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

Tenth Meeting
Paris, France
23–24 February 2017
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This document contains the executive summary in English, French, Spanish and Russian.
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Executive summary

The Tenth Meeting of the Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems (TOWS-WG-X) was held in Paris, France, on 23-24 February 2017 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-XXVIII/Dec. 8.2 and IOC EC-XLIX/3.4.

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:

- Three exercises carried out (CARIBEWave 2016, IOWAVE 2016, PACWAVE 2017) and regular communication tests
- Accreditation of four Tsunami Service Providers in the North-Eastern Atlantic, the Mediterranean and Connected Seas Tsunami Warning and Mitigation System (NEAMTWS)
- With regards to Tsunami Evacuation Mapping:
  a) The PTWS successfully completed a Pilot Tsunami Evacuation Maps, Plans and Procedures (TEMPP) over two years in Honduras with regional participation
  b) The ITIC, CTWP & IOC-UNESCO programme CARIBE EWS built experience with regards to implementation of the TEMPP and are ready to provide guidance to countries that want to implement similar projects
  c) The Project identified and references existing best practice evacuation mapping guidelines that countries have developed
  d) The PTWS will finalise project documentation and make it available to ICGs, noting the interest of IOTWMS and CARIBE-EWS
- Tsunami Ready Community based performance recognition program achieved in St. Kitts & Nevis and Cedeño (Honduras)
- The progress made by DBCP in developing an educational strategy to address buoy vandalism and endorse the development of the strategy and recommend that each ICG review the strategy

The Group recommended the Assembly to encourage Member States to

- sustain and increase technical and financial support of the tsunami warning systems in their respective regions
- further promote tsunami awareness in communities and among authorities through communication and tsunami wave exercises, training, information, and community preparedness and recognition programmes
- share Tsunami source scenario data as well sea level data relevant to tsunami detection and alerts
- densify sea level networks particularly nearby tsunamigenic sources
- extend exercises to community level and include critical infrastructure in exercises (e.g. hospitals, fire stations, police stations, electric power plants, airports, ports and harbors)

The Group recommended the Assembly to instruct ICGs

- to consider piloting the CARIBE EWS Tsunami Ready guidelines and report back to the TOWS-XI with a view to develop harmonized consistent global guidelines
- to advocate the UN designated World Tsunami Awareness Day (5 November) 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 also use the Common Alerting Protocol (CAP) to facilitate warning messages to be consistently disseminated simultaneously over many warning communication systems to many applications
- to recommend TSPs and NTWCs register with international register of alerting authorities through WMO National Permanent Representative
- 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
- 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
- to encourage NTWCs disseminate tsunami bulletins to ports, harbours and other maritime authorities within their countries
- to share the results of Tsunami exercises and communication tests with WMO to facilitate improved performance of WMO related communication systems

The Group recommended the Assembly to take the following actions

- to conduct a symposium in early 2018 in Paris on enhancing existing TSP and NTWC operational tsunami forecasting to further develop warning products and enhancing timely, accurate, reliable and effective decision-making and community response, involving experts from monitoring networks, seismology, tsunami forecast modelling and warning centres, maritime authorities, and national and local emergency management authorities with advice on product requirements
- 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 to reflect work related to enhancements to the accuracy and effectiveness of tsunami forecast information for users

The Group accepted the reports from the Task Teams on Disaster Management and Preparedness and Watch Operations and instructed the Task Team on Watch Operations
- to develop in consultation with WWNWS-SC specific tsunami threat messages for vessels at sea
- to consider tsunamis generated by non-seismic sources for integration into Tsunami watch operation

The Group noted the information presented by the World Meteorological Organization (WMO) on the new developments on the WMO Information System and its use for dissemination of Tsunami alerts as well as WIS performance monitoring of messages and particular types of messages.

The Group recommended WMO to explore rendering assistance to CARIBE-EWS concerning usage of GTS and WIS for dissemination of tsunami alerts in the Caribbean region.

The Group recognized that the current financial situation strongly limits the implementation of the tasks of the Group, ICGs and Inter-ICG Task Teams and recommended that the Member States to increase their extra-budgetary contributions to the IOC to provide the needed resources for the priorities identified by TOWS-WG and ICGs.
Résumé exécutif

La 10e 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-X) s'est tenue les 23 et 24 février 2017 à Paris (France), sous la présidence de M. Alexander Postnov (Vice-Président de la COI). Les participants à la réunion ont évalué les progrès accomplis relatifs aux actions menées et aux décisions prises par les organes directeurs par le biais des décisions IOC-XXVIII/8.2 et IOC-EC-XLIX/3.4.

