international register of alerting authorities through WMO National Permanent Representative;
• the ICG/PTWS (i) complete its present work on Key Performance Indicators (KPIs) and tailor them to the Sendai Target G Indicators for the Sendai Framework for Disaster Risk Reduction; (ii) develop a document with background and context for the proposed KPIs; and (iii) provide the document to all ICGs for consideration, with a view to present a consolidated report to the 30th IOC Assembly (2019).

**The Group recommended** the Executive Council to take the following actions:

• to extend the tenure of TOWS and its Task Teams on (i) Disaster Management and Preparedness and (ii) Tsunami Watch Operations, with existing Terms of References;
• to consider organizing similar symposia periodically to inform governing bodies and advance the Global Tsunami Warning System.

**The Group accepted** the reports from the Task Teams on Disaster Management and Preparedness and Watch Operations and **instructed** the Task Teams:

• to finalise sample tsunami threat messages for vessels at sea in consultation with the IHO/IMO/WMO World-Wide Navigational Warning Service Sub-Committee;
• to continue efforts for monitoring and responding to tsunamis generated by non-seismic sources and possible integration into Tsunami watch operation;
• to consider the summary statement from the Symposium;
• to prepare concept note for developing capacity that can lead to transformative tsunami warning products that enable stakeholders to manage public response efficiently;
• to contribute to OceanObs 19 and the planning of the UN Decade of Ocean Science for Sustainable Development.

**The Group noted with appreciation** the information presented by the WMO, on governance reform, marine competency standards for National Marine and Hydrological and Meteorological Services and ongoing efforts to develop multi hazard early warning systems.
**Resumé exécutif**

La 11ᵉ réunion du Groupe de travail sur les systèmes d’alerte aux tsunamis et autres aléas liés au niveau de la mer, et de mitigation (TOWS-WG-XI) s’est tenue à Paris (France) les 16 et 17 février 2018, sous la présidence de M. Alexander Postnov (Vice-Président de la COI). Les participants à la réunion ont évalué les progrès accomplis s’agissant des actions menées et des décisions prises par les organes directeurs par le biais de la décision IOC-XXVIX/7.2.

**Le Groupe a pris acte** du succès du colloque intitulé « Les avancées en matière d’alerte aux tsunamis mises au service des populations », organisé du 12 au 14 février 2018 à Paris (ci-après « le Colloque »), et qui a fait le point sur l’état des systèmes opérationnels d’alerte aux tsunamis ainsi que sur le niveau de résilience actuel des populations et défini les futures orientations à suivre pour les améliorer.

**Le Groupe a constaté** les conséquences matérielles, économiques et sociales de la saison cyclonique 2017 et d’autres catastrophes naturelles dans la région des Caraïbes.

Par ailleurs, **il a pris acte** que, dans le cadre de la résolution d’ensemble sur « Les océans et le droit de la mer » (A/RES/72/73), l’Assemblée générale des Nations Unies a décidé de « proclamer la Décennie des Nations Unies pour les sciences océaniques au service du développement durable, pour la période commençant le 1ᵉʳ janvier 2021 » et a demandé « à la Commission océanographique intergouvernementale d’élaborer un plan de concrétisation de la Décennie en concertation avec les États membres, les institutions spécialisées, les fonds, les programmes et les organismes des Nations Unies, ainsi que d’autres organisations intergouvernementales, des organisations non gouvernementales et les parties prenantes concernées ».

**Le Groupe a examiné** les rapports des groupes intergouvernementaux de coordination (GIC) de la COI, ainsi que ceux de ses Équipes spéciales sur la gestion et la préparation en cas de catastrophe, d’une part, et sur les opérations de veille aux tsunamis, d’autre part.

**Il a noté avec satisfaction** les progrès accomplis au cours de la période intersessions, notamment :

- les trois exercices menés (CARIBEWave 2017 et NEAMWAVE 17) et les tests de communication régulièrement effectués ;
- les progrès en matière de communication des résultats des exercices d’alerte aux tsunamis et des tests de communication à l’Organisation météorologique mondiale (OMM) ;
- l’augmentation du nombre de stations marégraphiques dans la région de l'Atlantique du Nord-Est et de la Méditerranée, en vue de rétablir les capacités de surveillance, de détection, de communication et d’alerte ;
- l’adaptation et l’expérimentation, dans l’océan Pacifique et l’océan Indien, du programme « Tsunami Ready » du Système d’alerte aux tsunamis et autres risques côtiers dans la mer des Caraïbes et les régions adjacentes (CARIBE-EWS), un programme de certification des communautés fondée sur les résultats en matière de préparation aux tsunamis ;
- la mise en œuvre de la stratégie éducative visant à lutter contre les actes de vandalisme dont les bouées font l’objet et la contribution des GIC à cet égard.
Le Groupe a recommandé au Conseil exécutif d’encourager les États membres à :

- continuer d’apporter et intensifier leur appui technique et financier aux systèmes d’alerte aux tsunamis et autres aléas côtiers dans leurs régions respectives, au vu de l’ampleur des conséquences de ces phénomènes sur la vie et les moyens de subsistance des communautés côtières ;
- encourager la sensibilisation aux tsunamis dans les communautés et auprès des autorités, par le biais d’exercices de communication et de préparation aux vagues de tsunami ainsi que de programmes de formation, d’information, de préparation des communautés et de reconnaissance ;
- densifier les réseaux les réseaux d’observation du niveau de la mer, en particulier à proximité des sources tsunamigènes ;
- appuyer la réhabilitation et l’amélioration des infrastructures de détection, de communication et d’alerte pour assurer la préparation aux futurs événements dans la région des Caraïbes ;
- examiner les recommandations qui figurent dans le compte rendu du Colloque.

Le Groupe a recommandé au Conseil exécutif de prier les GIC :

- de promouvoir la Journée mondiale de sensibilisation aux tsunamis auprès des États membres et de les informer de la disponibilité des documents du Bureau des Nations Unies pour la prévention des catastrophes (UNISDR) à ce sujet, ainsi que de partager des activités et des documents avec l’UNISDR et les centres d’information sur les tsunamis ;
- de recommander aux prestataires de services relatifs aux tsunamis et aux centres nationaux d’alerte aux tsunamis de continuer de renseigner le Registre international des autorités d’alerte par l’intermédiaire du représentant permanent de leur pays auprès de l’OMM ;
- le Groupe intergouvernemental de coordination du Système d’alerte aux tsunamis et de mitigation dans le Pacifique (GIC/PTWS) : (i) d’achever ses travaux sur les principaux indicateurs de performance en les adaptant aux indicateurs de l’objectif G du Cadre d’action de Sendai pour la réduction des risques de catastrophe ; (ii) d’élaborer un document contenant des éléments de base et des informations contextuelles concernant les principaux indicateurs de performance proposés ; (iii) de soumettre ce document à tous les GIC pour examen, en vue de présenter un rapport de synthèse à l’Assemblée de la COI à sa 30e session (2019).

Le Groupe a recommandé au Conseil exécutif de prendre les mesures suivantes :

- prolonger les mandats du TOWS-WG et de ses Équipes spéciales sur (i) la gestion et la préparation en cas de catastrophe et (ii) les opérations de veille aux tsunamis, en reconduisant les mandats actuels ;
- envisager d’organiser régulièrement des colloques similaires pour informer les organes directeurs et faire progresser le système mondial d’alerte aux tsunamis.

Le Groupe a approuvé les rapports soumis par les Équipes spéciales sur la gestion et la préparation en cas de catastrophe et sur les opérations de veille aux tsunamis, et leur a donné instruction :

- de finaliser des exemples de messages d’alerte aux tsunamis destinés aux navires en mer, en consultation avec le Sous-Comité sur le Service mondial d’avertissements de navigation de l’OHI/OMI/OMM ;
• de poursuivre les efforts déployés pour surveiller les tsunamis générés par des sources non sismiques et y faire face, et envisager de les intégrer dans les opérations de veille aux tsunamis ;
• d'examiner le compte rendu du Colloque ;
• d'élaborer une note conceptuelle sur le développement de capacités pouvant permettre la mise au point de produits d'alerte aux tsunamis transformateurs, grâce auxquels les parties prenantes pourront gérer efficacement les opérations d'intervention des autorités publiques ;
• de contribuer à la conférence OceanObs 19 ainsi qu'à la planification de la Décennie des Nations Unies pour les sciences océaniques au service du développement durable.

Le Groupe a pris note avec satisfaction des informations présentées par l'OMM concernant la réforme de la gouvernance, les normes de compétence maritime applicables aux services maritimes et météorologiques et hydrologiques nationaux, ainsi que les travaux en cours liés à la mise en place des systèmes d'alerte rapide multirisques.
Resumen dispositivo

La undécima reunión del Grupo de Trabajo sobre sistemas de alerta contra tsunamis y otros peligros relacionados con el nivel del mar y atenuación de sus efectos (TOWS-WG XI) se celebró en París (Francia) los días 16 y 17 de febrero de 2018 bajo la presidencia del Sr. Alexander Postnov (Vicepresidente de la COI). En la reunión se pasó revista a los avances relacionados con las medidas y decisiones adoptadas por los órganos rectores mediante la decisión IOC-XXIX/7.2.

El Grupo reconoció el éxito del simposio sobre los avances en materia de alertas contra los tsunamis para mejorar las respuestas comunitarias (París, 12-14 de febrero de 2018) (en adelante, “el simposio”) a la hora de determinar la situación actual y las orientaciones futuras para mejorar las alertas operacionales y la resiliencia de las comunidades.

El Grupo reconoció las repercusiones físicas, económicas y sociales de la temporada de huracanes de 2017 y de otros desastres naturales ocurridos recientemente en la región del Caribe.

El Grupo tomó nota de la decisión de la Asamblea General de las Naciones Unidas, en el marco de su resolución general sobre los océanos y el derecho del mar (A/RES/72/73), de “proclamar el Decenio de las Naciones Unidas de las Ciencias Oceánicas para el Desarrollo Sostenible en el período de diez años que comenzará el 1 de enero de 2021” y “exhorta[r] a la Comisión Oceanográfica Intergubernamental a preparar un plan de ejecución para el Decenio de las Ciencias Oceánicas en consulta con los Estados Miembros, los organismos especializados, los fondos, programas y órganos de las Naciones Unidas […] y los interesados pertinentes”.

El Grupo examinó los informes de los grupos intergubernamentales de coordinación (ICG) de la COI, así como de sus propios equipos de trabajo sobre gestión de desastres y preparación y sobre actividades de vigilancia.

El Grupo tomó nota con satisfacción de los progresos obtenidos durante el periodo entre reuniones, a saber:

- realización de dos ejercicios (CARIBEWave 2017 y NEAMWAVE 17) y pruebas periódicas de verificación de las comunicaciones;
- avances en lo tocante a compartir los resultados de las simulaciones de tsunamis y las pruebas de verificación de las comunicaciones con la Organización Meteorológica Mundial (OMM);
- aumento del número de estaciones de medición de nivel del mar en la región del Atlántico Nororiental y el Mediterráneo a fin de recuperar las capacidades de seguimiento, detección, comunicación y alerta;
- publicación del documento “Plans and Procedures for Tsunami Warning and Emergency Management” (Manuales y Guías de la COI 76);
- adaptación y experimentación del programa de acreditación de la preparación comunitaria frente a los tsunamis del CARIBE-EWS en las regiones del Pacífico y el Índico;
- finalización de la estrategia pedagógica para hacer frente a los actos vandálicos contra las boyas y contribución de los ICG a su elaboración.
El Grupo recomendó al Consejo Ejecutivo que alentara a los Estados Miembros a:

- aumentar y mantener el apoyo técnico y financiero a los sistemas de alerta contra los tsunamis y otros peligros costeros en sus respectivas regiones, habida cuenta de las importantes consecuencias de estos peligros para la vida y los medios de subsistencia de las comunidades costeras;

- seguir promoviendo la sensibilización sobre los tsunamis en las comunidades y entre las autoridades, mediante ejercicios de comunicación y simulación de tsunamis, actividades de formación e información y programas de preparación y reconocimiento dirigidos a las comunidades;

- densificar las redes de medición del nivel del mar y las redes sísmicas, en particular cerca de las fuentes tsunamigénicas;

- apoyar la rehabilitación y la mejora de las infraestructuras de detección, comunicación y alerta para contribuir a la preparación ante los fenómenos que se puedan producir en el Caribe;

- tener en cuenta las recomendaciones del simposio que figuran en el resumen de su declaración final.

El Grupo recomendó al Consejo Ejecutivo que encargara a los ICG lo siguiente:

- que promuevan el Día Mundial de Concienciación sobre los Sunamis entre los Estados Miembros, les presten asesoramiento sobre la disponibilidad de material de la Oficina de las Naciones Unidas para la Reducción del Riesgo de Desastres (UNISDR) al respecto y compartan actividades y materiales con la UNISDR y los centros de información sobre los tsunamis;

- que recomienden a los proveedores de servicios sobre tsunamis y a los centros nacionales de alerta contra los tsunamis que sigan aportando datos al Registro Internacional de Autoridades de Alerta de la OMM por conducto del representante nacional permanente de la OMM;

- que el ICG/PTWS: i) complete su labor en curso sobre los indicadores clave del desempeño y los ajuste a los indicadores de la meta G del Marco de Sendái para la Reducción del Riesgo de Desastres 2015-2030; ii) elabore un documento en el que figuren los antecedentes y el contexto de los indicadores clave del desempeño propuestos; y iii) transmita el documento a todos los ICG para su examen, a fin de presentar un informe consolidado a la Asamblea de la COI en su 30ª reunión (2019).

El Grupo recomendó al Consejo Ejecutivo que adoptara las siguientes medidas:

- prorrogar el mandato del TOWS y sus equipos de trabajo en cuanto a: i) la gestión de desastres y la preparación; y ii) las operaciones de vigilancia de los tsunamis, manteniendo el mismo contenido del mandato actual;

- estudiar la posibilidad de organizar periódicamente simposios similares con objeto de informar a los órganos rectores y promover el sistema mundial de alerta contra los tsunamis.

El Grupo acogió con beneplácito los informes de los equipos de trabajo sobre gestión de desastres y preparación y sobre actividades de vigilancia, y encargó a los equipos de trabajo lo siguiente:

- finalizar los modelos de mensajes sobre amenazas de tsunamis para buques en el mar en consulta con el subcomité del Servicio Mundial de Radioavisos Náuticos de la OHI, la OMI y la OMM;
proseguir los esfuerzos relativos a la vigilancia y la respuesta ante los tsunamis ocasionados por fuentes no sísmicas y a su posible integración en las operaciones de vigilancia de los tsunamis;

• tener en cuenta el resumen de la declaración final del simposio;

• preparar una nota conceptual para el desarrollo de capacidades a fin de lograr unos productos de alerta contra los tsunamis que sean transformadores y permitan a los interesados gestionar con eficiencia las respuestas públicas;

• contribuir a la conferencia OceanObs 19 y a la planificación del Decenio de las Naciones Unidas de las Ciencias Oceánicas para el Desarrollo Sostenible.

El Grupo tomó nota con reconocimiento de la información presentada por la OMM en relación con la reforma de la gobernanza, las normas sobre competencias de los servicios marítimos, hidrológicos y meteorológicos nacionales y los esfuerzos en curso para desarrollar sistemas de alerta temprana multirriesgos.
Рабочее резюме

Одиннадцатое заседание Рабочей группы по системам предупреждения о цунами и других опасных явлениях, связанных с изменением уровня моря, и смягчения их последствий (РГ-СПЦО-XI) прошло в Париже, Франция, 16-17 февраля 2018 г. под председательством г-на Александра Постнова (заместитель Председателя МОК). Участники совещания оценили прогресс в деятельности Рабочей группы и осуществлении мер, утвержденных Руководящими органами в решении IOC-XXVIX/7.2.

Группа отметила успешное проведение симпозиума «Прогресс в области предупреждений о цунами в поддержку мер реагирования со стороны общин» (12-14 февраля 2018 г., Париж, Франция) (далее именуемого «Симпозиум»), который позволил выявить сегодняшнее состояние и будущие направления деятельности по совершенствованию оперативных предупреждений о цунами и укреплению потенциала жизнестойкости общин.

Группа отметила физические, экономические и социальные последствия сезонных ураганов и других стихийных бедствий в регионе Карибского бассейна в прошедшем 2017 г.

Группа приняла к сведению сводную резолюцию Генеральной Ассамблеи ООН по Мировому океану и морскому праву (A/RES/72/73), в которой она постановила «провозгласить 10-летний период, начинающийся 1 января 2021 года, Десятилетием Организации Объединенных Наций, посвященным науке об океане в интересах устойчивого развития», и призвала «Межправительственную океанографическую комиссию подготовить план проведения этого Десятилетия в консультации с государствами-членами, органами ООН и соответствующими заинтересованными сторонами».

Группа рассмотрела представленные межправительственными координационными группами МОК (МКГ) доклады и провела обзор работы собственных целевых групп по обеспечению готовности к стихийным бедствиям и ликвидации их последствий, а также по наблюдению за цунами.

Группа с удовлетворением отметила прогресс, достигнутый в межсессионный период, в том числе следующие аспекты:

• проведение двух мероприятий (CARIBEWave 2017 и NEAMWAVE 17), а также регулярное тестирование систем связи;
• развитие обмена результатами учений по цунами и тестирования систем связи с Всемирной метеорологической организацией (ВМО);
• увеличение числа станций для измерения уровня моря в регионе северо-восточной части Атлантики и Средиземного моря в целях восстановления потенциала для мониторинга, отслеживания, коммуникации и предупреждений;
• публикация документа «Планы и процедуры для предупреждений о цунами и действий в чрезвычайных ситуациях» (выпуск № 76 в серии «Справочники и руководства МОК»);
• адаптация и пилотное применение руководящих принципов программы сертификации готовности общин к цунами МКГ/КАРИБ-СРП в Тихом и Индийском океанах;
• завершение разработки просветительской стратегии по предотвращению вандализма в отношении буев и вклад всех МКГ в эту работу.
Группа рекомендовала Исполнительному совету призвать государства-члены:

- обеспечить увеличение и стабильность технической и финансовой поддержки систем предупреждений о цунами и других опасных явлениях в прибрежной зоне в их соответствующих регионах с учетом значительных последствий этих явлений для человеческих жизней и источников средств к существованию в прибрежных общинах;
- способствовать дальнейшему повышению осведомленности о цунами местных общин и властей посредством проведения учений по оповещению и по цунами, профессиональной подготовки, информационно-просветительской работы и программ по подготовке к цунами и сертификации такой готовности;
- уплотнить сети наблюдений за уровнем моря и за сейсмическими явлениями, в особенности в цунамигенных районах;
- оказывать поддержку восстановлению и укреплению инфраструктуры зондирования, коммуникации и предупреждений для обеспечения готовности к будущим опасным событиям в Карибском бассейне;
- учесть рекомендации Симпозиума, содержащиеся в итоговом заявлении.

Группа рекомендовала Исполнительному совету поручить МКГ:

- провести информационно-просветительскую работу для популяризации Всемирного дня распространения информации о проблеме цунами среди государств-членов и сообщить им о наличии соответствующих материалов Управления Организации Объединенных Наций по уменьшению опасности бедствий (МСУОБ), а также обеспечить совместное проведение мероприятий и использование материалов центрами информации о цунами и МСУОБ;
- рекомендовать провайдерам услуг и национальным центрам оповещения о цунами продолжить пополнение международного реестра органов оповещения через своих национальных постоянных представителей при ВМО;
- поручить МКГ/СПЦТО (i) завершить в полном объеме свою сегодняшнюю работу над ключевыми показателями эффективности (КПИ) и увязать их с Сендайскими целевыми показателями для Сендайской рамочной программы действий по сокращению риска стихийных бедствий; (ii) разработать документ с изложением истории вопроса и контекста предлагаемых КПИ; и (iii) представить этот документ на рассмотрение всем МКГ с целью подготовки сводного доклада для 30-й Ассамблеи МОК (2019 г.).

Группа рекомендовала Исполнительному совету принять следующие меры:

- продлить срок полномочий СПЦО и ее целевых групп (i) по обеспечению готовности к стихийным бедствиям и ликвидации их последствий и (ii) по наблюдению за цунами, сохранив их сегодняшний круг ведения;
- рассмотреть вопрос организации аналогичного симпозиума на периодической основе в целях информирования руководящих органов и разработки Глобальной системы предупреждения о цунами.

Группа одобрила доклады целевой группы по обеспечению готовности к стихийным бедствиям и ликвидации их последствий и целевой группы по наблюдению за цунами и поручила им:

- завершить разработку образчиков конкретных сообщений об угрозе цунами для морских судов в консультации с подкомитетом МГО/ИМО/ВМО по Всемирной службе навигационных предупреждений;
продолжать усилия по мониторингу и мерам реагирования на цунами несейсмического происхождения с их возможным охватом проводимыми наблюдениями;

учесть итоговое заявление Симпозиума;

подготовить концептуальную записку по вопросам развития потенциала в перспективе разработки эффективных продуктов предупреждения о цунами, предоставляемых заинтересованным сторонам возможность для действенного управления мерами общественного реагирования;

обеспечить вклад в подготовку конференции «OceanObs 19» и планирование Десятилетия Организации Объединенных Наций, посвященного науке об океане в интересах устойчивого развития.

Группа с удовлетворением приняла к сведению представленную ВМО информацию о реформе управления, стандартах морской компетентности для национальных морских и гидрологических и метеорологических служб и постоянных усилиях по разработке систем раннего предупреждения о многих видах бедствий.
1. OPENING AND WELCOME

1.1 OPENING

1. The Chair, Alexander Postnov, opened the meeting. He invited Vladimir Ryabinin, Executive Secretary of IOC, for welcoming remarks.

2. Mr Ryabinin highlighted that the United Nations General Assembly on 5 December 2017 had proclaimed a Decade of Ocean Science for Sustainable Development (2021-2030) to gather ocean stakeholders worldwide behind a common framework that will ensure ocean science can fully support countries in the achievement of the Sustainable Development Goal 14 on the ocean. As mandated by the UN General Assembly, the Intergovernmental Oceanographic Commission (IOC) of UNESCO will coordinate the Decade’s preparatory process, inviting the global ocean community to plan for the next ten years in ocean science and technology. The UN Decade of Ocean Science seeks to transform and bolster the way in which the scientific community, governments, civil society, and the UN System coordinate their actions toward “conserving and sustainably using the oceans, seas and marine resources for sustainable development” – as stated in Objective 14 of the Sustainable Development Goals. The Decade will act to fill major gaps in our knowledge of the ocean and ability to sustainable manage its resources. The planning process is expected to get fully underway following the 51st IOC Executive Council (3–6 July 2018, Paris). In closing, Mr Ryabinin encouraged TOWS-WG to reflect on how to catalyse and synthesize requirements in the area of Tsunami Early Warning systems and provide this as input to the planning process.

1.2 ADOPTION OF AGENDA

3. The agenda was adopted as given in Annex I.

1.3 WORKING ARRANGEMENTS

4. Mr Thorkild Aarup provided an overview of logistic details for the meeting. All documents and presentations delivered at this meeting are available from the following website: www.ioc-unesco.org/tows-wg11.

2. REPORTS FROM PARTICIPANT BODIES

2.1 REPORT FROM IOC BODIES

2.1.1 Tsunami and Other Coastal Hazards Warning System for the Caribbean and Adjacent Regions (CARIBE-EWS)

5. Christa von Hillebrandt-Andrade (USA), Chair of the Intergovernmental Coordination Group for the Tsunami and Other Coastal Hazards Warning System for the Caribbean and Adjacent Regions (ICG/CARIBE-EWS), recalled that over the past 500 years more than 75 tsunamis have killed 4,484 people in the Caribbean and Adjacent Regions. She mentioned as examples those of 1867 in the US Virgin Islands, 1918 in Puerto Rico and 1946 in Dominican Republic.

6. She indicated that ICG/CARIBE EWS is currently organized with a Board of Officers, four Working Groups (WGs) and six Task Teams (TTs) for the period 2017–2018. She further indicated that all of CARIBE-EWS nations and territories have designated Tsunami Warning Focal Points (TWFPs) and half of them have nominated National Tsunami Warning Centres (NTWCs).
Ms von Hillebrandt-Andrade recalled that the Hawaii, USA, based Pacific Tsunami Warning Center (PTWC) is the CARIBE-EWS Tsunami Service Provider, which began the issuance of Enhanced Products as of 1 March 2016 and also began covering the domestic service for Puerto Rico and Virgin Islands in 2017 becoming the sole CARIBE-EWS provider.

She reported that on 10 January 2018 (UTC) an earthquake and tsunami event was registered North West of Honduras. For this event, PTWC issued products in timely manner and in agreement with the procedures described in the User's Guide for the Pacific Tsunami Warning Center Enhanced Products for the Tsunami and other Coastal Hazards Warning System for the Caribbean and Adjacent Regions (CARIBE-EWS). IOC Technical Series No 135. All countries with coastlines within 1000 km of the epicenter were included in the initial threat message. A small tsunami was first measured in Belize and Cayman, thanks to new sea level stations installed in those countries. She indicated that more sea level stations are required for even quicker assessments. From this event, some lessons learnt are that there is a need for greater consistency/non-conflicting information between TSP and National Alerts when issued by the same Center, as well as consider using Tsunami Travel Time, instead of distance from epicentre, to determine areas to be placed under initial threat. She further reported that an After Action Assessment will be conducted under the coordination of CTIC and reported to the Thirteen Session of the ICG/CARIBE-EWS.

She indicated that the US NWS Caribbean Tsunami Warning Program established by NOAA NWS as a contribution to the CARIBE EWS in 2010 and located in Mayagüez, Puerto Rico, continued to support sea level, seismic and GNSS monitoring efforts. Furthermore it continued to support Tsunami Operational Procedures training, CARIBE WAVE exercises, the US TsunamiReady® and UNESCO/IOC pilot Tsunami Ready programmes, and provided local and regional support for PTWC and PTWC products.

She reported on the Twelfth session of the ICG/CARIBE-EWS hosted in Puntarenas, Costa Rica, 10–12 May 2017.

She recalled that the ICG/CARIBE-EWS decided in 2009 to accept the offer of the Government of Barbados to establish and host a Caribbean Tsunami Information Center (CTIC), which was established in 2013 through an MOU between UNESCO and Government of Barbados. CTIC has conducted numerous trainings and development of education and outreach materials. It reopened in August 2017 after a period of inactivity from January 2016 to July 2017. She indicated that the Twelfth session of the ICG/CARIBE-EWS had expressed its appreciation to the Government of Barbados for its efforts on the renewal of the MOU to host the CTIC, and to the IOC Executive Secretary for including the support for the CTIC director position in Barbados within the IOC budget.

The Twelfth session of the ICG/CARIBE-EWS also initiated a study towards strengthening of tsunami monitoring by recognizing the potential benefit of high rate, real-time GNSS data to improve earthquake and tsunami detection and assessment. The study will be carried out by a dedicated Task Team on Global Navigation Satellite System (GNSS) under Working Group 1 on Monitoring and Detection Systems. The ICG/CARIBE-EWS expects that these data will complement the seismic and sea level data.

Ms von Hillebrandt-Andrade reported that after a 12-year focus on tsunamis and considering the original intention was to include other coastal hazards taking advantage of existing observational resources, the ICG/CARIBE-EWS is in the process of constituting a Group of Experts to address other coastal hazards in the Caribbean and adjacent regions. This is in full agreement with the Sendai framework for action (2015–2030) and its target 7 to increase access to multi hazard early warning systems, to optimize national and local resources.
14. She also reported that there are 52 communities in the Caribbean that have implemented a community based performance recognition programme. She indicated that in 2015 the IOC Assembly approved the CARIBE EWS Tsunami Ready guidelines. She further indicated that British Virgin Islands became recognized as Tsunami Ready in 2016, its previous recognition was TsunamiReady®. She further reported that currently there are Tsunami Ready pilots in Grenada, Haiti and Barbados with Anguilla (UK) preparing a submission for renewal. Funding has been secured for additional 2-3 Pilots in CARIBE EWS from USAID/OFDA and CTIC is preparing a proposal for additional pilots. In connection with this, the Twelfth session of the ICG/CARIBE-EWS established a joint Task Team of Working Group 2 on Hazard Assessment and Working Group 4 on Public Awareness, Education and Resilience, to improve capacity building in the region in order to have Tsunami Evacuation Maps for as many coastal communities as possible.

15. Ms von Hillebrandt-Andrade informed that the Exercise Caribe Wave 17 held on 21 March 2017 had 679,985 participants registered to participate in the exercise, with the next Exercise Caribe Wave 18 scheduled on Thursday, 15 March 2018 with 3 scenarios for the Member States to choose from, with source earthquakes located off Barbados, Colombia and Puerto Rico, and 93,136 people already registered at the www.tsunamizone.org website.

16. She noted that due to the impact of Hurricanes Irma and Maria in 2017, there has been a loss of capability to detect earthquakes in Northeastern Caribbean due to destruction of seismic stations, which increased detection time of 1-2 minutes in this region. Similarly, there is a loss of capability to detect tsunamis due to destruction of 15 tide gauges, 20% of the existing network. Another impact of the hurricanes was the loss of communication capability for communication from PTWC to the TWFP in the NE Caribbean. To evaluate the impact and discuss recovery and resilience strategies a CARIBE EWS Mid Term Officers meeting was held in Dominican Republic in November 2017. One of the conclusions contained in the Report of this Mid Term meeting is that being Tsunami Ready/TsunamiReady helped communities before, during, and after the Hurricanes.

17. In response to a question of TOWS-WG Chair Mr Postnov, Ms Hillebrandt indicated that near-shore bathymetry is still required and essential for modelling purposes. Closer cooperation with GEBCO may help to address this gap.

18. Responding to Mr Yuelong (Australia), Ms von Hillebrandt-Andrade indicated that the high participation in Caribe Wave exercises is due to the participation of Member States, with the coordination by CTWP and CTIC. She indicated that schools are targeted and provide one of the most numerous participating groups. Coordination of social media (hashtags, Facebook) also help. She further indicated that as this exercise is done annually and people know this is in March, Emergency Managers do know this is an opportunity for tsunami awareness.

2.1.2 Indian Ocean Tsunami Warning and Mitigation System (IOTWMS)

19. Andi Eka Sakya made the presentation on IOTWMS. He provided an overview of the structure of the ICG/IOTWMS which comprises a Steering Group, two technical Working Groups, one sub-regional Working Group, a Task Team for the IOWave18 exercise and a Task Team for the Capacity Assessment of Tsunami Preparedness. IOTWMS Secretariat is supported by funding from the Bureau of Meteorology, Government of Australia and a partnership agreement between IOC/UNESCO and BPBD has recently been signed for support of IOTIC from 2017 until 2022.

20. Mr Sakya reported that seismic and sea level monitoring networks including tide gauges and tsunami buoys have greatly expanded in the Indian Ocean. There are three operational Tsunami Service Providers from Australia, India and Indonesia providing
interoperable tsunami threat information to the IOTWMS NTWCs, which in turn are responsible for provision of detailed tsunami threat information for their coastal regions. Communications tests are conducted in June and December every year.

21. On Tsunami Risk, Community Awareness and Preparedness, Mr Sakya reported that there have been many achievements especially through the activities of the Indian Ocean Tsunami Information Centre (IOTIC) and extra budgetary projects supported by UNESCAP, Indonesian Fund in Trust (IFiT) and Malaysian Fund in Trust (MFiT). Activities include several capacity building workshops, documenting the impacts of 1945 Makran and 1950 Ambon tsunamis, IOWave 16 regional communication platform, etc. A training of trainers on Tsunami Emergency Maps, Plans and Procedures (TEMPP) was organised in Citeko, Indonesia in November 2017.

22. The IOTWMS conducted a highly successful IOWave16 exercise on 7-8 September 2016 and all 24 Member States participated. There was a marked improvement in community involvement in IOWave16 with 59,000 people from 12 Member States conducting evacuations. Most community evacuations were done in India. A post-IOWave16 workshop was conducted to share lessons learnt from the community evacuations.

23. Mr Sakya briefed on the outcomes of the 11th ICG/IOTWMS Session held in Putrajaya, Malaysia in April 2017 and the 1st integrated intersessional meetings held in Jakarta, Indonesia during September 2017. Current and future work of the IOTWMS is focussed on sustaining the system, enhancing the “last-mile” and adopting a multi hazard approach. Initiatives are underway to conduct a baseline capacity assessment survey, continue capacity development workshops, pilot Indian Ocean Tsunami Ready (IOTR) programme, conduct IOWave 18 in September 2018 and strengthen collaboration in the Makran region. Upcoming activities include the 2nd integrated intersessional meetings of the ICG/IOTWMS in Hyderabad, India during June/July 2018, a post-IOWave 18 workshop in Jakarta during November 2018 and the 12th session of the ICG/IOTWMS in Iran during March 2019.

2.1.3 Tsunami Early Warning and Mitigation System in the North-Eastern Atlantic, the Mediterranean and Connected Seas (NEAMTWS)

24. François Schindelé reported on behalf of Gerassimos Papadopoulos. He highlighted some of the major developments since the 10th session of TOWS-WG.

25. Mr Papadopoulos was elected chair at the 14th session of ICG/NEAMTWS (21–23 November 2017, Lisbon). Stefano Lorito was re-elected for a second term as vice-chair, and Anna von Gyldenfeldt was also re-elected as vice-chair for a second term.

26. Four TSPs received the formal accreditation at the 29th IOC Assembly (June 2017). The Portuguese National Tsunami Warning Center was inaugurated back-to-back with 14th session of ICG/NEAMTWS. The center now also functions as a Candidate TSP and offers alert services to interested countries.

27. He reminded that the NEAMTWS is an operational system, which provides Tsunami Services only for Tsunamis triggered by seismic event. NEAMTWS does not cover volcanic and landslide Tsunamis. Only on the Italian island in Stromboli is there a local system for monitoring volcanic generated tsunamis. A proposal for the European Commission - Volcanic Tsunami Risk Reduction in Europe (VOLTAIRE) has been submitted with the aim to increase preparedness and capacity building against volcanic tsunamis in Europe (including European territories in the Caribbean Sea).
28. Mr Schindelé also highlighted the recent earthquakes that generated Tsunamis (Lesvos, 12 June 2017 and Kos/Bodrum, 21 July 2017) – further details are provided in the report of the Task Team on Operations (see Annex IV).

29. The third NEAMWave17 exercise took place from 31st October to 3 November 2017. Four tsunami exercise scenarios had been prepared by the five message providers. In preparation of the NEAMWave 17, two information meetings were organized in September 2017 in respectively Tunisia (in collaboration with the Arab League Educational, Cultural and Scientific Organization (ALECSO) and the Institut National de la Météorologie (INM)) and in Spain (in collaboration with the Protecció Civil y Emergencies and the Instituto Español de Oceanografía). Preliminary evaluation NEAMWave 17 indicated satisfactory performance and a significant increase in media interest in the exercise. A full exercise report is under preparation.

30. Several EU funded projects that relate to NEAMTWS have been completed or are close to completion, i.e. ASTARTE (http://www.astarte-project.eu); TSUMAPS (http://www.tsumaps-neam.eu) and ARISTOTELE (http://aristotle.ingv.it). Presently there are no new calls for proposals from the European Union that may offer funding opportunities for joint NEAMTWS projects.

31. Mr Schindelé summarised the challenges and opportunities for NEAMTWS as follows:

- There is a need for a holistic assessment of tsunami hazard and risk in the NEAM region, as a basis for long term risk mitigation planning, and as a tool for evacuation planning in case of a tsunami warning.

- There is a need for an increased efforts to maintain and improve real time seismic and sea level observing networks ensuring a more uniform coverage around the NEAM region.

- The three NEAMWave exercises have shown that there is a need to further simplify the alert message distributed by TSPs. This will further improve the information flow to the end users.

- In terms of response capability then NEAMTWS activities need to focus on providing civil protection personnel in all member states with a basic understanding of the early warning elements and features of NEAMTWS. The procedures for evacuation planning and the need for Civil Protection organizations to demonstrate and maintain a capability to respond effectively to a rare, though possibly devastating event by carrying out regular drills and exercise. Furthermore education and preparedness are the fundamental challenge to be addressed in the NEAM region.