Le Groupe a examiné les rapports des groupes intergouvernementaux de coordination 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.

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

- les trois exercices menés à bien (CARIBEWave2016, IOWave2016, PACWave2017) et les tests de communication régulièrement effectués ;
- l'accréditation de quatre prestataires de services relatifs aux tsunamis au sein du Système d'alerte rapide aux tsunamis et de mitigation dans l'Atlantique du Nord-Est, la Méditerranée et les mers adjacentes (NEAMTWS) ;
- en ce qui concerne la cartographie des voies d'évacuation en cas de tsunami :
  (a) le Système d'alerte aux tsunamis et de mitigation dans le Pacifique (PTWS) a expérimenté avec succès un projet de Cartes, plans et procédures d'évacuation en cas de tsunami (TEMPP) sur une période de deux ans, au Honduras, avec la participation de la région ;
  (b) le Centre international d'information sur les tsunamis (CIIT), le Programme d'alerte aux tsunamis dans les Caraïbes (CTWP) et le Système d'alerte aux tsunamis et autres risques côtiers dans la mer des Caraïbes et les régions adjacentes (CARIBE-EWS) de la COI-UNESCO, forts de l'expérience acquise dans la mise en œuvre des TEMPP, sont prêts à aider les pays qui souhaiteraient mener des projets similaires ;
  (c) le Projet a recensé et référencé les directives fondées sur les meilleures pratiques existantes en matière de cartographie des voies d'évacuation élaborées par les pays ;
  (d) le PTWS établira définitivement la documentation du projet et la mettra à la disposition des groupes intergouvernementaux de coordination (GIC), ayant pris note de l'intérêt manifesté par les GIC du Système d'alerte aux tsunamis et de mitigation dans l'océan Indien (IOTWMS) et du CARIBE-EWS ;
- la mise en œuvre du Programme de certification des communautés en matière de préparation aux tsunamis fondé sur les résultats (Tsunami Ready) à Saint-Kitt-et-Nevis et à Cedeño (Honduras) ;
- les progrès réalisés par le Groupe de coopération pour les programmes de bouées de mesure (DBCP) concernant l’élaboration d’une stratégie éducative visant à lutter contre les actes de vandalisme dont les bouées font l’objet, en approuvant l’élaboration de ladite stratégie et en encourageant chaque GIC à l’examiner.
Le Groupe a recommandé à l'Assemblée d'encourager les États membres à :

- continuer d'apporter et intensifier leur appui technique et financier aux systèmes d'alerte aux tsunamis dans leurs régions respectives ;

- faire davantage progresser 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 ;

- partager les données des scénarios relatifs aux sources de tsunami ainsi que les données relatives au niveau de la mer utiles à la détection et à l'alerte en cas de tsunami ;

- renforcer les réseaux d'observation du niveau de la mer, en particulier à proximité des sources tsunamigènes ;

- étendre les exercices à l'échelon des communautés, en y faisant participer les infrastructures essentielles (hôpitaux, casernes de pompiers, postes de police, centrales électriques, aéroports, ports, etc.).

Le Groupe a recommandé à l'Assemblée de donner instruction aux GIC :

- d’envisager d’appliquer à titre expérimental les principes directeurs du CARIBE-EWS pour la préparation aux tsunamis, puis d’en rendre compte à la 11e réunion du TOWS-WG afin d’élaborer des directives mondiales cohérentes et harmonisées ;

- de s’employer à faire reconnaître la Journée mondiale de sensibilisation aux tsunamis (5 novembre) proclamée par les Nations Unies parmi les États membres et de les informer de la disponibilité d’une documentation émanant 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 (NTWC) d’appliquer également le Protocole d’alerte commun (PAC) pour faciliter la diffusion cohérente et simultanée des messages d’alerte sur de nombreux systèmes de communication d’alerte vers de nombreuses applications ;

- de recommander aux prestataires de services relatifs aux tsunamis et aux NTWC de s’inscrire sur le Registre international des autorités d’alerte par l’intermédiaire du représentant permanent de leur pays auprès de l’Organisation météorologique mondiale (OMM) ;

- d’envisager de fournir au DBCP des documents pédagogiques ou de sensibilisation concernant les actes de vandalisme sur les bouées de mesure afin de constituer une trousse à outils de documents adaptés au contexte régional pour lutter contre ce phénomène ;