- Future sustainability of the NEAMTWS strongly depends on how it is successfully rooted within the communities at risk, and the level of participation of all Member States, relevant actors and stakeholders in the region. He emphasized that funded projects (e.g. EU) do not cover all NEAMTWS Member States, and have so far focused on the technical early warning system and/or tsunami hazard assessments. For that reason, it is important to be more inclusive, focus attention on the vulnerability, and raise the awareness on tsunami hazard and risk.

- Future NEAMTWS developments will necessitate (i) active involvement of Member States and their Civil Protection Authorities (CPAs) in the routine activities of the ICG; (ii) improvement of real-time exchange of seismic and sea-level data between the countries along the southern rim of the Mediterranean Sea; (iii) engagement and support of Member States; and (iv) that the NEAM Tsunami Information Centre
(NEAMTIC), which works in tandem with the NEAMTWS, be strengthened and Member States are encouraged to support through funding and secondments to contribute to its maintenance and further improvement.

2.1.4 Pacific Tsunami Warning and Mitigation System (PTWS)

32. Wilfried Strauch (Nicaragua), Chair (a.i.) of the Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System (ICG/PTWS) reported for ICG/PTWS. He recalled the Area of Responsibility (AoR) of the ICG/PTWS and its governance structure. He indicated that the PTWS has three technical Working Groups, four regional working groups and five Task Teams.

33. He recalled the key role of its two Tsunami Service Providers (TSPs), the Pacific Tsunami Warning Center (PTWC) and the North West Pacific Tsunami Advisory Center (NWPTAC), as well as the International Tsunami Information Center (ITIC), providing details about the Enhanced PTWS Products provided by PTWC and the current seismic and sea level monitoring network available to TSPs.

34. Mr Strauch reported that for the current intersessional period and in accordance with the decisions of the Twenty-seventh Session of the Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System, there will be a more balanced effort of the ICG/PTWS across: a) risk and hazard assessment; b) warning systems; and c) awareness and preparedness. This will be advanced taking into consideration Member States reporting and targets under the Sendai Framework 2015–2030. He further reported that PTWS has taken a more proactive role in the field of Disaster Management through the initiatives of TEMPP (Tsunami Evacuation Mapping and Planning) and Tsunami Ready pilots.

35. He noted that the 27th session of the ICG/PTWS agreed to organize an Exercise Pacific Wave 2018 (PacWave18) from September to November 2018, in support to the International Disaster Risk Reduction Day (13 October) and the World Tsunami Awareness Day (5 November). The ICG instructed its WG 2 to review the sensing network of the PTWS and develop an optimal (defined by functional, resourcing and capability requirements) multi-instrument design. ICG/PTWS also decided to establish a Task Team on Tsunami Evacuation Maps, Plans, and Procedures (TEMPP) and Tsunami Ready. The ICG also endorsed the Northwest Pacific Tsunami Advisory Center’s (NWPTAC) plan to begin issuing in experimental mode its new NWPTAC Enhanced products in 2017 and decided to commence the trial operation of the South China Sea Tsunami Advisory Center (SCSTAC) in late 2017.

36. He indicated that the TEMPP course, which is piloting the PTWS new course on tsunami evacuation maps for the community of Cedeno on the Pacific coast of Honduras, was delivered and completed over five sessions from June 2016 to February 2017 in Honduras. ITIC and the NOAA Caribbean Tsunami Warning Programme (CTWP) piloted this course. As a result, Honduras adopted the Tsunami Ready pilot programme, becoming the first country in the PTWS to do this. (To support this process, ITIC developed a tsunami map based on historical records for the region; the intent is to develop similar maps for other countries.) In addition, Costa Rica has also started implementation of Tsunami Ready pilots.

37. Mr Strauch provided information on 13 earthquakes that generated tsunamis in the Area of Responsibility (AoR) of PTWS in 2017, including one event that was generated by a landslide in Colombia. He reported that for the event of magnitude 8.2 on 8 September 2017 in Mexico, sea level changes were noticed even 12 hours after the event, which may require a revision of local procedures for distant events that can produce effects that remain for several hours.
38. He reported on the DIPECHO project “Building resilient communities and integrated Early Warning Systems for tsunamis but also on storm hazards in central America” lead by UNESCO San Jose Office and IOC, that was very successful and provided very useful support for developing SOPs and community level SOPs and drills in El Salvador, Guatemala, Honduras and Nicaragua.

39. Mr Strauch informed that the ICG/PTWS accepted with appreciation the kind offer of Nicaragua to host the Twenty-eighth session of the ICG/PTWS in March 2019 back-to-back with an International Tsunami Workshop, organised by UNESCO/IOC, Nicaraguan Geosciences Institute INETER and the Central American Tsunami Advisory Center (CATAC).

40. Mr Strauch further informed that PTWS is investigating the possibility of piloting an experimental Tsunami Ready recognition process in Samoa, Tonga and Vanuatu in the South West Pacific and Ecuador in the South East Pacific. As indicated above it was initially tested in one small community (Cedeno) in Honduras. In Costa Rica, the community of Ostional on the Pacific coast was recognized to be Tsunami Ready as an outcome of TEMPP in May 2017.

41. Mr Strauch provided information about recent activities of the PTWS regional working groups for the South China Sea region and the Central America Pacific region. The Sixth session of the ICG/PTWS Regional Working Group on Tsunami Warning and Mitigation System in the South China Sea Region (ICG/PTWS WG-SCS) took place on 1–3 March 2017, in Shanghai, China. This group will meet again, for its Seventh session in Hanoi, Vietnam, 6–8 March 2018, and continue to oversee the establishment of the South China Sea Tsunami Advisory Center (SCSTAC). Similarly, the Task Team on the establishment of the Central America Tsunami Advisory Center (CATAC) met on 29 August–01 September 2017, in Managua at the occasion of a Regional Meeting on the 25th anniversary of the destructive Tsunami that hit Nicaragua in 1992. CATAC at INETER in Managua, Nicaragua, continued enhancing its ability to become a sub-regional TSP, with support by the Japan International Cooperation Agency (JICA). This included Installation of SeisComP3 PRO and TOAST (tsunami modelling in real time) finished in January/February 2018 and training courses on seismology and tsunamis for CATAC personnel.

42. In response to a question by Ms Hillebrandt Andrade, Chair of ICG/CARIBE-EWS, Mr Strauch responded that Nicaragua was asked to develop CATAC and started in 2013. Support from JICA started from October 2016 and will continue until November 2019. Routine trials will begin in 2019, for services delivered only for Central America coasts. In response to a follow-up question from Mr Aarup (Secretariat), Mr Strauch indicated that INETER is committed to have and integrated institutional framework, with support letters from all institutions (i.e. seismic networks and sea level networks, as well as Civil Protection agencies).

2.2 REPORT OF NON-IOC BODIES

43. There was no formal reports under this item.

44. Thorkild Aarup briefly informed about the Seabed 2030 project, which is a collaborative project between the Nippon Foundation of Japan and the General Bathymetric Chart of the Oceans (GEBCO). It aims to bring together all available bathymetric data to produce the definitive map of the world ocean floor by 2030 and make it available to all. The project was launched at the United Nations (UN) Ocean Conference in June 2017 and is aligned with the UN's Sustainable Development Goal #14 to conserve and sustainably use the oceans, seas and marine resources. More information about the project is available at https://seabed2030.gebco.net.
2.2.1 World Tsunami Awareness Day (UNISDR)

45. Mr Aarup provided a presentation on behalf of Brigitte Leoni, United Nations Office for Disaster Risk Reduction (UNISDR).

46. UN GA Resolution A/70/203 designated 5 November as World Tsunami Awareness Day (WTAD). UN Office for Disaster Risk Reduction, in collaboration with relevant organizations of the United Nations system to facilitate the observance of World Tsunami Awareness Day.

47. The objectives of WTAD are (i) raise awareness on the long term and negative impacts of tsunamis on communities (impacts on housing, main infrastructure, assets, jobs) and share innovative approaches to reduce tsunami risks; (ii) highlight the contribution of the Sendai framework to reduce economic losses; (iii) evidence progress on tsunami early warning, education and disaster risk reduction measures to reduce tsunami economic losses; (iv) reaffirm the interlinkage between DRR and SDGs.

48. In 2018, the WTAD theme will focus on Target “c” of the Sendai Framework which aims at reducing disaster economic losses in relation to global GDP by 2030. The 2018 WTAD theme will focus on “The costs of tsunamis”.

49. The world tsunami campaign will include: (i) continue the ongoing work on raising awareness about WTAD and organize the following events: Six public awareness events in Africa, the Americas, Asia and Europe that will coincide with the UNISDR regional platforms in Central Asia (June 2018); Asia (16–19 July 2018); Americas, (20–22 June 2018); in Arab states and Africa (October 2018); and in Europe (November 2018); (ii) An event in July 2018 in Papua New Guinea to recall the earthquake and tsunami in 1998; (iii) Major other events in Japan; (iv) Document the IOC Wave exercises in the Caribbean on 15 March 2018, in the Pacific in September-November 2018 and in the Indian Ocean on 4–5 September 2018; (v) Motivate partners and national governments to organize events, workshops and create the buzz around the WTAD; (vi) Collect and compile stories and good case studies.

50. Finally it was mentioned that UNISDR makes promotional tools for WTAD available to partners from their web-site.

51. Summarising the ensuing discussion TOWS emphasized that this year’s theme for WTAD is highly relevant for regional TWS and member states. Having additional information on that topic could provide important arguments to government concerning the value of Tsunami Warning Systems. Pending resources TOWS encouraged organizing a WTAD event at UNESCO HQ and encouraged development of material that can provide information on the economic losses associated with tsunamis.

2.2.2 World Meteorological Organization

52. Sarah Grimes, Alasdair Hainsworth, and David Thomas (all WMO) reported on this item via video conference.

53. An update was provided for tsunami relevant programme issues pertaining the WMO/IOC’s Joint Technical Commission for Oceanography and Marine Meteorology (JCOMM). At its 5th Session, JCOMM (October 2017) endorsed strengthened provision of met-ocean information for improving safety of lives/property at sea and in coastal areas, and commits to continue working with TOWS-WG. Other relevant recommendations and decisions at JCOMM-5: (i) supporting development (and strengthening existing) multi-hazard, impact-based services in the marine sector in line with Sendai. (This includes working with Coastal Inundation Forecasting Demonstration Project (CIFDP) and to account for
inundation, tsunami, tide and storm surge and impact); (ii) restructuring of Services & Forecasting Systems Programme Area, including a dedicated Expert Team on DRR (replacing the expert team on Coastal Waves and Hazards); (iii) introduction of National Marine Service Focal Points per JCOMM Member, for improving communication of maritime and coastal safety information at national level; (iv) updates to Manual on Marine Meteorological Services (WMO-No.558) and Guide for Marine Meteorological Services (WMO-No.471).

54. WMO has at previous sessions of TOWS-WG highlighted developments under the Coastal Inundation Forecasting Demonstration Projects (CIFDP). Demonstration projects in Bangladesh, Dominican Republic/Haiti, Fiji and Indonesia are coming to an end, and the JCOMM-5 and the 15th session of the Commission for Hydrology (CHy) have endorsed that an evaluation of the CIFDP shall be carried out in 2018 and with a view to report to WMO Congress in 2019 with recommendations for the future of the CIFDP projects.

55. WMO’s emerging plans for a Global Multi-Hazard Alert System (GMAS) were briefly described. The GMAS is (among other aims) expected to provide WMO Members and other stakeholders with an aggregated and standardized authoritative multi-hazard alerts and warnings issued by NMHSs and other officially Authorities. It will facilitate increased standardization/harmonization of hydrometeorological warnings, including utilization of CAP and subsequent update of the WMO Technical Regulations. The plans are in a draft stage and will be presented at the 70th WMO Executive Council.

56. WMO has supported Tsunami Wave exercises and communication tests. It was noted that ICG sharing exercises and communication test results with WMO has helped facilitate improved performance of WMO related communication systems.

57. TOWS and IOC have encouraged Tsunami Service Providers and National Tsunami Warning Centres to register with the WMO Register of Alerting Authorities. WMO reported that few have done so far.

58. WMO highlighted the upcoming Satcom 2018 working group meeting and encouraged participation in that. WMO also mentioned ongoing efforts to strengthen collaboration with the Emergency Telecommunications Cluster (ETC) (https://www.etcluster.org) under the UN World Food Program. Several recent hurricanes and tsunamis have demonstrated how the land communication system can be impacted. A strengthened collaboration may help with re-establish communication channels to disaster management and observing system institutions.

59. Finally, WMO mentioned the ongoing efforts to review and reform its constituent bodies including WMO-IOC joint commission (JCOMM) and other of the WMO commissions. The review and proposed organizational changes will be discussed at the forthcoming 70th WMO Executive Council.

60. TOWS-WG appreciated the presentation and the progress noted on the WMO related communication system.

61. It was noted that the Internet did not work well Caribbean met offices during the recent hurricanes. Satellite communication was the only reliable channel (e.g. MWIN satellite system) which few Caribbean meteorological offices presently have, and it underlines the need to strengthen this capacity in the region.

62. The TOWS-WG recommended Tsunami Service Providers and National Tsunami Warning Centres to continue populating the international register of alerting authorities through WMO National Permanent Representatives.
3. REVIEW OF PROGRESS

3.1 STATUS OF IMPLEMENTATION OF IOC DECISION EC-XLIX/3.4

63. Thorkild Aarup reviewed briefly the actions pertaining to Decision IOC-XXIX/7.2 of the 29th IOC Assembly (21–29 June 2017, Paris, France; see also http://www.ioc-unesco.org/components/com_oe/oe.php?task=download&id=35612&version=1.0&lang=1&format=1). Most actions were targeted at Member States and ICGs. Concerning Member State actions he highlighted: (i) Indonesia’s new financial support to IOTIC; (ii) an increase in number of sea level stations in the NEAMTWS region; (ii) growth in piloting the CARIBE-EWS Tsunami Ready guidelines; (iv) the increasing traction among Member States for World Tsunami Awareness Day (5 November).

64. He also reminded that the IOC Assembly at its 28th session (2015) had decided that all Intergovernmental Coordination Groups for Tsunami Early Warning Systems include in their reports to the IOC Governing Bodies a section with their performance against targets of the Sendai Framework for Disaster Risk Reduction 2015–2030. Towards that goal the ICGs are looking towards and awaiting the advice on ICG/PTWS subcommittee on recommended KPIs.

4. REPORTS OF THE INTER-ICG TASK TEAMS

4.1 INTER-ICG TASK TEAM ON DISASTER MANAGEMENT AND PREPAREDNESS

65. David Coetze reported on the outcome of the Inter-ICG Task Team on Disaster Management and Preparedness which met on 14 and 15 February 2018 in Paris, France. The full summary of the Task Team meeting and its recommendations are provided in Annex III of this report.

4.2 INTER-ICG TASK TEAM ON TSUNAMI WATCH OPERATIONS

66. Charles McCreery reported on the outcome of the Inter-ICG Task Team on Tsunami Watch Operations which met on 14 and 15 February 2018 in Paris, France. The full summary of the Task Team meeting and its recommendations are provided in Annex IV of this report.

5. OTHER ISSUES

6. DATE AND PLACE OF THE NEXT MEETING

67. The Chair and Technical Secretary will establish when and where the 12th session of TOWS-WG will take place.

7. CLOSURE OF MEETING

68. The Eleventh meeting of TOWS-WG was closed at 13:00 on 17 February 2018.
ANNEX I

AGENDA

1. OPENING AND WELCOME
   1.1 OPENING
   1.2 ADOPTION OF AGENDA
   1.3 WORKING ARRANGEMENTS

2. REPORTS FROM PARTICIPANT BODIES
   2.1 REPORT FROM IOC BODIES
   2.2 REPORT OF NON-IOC BODIES
      2.2.1 World Tsunami Awareness Day (UNISDR)

3. REVIEW OF PROGRESS
   3.1 STATUS OF IMPLEMENTATION OF IOC DECISION EC-XLIX/3.4

4. REPORTS OF THE INTER-ICG TASK TEAMS
   4.1 INTER-ICG TASK TEAM ON DISASTER MANAGEMENT AND PREPAREDNESS
   4.2 INTER-ICG TASK TEAM ON TSUNAMI WATCH OPERATIONS

5. OTHER ISSUES

6. DATE AND PLACE OF THE NEXT MEETING

7. CLOSURE OF MEETING
 ANNEX II

DECISIONS AND RECOMMENDATIONS

The Eleventh Meeting of the Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems (TOWS-WG-XI) was held in Paris, France, on 16–17 February 2018 under the Chairmanship of Mr Alexander Postnov (IOC Vice-Chair). The meeting evaluated progress in actions and decisions taken by the Governing Bodies through IOC-XXVIX/Dec. 7.2.