- s’agissant du GIC/PTWS, de poursuivre, en application de la décision 8.2 adoptée par l’Assemblée de la COI à sa XXVIIe session, ses travaux sur les indicateurs de performance clés de façon à couvrir l’ensemble des aspects des systèmes de mitigation et d’alerte aux tsunamis, le plus conformément possible au Cadre de Sendai, et d’en partager les résultats avec les autres GIC afin que les États membres
puissent les examiner, ainsi que d’en rendre compte au Groupe de travail à sa 11e réunion en vue de définir des indicateurs de performance clés mondiaux ;

- d’encourager les NTWC à diffuser des bulletins relatifs aux tsunamis auprès des zones portuaires et autres autorités maritimes de leur pays ;

- de partager avec l’OMM les résultats obtenus à l’occasion des exercices de préparation aux tsunamis et des tests de communication, afin de favoriser l’amélioration des performances des systèmes de communication de l’OMM.

**Le Groupe a recommandé** à l’Assemblée de prendre les mesures suivantes :

- organiser un colloque au début de 2018, à Paris, sur le renforcement des prévisions opérationnelles en matière de tsunami des prestataires de services relatifs aux tsunamis et des NTWC en place en vue de perfectionner les produits d’alerte, ainsi que sur l’amélioration de la rapidité, de l’exactitude, de la fiabilité et de l’efficacité de la prise de décision et de la réponse des communautés, en rassemblant des experts des réseaux de suivi, des centres de sismologie, de modélisation des prévisions des tsunamis et d’alertes, des autorités maritimes ainsi que des autorités nationales et locales de gestion des situations d’urgence pour leur fournir des indications relatives aux besoins en matière de produits ;

- de prolonger les fonctions 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 selon les mandats définis dans la résolution IOC-XXIV-4 (pour ce qui est du TOWS-WG) et à l’annexe II du document IOC/TOWS-WG-VI/3 (pour l’Équipe spéciale sur la gestion et la préparation en cas de catastrophe) et le mandat de l’Équipe spéciale sur les opérations de veille aux tsunamis, afin de refléter les travaux relatifs aux améliorations apportées à l’exactitude et à l’efficacité des informations en matière de prévision des tsunamis à l’intention des utilisateurs.

**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 **a donné instruction** à cette dernière :

- d’élaborer, en consultation le Sous-Comité sur le Service mondial d’avertissements de navigation (SC-SMAN), des messages spécifiques en cas de risque de tsunami à l’intention des navires en mer ;

- d’envisager de prendre en compte les tsunami générés par des sources non sismiques dans les opérations de veille aux tsunamis.

**Le Groupe a pris note** des informations présentées par l’Organisation météorologique mondiale (OMM) concernant les dernières évolutions du système d’information de l’OMM (SIO) et de son utilisation aux fins de diffusion des alertes aux tsunami, ainsi que du suivi des performances des messages et de certains types de messages par le SIO.

**Le Groupe a recommandé** à l’OMM d’étudier la possibilité d’apporter au CARIBE-EWS une aide à l’utilisation du Système mondial de télécommunications (SMT) et du SIO en vue de pouvoir diffuser des alertes aux tsunami dans la région des Caraïbes.

**Le Groupe a reconnu** que la situation financière actuelle limite considérablement la mise en œuvre de ses activités ainsi que des activités des GIC et des équipes spéciales inter-GIC et **a recommandé** que les États membres augmentent leurs contributions extrabudgétaires à la COI afin de fournir les ressources nécessaires aux priorités identifiées par le TOWS-WG et les GIC.
Resumen dispositivo

La décima 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 X) se celebró en París (Francia) los días 23 y 24 de febrero de 2017 bajo la presidencia del Sr. Alexander Postnov (Vicepresidente de la COI). En la reunión se evaluaron los avances de las actividades emprendidas y las decisiones adoptadas por los órganos rectores en el marco de las decisiones IOC-XXVIII/8.2 e IOC EC-XLIX/3.4.

El Grupo examinó 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:

- Tres ejercicios realizados (CARIBE Wave 2016, IOWAVE 2016, PACWAVE 2017) y pruebas periódicas de verificación de las comunicaciones.
- Acreditación de cuatro proveedores de servicios sobre tsunamis en el Sistema de Alerta Temprana contra los Tsunamis y Atenuación de sus Efectos en el Atlántico Nororiental y el Mediterráneo y Mares Adyacentes (NEAMTWS).
- En relación con la elaboración de mapas para la evacuación en caso de tsunami:
  a) El PTWS llevó a cabo con éxito un proyecto piloto de elaboración de mapas y planificación para la evacuación en caso de tsunami (TEMP) a lo largo de dos años en Honduras, que contó con una participación regional.
  b) El ITIC, el CTWP y el programa CARIBE-EWS de la COI y la UNESCO acumularon experiencia en relación con la ejecución del proyecto TEMPP, y están listos para guiar a países que deseen poner en marcha proyectos similares.
  c) En el marco del PTWS se encontraron y referenciaron directrices existentes sobre la mejor manera de elaborar mapas para la evacuación, formuladas por los países.
  d) En el PTWS se concluirá la documentación del proyecto, la cual se pondrá a disposición de los grupos intergubernamentales de coordinación, tomando nota del interés del IOTWMS y el CARIBE-EWS.
- Finalización del programa de acreditación de la preparación comunitaria frente a los tsunamis en Saint Kitts y Nevis, y Cedeño (Honduras).
- Avances realizados por el DBCP en la formulación de una estrategia educativa para hacer frente al vandalismo de boyas, respaldo para elaborar la estrategia, y la recomendación de que cada ICG examine la estrategia.

El Grupo recomendó a la Asamblea que alentara a los Estados Miembros a realizar lo siguiente:

- mantener y reforzar el apoyo técnico y financiero a los sistemas de alerta contra los tsunamis en sus respectivas regiones;
- seguir promoviendo la sensibilización sobre tsunamis en las comunidades y entre las autoridades, mediante ejercicios de comunicación y simulación de tsunamis,
actividades de capacitación e información, y programas de preparación y reconocimiento dirigidos a las comunidades;

- compartir datos sobre los posibles orígenes de los tsunamis, así como datos sobre el nivel del mar, útiles para la detección y alertas de los tsunamis;

- ampliar las redes de medición del nivel del mar, en particular cerca de fuentes tsunamigénicas;

- llevar los ejercicios al plano comunitario e incluir la infraestructura clave en los ejercicios (por ejemplo, hospitales, estaciones de bomberos, comisarías de policía, centrales eléctricas, aeropuertos y puertos).

El Grupo recomendó a la Asamblea que encargara a los ICG lo siguiente:

- considerar la aplicación experimental de las directrices de preparación frente a los tsunamis del CARIBE-EWS e informar al respecto al TOWS-WG XI, con miras a formular directrices mundiales armonizadas y coherentes;

- promover entre los Estados Miembros el Día Mundial de Concienciación sobre los Sunamis (5 de noviembre), proclamado por las Naciones Unidas, e informarles sobre la disponibilidad de material de la UNISDR al respecto, y compartir actividades y materiales por medio de la UNISDR y las TIC;

- recomendar a los proveedores de servicios de tsunamis y los centros nacionales de alerta contra tsunamis que empleen también el Protocolo de Alerta Común (CAP) para facilitar que los mensajes de alerta se difundan sistemáticamente y de forma simultánea por medio de varios sistemas de comunicación de alertas con fines diversos:

- recomendar a los proveedores de servicios de tsunamis y los centros nacionales de alerta contra tsunamis que se inscriban en el Registro Internacional de Autoridades de Alerta de la OMM por conducto del representante nacional permanente de la OMM;

- considerar proporcionar todo material educativo o de divulgación relativo al vandalismo de boyas de datos al DBCP para que se incluya en una serie de materiales de alcance regional destinada a frenar el vandalismo;

- instar al ICG/PTWS, de conformidad con la decisión 8.2 de la 27a reunión de la Asamblea de la COI, a proseguir su labor relativa a los indicadores clave de desempeño con miras a cubrir todos los aspectos de los sistemas de alerta contra los tsunamis y la atenuación de sus efectos, ajustándose lo más posible al Marco de Sendai, a compartirlo con los demás ICG para que los Estados Miembros la examinen, y a informar al respecto al TOWS-WG XI con el fin de formular indicadores clave de desempeño mundiales;

- alentar a los NTWC a difundir boletines de tsunami a los puertos y otras autoridades marítimas dentro de sus países;

- compartir los resultados de los ejercicios sobre tsunamis y las pruebas de verificación de comunicaciones con la OMM, a fin de facilitar un mejor desempeño de los sistemas de comunicación relacionados con la OMM.
El Grupo recomendó a la Asamblea que adoptara las siguientes medidas:

- Organizar un simposio a principios de 2018 en París enfocado en la mejora de la previsión operativa de tsunamis de los proveedores de servicio de tsunamis y NTWC existentes, con miras a seguir elaborando productos de alerta y promover una toma de decisiones y una respuesta comunitaria puntuales, precisas, serias y eficaces, con la participación de expertos de redes de vigilancia, sismología, modelización de previsión y centros de alerta de tsunamis, autoridades marítimas, y autoridades nacionales y locales de gestión de emergencia, para que brinden asesoramiento sobre los requisitos de los productos.