Recognising the success of the symposium Advances in Tsunami Warning to Enhance Community Responses (12-14 February 2018, Paris, France) (hereafter “the Symposium”) in identifying the current status and future directions to improve operational tsunami warnings and community resilience,

Recognising the physical, economic and social impact of the recent 2017 Hurricane Season and other Natural Disasters in the CARIBE-EWS region,

Noting the decision by the UN General Assembly, as part of the Omnibus Resolution for Oceans and the law of the sea (A/RES/72/72), to “proclaim the United Nations Decade of Ocean Science for Sustainable Development for the 10-year period beginning on 1 January 2021, and called upon the Intergovernmental Oceanographic Commission to prepare an implementation plan for the Decade in consultation with Member States, UN Bodies, and relevant stakeholder”;

The Group reviewed reports by the IOC Intergovernmental Coordination Groups as well as its own Task Teams on Disaster Management and Preparedness and Watch Operations;

The Group noted with satisfaction the progress made during the intersessional period, including:

- Two exercises carried out (CARIBEWave 2017, NEAMWAVE 17) and regular communication tests performed,
- Progress in sharing the results of Tsunami exercises and communication tests with World Meteorological Organization (WMO),
- Increased number of sea level stations in NEAMTWS region to ensure reinstatement of monitoring, detection, communication and warning capacity,
- The publication of the document Plans and Procedures for Tsunami Warning and Emergency Management (IOC Manuals and Guides, 76),
- PTWS and IOTWMS have adapted and begun piloting the CARIBE-EWS Tsunami Ready community based performance recognition programme,
- The completion of the educational strategy to address buoy vandalism and the contribution of the ICGs towards it;

The Group recommended the Executive Council to encourage Member States to:

- increase and sustain technical and financial support of the tsunami and other coastal hazards warning systems in their respective regions considering the significant impacts of these hazards on lives and livelihoods in coastal communities;
- further promote tsunami awareness in communities and among authorities through communication and tsunami wave exercises, training, information, and community preparedness and recognition programmes;
• densify sea level networks and seismic network particularly nearby tsunamigenic sources;
• support the rehabilitation and enhancement of the sensing, communication and warning infrastructure to insure readiness from future events in CARIBE-EWS;
• to consider the recommendations from the Symposium contained in the summary statement;

The Group recommended the Executive Council to instruct ICGs:
• to advocate WTAD among Member States and advise them of the availability of material from the UNISDR in this regard, and share activities and materials with UNISDR and TICs;
• to recommend TSPs and NTWCs to continue populating international register of alerting authorities through WMO National Permanent Representative;
• the ICG/PTWS: (i) complete its present work on Key Performance Indicators (KPIs) and tailor them to the Sendai Target G Indicators; (ii) develop a document with background and context for the proposed KPIs; and (iii) provide the document to all ICGs for consideration, with a view to present a consolidated report to the 30th IOC Assembly (2019).

The Group recommended the Executive Council to take the following actions:
• to extend the tenure of TOWS and its Task Teams on (i) Disaster Management and Preparedness and (ii) Tsunami Watch Operations, with ToRs as given in IOC Resolution XXIV-4 [for TOWS-WG] and IOC/TOWS-WG-VI/3 [Annex II; for TTDMP] and ToRs for TTTWO as given in IOC/TOWS-WG-X Appendix I;
• to consider organising similar symposia periodically to inform governing bodies and advance the Global Tsunami Warning System;

The Group accepted the reports from the Task Teams on Disaster Management and Preparedness and instructed the Task Teams:
• to finalise sample tsunami threat messages for vessels at sea in consultation with the IHO/IMO/WMO World-Wide Navigational Warning Service Sub-Committee;
• to continue efforts for monitoring and responding to tsunamis generated by non-seismic sources and possible integration into Tsunami watch operation;
• to consider the summary statement from the Symposium;
• to prepare concept note for developing capacity that can lead to transformative tsunami warning products that enable stakeholders to manage public response efficiently;
• to contribute to OceanObs 19 and the planning of the UN Decade of Ocean Science for Sustainable Development;

The Group noted with appreciation the information presented by the WMO, on governance reform, marine competency standards for National Marine and Hydrological and Meteorological Services and ongoing efforts to develop multi hazard early warning systems.
REPORT OF THE TOWS-WG INTER-ICG TASK TEAM
ON DISASTER MANAGEMENT AND PREPAREDNESS

14–15 February 2018
Paris, France

Task Team Members

David Coetzee (Chair) ICG/PTWS
Laura Kong ITIC; ICG/PTWS
Harkunti Pertiwi Rahayu ICG/IOTWMS
Ardito Kodijat IOIC, ICG/IOTWS
Marzia Santini ICG/NEAMTWS
Amir Yahav ICG/NEAMTWS
Alison Brome CTIC; ICG/CARIBE-EWS
Patrick Tyburn ICG/CARIBE-EWS
Bernardo Aliaga IOC Secretariat
Denis Chang Seng IOC Secretariat

Observers

Sarah-Jayne McCurrach ICG/PTWS; MCDEM New Zealand
Donna Pierre CREWS/World Bank
Andres Ibaceta ONEMI/Chile
Carlos Zuniga SHOA/Chile

BACKGROUND AND TERMS OF REFERENCE

The Terms of Reference (TORs) of the Inter-ICG Task Team on Disaster Management and Preparedness (TT-DMP) are to:

• Facilitate in collaboration with organizations such as UNISDR (United Nations Office for Disaster Risk Reduction), the exchange of experiences and information on preparedness actions, education/awareness raising campaigns and other matters related to disaster management and preparedness;
• Promote preparedness in coastal communities through education and awareness products and campaigns;
• Facilitate SOP training across ICGs to strengthen emergency response capabilities of Member States and their Disaster Management Offices;
• Promote preparedness programmes and assessment tools that have been successful in one regional Tsunami Warning and Mitigation System in the others as appropriate;
• Facilitate the coordination of the TICs of the ICGs;
• Report to the TOWS-WG.

The representatives to the TT-DMP are nominated by their respective Chairpersons of the Intergovernmental Coordination Groups (ICGs). The membership consists of two representatives from each ICG, one of which should represent the ICG’s Tsunami Information Center. The IOC Chair appoints the Chair of the Task Team.
The first meeting of the TT-DMP was held in December 2010 in Seattle, USA (IOC/TOWS-WG/TT2-I/3). Due to funding limitations the task team was unable to reconvene in the period up to February 2014 when it met in Paris, France (IOC/TOWS-WG/TT2-II). Since then the TT-DMP managed to meet annually: March 2015 in Morioka, Japan (IOC/TOWS-WG/TT2-III), February 2016 in Paris (IOC/TOWS-WG/TT2-IV), and in February 2017 (IOC/TOWS-WG/TT2-V). This report covers the period 2017–2018.

**TASK TEAM MEETING**

1. **OPENING AND MEETING ORGANIZATION**

   The Chair introduced the meeting logistics and asked self-introductions of the participants.

2. **REFLECTION ON SYMPOSIUM (12–14 FEBRUARY 2018)**

   The meeting re-capped on the Symposium to confirm the Meeting Agenda.

   From Disaster Management conclusions that besides for Multi-Hazard Tsunami Warning approach and education in schools, the important points are already covered.

   The meeting noted that the following items should we added to the agenda:
   - Multi-Hazard Early Warning approach
   - Schools programmes
   - Marine & Harbors Guidance
   - Structural Design Guidance
   - Vertical Evacuation Guidance

   The absence of Pacific Island Countries, South China Sea and Russian representatives at the symposium was noted as a gap.

   The reflections of Francois Schindelé ("Towards a Roadmap for Future Development of the Global TWS") were also reviewed to determine its effect on the agenda. It was noted that these views should be considered as an informal input. The meeting felt that they could agree with most of the observations although timelines are uncertain, and more detail is required around the notion of the establishment of an expert group, i.e. what, when, where, what the role for ICGs and IOC would be and how will it be different from TOWS-WG? The meeting felt that the latter is an important and potentially very useful initiative and a wider discussion about the concept at the TOWS meeting will be welcomed.

   With regards to Safe Elevation (SE refuge zone), the meeting noted that we should never use the word “safe”. What is important is installing the right signs and an appropriate number of it, to facilitate evacuation. The group agreed that this is a country/case by case decision, not very easy to define a common number.

3. **REFLECTION ON TT REPORT TO TOWS WG X (2017)**

   The meeting worked through the previous TT Report to TOWS and confirmed that the meeting agenda reflects the points to be followed up from that report.

4. **UPDATES FROM ICG WORKING GROUPS AND TICS**

   The task team collected updates on Disaster Management and Preparedness and Tsunami Information Centre activities across ocean basins over the last year. This information reflects
the progress and identification of collective relevant issues to be addressed at global level. The reports are posted on the meeting website and due to their size are not included in this report.

5. WAVE EXERCISES

Every ICG maintains a programme of international tsunami exercises to test and improve their products as well as processes and readiness of regional warning centres and Member States. Information about these exercise are included in the ICG Working Group reports above.

The Task Team particularly noted with interest reports about successes in regions where regional Wave exercises were extended to include community activities. The Task Team therefore encourages ICGs to note the value taken from extending these exercises to community level.

A need for greater consistency in exercise evaluation was identified. Exercise coordinators in the respective ICGs were reminded to share exercise questionnaires with a view on simplification and standardising evaluation of Wave exercises.

6. TASK TEAM ACTIONS: REPORT

The Task Team reflected the activities agreed by the TOWS-WG in February 2017 and the progress against each. The summary below reflects the activities assigned to the Task Team on Disaster Management and Preparedness:

6.1 Development of Key Performance Indicators in relation with the Sendai Framework Indicators (Joint discussion with TT-TWO)

Sarah-Jayne McCurrach and Rick Bailey (former chair of the PTWS TT on Goals and Performance) reported that a first draft was developed and discussed by the PTWS ICG. There is some ongoing refining to adjust language to reflect the Sendai Technical Indicators document.

The Secretariat (Bernardo Aliaga and Thorkild Aarup) reported that the document on Technical Indicators for Target G should be considered as a reference to tailor/adapt language of the KPIs defined by ICGs, where applicable. The KPIs must be able to scale up into a few higher-level indicators that are appropriate for the level of Governing Bodies. The Chair indicated that the format should be such that it enables escalating of detail into higher level measures, that can serve both the seeking of support/funding and reporting to governing bodies.

The Secretariat also requested that the KPIs should be supported by a contextual introduction that informs about its development, i.e. it is the result of TOWS deliberations supported by work in the PTWS as a starting point.

Action: The PTWS KPIs will be refined to adapt/tailor to Target G Indicators and addition of contextual information. The revised version will then be sent to all ICGs for consideration. ICGs are to discuss it at its regular meetings (i.e. the SC meeting of PTWS in June), aiming at a global report to the next Assembly.

6.2 World Tsunami Awareness Day (Joint discussion with TT-TWO)

The chair introduced the topic and indicated we are coordinating with UNISDR. The question was asked if we need to coordinate a common reporting to the Assembly.
The chair suggested this happens through each ICG and is taken to Governing Bodies by each ICG that in some case have been able to align the dates of its Wave exercises with the international DRR and WTADs. There is no obligation to report to UNISDR, so there is no consolidated picture of the WTAD.

Carlos Zuniga (Chile, observer) indicated that perhaps defining themes for each WTAD could be a useful driving. The Secretariat indicated that UNISDR is leading WTAD and defined to align each WTAD with targets of Sendai, this year is “Economic losses”.

A discussion followed on the need to take a more active and outcome-driven WTAD by the Secretariat and Member States. Adm. Carrasco reported that IHO has a proactive role in promoting one annual day that focuses specifically on a subject, without funding associated but is well coordinated.

**Action:** The Group agreed to request the Secretariat to inform Member States about the WTAD theme chosen by UNISDR for this year and ask ICGs to consider feedback on activities by countries.

**Action:** Secretariat to ask UN terminology in New York if the Spanish translation of tsunami, “tsunami” be revisited.

### 6.3 Tsunami Evacuation Mapping

Laura Kong walked the meeting though the TEMPP programme and the draft Course Manual that is intended as an IOC publication in 2018. It consists of four modules:

- Hazard Assessment- Inundation Modelling
- Evacuation Mapping
- Response Planning
- Exercising

These are supported as a Quick Guide (hard copy) and Supplement (electronic).

The IOTWMS conducted a Train-the-Trainer Training on TEMPP and Tsunami Ready for six countries in November 2018.

**Action:** The draft Course Manual requires final review. ICGs and the TT-DMP offered to provide feedback, especially the IOTIC and CTIC; the document will be sent by Laura Kong to all TT members for feedback by the end of May 2018.

### 6.4 UNESCO-IOC Tsunami Ready (UNESCO-IOC TR) Community – based tsunami recognition programme

The IOTWMS held a workshop with 18 Member States, 6 countries indicated they will pilot it but have not started. Adapted guidelines at the workshop for Indian Ocean. Question re international recognition- who will be responsible? International recognition postponed, focus on national recognition instead. Considering there might be legal and resource implications in giving international recognition, IOTWMS requested further guidance on the process for international recognition, which serves as a greater motivation for countries.

The CARIBE-EWS has funding support and assistance from USAID/OFDA for the Caribbean and Latin American Countries.
The NEAMTWS issued a questionnaire to countries to canvass interest in Tsunami Ready; however many activities are underway that build to the same objectives. What is lacking is a coordinating body that can track progress and identify gaps.

The PTWS has lots of interest but no funding; countries will have to do it by themselves. Some have found a way though multi hazard preparedness programmes. Three communities in three countries have piloted – Honduras and Costa Rica, as an outcome of the TEMPP Pilot, and Samoa.

The TT noted that currently documents are sent by the country Tsunami Ready Board via the relevant ICG TIC to the Secretariat for certification; ceremony follows after that.

It was noted that the administrative overload for TICs and IOC may become unmanageable in the future if too many countries become involved.

**Action:** The TT will also recommend to the TOWS WG that ICGs continue to consider to pilot it with international recognition. ICG workshops are recommended; CTWP may be able to assist with Webinars.

**Action:** The TOWS TT will coordinate the development of a feedback mechanism for countries to validate the programme and process.

**Action:** To inform the TOWS-WG meeting that TICs will find it exceedingly challenging to facilitate the process once it gets to full implementation.

### 7. OTHER MATTERS CONSIDERED BY THE TASK TEAM

#### 7.1 Multi-Hazard Warning Approach

The meeting sought clarity from the secretariat on the concept of multi hazard early warning systems approach.

A comment was made that tsunami early warning systems are by default multi hazard. Indonesia has been working towards this field at national government level working now with financial support from China on developing a hub to disseminate multi-hazard warning information to the reach the public and related institutions.

Donna Pierre (CREWS, observer) also provided perspectives and emphasised the challenge with the meaning of ‘multi-hazard’.

The meeting noted that WMO will address the matter at the TOWS-WG meeting.

#### 7.2 Marine & Ports Guidance

Laura Kong (ITIC) reported that the USA draft is planned for finalization in 2018. There is a wealth of information available from Japan (but in Japanese). She volunteered to check on translation options with the Secretariat and Japan. Some work is also underway in New Zealand in this regard, while Israel also have material. Indonesia may also be able to assist.

**Action:** ITIC will send best practices to the TT with informal translations and pursue formal translations of the documents from Japan.
### 7.3 Structural Design Guidance for buildings that can be used as evacuation shelters (including vertical evacuation)

Laura Kong informed the US ASCE 7-16 Tsunami Loads engineering provisions on high capacity structures (that can serve as evacuation shelters for tsunami) are now available as part of the 2018 International Building Code. A training seminar was conducted in December and others are expected.

In New Zealand a two-phased approach is being developed for the designation and design considerations for tsunami safe structures. Phase One will be completed in July 2018 and will include a decision making process for local authorities to assess whether or not, given residual risk, vertical evacuation should be considered for their region. This will also include guidance on either aspects to consider such as welfare and public education. As part of this work an assessment of costs to retrofit existing buildings to be tsunami safe, and also building new vertical evacuation structures will be completed. Phase two will consider engineering design requirements for tsunami safe structures and will likely be completed in 2019. In New Zealand, vertical evacuation will be promoted as a last resort, not an option over horizontal evacuation.

Indonesia has developed material in 2014 under collaboration of Bandung Institute of Technology (ITB) and National Disaster Management Agency (BNPB), in Bahasa, which has been used to plan, design and build new tsunami evacuation structures but as well as to identify potential existing buildings that can used as evacuation structures. Other guidelines relate to the planning and design of artificial hills (man-made) for evacuations. The IOTWS WG1 chair and IOTIC will pursue options for translation.

**Action:** The TT noted the 2018 IBC is available and noted with anticipation the work conducted by New Zealand and the material available in Indonesia.

### 7.4 School Programmes

The meeting noted the frequent reference to the importance of tsunami education in schools. It was noted that many school programmes exists, however to review all of them will require a significant effort while the education expertise does not exist in the Task Team. The potential of working with/through UNESCO and UNISDR Global Alliance for DRR and Resilience in the Education Sector / World Safe Schools to enhance school education programmes in terms of content and mandate for inclusion in curricula, was discussed.

The Indonesian Institute of Sciences, UNESCO and UNDP developed a mobile application called STEP-A (School Tsunami & Earthquake Preparedness Assessment) tool. The tool is to measure the level of school preparedness based on five parameters:

- School Policy
- Knowledge
- Early warning system
- Emergency response plan
- Resource mobilisation

STEP-A was introduced to IOTWMS Member States at the Indian Ocean Tsunami Ready workshop in September 2017.

**Action:** Request the advice of TOWS WG how best to explore with UNISDR and UNESCO the potential of assistance to validate, improve and mandate tsunami school programmes.
**Action:** IOTIC to provide the school preparedness questionnaires used in STEP-A in the meeting website.

8. **PRESENTATION ON TSUCAT**

Dr Laura Kong introduced the Tsunami Coastal Assessment Tool (TsuCAT), a simple and quick yet powerful tool for exploring the impact from many different tsunamis. It was developed by the NOAA Centre for Tsunami research (NCTR) to support the ITIC’s effort to provide countries with tsunami decision support tools.

TsuCAT provides access to database of tsunami modelling results from NOAA’s pre-computed catalogue of sources (Propagation Database) using the MOST and RIFT numerical models to assist a country in its hazard assessment, tsunami exercise and response planning, and warning decision making. It includes information on tsunami travel times, offshore maximum wave amplitudes, and coastal hazard guidance at forecast points and in polygons (such as used by the PTWC in its international products for the PTWS and CARIBE-EWS). TsuCAT is available on request from the ITIC and NCTR.

9. **PRESENTATION BY ISRAEL**

Amir Yahav (Israel) presented to the meeting the lessons identified during their recent tsunami preparedness exercise. The exercise emphasised the use and need for tsunami signage and the Task Team agreed that it serves as further encouragement for countries to invest in signage.