- Ampliar 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, partiendo del mandato de los equipos de trabajo que figura en la resolución XXIV-4 de la COI (para el TOWS-WG) y el documento IOC/TOWS-WG-VI/3 (Anexo II, para el equipo de trabajo sobre gestión de desastres y preparación), y el mandato del equipo de trabajo sobre actividades de vigilancia de tsunamis, con miras a reflejar la labor relativa al refuerzo de la precisión y eficacia de la información para la predicción de tsunamis para los usuarios.

El Grupo acogió con agrado los informes de los equipos de trabajo sobre gestión de desastres y preparación y sobre actividades de vigilancia, y pidió al equipo de trabajo sobre actividades de vigilancia que realizara lo siguiente:

- elaborar, en consulta con el subcomité del servicio mundial de avisos a la navegación (WWNWS-SC), mensajes específicos sobre la amenaza de tsunamis para buques en el mar;

- considerar incluir a los tsunamis ocasionados por fuentes no sísmicas en las actividades de vigilancia de tsunamis.

El Grupo tomó nota de la información presentada por la Organización Meteorológica Mundial (OMM) sobre las novedades del Sistema de Información de la OMM (SIO) y su utilidad para la difusión de alertas de tsunamis, así como el seguimiento del desempeño del SIO en cuanto a mensajes generales y específicos.

El Grupo recomendó a la OMM que examinara la posibilidad de dar asistencia al programa CARIBE-EWS sobre el uso del Sistema Mundial de Telecomunicación (SMT) y el Sistema de Información de la OMM (SIO) para difundir alertas de tsunami en la región del Caribe.

El Grupo reconoció que la actual situación financiera limitaba considerablemente la realización de sus actividades y de las actividades de los ICG y los equipos de trabajo de los ICG, y recomendó a los Estados Miembros que incrementaran sus contribuciones extrapresupuestarias a la COI con miras a proporcionar los recursos necesarios para atender a las prioridades definidas por el TOWS-WG y los ICG.
Рабочее резюме

Десятое совещание Рабочей группы по системам предупреждения о цунами и других опасных явлениях, связанных с изменением уровня моря, и смягчения их последствий (РГ-СПЦО-Х) состоялось 23-24 февраля 2017 г. в Париже (Франция) под председательством г-на Александра Постнова (заместитель Председателя МОК). Участники совещания оценили прогресс в осуществлении мероприятий и выполнении решений руководящих органов IOC-XXVIII/8.2 и IOC/EC-XLIX/3.4.

Группа рассмотрела представленные межправительственными координационными группами МОК доклады и провела обзор деятельности 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 трех учений («Карибская волна-16» (CARIBEWave 2016), «Индийская волна-16» (IOWAVE 2016) и «Тихоокеанская волна-17» (PACWAVE 2017)) и регулярных проверок систем оповещения;

- аккредитация четырех провайдеров данных слежения за цунами в системе предупреждения о цунами и смягчения их последствий в Северо-Восточной Атлантике, Средиземном и прилегающих морях (СПЦСВАСМ);

- разработка карт маршрутов эвакуации при цунами:
  - (a) В рамках СПЦТО был успешно завершен пилотный проект по разработке карт маршрутов, планов и процедур эвакуации при цunami (МПЭЦ), осуществляющийся на протяжении двух лет в Гондурасе при участии соответствующего региона.
  - (b) В рамках ИТИК, КППЦ и программы МОК-ЮНЕСКО КАРИБ-СРП был наработан опыт использования МПЭЦ, они готовы предоставить руководящие указания странам, желающим реализовать подобные проекты.
  - (c) В рамках данного проекта был выявлен и каталогизирован передовой опыт стран в области разработки руководящих принципов составления карт эвакуации.
  - (d) В рамках СПЦТО с учетом заинтересованности со стороны СПЦИО и КАРИБ-СРП будет доработана и предоставлена в распоряжение МКГ проектная документация.

- завершение программы сертификации готовности общин к цунами в Сент-Китс и Невисе и Седеньо (Гондурас);

- успехи ГСБД в разработке образовательной стратегии по противодействию вандализму в отношении буев в целях одобрения дальнейшей разработки стратегии и рекомендации всем МКГ провести обзор стратегии.