10. **RECOMMENDATIONS TO THE TOWS-WG-XI**

The Task Team recommends that the TOWS-WG-XI:

10.1 **Notes** the Task Team has met on 15–16 February 2018 and considered:
   a) The Symposium *Advances in Tsunami Warning to Enhance Community Responses*, held from 12 to 14 February 2018
   b) Reports from the respective ICG working groups and TICs
   c) Progress with regards to activities agreed in March 2017
   d) Focus areas and activities for the next year;

10.2 **Notes** the Task Team’s request for further deliberation and clarification on the concept of the establishment of an ‘experts group’, as suggested by Francois Schindele in his conclusion remarks at the Symposium from 12–14 February;

10.3 **Notes** that the PTWS Key Performance Indicators (KPIs) will be refined to tailor them to the Sendai Target G Indicators and to add contextual information; the revised version will then be sent to all ICGs for consideration. ICGs are to discuss it at its regular meetings, aiming towards a global report to the next Assembly;

10.4 **Notes** that the Task Team requests the Secretariat to inform Member States about the WTAD theme chosen by UNISDR for this year and ask ICGs to consider feedback on activities by countries; and to ask the UN terminology department in New York if the Spanish translation of tsunami, “sunami” can be revisited;

10.5 **Notes** with regards to the UNESCO-IOC Tsunami Ready (UNESCO-IOC TR) Community-based tsunami recognition programme:
10.5.1 The Task Team recommends that ICGs continue to consider and pilot the programme with international recognition

10.5.2 The Task Team will coordinate the development of a feedback mechanism for countries to validate the programme & process

10.5.3 Tsunami Information Centres (TICs) will find it exceedingly challenging to facilitate the process when it comes to full implementation;

10.6 **Notes** that the Task Team will continue work with regards to:

10.6.1 A course manual with regards to evacuation mapping

10.6.2 Tsunami Guidance for Maritime and Ports

10.6.3 Structural design guidance for buildings that can be used as shelters;

10.7 **Notes with appreciation** the finalization and publication of the document “Plans and Procedures for Tsunami Warning and Emergency Management”. Paris, Intergovernmental Oceanographic Commission of UNESCO 2017. 72 pp., (IOC Manuals and Guides No.76);

10.8 **Considers and advise** how UNESCO and/or UNISDR can be of assistance to validate, improve and mandate tsunami school programmes;

10.9 **Recommends** that the Task Team meets again prior to the next meeting of the TOWS-WG so that the current activities can be consolidated and further activities can be considered.
1. OPENING AND MEETING ORGANISATION

Charles (Chip) McCreery, the Chair of the Task Team on Tsunami Watch Operations (TTTWO) welcomed all participants to the meeting (list of participants in Appendix 2). He introduced the provisional meeting agenda, which was adopted without any modifications (Appendix 1). He reminded the Task Team of the outcomes of the symposium on “Advances in tsunami warning to enhance community response” held at IOC during 12–14 February 2018. The symposium identified the need for even more timely and accurate tsunami warnings than currently available, and for developing adequate procedures to enable more effective and inclusive community and local responses to tsunami threats. While deliberating its agenda and developing its work plan, Mr McCreery highlighted that the Task Team needs to consider the important outcomes of the symposium. Further, the Task Team unanimously agreed that the symposium is very useful in driving future developments of the end-to-end tsunami early warning systems and recommended that such symposia be held once in every few years.

**Recommendation 1:** Recognising the success of the symposium in identifying the current status and future directions to improve operational tsunami warnings, request Member States to consider the recommendations contained in the summary statement and further recommend organising such symposium once in every 3–4 years.

2. REVIEW OF ACTION ITEMS FROM THE PREVIOUS MEETING

Mr McCreery reviewed the outstanding recommendations and actions from the TTTWO meeting held in Paris, France, 21–22 February 2017 (ref: Summary Report, TOWS-WG, Tenth Meeting, Annex IV, Section 13.2, page 48). The status of actions is listed below:

<table>
<thead>
<tr>
<th>Action Item</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Action 1: Rick Bailey, Francois Schindelé, Thorkild Aarup, representatives for TTDMP, IUGG, to come up with a concept paper to facilitate IOC with the organization of the symposium back-to-back with the Task Team and TOWS-WG meetings in February 2018.</td>
<td>Done. Symposium on Advances in Tsunami Warning to Enhance Community Responses organised during 12–14 February 2018</td>
</tr>
<tr>
<td>Action 2: All significant earthquake/tsunami events handled by the ICGs during the inter-sessional period to be reported against the KPIs agreed by the respective ICGs as a standing agenda item in the joint Task Team meetings. The list of events to be compiled in the report of the TTTWO.</td>
<td>Done. To be further discussed under Agenda Item 5</td>
</tr>
<tr>
<td>Action 3: Thorkild Aarup in consultation with TSPs to prepare a message to be used by all the ICG TSPs on their webpages acknowledging that the services are provided under the IOC-UNESCO framework.</td>
<td>Done. To be further discussed under Agenda Item 11</td>
</tr>
<tr>
<td>Action 4</td>
<td>Continue working on optimal mechanism to provide global tsunami forecast information to the public through an integrated web interface for all ICGs acknowledging the IOC-UNESCO tsunami programme</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Action 5</td>
<td>Continue to consider methods to handle tsunamis from earthquakes in non-subduction zones and non-seismic sources (e.g. meteo-tsunamis) taking into account the ongoing efforts</td>
</tr>
<tr>
<td>Action 6</td>
<td>Chip McCreery &amp; Francois Schindelé to provide a write up on a methodology that can be followed by the ICGs for optimal design of seismic and sea level network based on similar work done in the PTWS and NEAMTWS with inputs from other ICGs. A global map to be generated which will give a picture of the global network.</td>
</tr>
<tr>
<td>Action 7</td>
<td>Rick Bailey &amp; Chip McCreery develop draft messages for vessels at sea for TSPs for relevant NAVAREA coordinators for WWNWS-SC to review and provide feedback at their next meeting in August taking into account based on the template in IHO Manual S57 and feedback received from the Chair of WWNWS-SC</td>
</tr>
<tr>
<td>Action 8</td>
<td>Rick Bailey to provide feedback to DBCP on the draft strategy for data buoy vandalism</td>
</tr>
<tr>
<td>Action 9</td>
<td>To incorporate revised/new procedures into the next revision of the Global Service Definition Document as required</td>
</tr>
</tbody>
</table>

### 3. REVIEW OF THE STATUS OF IMPLEMENTATION OF TOWS-WG REQUESTS TO TTTWO

Mr McCreery listed the six recommendations made by TOWS-WG relevant to TTTWO during the last meeting held in Paris France, February 23–24, 2017 (Summary Report, TOWS-WG, Tenth Meeting, Annex II, page 16). The status of actions is listed below:

<table>
<thead>
<tr>
<th>Action Item</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>To recommend TSPs and NTWCs to also use the Common Alerting Protocol (CAP) to facilitate warning messages to be consistently disseminated simultaneously over many warning communication systems to many applications</td>
<td>Ongoing. PTWS and IOTWMS have initiated efforts to evolve a format for their CAP messages. INGV has also been working with their civil protection authorities on a CAP format and this experience will be discussed in the NEAM-TWS</td>
</tr>
<tr>
<td>To recommend TSPs and NTWCs register with international register of alerting authorities through WMO National Permanent Representative</td>
<td>Ongoing</td>
</tr>
</tbody>
</table>
to consider contributing any education or outreach materials related to data buoy vandalism to the DBCP for inclusion in a tool kit of regionally relevant materials to counter vandalism | Ongoing

| the ICG/PTWS, in line with the IOC-XXVII Assembly decision 8.2, to continue its work on the Key Performance Indicators to cover all aspects of the Tsunami Warning and Mitigation Systems, aligning as closely as possible with the Sendai Framework, and share it to the other ICGs for consideration by the Member States, and report back to TOWS XI with a view to establish global KPIs | Ongoing | To be further discussed under Agenda Item 6

| to encourage NTWCs disseminate tsunami bulletins to ports, harbours and other maritime authorities within their countries | Ongoing

| to share the results of Tsunami exercises and communication tests with WMO to facilitate improved performance of WMO related communication systems | Ongoing | The results of IOTWMS and CARIBE-EWS exercises and communication tests are routinely shared with WMO

4. TSUNAMI WATCH OPERATIONS - CURRENT STATUS AND PLANS

4.1 CARIBE-EWS

Elizabeth Vanacore gave a presentation on the status of the CARIBE-EWS. There are 32 Member States and 16 territories (6 associate Member States of UNESCO), including 16 Small Island Developing States in the CARIBE-EWS with all of them having designated TWFP and TNC. The monitoring networks include 30 different seismic networks and operators contributing to the system with current station density meeting the detection time goal of 1 minute for earthquakes within the region. Tide gauge network coverage in the region enables tsunamis originating within the region to be detected at most of the coastal regions within less than 20 minutes. However, due to damages caused by hurricanes Irma and Maria, the detection time for earthquakes and tsunamis in the northeast Caribbean has gone up considerably. An earthquake in January 2018 in Honduras generated a minor tsunami that was recorded on tide gauges at Belize and Georgetown. Further, the Central American Tsunami Advisory Centre (CATAC) conducted a training programme for seismic analysis. Regular communications tests and wave exercises are conducted, with the latest CARIBE Wave exercise in 2017 involving 670,000 participants. CARIBE Wave 2018 is scheduled on 15 March 2018.

4.2 NEAMTWS

Francois Schindele made a presentation on the status of NEAMTWS. Currently four accredited TSPs are operating in the region with centres in France (CENALT), Greece (NOA), Italy (INGV) and Turkey (KOERI) and one Candidate TSP in Portugal (IPMA) monitoring different sub-regions of the NEAMTWS. Tsunami bulletins are sent to the Member States on a subscription basis. Mr Schindelé mentioned that some Member States have not yet subscribed to receiving bulletins from any of the TSPs and a few others have not identified their Tsunami Warning Forecast Points. He described seismic and sea level networks in the region and mentioned that there are several new sea level stations in the region. The ICG requested Member States to share data from all the sea level stations that are not currently available and also established a new Task Team on documentation. Fernando Carrilho provided further information on the operations of IPMA that was identified as a CTSP during the ICG session in November 2017.
4.3 PTWS

Mr McCreery, Director of the Pacific Tsunami Warning Center and Chair of the TTTWO, provided a status report on behalf of the PTWS. He informed that the Pacific Tsunami Warning System has been benefitting from enhanced seismic networks in the South Pacific through the Oceania Regional Seismic Network Project (ORSNET) project. The noted that the coverage of DART sensors is still much better in the northern Pacific as compared to the southern Pacific region. The ICG/PTWS appealed to the Member States to enhance observing networks and their own detection and analysis capabilities in order to handle their near source events more efficiently and not to depend entirely on regional products from Tsunami Service Providers. Satoshi Harada, Japan Meteorological Agency (JMA) followed up with a presentation on NWPTAC enhanced products, which were tested during the Pacific Wave 17 exercise. Coastal Forecast Points and coastal blocks have been updated in coordination with the recipient countries. Parallel issuance of existing and enhanced products initiated in December 2017 and the final changeover to enhanced products is expected to take place in 2018 after approval by the PTWS Steering Group. Trial operation of the South China Sea Tsunami Advisory Centre (SCSTAC) started on 26 January 2018. The next Pacific Wave Exercise (PacWave18) is planned during September–November 2018.

4.4 IOTWMS

Yuelong Miao provided an update on the status of IOTWMS. There are three Tsunami Service Providers in the IOTWMS. The IOTWMS Area of Service has now been operationalised for the coasts of South Africa and Papua New Guinea bordering the Indian Ocean and accordingly the global map needs to be updated. TSP-Australia is currently implementing Seiscomp3 and has also initiated an upgrade to the decision support software and development of the TSP public warning webpage. TSP-India has been providing upgrades to the Coastal Forecast Zones, Coastal Forecast Points, and NTWC status reporting system, and is working on an automatic reporting system for Key Performance Indicators. TSP-Indonesia is using Seiscomp3 for earthquake detection and upgraded to the TOAST software. The 1st Integrated Intersessional Meetings were hosted by Indonesia during September 2017. The office of the Indian Ocean Tsunami Information centre (IOTIC) is being supported by the BMKG, Indonesia for the period 2017–2022. Working Group-2 plans to undertake a study on optimal sea level and seismic networks and also investigate the possibility of tsunami threat for the coastlines of the Persian/Arabian Gulf and Red Sea. Issuing of the IOTWMS public bulletins over GTS and the IOC public list server has been reinitiated by TSP-India. The next Indian Ocean Wave Exercise (IOWave18) is scheduled to be held during 4–5 September 2018.

5. SIGNIFICANT OPERATIONAL EVENTS IN THE INTER-SESSIONAL PERIOD

Mr McCreery initiated the discussion by presenting a list of the significant earthquake and tsunami events in the last inter-sessional period for which messages were issued by the PTWS TSPs, and issues of interest that arose in the handling of those events. The list of events is attached as Appendix 3.

Mr McCreery briefed on the Mw 7.8 earthquake near Komandorskie Islands on 17 July 2017. The PTWC issued a threat bulletin for this event for areas within 300 km from the epicentre. This was based on an initial magnitude of 7.4, which was updated to 7.8 based on the Mw CMT in the subsequent bulletins. The event generated a minor tsunami wave of 0.3 ft (0.09 m). The location of this earthquake was at the border between PTWC and United States NTWC authoritative areas and there is a possibility that such events might lead to conflicting
information if both centres issue independent advisories – each believing the event to be in their area. There is also a possibility that both centres might delay issuing a bulletin presuming it to be in the authoritative area of the other centre. Further, travel time maps displayed on the United States NTWC website covered the entire Pacific and were reportedly misunderstood by some viewers along the US West Coast to mean a tsunami threat, though the estimated wave amplitudes were way below the threat threshold. Discussion ensued on the most optimal way to generate and display tsunami travel time maps. Mr Miao briefed that TSP-Australia is working on improving travel time estimates in their bulletins and will share a write up with the Task Team.

The Mw 8.2 earthquake on 08 September 2017 near Chiapas, Mexico led to PTWC issuing a tsunami threat based on initial magnitude of 8.0 that was later upgraded to 8.2. The earthquake resulted in a tsunami measuring 5.8 ft (1.75 m) at Chiapas, Mexico. PTWC’s RIFT forecast for American Samoa predicted waves of just above the 0.3m Advisory threshold, but PTWC kept them out of Advisory status based on other information from gauge readings and their SIFT model forecast results. Waves above 0.3m were subsequently not observed, but the RIFT forecast in the international product did cause some concern.

The Mw 7.0 earthquake on 19 November 2017 off Loyalty Islands, New Caledonia led to PTWC issuing a tsunami threat based on an initial magnitude of 7.3 that was later downgraded to 7.0. Mr Schindele briefed that this event was a normal fault, which is not represented in the tsunami forecast databases. Further, there were seven earthquakes between magnitude 6.0 to 7.0 between 31 October 2017 to 19 November 2017 in the near vicinity, all of which produced minor tsunamis of amplitude between 5 cm and 45 cm on tide gauges.

The Mw 7.5 earthquake on 10 January 2018 north of Honduras led to PTWC issuing a tsunami threat based on an initial magnitude estimate of 7.8 that was later downgraded to 7.6. To a question by Ms Christa Von Hillebrandt-Andrade on how important are sea level observations in reducing forecast uncertainties in the warning process, Mr McCreery clarified that RIFT model scenarios are run in real-time using updated earthquake mechanism and magnitude (Mw CMT) and the results can be compared with DART observations to refine the forecasts.

The Mw 7.9 earthquake on 23 January 2018 in the Gulf of Alaska also led to PTWC issuing a tsunami threat in the Pacific. Mr McCreery recalled that Mw CMTs calculated by PTWC within 20–25 minutes for large events over the past few years have been found to usually match within 0.1 magnitude units of final USGS estimates. This is very promising for reducing uncertainties in tsunami forecasts in the initial phases of the event.

Mr Schindele briefed on two tsunami events in the NEAMTWS region. The Mw 6.3 earthquake on 12 June 2017 at the Lesvos Island and the Mw 6.6 earthquake on 20 July 2017 near Bodrum-Kos resulted in generation of minor tsunamis. Bodrum-Kos tsunami measured about 1.5 m. NEAMTWS TSPs issued tsunami early warning bulletins for these events. However, there were limited tide gauge observations in the near field. Video records and field surveys were found to be useful in post-event assessment of the tsunami waves. Warnings were received by the local authorities but were not disseminated to the public. Even when public realised there was a tsunami, several did not evacuate. These events, though moderate, highlighted the threat of tsunamis in the Mediterranean region. Another notable event was the 17 June 2017 Greenland tsunami that was generated due to a cliff failure that resulted in 3 missing people. This tsunami, being generated by non-seismic source and preceded by two similar events in 2000 and 2012 called for renewed discussion regarding methods to handle such events.
Mr Miao briefed on the recent events in the IOTWMS. The Mw 6.5 earthquake on 13 August 2017 off South Java led to all the IOTWMS TSPs issuing threat bulletins. Another earthquake of Mw 6.5 occurred on 15 December 2017 off Java for which all the TSPs issued No Threat bulletins. However, for this event, it was noted that TSP Indonesia mistakenly reissued a Mw 9.2 bulletin that was related to a recent Communications Test due to an operator’s error. A similar instance was reported in the Pacific wherein a routine test message was mistakenly communicated as tsunami warning for the US west coast by a private agency. The Task Team was informed that the IOTWMS is working on systems and procedures for TSPs to minimise the inadvertent issue of bulletins that are inconsistent with the agreed service definition. To handle such inadvertent errors, an appropriate procedure is being worked out by the WG-2 of the ICG/IOTWMS that will be shared with the Task Team.

Ms Hillebrandt-Andrade highlighted that the PTWS criteria for determining the list of countries under threat (local/regional/distant tsunami) in the initial message is currently based on earthquake magnitude and distance from the epicentre. As coastal areas with shallow shelf will have longer tsunami travel time even though they are closer to the epicentre, there might be a merit in deciding this based on the travel times. In the NEAMTWS also, regional bulletins use alert levels based on magnitude and distance from the epicentre and this is a problem with several countries since national threat levels may be different. Discussion followed on contradicting forecast information / threat levels from the same centre for its national and international products for the same coastal forecast zone due to use of different techniques to estimate the forecast amplitudes at the coast or due to use of different threat thresholds. Mr Harada clarified that NWPTAC bulletins do not contain information for the coasts of Japan to avoid conflicting information with the national bulletins issued by JMA.

Recommendation 2: TSPs of the PTWS, CARIBE-EWS and NEAMTWS, in consultation with their ICGs, to explore the use of “travel time” instead of “distance from the epicentre” to determine the list of countries under threat in their initial messages.

Recommendation 3: TSPs of all ICGs to review their regional and domestic products to avoid any conflicting information in their products.

Action 1: Yuelong Miao to share a write up with the Task Team on methods to improve travel time estimates in tsunami bulletins and maps.

Action 2: IOTWMS to share with the Task Team, procedures for TSPs to handle inadvertent errors in issuing bulletins that are inconsistent with the agreed service definition.

6. KPIs FOR ENTIRE WARNING SYSTEM AND MAPPING TO SENDAI FRAMEWORK

Sarah Jayne McCurrach reported on behalf of the PTWS Task Team on Goals and Performance Indicators. She indicated that based on a first draft document delivered by the former Chair of the Task Team, there is ongoing effort to tailor the language to the Sendai Framework Target G Technical Indicators document. Thorkild Aarup suggested that the PTWS document be developed to include a background and context for the proposed Key Performance Indicators (KPIs) which the other ICGs will be able to review at their regular meetings. Further, the ICG KPIs need to be summarised into a few relevant indicators to go up to the level of Governing Bodies. David Coetzee indicated that the format should be one that enables escalating, to seek high-level support as required.

It was decided that the ICG/PTWS complete its present work on KPIs and tailor them to the Sendai Target G Indicators, develop a document with background and context for the proposed KPIs, and provide the document to all ICGs for consideration, with a view to present a
consolidated report to the 30th IOC Assembly (2019). An action to this effect is recorded in the report of the Task Team on Disaster Management and Preparedness (TTDMP).

7. **WORLD TSUNAMI AWARENESS DAY (WTAD)**

David Coetzee briefed that the World Tsunami Awareness Day (WTAD) is observed on 5 November and there are ongoing coordination efforts between IOC and UNISDR. To a query from Mr McCreery if there is a need to coordinate a common reporting to the Assembly, Mr Coetzee informed that this does happen through the reports of each ICG to Governing Bodies. In some cases, the ICGs have been able to align the dates of their wave exercises with the international Disaster Risk Reduction Day and the WTAD.

A discussion followed on the need to take a more active and outcome-driven WTAD by the Secretariat and Member States. Carlos Zuniga Araya indicated that defining themes for each WTAD could be a useful. Patricio Carrasco informed that International Hydrographic Organisation (IHO) has a proactive role to facilitate better coordination in promoting the World Hydrographic Day that focuses on a specific theme each year. Mr Aarup reminded that in the case of WTAD the responsibility of coordination lies with the UNISDR, which has decided to align each WTAD with targets of Sendai Framework. Accordingly, this year’s theme would be reducing direct disaster economic losses.

The Group agreed to inform Member States of the WTAD theme chosen by UNISDR for this year and ask ICGs to consider and feedback on activities by countries. Further, it was also decided to request UN terminology in New York if the Spanish translation of tsunami, “sunami” can be reverted back to the original word. Actions to this effect are recorded in the report of the TTDMP.

8. **UPDATES TO AREA OF SERVICE AND ESZ MAPS OF THE ICGS**

Mr McCreery initiated the discussion by displaying the current map of the Area of Service. Mr Miao advised of changes to be incorporated in the IOTWMS Area of Service to represent operational service to coasts of South Africa and Papua New Guinea bordering the Indian Ocean. Mr Araya advised of extending the PTWS coverage for the coast of Chile within the Magellan Strait since this is already covered by the PTWS. It was also decided to update the text box within NEAMTWS to incorporate IPMA, which is the new CTSP. The revised map incorporating these changes is attached as Appendix 4.

Mr Harada mentioned that the Area of Service of the NWPTAC will remain unchanged until the enhanced products are operationalised later in 2018. The same is the case with the South China Sea Tsunami Advisory Centre. Mr McCreery enquired if the Banda / Java sea coastlines are to be covered by a line to represent coverage by the Indonesian national system, similar to the representation of the domestic service of US NTWC for the coasts of North America. Further, there was a discussion if the thin line covering east coast of Brazil representing future Area of Service should be retained since there are no immediate plans by any TSP to cover this area. Other discussions focused on tsunami service coverage for South Atlantic coasts from possible earthquakes in the Scotia arc and also for the Antarctic coasts. Since there are currently no plans for any regional tsunami service to cover these areas, it was decided not to make any changes at this stage and revisit all these points during the next meeting.
Recommendation 4: Recommend the following changes to the AoS Map:

- Thin blue line near coasts of South Africa and Papua New Guinea representing future area of service be replaced by a thick line since service for those areas is operational.

- The coast of Chile within the Magellan Strait be represented as thick orange line since this is already covered by the PTWS.

- Update the text box of the NEAMTWS, with the new CTSP in the NEAMTWS, IPMA.

9. HANDLING OF TSUNAMIS FROM NON-SEISMIC SOURCES

Mike Angove, Director, NOAA Tsunami Program, initiated this discussion with a presentation on the US operational consideration of non-seismic source tsunamis. He listed several meteo-tsunamis that struck the US coast, including the Boothbay Harbor event of Oct 28, 2008 wherein waves up to 12 ft high emptied and flooded the harbor at least 3 times over 15 minutes, damaging boats and shoreline infrastructure. NOAA identified this as a potential tsunami in their post analysis. The source was identified as non-seismic and of meteorological origin – a fast-moving low-pressure system passing over the shallow ocean on the continental shelf at tsunami speed and thus generating tsunami-like gravity waves that were detected on DART buoys. Mr Angove concluded that the US tsunami warning system currently does not operationally alert the public to non-seismic source tsunamis, but upon detection on DART buoys, proposes to support local weather forecast offices regarding this threat. NOAA also works with the storm surge community on modelling and is exploring the use of existing HF radar data to detect meteo-tsunamis.

Tsunamis induced due to aerial and subaerial landslides as well as volcanic eruptions are other possible sources that need to be considered from an operational tsunami warning perspective. The 17 June 2017 Greenland tsunami that was generated due to a cliff failure (preceded by two similar events in 2000 and 2012) points to an increased frequency possibly due to climate change and calls for Member States to develop a warning and mitigation strategy. Discussions also followed on the ongoing initiatives in the CARIBE-EWS to investigate methods to address tsunamis from volcanic sources. The group agreed to continue efforts for monitoring and responding to tsunamis generated by non-seismic sources and possible integration into tsunami watch operation.

Recommendation 5: Encourages CARIBE-EWS to continue work on handling tsunamis from volcanoes and share as guidance for the other ICGs

Recommendation 6: Recognising the increasing threat of aerial and subaerial landslide induced tsunamis related interalia to climate change, encourage Member States to assess risk and develop possible warning and mitigation strategy

Recommendation 7: Recognising the progress made in understanding the meteo-tsunami threat, encourage Member States to share best practices

Action 3: CARIBE-EWS to share with the Task Team, procedures for TSPs to handle tsunamis from volcanoes.
**Action 4**: PTWC to provide guidance based on their experience with the W phase CMT and RIFT model on procedures to handle tsunamis generated from non-subduction earthquakes and mechanisms for sharing with the other ICGs

**10. PRODUCTS FOR THE MARITIME COMMUNITY**

Mr McCreery briefed on the background of this agenda item. As a follow-up on the actions from the last meeting of the TTTWO and the TOWS-WG, it was noted that several ICGs have recommended their NTWCs to disseminate tsunami bulletins to ports, harbours, and other maritime authorities within their countries. He noted that further work needs to be done by the Task Team for developing specific tsunami threat messages for vessels at sea based on the advice received from the Chair of WWNWS-SC and in line with the examples of navigational warnings for tsunamis and other natural phenomena, such as abnormal changes to sea level listed in the Joint IMO/IHO/WMO Manual on Maritime Safety Information (Manual 53, published in 2016). Further, Mr Araya informed that Chile already issues specific bulletins to their ports and maritime authorities that could be shared with the Task Team as preliminary guidance. It was decided that the Task Team will continue to develop draft messages for vessels at sea for use by the TSPs.

**Action 5**: Yuelong Miao, Carlos Zuniga Araya, Patricio Carrasco and Chip McCreery to help develop draft messages for vessels at sea for TSPs based on the template in IHO Manual S53 for WWNWS-SC to review and provide feedback

**11. GLOBAL PUBLIC ACCESS TO TSUNAMI THREAT INFORMATION**

Mr McCreery reminded the Task Team that the original intention of this agenda was to explore the possibility of developing an integrated webpage/portal under the IOC-UNESCO tsunami programme which could have links to, or source information from all the ICG TSPs/NTWCs to provide public with authentic and up-to-date status of tsunami warnings in different ocean basins. After detailed discussions on the roles and responsibilities of different stakeholders involved in the end-to-end warning chain and the complexities involved in developing a portal for unified global access to tsunami warnings, it was decided during last meeting that all the TSPs operating in the ICG framework incorporate an agreed text in their websites acknowledging that the tsunami services are provided under the IOC-UNESCO framework. The Secretariat has come up with a draft text, which was discussed and finalised in the meeting (Appendix 5). This statement could be used by TSPs on their webpages for regional services.

**Recommendation 8**: Approve the text to be used on TSP webpages and request the ICG TSPs to display the statement on their websites.

**12. OPTIMAL DESIGN OF SEA-LEVEL NETWORKS**

Mr McCreery presented a write-up on the methodology that he prepared along with Mr Schindele based on similar work done in the PTWS and NEAMTWS, and could be used by the ICGs for optimal design of seismic and sea-level network in their regions. Mr Miao informed about a similar effort in the IOTWMS to prepare maps of optimal seismic and sea level networks. Ms Hillebrandt-Andrade suggested that similar works done in the CARIBE-EWS and other ocean basins be added as references in the write-up. The revised methodology incorporating these references was accepted by the Task Team (refer to Appendix 6). This is to be incorporated in the next revision of the Global Service Definition Document (GSSD). It was
further decided that maps of current seismic and sea level network timing response for earthquakes and tsunamis for the four ICG regions be developed based on the accepted methodology to be used as examples to develop similar response maps at much finer sub-regional scales.

**Action 6:** Chip McCreery and Francois Schindele to develop maps of the current seismic and sea level network timing response for earthquakes and tsunamis for the four ICG regions based on the methodology accepted in the current Task Team meeting as examples of how to examine similar responses on a sub-regional level.

13. **REVIEW OF ACTION ITEMS AND RECOMMENDATIONS TO THE TOWS-WG**

13.1 **RECOMMENDATIONS:**

**Recommendation 1:** Recognising the success of the symposium in identifying the current status and future directions to improve operational tsunami warnings, request Member States to consider the recommendations contained in the summary statement and further recommend organising such symposium once in every 3–4 years.

**Recommendation 2:** TSPs of the PTWS, CARIBE-EWS and NEAMTWS, in consultation with their ICGs, to explore the use of “travel time” instead of “distance from the epicentre” to determine the list of countries under threat in their initial messages.

**Recommendation 3:** TSPs of all ICGs to review their regional and domestic products to avoid any conflicting information in their products.

**Recommendation 4:** Recommend the following changes to the AoS Map:

- Thin blue line near coasts of South Africa and Papua New Guinea representing future area of service be replaced by a thick line since service for those areas is operational.
- The coast of Chile within the Magellan Strait be represented as thick orange line since this is already covered by the PTWS.
- Update the text box of the NEAMTWS, with the new CTSP in the NEAMTWS, IPMA.

**Recommendation 5:** Encourages CARIBE-EWS to continue work on handling tsunamis from volcanoes and share as guidance for the other ICGs.

**Recommendation 6:** Recognising the increasing threat of aerial and sub aerial landslide induced tsunamis related interalia to climate change, encourage Member States to assess risk and develop possible warning and mitigation strategy.

**Recommendation 7:** Recognising the progress made in understanding the meteo-tsunami threat, encourage Member States to share best practices.

**Recommendation 8:** Approve the text to be used on TSP webpages and request the ICG TSPs to display the statement on their websites.

**Recommendation 9:** Recommends extension of the tenure of the TTTWO for a further term with the same ToRs.
13.2 ACTIONS:

**Action 1**: Yuelong Miao to share a write up with the Task Team on methods to improve travel
    time estimates in tsunami bulletins and maps

**Action 2**: IOTWMS to share with the Task Team, procedures for TSPs to handle inadvertent
    errors in issuing bulletins that are inconsistent with the agreed service definition.

**Action 3**: CARIBE-EWS to share with the Task Team, procedures for TSPs to handle tsunamis
    from volcanoes.

**Action 4**: PTWC to provide guidance based on their experience with the W phase CMT and
    RIFT model on procedures to handle tsunamis generated from non-subduction earthquakes and
    mechanisms for sharing with the other ICGs

**Action 5**: Yuelong Miao, Carlos Zuniga Araya, Patricio Carrasco and Chip McCreery to help
    develop draft messages for vessels at sea for TSPs based on the template in IHO Manual S53
    for WWNWS-SC to review and provide feedback

**Action 6**: Chip McCreery and Francois Schindele to develop maps of the response of the
    current seismic and sea level network timing response for earthquakes and tsunamis for the
    four ICG regions based on the methodology accepted in the current Task Team meeting as
    examples of how to examine similar responses on a sub-regional level.

14. **CLOSE OF MEETING**

Mr McCreery closed the meeting at 12:30 p.m. and thanked the participants for their contribution
    to a highly productive meeting.
APPENDIX 1

TOWS-WG Inter-ICG Task Team on Tsunami Watch Operations

14–15 February 2018
Paris, France

Provisional Agenda and Timetable

Task Team Members:
Dr Charles McCreery, Pacific Tsunami Warning Center (NOAA, Hawaii, USA) – ICG/PTWS
Mr Satoshi Harada, Japan Meteorological Agency (Japan) – ICG/PTWS
Dr Francois Schindele, Centre d’alerte aux tsunamis (France) – ICG/NEAMTWS
Dr Fernando Carrilho, Portugese Sea and Atmosphere Institute (Portugal) – ICG/NEAMTWS
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<th>Day 1: Wednesday, February 14, 2018</th>
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<th>Topic</th>
<th>Reference</th>
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| 1  | 1500-1515 | Opening and Session Organization | • Registration  
• Overview of meeting logistics, introduction of participants, review of the agenda, etc.  
• Outcomes of the Tsunami Symposium (12-14 Feb 2018) for consideration by the TTTWO | Chip McCreery |
ICG-Representatives |
| 3  | 1545-1630 | Review the Status of Implementation of the TOWS-WG Requests to the TTTWO | Summary Report, TOWS-WG, Tenth Meeting, Annex II, page 16 | Chip McCreery  
ICG-Representatives |
| 4  | 1700-1830 | Tsunami Watch Operations - Current Status and Plans in all ICGs | ICG-Representatives |

Day 1 Close
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<tr>
<td>0900-1030</td>
<td>Significant Operational Events Since Last Meeting</td>
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<td>- Actions Taken</td>
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<td>- Recommendations</td>
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<td>1100-1130</td>
<td>KPIs for Entire Warning System and Mapping to Sendai Framework</td>
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<td>1130-1200</td>
<td>World Tsunami Awareness Day</td>
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<td>1300-1345</td>
<td>Updates to Area of Coverage and ESZ Maps of the ICGs</td>
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<td>Handling of Tsunamis from Non-Seismic Sources: Meteorological, Landslide, Volcanic, Bolide and Non-subduction Zone Earthquakes</td>
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**Notes:**
- See Attached Table
- ICG-Representatives
- Joint Session with Task Team on Disaster Management and Preparedness
- Summary Report, TOWS-WG, Tenth Meeting, Annex IV, page 45
- Summary Report, TOWS-WG, Tenth Meeting, Annex IV, Section 10, page 44
- Summary Report, TOWS-WG, Tenth Meeting, Annex IV, Section 11, page 46-47
- Chip McCreery
|   | 1600-1630 | **Other Harmonization Issues**  
  • **Optimal Design of Sea-level networks** | **Summary Report, TOWS-WG, Tenth Meeting, Annex IV, Section 12.2, page 47** | **ICG-Representatives** |
|---|----------|--------------------------------------------------|------------------------------------------------------------------|------------------------|
| 13 | 1630-1700 | **Recommendations and Actions for Reporting to the TOWS WG**  
 **Conclusion** | | **Chip McCreery**  
 **IOC-Representative** |

Meeting Close
SIGNIFICANT OPERATIONAL EVENTS IN THE INTER-SESSIONAL PERIOD

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* This W-phase CMT, available about 20-25 minutes after any large earthquake, is currently only used by PTWC so values are only shown for PTWS events.
APPENDIX 3

TOWS-WG Inter-ICG Task Team on Tsunami Watch Operations

14–15 February 2018
Paris, France

Revised Area of Service Map
Common Text to be used on the Websites of all Tsunami Service Providers operating under the IOC’s ICG Framework

The << name of the centre>> functions as an approved Tsunami Service Provider of the <<name of the regional system>> that is an integral part of the Global Tsunami Warning and Mitigation System, established and coordinated by the Intergovernmental Oceanographic Commission (IOC) of UNESCO.

**Tsunami Programme of IOC-UNESCO**

The Tsunami Programme of IOC-UNESCO ([http://www.ioc-tsunami.org/](http://www.ioc-tsunami.org/)), through the coordination of regional meetings, capacity building activities and support of national and regional projects is a key stakeholder for tsunami risk reduction at the global level.

Four Intergovernmental Coordination Groups (ICGs) corresponding to the Pacific Ocean, Caribbean Sea, Indian Ocean, and Northeast Atlantic Ocean & Mediterranean Sea have been established by IOC-UNESCO to address particular regional needs.

Further, to advise the IOC governing bodies on coordinated development of warning and mitigation system for tsunamis and other hazards related to sea level that are of common interest to all the ICGs, the IOC Assembly at its 24th Session ([Resolution XXIV-14](http://www.ioc-tsunami.org/)) established a Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems (TOWS-WG).

**Tsunami Warning Service Framework**

The end-to-end tsunami early warning and mitigation system consists of Risk Assessment & Reduction, Detection, Warning & Dissemination, and Awareness & Response.

Regional tsunami warning systems operating within different ocean basins are the building blocks of the end-to-end tsunami warning and mitigation system, coordinated by IOC-UNESCO as a global “system of systems”.

The service framework within each regional tsunami warning system ideally is comprised of National Tsunami Warning Centres (NTWCs) / Tsunami Warning Focal Points (TWFPs) in each Member State receiving tsunami forecast information from one or more Tsunami Service Providers (TSPs).