Группа рекомендовала Ассамблее призвать государства-члены:

- обеспечить дальнейшую техническую и финансовую поддержку систем предупреждения о цунами в их регионах и ее расширение;
• содействовать и далее повышению осведомленности о цунами местных общин и властей посредством проведения тренировок по оповещению и учений по цунами, профессиональной подготовки, информационно-просветительской работы и программ подготовки общин к цунами и сертификации такой готовности;

• обмениваться данными о возможных местах начала цунами и имеющими отношение к обнаружению цунами и оповещению о нем данными об уровне моря;

• уплотнить сети наблюдений за уровнем моря, особенно вблизи цунамигенных источников;

• расширить учения вплоть до уровня общин и задействовать в них важнейшие инфраструктурные объекты (например, больницы, пожарные части, полицейские участки, электростанции, аэропорты, порты и гавани).

Группа рекомендовала Ассамблее поручить МКГ:

• рассмотреть вопрос о пилотном использовании руководства КАРИБ-СРП по обеспечению подготовленности к цунами и представить соответствующий доклад на 11-ом совещании СПЦО с целью разработки согласованного и последовательного глобального руководства в этой области;

• популяризировать учрежденный ООН Всемирный день распространения информации о проблеме цунами (5 ноября) среди государств-членов и информировать их о наличии соответствующих материалов МСУОБ ООН, а также осуществлять совместные мероприятия и обмениваться материалами с МСУОБ ООН и ЦИЦ;

• рекомендовать ПУЦ и НЦПЦ также использовать протокол общего оповещения (КАП) с целью содействия согласованному одновременному распространению предупреждающих сообщений через многие системы оповещения на многие приложения;

• рекомендовать ПУЦ и НЦПЦ зарегистрироваться в Международном реестре органов оповещения через национального постоянного представителя ВМО;

• рассмотреть возможность предоставления ГСБД любых материалов образовательного или информационно-просветительского характера, касающихся вандализма в отношении буев для сбора данных, с целью их включения в подборку материалов регионального значения по противодействию вандализму;

• МКГ/СПЦТО в соответствии с решением 8.2 27-й сессии Ассамблеи МОК продолжить работу над ключевыми показателями эффективности (КПЭ) для охвата всех аспектов систем предупреждения о цунами и смягчения их последствий, обеспечивая их максимальное соответствие Сэндайской рамочной программе, и предоставить результаты этой работы другим МКГ для рассмотрения государствами-членами, а также представить соответствующий доклад СПЦО на ее 11-ом совещании с целью разработки глобальных КПЭ;

• призвать НЦПЦ рассылать информационные бюллетени о цунами руководству портов, гаваней и прочим морским ведомствам в их странах;
предоставить ВМО результаты учений по реагированию на цунами и проверок систем оповещения в целях содействия повышению эффективности связанных с ВМО систем оповещения.

Группа рекомендовала Ассамблее принять следующие меры:

- провести в начале 2018 г. в Париже симпозиум по совершенствованию осуществляемого в настоящее время ПУЦ и НЦПЦ оперативного прогнозирования цунами для дальнейшей разработки средств предупреждения и повышения своевременности, точности, надежности и эффективности принятия решений и реагирования на местном уровне с привлечением экспертов в области систем мониторинга и сейсмологии, центров прогнозистического моделирования и предупреждения о цунами, морских ведомств, а также национальных и местных органов реагирования на чрезвычайные ситуации для консультирования по требованиям к средствам предупреждения о цунами;

- продлить срок полномочий СПЦО и ее целевых групп (i) по обеспечению готовности к стихийным бедствиям и ликвидации их последствий (ЦГ-ГСБЛП) и (ii) по наблюдению за цунами (ЦГ-НЦ) с кругом ведения в соответствии с резолюцией МОК XXIV-4 [для РГ-СПЦО] и документом МОК IOC/TOWS-WG-VI/3 [приложение II, для ЦГ-ГСБЛП] с кругом ведения ЦГ-НЦ с целью учета работы по повышению точности и эффективности предоставляемых пользователям прогнозов о цунами.

Группа одобрила доклады целевой группы по обеспечению готовности к стихийным бедствиям и ликвидации их последствий и целевой группы по наблюдению за цунами, поручив последней:

- разработать в консультации с ПК-ВСНП конкретные сообщения об угрозе цунами для морских судов;

- рассмотреть вопрос о включении в проводимые наблюдения цунами несейсмического происхождения.

Группа приняла к сведению предоставленную Всемирной метеорологической организацией (ВМО) информацию о новых изменениях в информационной системе ВМО и ее использовании для распространения предупреждений о цунами, а также о мониторинге ИСВ эффективности рассылаемых сообщений в целом и определенных видов сообщений в частности.

Группа рекомендовала ВМО изучить возможность оказания поддержки КАРИБ-СРП в использовании ГСТ и ИСВ для передачи оповещений об угрозе цунами в Карибском регионе.

Группа отметила, что текущая финансовая ситуация в значительной степени ограничивает возможности самой Группы, а также МКГ и общих целевых групп МКГ в осуществлении возложенных на них задач, и рекомендовала государствам-членам увеличить внебюджетные взносы в МОК в целях предоставления необходимых средств на осуществление утвержденных РГ-СПЦО и МКГ приоритетных направлений деятельности.
1. OPENING AND WELCOME

1.1 OPENING

1. The Chair, Dr Alexander Postnov, opened the meeting.

2. Vladimir Ryabinin, Executive Secretary of IOC, welcomed the Group and thanked participants for their many contributions to the IOC Tsunami Programme. The Tsunami community is a dynamic community that is providing an essential operational service to society, and is engaged actively with harmonization and testing readiness of the systems through exercises, and enhancing preparedness through many training activities.

3. Vladimir Ryabinin provided a brief overview of the general outlook for IOC. Since 2015 four global agreements have been in place i.e. the 2030 Agenda for Sustainable Development; the Sendai Framework for Action; the Paris Climate Agreement; and the SIDS Accelerated Modalities of Action [S.A.M.O.A.] Pathway. IOC’s programs are relevant for all these agreements. Concerning the Sustainable Development Goal No 14 - Conserve and sustainably use the oceans, seas and marine resources, the IOC is designated custodian agency for target 14.3 “Minimize and address the impacts of ocean acidification, including through enhanced scientific cooperation at all levels” and 14.a “Increase scientific knowledge, develop research capacity and transfer marine technology, taking into account the Intergovernmental Oceanographic Commission Criteria and Guidelines on the Transfer of Marine Technology, in order to improve ocean health and to enhance the contribution of marine biodiversity to the development of developing countries, in particular small island developing States and least developed countries”. A high-level United Nations Conference to Support the Implementation of Sustainable Development Goal 14 will be convened at United Nations Headquarters in New York from 5 to 9 June 2017. The Conference is intended to initiate a process that will lead to a reversal of the decline in the health of the ocean for the benefit of people, planet and for prosperity (more details available at https://oceanconference.un.org/). Capacity Development will play a significant role in meeting the SDG 14 targets and IOC has a proven track record in this area and as also demonstrated in the newly adopted IOC Capacity Development Strategy, 2015-2021.

4. Another important development relates to the further elaboration of a proposal for launching an International decade on ocean science for sustainable development (2021-2030) - Towards the ocean we need for the future we want – potentially under the auspices of the United Nations. The document (IOC/INF-1341; see also http://www.unesco.org/new/fileadmin/MULTIMEDIA/HQ/SC/pdf/IOC_Gatefold_Decade_SinglePanels_PRINT.pdf) provides a broad rationale and context, outlines possible goals and activities, themes and expected results. It has been prepared as follow-up of a decision by the IOC Executive Council during its agenda item “Future of the IOC” in June 2016. The IOC Executive Council encouraged the IOC Officers to pursue and develop such an initiative for an in-depth examination by the IOC Assembly in June 2017.

5. The IOC’s work and competences are in high demand. On UNESCO’s 39 C/5 budget questionnaire more than 50% of responding Member States placed SDG 14 on Ocean and SDG 13 on Climate Change among the five highest priorities. The UNESCO Program and Budget is presently under development and it will be formally adopted at the 39th UNESCO General Conference in November 2017. Ocean is increasingly recognized within UNESCO. On UNESCO’s 39 C/5 budget questionnaire more than 50% of responding Member States placed SDG 14 on Ocean and SDG 13 on Climate Change among the five highest priorities. Moreover, IOC will for the first time have a separate chapter in the UNESCO Program and Budget document (C/5). The financial situation is still very strained and at best only very moderate reinforcement is foreseen to support IOC’s work in support of the SDG 14 and
establishment of the position as IOC/UNESCO funded position as director for the Caribbean Tsunami Information Center (CTIC). In closing Vladimir Ryabinin strongly appealed to Member States to support IOC with extrabudgetary funds.

1.2 ADOPTION OF THE AGENDA

6. The agenda was adopted as given in Annex I

1.3 WORKING ARRANGEMENTS

7. 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-wg10

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)

8. Ms 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 ICG/CARIBE-EWS has 32 Member States and 16 territories. It extends from Bermuda to the North until Brazil in the South, covering all the Lesser and Greater Antilles as well as the Gulf, Caribbean and Atlantic Coasts of Mexico, Central America and South America; over 70% of its Member States and Territories are SIDS.