The TSPs operate 24x7 to rapidly detect large earthquakes using real-time seismic networks, assess tsunamigenic potential, monitor tsunami waves using real-time sea-level networks and distribute agreed-upon products to NTWCs/TWFPs operating within the ocean basin or sea.

Ultimately it is the responsibility of mandated national organisations operating within the legal framework of the sovereign nation in which they reside and serve, to provide alerts to their citizens and communities. These alerts are based either on their own analysis of the situation, on the forecast information received from Tsunami Service Providers, or on a combination of both.
Area of Service

The Area of Service of Tsunami Service Providers operating within a regional tsunami warning system are decided by the respective ICGs. The TOWS-WG provides coordination at the global level to ensure coverage to vulnerable coastal regions of participating Member States, while ensuring a high standard of service and inter-operability.

Tsunami Service Providers

The approved Tsunami Service Providers that are currently operating under the IOC-UNESCO framework are given below:

Pacific Tsunami Warning and Mitigation System (PTWS):
- Pacific Tsunami Warning Centre (PTWC):
  http://tsunami.gov/
- North West Pacific Tsunami Advisory Centre (NWPTAC)

Caribbean and Adjacent Regions (CARIBE EWS):
- Pacific Tsunami Warning Centre (PTWC)
  http://tsunami.gov/

Indian Ocean Tsunami Warning and Mitigation System (IOTWMS)
- Joint Australian Tsunami Warning Centre (JATWC)
- Indian Tsunami Early Warning Centre (ITEWC)
  http://www.incois.gov.in/incois/tsunami/eqevents.jsp
- Indonesian Tsunami Early Warning System (InaTEWS)
  http://rtsp.bmkg.go.id

Northeast Atlantic, Mediterranean and Connected Seas (NEAMTWS):
- French National Tsunami Warning Centre (CENALT)
  http://www.info-tsunami.fr
- Institute of Geodynamics, National Observatory of Athens
  http://www.gein.noa.gr/en/
- Kandilli Observatory and Earthquake Research Institute, Turkey
  http://www.koeri.boun.edu.tr/2/en/
- National Institute of Geophysics and Volcanology (INGV), Italy
  http://www.ingv.it/en/
- Instituto Português do Mar e da Atmosfera (IPMA), Portugal

Disclaimer:

The tsunami forecast information provided does not originate within IOC-UNESCO. It is provided by <<name of the centre>> in support of the IOC-UNESCO <<name of the regional system>>. It is the responsibility of mandated national organisations operating within the legal framework of the sovereign nation in which they reside and serve, to provide alerts to their citizens and communities. IOC-UNESCO does not warrant, guarantee, or make any representations regarding the timeliness, currency, correctness, accuracy, reliability, or other aspect of the characteristics or use of the information.
APPENDIX 5

TOWS-WG Inter-ICG Task Team on Tsunami Watch Operations

14–15 February 2018
Paris, France

Creating Maps to Assess Response Times and Plan Improvements to Seismic and Sea Level Networks

Define Grid: First define a grid of points across the area on the map where you want to evaluate the response of the network. The grid should cover all the potential earthquake or tsunami source areas. The grid spacing should be dense enough so that there are sufficient points to contour with meaningful resolution.

Specify Observational Network: Specify the location of each seismic station or each sea level gauge in existing networks. To this you may add stations as desired to see how they might improve the network response.

Specify Station Transmission Delays: Every seismic and sea level station has associated transmission delays associated with the packetizing of data or with other delays associated with the data first being collected by the local network operator before being transmitted to your facility.

Compute Travel Times: For each point on the grid, compute the appropriate travel time to each station in the network. This might be the seismic P-wave travel time or the tsunami travel time. To these times, add the station transmission delay for each station. This may be added either as an average time or a maximum time. For example, if a sea level station transmits its data every 10 minutes, then on average the delay between when the tsunami signal would arrive and when the transmission of that arrival would be received would be 5 minutes. On the other hand, if you want to be conservative so the plot represents the guaranteed response time, then 10 minutes should be added. Further, add an amount of time that represents the amount of data needed after the first arrival to do the measurement. For a tsunami, you might want to add 10 minutes to ensure measuring at least a half cycle of the tsunami wave, or 20 minutes to ensure measuring a full cycle.

Order Results: For each point on the grid, you will now have a list of times to each station. Order the list for each grid point from the smallest time to the largest time.

Define Plot Parameters: To proceed further, you need to define what you want the plot to represent. For example, you might want to examine the time it will take to get at least 8 P-wave first arrival measurements for locating an earthquake. In that case, for each point on the grid you will need to extract the time from the eighth station on that point’s ordered list. You can even add other constraints such as having a minimum azimuth gap of, say, 200 degrees. In that case you will need to start with the eighth entry and compute the azimuth gap for the first 8 stations. If it does not meet the minimum then you need to go to the ninth entry and compute the azimuth gap for those 9 stations. When the azimuth gap requirement is satisfied, then the time of that entry is the minimum time for that point. For the sea level data you could want to examine the minimum time to get one reading, or the minimum time to get 3 readings and at least one reading from a deep-ocean sensor.

Contour Results: When this procedure has been done for each point on the grid, then you will have a minimum time for each grid point. This can be plotted on a map with the values contoured. From this plot it will be apparent which epicenters or which tsunami sources will take longer to get sufficient data for doing the analysis as defined in the step above. You can
then try adding new station locations and repeating the process to see how that improves the response.

**Example 1:** Below is an example map of seismic response in part of the Caribbean near Puerto Rico. The grid was defined over the entire domain of the map. The white triangles are the locations of the seismic stations – in this case assuming all are working with no delays. The criterion for the plot was that the P-wave arrived at least 8 stations. There was no azimuth gap criterion. The data have been contoured and colored in 10 second intervals.

**Example 2:** Below is a tide gage sea level response in part of the Western Mediterranean sea. The grid was defined over the entire domain of the map. The blue dots are the locations of the seismic stations – average delays specific for each station is added. The criterion for the plot was that the tsunami-wave arrived at 1 station.
References:
## LIST OF PARTICIPANTS

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<table>
<thead>
<tr>
<th>Name</th>
<th>Position</th>
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ANNEX VI

LIST OF ACRONYMS

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMKG</td>
<td>Indonesian Agency for Meteorological, Climatological and Geophysics</td>
</tr>
<tr>
<td>BPBD</td>
<td>Badan Penanggulangan Bencana Daerah (Local Disaster Management Agency)</td>
</tr>
<tr>
<td>CAP</td>
<td>Common Alert Protocol</td>
</tr>
<tr>
<td>CATAC</td>
<td>Central America Tsunami Advisory Center</td>
</tr>
<tr>
<td>CARIBE WAVE</td>
<td>Caribbean Wave Exercise</td>
</tr>
<tr>
<td>CENALT</td>
<td>CENtre d'Alerte aux Tsunamis, France</td>
</tr>
<tr>
<td>CIFDP</td>
<td>Coastal Inundation Forecasting Demonstration Project</td>
</tr>
<tr>
<td>CMT</td>
<td>Centroid Moment Tensor</td>
</tr>
<tr>
<td>CTIC</td>
<td>Caribbean Tsunami Information Center</td>
</tr>
<tr>
<td>CTSP</td>
<td>Candidate Tsunami Service Provider</td>
</tr>
<tr>
<td>CTWP</td>
<td>Caribbean Tsunami Warning Programme</td>
</tr>
<tr>
<td>DART</td>
<td>Deep-ocean Assessment and Reporting of Tsunamis</td>
</tr>
<tr>
<td>DBCP</td>
<td>Data Buoy Cooperation Panel</td>
</tr>
<tr>
<td>EC</td>
<td>Executive Council</td>
</tr>
<tr>
<td>GNSS</td>
<td>Global Navigation Satellite System</td>
</tr>
<tr>
<td>GSSD</td>
<td>Global Service Definition Document</td>
</tr>
<tr>
<td>GTS</td>
<td>Global Telecommunication System (WMO)</td>
</tr>
<tr>
<td>ICG</td>
<td>Intergovernmental Coordination Group</td>
</tr>
<tr>
<td>ICG/CARIBE-EWS</td>
<td>Intergovernmental Coordination Group for the Tsunami and Other Coastal Hazards Warning System for the Caribbean and Adjacent Regions</td>
</tr>
<tr>
<td>ICG/IOTWMS</td>
<td>Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System</td>
</tr>
<tr>
<td>ICG/NEAMTWS</td>
<td>Intergovernmental Coordination Group for the Tsunami Early Warning and Mitigation System in the North-Eastern Atlantic, the Mediterranean and Connected Seas</td>
</tr>
<tr>
<td>ICG/PTWS</td>
<td>Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System</td>
</tr>
</tbody>
</table>
IHO
IMO
INGV
IOC
IOTIC
IOWave
IPMA
ITB
ITEWC
ITIC
ITP
IUGG
JATWC
JCOMM
JICA
JMA
KOERI
KPI
M
Mw
MFIT
NEAMTIC
NOA
NOAA
NTWC
NWPTAC
ORSNET

International Hydrographic Organization
the International Maritime Organization
Istituto Nazionale di Geofisica e Vulcanologia, Italy
Intergovernmental Oceanographic Commission
Indian Ocean Tsunami Information Centre
Indian Ocean Wave Exercise
Instituto Português do Mar e da Atmosfera
Institut Teknologi Bandung
Indian Tsunami Early Warning Centre
International Tsunami Information Center
ITIC Training Programme
International Union of Geodesy and Geophysics
Joint Australian Tsunami Warning Centre
Joint Technical Commission for Oceanography and Marine Meteorology
Japan International Cooperation Agency
Japan Meteorological Agency
Kandilli Observatory and Earthquake Research, Turkey
Key Performance Indicators
Magnitude
Moment Magnitude
Malaysia Fund in Trust
Tsunami Information Centre for the North-Eastern Atlantic, the Mediterranean and Connected Seas
National Observatory of Athens, Greece
National Oceanic and Atmospheric Administration
National Tsunami Warning Center
North West Pacific Tsunami Advisory Center
Oceania Regional Seismic Network Project
<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>PacWave</td>
<td>Pacific Wave Exercise</td>
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<tr>
<td>PTWC</td>
<td>Pacific Tsunami Warning Centre</td>
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<tr>
<td>PTWS</td>
<td>Pacific Tsunami Warning and Mitigation System</td>
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<tr>
<td>RIFT</td>
<td>Real-time Inundation Forecasting of Tsunamis</td>
</tr>
<tr>
<td>SC</td>
<td>Steering Committee</td>
</tr>
<tr>
<td>SCSTAC</td>
<td>South China Sea Tsunami Advisory Centre</td>
</tr>
<tr>
<td>SOP</td>
<td>Standard Operating Procedure</td>
</tr>
<tr>
<td>TEMPP</td>
<td>Tsunami Evacuation Maps, Plans and Procedures</td>
</tr>
<tr>
<td>TIC</td>
<td>Tsunami Information Centres</td>
</tr>
<tr>
<td>TNC</td>
<td>Tsunami National Contact</td>
</tr>
<tr>
<td>TOAST</td>
<td>Tsunami Observation and Simulation Terminal</td>
</tr>
<tr>
<td>TOR</td>
<td>Terms of Reference</td>
</tr>
<tr>
<td>TOWS-WG</td>
<td>Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems</td>
</tr>
<tr>
<td>TSP</td>
<td>Tsunami Service Provider</td>
</tr>
<tr>
<td>TSU</td>
<td>Tsunami Unit</td>
</tr>
<tr>
<td>TT</td>
<td>Task Team</td>
</tr>
<tr>
<td>TTDMP</td>
<td>Task Team on Disaster Management and Preparedness</td>
</tr>
<tr>
<td>TTT</td>
<td>Tsunami Travel Time</td>
</tr>
<tr>
<td>TTTRP</td>
<td>Task Team on Tsunami Recognition Programme</td>
</tr>
<tr>
<td>TTTWO</td>
<td>Task Team on Tsunami Watch Operations</td>
</tr>
<tr>
<td>TWFP</td>
<td>Tsunami Warning Focal Points</td>
</tr>
<tr>
<td>UNDP</td>
<td>United Nations Development Programme</td>
</tr>
<tr>
<td>UNESCAP</td>
<td>UN Economic and Social Commission for Asia and the Pacific</td>
</tr>
<tr>
<td>UNESCO</td>
<td>United Nations Educational, Scientific and Cultural Organization</td>
</tr>
<tr>
<td>UNISDR</td>
<td>United Nations Office for Disaster Risk Reduction</td>
</tr>
<tr>
<td>USAID/OFDA</td>
<td>United States Agency for International Development/Office of U.S. Foreign Disaster Assistance</td>
</tr>
<tr>
<td>USGS</td>
<td>United States Geological Survey</td>
</tr>
</tbody>
</table>
WIS  WMO Information System
WMO  World Meteorological Organization
WTAD  World Tsunami Awareness Day
WWNWS-SC  World-wide Navigational Warning Service Sub-Committee
In this Series, entitled

Reports of Meetings of Experts and Equivalent Bodies, which was initiated in 1984 and which is published in English only, unless otherwise specified, the reports of the following meetings have already been issued:

1. Third Meeting of the Central Editorial Board for the Geological/Geophysical Atlases of the Atlantic and Pacific Oceans
3. First Session of the IOC-FAO Guiding Group of Experts on the Programme of Ocean Science in Relation to Living Resources
4. First Session of the ICO-UN(OETB) Guiding Group of Experts on the Programme of Ocean Science in Relation to Non-Living Resources
5. First Session of the Editorial Board for the International Bathymetric Chart of the Mediterranean and Overlay Sheets
6. First Session of the Joint CCOP(SOPAC)-IOC Working Group on South Pacific Tectonics and Resources
7. First Session of the IOE Group of Experts on Marine Information Management
8. First Session of the IOC Consultative Group on Ocean Mapping *(Also printed in French and Spanish)*
9. Joint 100-WMO Meeting for Implementation of IGOSS XBT Ships-of-Opportunity Programmes
10. Second Session of the Joint CCOP(SOPAC)-IOC Working Group on South Pacific Tectonics and Resources
11. Third Session of the Group of Experts on Format Development
12. Eleventh Session of the Joint CCOP-IOC Working Group on Post-IDOE Studies of South-East Asian Tectonics and Resources
13. Second Session of the IOC Editorial Board for the International Bathymetric Chart of the Mediterranean and Overlay Sheets
14. Seventh Session of the IOC-UNEP Group of Experts on Methods, Standards and Intercalibration
15. Second Session of the IOC Group of Experts on Effects of Pollutants
16. First Session of the IOC Consultative Group on Ocean Mapping *(Also printed in French and Spanish)*
17. First Session of the IOC Group of Experts on Marine Geology and Geophysics in the Western Pacific
18. Second Session of the IOC-UN(OETB) Guiding Group of Experts on the Programme of Ocean Science in Relation to Non-Living Resources *(Also printed in French and Spanish)*
19. Third Session of the IOC Group of Experts on Effects of Pollutants
20. Eighth Session of the IOC-UNEP Group of Experts on Methods, Standards and Intercalibration
21. Seventh Session of the Joint IOC-IOE Working Committee for the General Bathymetric Chart of the Oceans *(Also printed in French)*
22. Second Session of the IOC-FAO Guiding Group of Experts on the Programme of Ocean Science in Relation to Living Resources
23. First Session of the IOC Consultative Group on Ocean Mapping *(Also printed in French and Spanish)*
24. Eighth Session of the IOC-UN(OETB) Guiding Group of Experts on the Programme of Ocean Science in Relation to Non-Living Resources *(Also printed in French and Spanish)*
25. Eleventh Session of the Joint IOC-IOE Working Committee for the General Bathymetric Chart of the Oceans *(Also printed in French)*
26. Second Session of the IOC-FAO Guiding Group of Experts on the Programme of Ocean Science in Relation to Living Resources
27. First Session of the IOC Group of Experts on Standards and Reference Materials
28. First Session of the IOC Group of Experts on Recruitment in Tropical Coastal Demersal Communities *(Also printed in Spanish)*
29. Second IOC-WMO Meeting for Implementation of IGOSS XBT Ship-of-Opportunity Programmes
30. Thirteenth Session of the Joint CCOP-IOC Working Group on Post-IDOE Studies of South-East Asian Tectonics and Resources
31. Second Session of the IOC Task Team on the Global Sea-Level Observing System
32. Third Session of the IOC Editorial Board for the International Bathymetric Chart of the Mediterranean and Overlay Sheets
33. Fourth Session of the IOC-UNEP-IMO Group of Experts on Effects of Pollutants
34. First Consultative Meeting on RNOCs and Climate Data Services
35. Second Joint IOC-WMO Meeting of Experts on IGOSS-IDOE Data Flow
36. Fourth Session of the Joint CCOP(SOPAC)-IOC Working Group on South Pacific Tectonics and Resources
37. Fourth Session of the IOE Group of Experts on Technical Aspects of Data Exchange
38. Sixteenth Session of the Joint CCOP-IOC Working Group on Post-IDOE Studies of South-East Asian Tectonics and Resources
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45. Fourth Session of the IOC Editorial Board for the International Chart of the Central Eastern Atlantic *(Also printed in French)*
46. Third Session of the IOC Editorial Board for the International Bathymetric Chart of the Caribbean Sea and the Gulf of Mexico *(Also printed in Spanish)*
47. Fifth Session of the IOC-UNEP-IMO Group of Experts on Effects of Pollutants
48. Fourth Session of the IOC Consultative Group on Ocean Mapping
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55. Fifth Session of the IOC-UNEP-IMO Group of Experts on Effects of Pollutants
56. Second Session of the IOC Editorial Board for the International Bathymetric Chart of the Western Indian Ocean
57. First Meeting of the IOC *ad hoc* Group of Experts on Ocean Mapping in the WESTPAC Area
58. Fourth Session of the IOC Consultative Group on Ocean Mapping
59. Second Session of the IOC-WMO/GOSS Group of Experts on Operations and Technical Applications
60. Second Session of the IOC Group of Experts on the Global Sea-Level Observing System
61. UNEP-IOC-WMO Meeting of Experts on Long-Term Global Monitoring System of Coastal and Near-Shore Phenomena Related to Climate Change
62. Third Session of the IOC-FAO Group of Experts on the Programme of Ocean Science in Relation to Living Resources
63. Second Session of the IODE-IAEA-UNEP Group of Experts on Standards and Reference Materials
64. Joint Meeting of the Group of Experts on Pollutants and the Group of Experts on Methods, Standards and Intercomparison
65. First Meeting of the Working Group on Oceanographic Co-operation in the ROPME Sea Area
66. Fifth Session of the Editorial Board for the International Bathymetric and its Geological/Geophysical Series
67. Thirteenth Session of the IOC-IHO Joint Guiding Committee for the General Bathymetric Chart of the Oceans (Also printed in French)
68. International Meeting of Scientific and Technical Experts on Climate Change and Oceans
69. Fourth Joint IOC-WMO Meeting for Implementation of IGOS-5 XBT Ship-of-Opportunity Programmes
70. ROPME-IQC Meeting of the Steering Committee for Oceanographic Co-operation in the ROPME Sea Area
71. Seventh Session of the Joint IOC-WMO-CPPS Working Group on the Investigations of ‘El Niño’ (Spanish only)
72. Fourth Session of the IOC Editorial Board for the International Bathymetric Chart of the Caribbean Sea and the Gulf of Mexico (Also printed in Spanish)
73. UNEP-IQC-ASPEI Global Task Team on the Implications of Climate Change on Coral Reefs
74. Third Session of the IODE Group of Experts on Marine Information Management
75. Sixth Session of the IODE Group of Experts on Technical Aspects of Data Exchange
76. ROPME-IQC Meeting of the Steering Committee for the Integrated Project Plan for the Coastal and Marine Environment of the ROPME Sea Area
77. Third Session of the IOC Group of Experts on the Global Sea-level Observing System
78. Third Session of the IOC-IODE-UNEP Group of Experts on Standards and Reference Materials
79. Fourth Session of the IOC-IQC-IHO Guiding Committee for the General Bathymetric Chart of the Oceans
80. FYI Joint IOC-WMO Meeting for Implementation of IGOS-XBT Ship-of-Opportunity Programmes
81. Second Meeting of the UNEP-IQC-ASPEI Global Task Team on the Implications of climate Change on Coral Reefs
82. Seventh Session of the JSC Ocean Observing System Development Panel
83. Fourth Session of the IODE Group of Experts on Marine Information Management
84. Sixth Session of the IOC Group of Experts on the Global Sea Level Observing System
85. Fourth Session of the Joint IOC-IJGIFS Panel on Carbon Dioxide
86. First Session of the IOC Editorial Board for the International Bathymetric Chart of the Western Pacific
87. Eighth Session of the JSC Ocean Observing System Development Panel
88. Ninth Session of the JSC Ocean Observing System Development Panel
89. Sixth Session of the IODE Group of Experts on Technical Aspects of Data Exchange
90. First Session of the IOC-FAO Group of Experts on OSLR for the IOCINCWIO Region
91. Fifth Session of the Joint IOC-IJGIFS CO, Advisory Panel Meeting
92. Tenth Session of the JSC Ocean Observing System Development Panel
93. First Session of the Joint CMM-IGOS-IODE Sub-group on Ocean Satellites and Remote Sensing
94. Third Session of the IOC Editorial Board for the International Chart of the Western Indian Ocean
95. Fourth Session of the IOC Group of Experts on the Global Sea Level Observing System
96. Joint Meeting of GEMS and GEEP Core Groups
97. First Session of the Joint Scientific and Technical Committee for Global Ocean Observing System
98. Second International Meeting of Scientific and Technical Experts on Climate Change and the Oceans
99. First Meeting of the Officers of the Editorial Board for the International Bathymetric Chart of the Western Pacific
100. Fifth Session of the IOC Editorial Board for the International Bathymetric Chart of the Caribbean Sea and the Gulf of Mexico
101. Second Session of the Joint Scientific and Technical Committee for Global Ocean Observing System
102. Fifteenth Session of the Joint IOC-IHO Committee for the General Bathymetric Chart of the Oceans
103. Fourth Session of the IOC Consultative Group on Ocean Mapping
104. Fifth Session of the IOC Group of Experts on Marine Information Management
105. Sixth Session of the Joint IOC-IJGIFS Panel on Carbon Dioxide
106. IOC-NHOM Ad hoc Consultation on Marine Biodiversity
107. Sixth Joint IOC-WMO Meeting for Implementation of IGOS XBT Ship-of-Opportunity Programmes
108. Third Session of the Health of the Oceans (HOTO) Panel of the Joint Scientific and Technical Committee for GLOSS
109. Second Session of the Strategy Subcommittee (SSC) of the IOC-WMO-UNEP Intergovernmental Committee for the Global Ocean Observing System
110. Third Session of the Joint Scientific and Technical Committee for Global Ocean Observing System
111. First Session of the Joint GCOS-GOOS-WCRP Ocean Observations Panel for Climate
112. Sixth Session of the Joint IOC-IJGIFS CO Advisory Panel Meeting
113. First Meeting of the IOC/WESTPAC Co-ordinating Committee for the North-East Asian Regional - Global Ocean Observing System (NEAR-GOOS)
114. Eighth Session of the Joint IOC-WMO-CPPS Working Group on the Investigations of “El Niño” (Spanish only)
115. Second Session of the IOC Editorial Board of the International Bathymetric Chart of the Central Eastern Atlantic (Also printed in French)
116. Tenth Session of the Officers Committee for the Joint IOC-IHO General Bathymetric Chart of the Oceans (GECO), USA, 1996
117. IOC Group of Experts on the Global Sea Level Observing System (GLOSS), Fifth Session, USA, 1997
121. IOC/WESTPAC Co-ordinating Committee for the North-East Asian Regional Global Ocean Observing System (NEAR-GOOS), Second Session, Thailand, 1997
122. First Session of the IOC-IUCN-NOAA Ad hoc Consultative Meeting on Large Marine Ecosystems (LME), France, 1997
123. Second Session of the Joint GCOS-GOOS-WCRP Ocean Observations Panel for Climate (OOPC), South Africa, 1997
124. Sixth Session of the IOC Editorial Board for the International Bathymetric Chart of the Caribbean Sea and the Gulf of Mexico, Colombia, 1996 (also printed in Spanish)
125. Seventh Session of the IOED Group of Experts on Technical Aspects of Data Exchange, Ireland, 1997
126. IOC-WMO-UNEP-ICSU Coastal Panel of the Global Ocean Observing System (GOOS), First Session, France, 1997
127. Second Session of the IOC-IUCN-NOAA Consultative Meeting on Large Marine Ecosystems (LME), France, 1998
128. Sixth Session of the IOC Consultative Group on Ocean Mapping (CGOM), Monaco, 1997
129. Sixth Session of the Tropical Atmosphere - Ocean Array (TAO) Implementation Panel, United Kingdom, 1997
132. Sixteenth Session of the Joint IOC-IHO Guiding Committee for the General Bathymetric Chart of the Oceans (GEBCO), United Kingdom, 1997
134. Fourth Session of the IOC Editorial Board for the International Bathymetric Chart of the Western Indian Ocean (IOC/EB-IBCWO-IWS), South Africa, 1997
136. Seventh Session of the Joint IOC-JGOFS C02 Advisory Panel Meeting, Germany, 1997
137. Implementation of Global Ocean Observations for GOOS/GCOS, First Session, Australia, 1998
139. Second Session of the IOC-WMO-UNEP-ICSU Coastal Panel of the Global Ocean Observing System (GOOS), Brazil, 1998
140. Third Session of IOC/WESTPAC Co-ordinating Committee for the North-East Asian Regional - Global Ocean Observing System (NEAR-GOOS), China, 1998
143. Seventh Session of the Tropical Atmosphere-Ocean Array (TAO) Implementation Panel, Abidjan, Côte d'Ivoire, 1998
144. Sixth Session of the IOED Group of Experts on Marine Information Management (GEMIM), USA, 1999
145. Second Session of the IOC-WMO-UNEP-ICSU Steering Committee of the Global Ocean Observing System (GOOS), China, 1999
146. Third Session of the IOC-WMO-UNEP-ICSU Coastal Panel of the Global Ocean Observing System (GOOS), Ghana, 1999
147. Fourth Session of the GCOS-GOOS-WCRP Ocean Observations Panel for Climate (OOPC); Fourth Session of the WCRP CLIVAR Upper Ocean Panel (UOP); Special Joint Session of OOPC and UOP, USA, 1999
149. Eighth Session of the Joint IOC-JGOFS C02 Advisory Panel Meeting, Japan, 1999
150. Fourth Session of the IOC/WESTPAC Co-ordinating Committee for the North-East Asian Regional – Global Ocean Observing System (NEAR-GOOS), Japan, 1999
151. Seventh Session of the IOC Consultative Group on Ocean Mapping (CGOM), Monaco, 1999
152. Sixth Session of the IOC Group of Experts on the Global Sea Level Observing System (GLOSS), France, 1999
153. Seventeenth Session of the Joint IOC-IHO Guiding Committee for the General Bathymetric Chart of the Oceans (GEBCO), Canada, 1999
154. Comité Editorial de la COI para la Carta Batimétrica Internacional del Mar Caribe y el Golfo de Mexico (IBCCA), Mexico, 1998
155. IOC Editorial Board for the International Bathymetric Chart of the Caribbean Sea and the Gulf of Mexico (IBCCA), Sixth Session, Mexico, 1998
156. Initial Global Ocean Observing System (GOOS) Commitments Meeting, IOC-WMO-UNEP-ICSU/Imlpl-III/3, France, 1999
157. First Session of the ad hoc Advisory Group for IOCARIIBE-GOOS, Venezuela, 1999 (also printed in Spanish and French)
158. Fourth Session of the IOC-WMO-UNEP-ICSU Coastal Panel of the Global Ocean Observing System (GOOS), China, 1999
162. Eighth Session of the IOED Group of Experts on Technical Aspects of Data Exchange, USA, 2000
163. Third Session of the IOC-IUCN-NOAA Consultative Meeting on Large Marine Ecosystems (LME), France, 2000
164. Fifth Session of the IOC-WMO-UNEP-ICSU Coastal Panel of the Global Ocean Observing System (GOOS), Poland, 2000
165. Third Session of the IOC-WMO-UNEP-ICSU Steering Committee of the Global Ocean Observing System (GOOS), France, 2000
166. Second Session of the ad hoc Advisory Group for IOCARIIBE-GOOS, Cuba, 2000 (also printed in Spanish and French)
167. First Session of the Coastal Ocean Observations Panel, Costa Rica, 2000
168. First GOOS Users’ Forum, 2000
170. First Session of the Advisory Body of Experts on the Law of the Sea (ABE-LOS), France, 2001 (also printed in French)
171. Fourth Session of the IOC-WMO-UNEP-ICSU Steering Committee of the Global Ocean Observing System, Chile, 2001
172. First Session of the IOC-SCOR Ocean CO2 Advisory Panel, France, 2000
173. Fifth Session of the GCOS-GOOS-WCRP Ocean Observations Panel for Climate (OOPC), Norway, 2000 (electronic copy only)
174. Third Session of the ad hoc Advisory Group for IOCARIIBE-GOOS, USA, 2001 (also printed in Spanish and French)
175. Second Session of the Coastal Ocean Observations Panel and GOOS Users’ Forum, Italy, 2001
176. Second Session of the Black Sea GOOS Workshop, Georgia, 2001
177. Fifth Session of the IOC/WESTPAC Co-ordinating Committee for the North-East Asian Regional – Global Ocean Observing System (NEAR-GOOS), Republic of Korea, 2000
178. Second Session of the Advisory Body of Experts on the Law of the Sea (IOC/ABE-LOS), Morocco, 2002 (also printed in French)
179. Sixth Session of the Joint GCOS-GOOS-WCRP Ocean Observations Panel for Climate (OOPC), Australia, 2001 (electronic copy only)
180. Cancelled

181. IOC Workshop on the Establishment of SEAGOOS in the Wider Southeast Asian Region, Seoul, Republic of Korea, 2001 (SEAGOOS preparatory workshop) (electronic copy only)

182. First Session of the IODE Steering Group for the Resource Kit, USA, 19–21 March 2001

183. Fourth Session of the IOC-IUCN-NOAA Consultative Meeting on Large Marine Ecosystems (LMEs), France, 2002

184. Seventh Session of the IODE Group of Experts on Marine Information Management (GEMIM), France, 2002 (electronic copy only)

185. Sixth Session of IOC/WESTPAC Coordinating Committee for the North-East Asian Regional - Global Ocean Observing System (NEAR-GOOS), Republic of Korea, 2001 (electronic copy only)

186. First Session of the Global Ocean Observing System (GOOS) Capacity Building Panel, Switzerland, 2002 (electronic copy only)

187. Fourth Session of the ad hoc Advisory Group for IOCARI-GEOS, 2002, Mexico (also printed in French and Spanish)

188. Fifth Session of the IOC Editorial Board for the International Bathymetric Chart of the Western Indian Ocean (IBCWO), Mauritius, 2000

189. Third session of the Editorial Board for the International Bathymetric Chart of the Western Pacific, China, 2000


192. Third Session of the Advisory Body of Experts on the Law of the Sea (IOC/ABE-LOS), Lisbon, 2003 (also printed in French)


196. Fourth Session of the Coastal Ocean Observations Panel, South Africa, 2002 (electronic copy only)


198. Fifth Session of the IOC-IUCN-NOAA Consultative Meeting on Large Marine Ecosystems (LMES), Paris, 2003

199. Ninth Session of the IOC Consultative Group on Ocean Mapping, Monaco, 2003 (Recommendations in English, French, Russian and Spanish included)

200. Eighth Session of the IOC Group of Experts on the Global Sea level Observing System (GLOSS), France, 2003 (electronic copy only)

201. Fourth Session of the Advisory Body of Experts on the Law of the Sea (IOC/ABE-LOS), Greece, 2004 (also printed in French)

202. Sixth Session of the IOC-IUCN-NOAA Consultative Meeting on Large Marine Ecosystems (LMES), Paris, 2004 (electronic copy only)

203. Fifth Session of the Advisory Body of Experts on the Law of the Sea (IOC/ABE-LOS), Argentina, 2005 (also printed in French)

204. Ninth Session of the IOC Group of Experts on the Global Sea level Observing System (GLOSS), France, 2005 (electronic copy only)

205. Eighth Session of the IOC/WESTPAC Co-ordinating Committee for the North-East Asian Regional – Global Ocean Observing System (NEAR-GOOS), China, 2003 (electronic copy only)

206. Sixth Meeting of the Advisory Body of Experts on the Law of the Sea (IOC/ABE-LOS), Spain, 2006 (also printed in French)

207. Third Session of the Regional Group of the Global Ocean Observing System, South Africa, 2006 (electronic copy only)

208. Seventh Session of the IOC-UNEP-IUCN-NOAA Consultative Meeting on Large Marine Ecosystems (LMES), Paris, 2005 (electronic copy only)

209. Eighth Session of the IOC-UNEP-IUCN-NOAA Consultative Meeting on Large Marine Ecosystems (LMES), Paris, 2006 (electronic copy only)

210. Seventh Meeting of the IOC Advisory Body of Experts on the Law of the Sea (IOC/ABE-LOS), Gabon, 2007 (bilingual English/French)

211. First Meeting of the IOC Working Group on the Future of IOC, Paris, 2008 (Executive Summary in English, French, Russian and Spanish included)

212. First meeting of the Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems (TOWS-WG), Paris, 3–4 April 2008 (Executive Summary in English, French, Russian and Spanish included)

213. First Session of the Panel for Integrated Coastal Observation (PICO-I), Paris, 10–11 April 2008 (electronic copy only)

214. Tenth Session of the IOC Group of Experts on the Global Sea level Observing System (GLOSS), Paris, 6–8 June 2007 (electronic copy only)


216. Fourth Session of the Global Ocean Observing System (GOOS) Regional Alliances Forum (GRAF), Guayaquil, Ecuador, 25–27 November 2008 (electronic copy only)

217. Second Session of the Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems (TOWS-WG), Paris, 27 March 2009 (Executive Summary in English, French, Russian and Spanish included)


219. First Session of the IOC-SCOR International Ocean Carbon Coordination Project (IOCCP) Scientific Steering Group (also IOCCP Reports, 3), Broomfield, Colorado, U.S.A., 1 October 2005 (electronic copy only)

220. Second Session of the IOC-SCOR International Ocean Carbon Coordination Project (IOCCP) Scientific Steering Group (also IOCCP Reports, 6), Paris, France, 20 April 2007 (electronic copy only)

221. Third Session of the IOC-SCOR International Ocean Carbon Coordination Project (IOCCP) Scientific Steering Group (also IOCCP Reports, 10), Villefranche-sur-mer, France, 3–4 October 2008 (electronic copy only)

222. Fourth Session of the IOC-SCOR International Ocean Carbon Coordination Project (IOCCP) Scientific Steering Group (also IOCCP Reports, 15), Jena, Germany, 14 September 2009 (electronic copy only)

223. First Meeting of the joint IOC-ICES Study Group on Nutrient Standards (SGONS) (also IOCCP Reports, 20), Paris, France, 23–24 March 2010 (Executive Summary in E, F, R, S included)

224. Third Session of the Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems (TOWS-WG), Lisbon, Portugal, 5–6 May 2010 (Executive Summary in English, French, Russian and Spanish included)


226. Second Session of the Panel for Integrated Coastal Observation (PICO-II), Paris, 24–26 February 2009 (electronic copy only)

227. First meeting of the Task Team on Seismic Data Exchange in the South West Pacific of the ICG/PTWS Regional Working Group for the Southwest Pacific, Port Vila, Vanuatu, 19–20 October 2009 (electronic copy only)

228. Fourth Session of the Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems (TOWS-WG), Paris, France, 20–21 March 2011 (Executive Summary in English, French, Russian and Spanish included)

229. Second Session of the IODE Steering Group for Ocean Teacher (SG-OI), Miami, Florida, 11–15 April 2011

230. First Meeting of the Inter-IoC Task Team 1 on Sea Level Monitoring for Tsunami (Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems (TOWS-WG), Seattle, USA, 20 November–1 December 2010