9. She indicated that ICG/CARIBE EWS is currently organized with a Board of Officers, 4 Working Groups (WGs) and 3 Task Teams (TTs) for the period 2016-2017. She further indicated that 98% of CARIBE-EWS nations and territories have designated Tsunami Warning Focal Points (TWFPs) and half of them have nominated National Tsunami Warning Centres (NTWCs).

10. She reported on the Eleventh session of the ICG/CARIBE EWS hosted in Cartagena, Colombia, April 5-7, 2016 (ICG/CARIBE-EWS-XI/3). She indicated that among other important decisions and recommendations it recommended a Tsunami Service Model for the region and agreed that the US PTWC (Hawaii) be referred to as the CARIBE EWS Tsunami Service Provider. The PTWC began the issuance of the Enhanced Products as of March 1, 2016 and will begin covering the domestic service for Puerto Rico and Virgin Islands – becoming the sole CARIBE EWS provider.

11. The Eleventh session of the ICG/CARIBE EWS also suggested that the ICG identify volcano observatories as the primary entities responsible for determining the potential of a volcano induced tsunami threat, and work with the PTWC to determine the appropriate types of threat information products for volcano observatories would make available to emergency managers to convey this threat potential. It decided to establish an ICG/CARIBE-EWS Task Team to identify the procedures to follow for volcanic crises.

12. Ms Hillebrandt-Andrade reported that after a 10-year steady increase in seismic and sea level data contributions, the number of available seismic stations improved from 10 to over 100 stations since 2004, which allowed tsunami bulletins to be issued in 5 minutes instead of 12 minutes. Sea level stations increased as well from 5 to almost 80 stations and the tsunami detection time dropped from 3 hours to 5-30 minutes. She emphasized that
regular operator’s workshops and bimonthly online meetings of all operators and members of the Working Groups are essential for sustainability.

13. 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, supports sea level, seismic and GNSS monitoring efforts, Tsunami Standard Operational Procedures training, CARIBE WAVE exercises, US TsunamiReady and UNESCO IOC Tsunami Ready Programs.

14. Ms Hillebrandt reported that an IOC and CME-NOC Programme Training Course for Operators of Sea Level Stations in the Caribbean and Adjacent Regions was held on 17 - 21 October 2016, in Rodney Bay, Saint Lucia, supported by the United Kingdom, United States and IOC. Plans are ongoing for a Seismic operators training hosted by Puerto Rico, United States in 2017 and a Training Course for Operators of Sea Level Stations in 2018.

15. Ms Hillebrandt-Andrade informed that the Exercise Caribe Wave 16 held on March 17, 2016, had over 330,000 participants registered to participate in the exercises, with the next Caribe Wave exercise scheduled on March 21, 2017, with a goal of increasing the participation by 10%.

16. Ms Hillebrandt reported that currently there are 52 Tsunami Ready communities in the Caribbean and Adjacent regions recognized by the US NWS TsunamiReady © and as part the International Tsunami Ready recognition program, implemented on a pilot basis by IOC as from 2015 (Recommended by the ICG/CARIBE EWS X). With funding from USAID/OFDA and in-country support St. Kitts and Nevis completed the International Tsunami Ready requirements and was recognized as Tsunami Ready during the World Tsunami Awareness Day on November 5, 2016. ICG CARIBE EWS looks forward to supporting other ICG’s with implementation of Tsunami Ready as also envisioned by TOWS.

17. 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 that expired on March 2016. Due to several reasons, CTIC has not been staffed since beginning of 2016, but the MOU was renewed in January 2017 and the reappointment of an Interim Director is expected to happen soon. She expressed appreciation to the IOC Executive Secretary for the support to CTIC through extra budgetary and regular program funds, and to the Kingdom of Netherlands for their funding for CTIC for 2017. She reiterated the importance of a permanent director position for CTIC in Barbados in the upcoming 2018-2021 programme and budget.

18. In response to a question of TOWS-WG Chair Dr Postnov about needs and gaps, Ms Hillebrandt indicated that still some sea level observing stations are required to complete the system and near-shore bathymetry is required and essential for modelling purposes.

19. With respect to the validity term of the Tsunami Ready recognition Ms Hillebrandt indicated that for the ICG/CARIBE EWS it is for 3 years renewable, but in the framework of the discussions by the Inter-ICG Task Team on Disaster Management and Preparedness, a validity term of 4 years may be decided for all Tsunami Ready pilots or programmes.

2.1.2 Indian Ocean Tsunami Warning and Mitigation System (IOTWMS)

20. Mr Rick Bailey made the presentation on IOTWMS on behalf of the acting chair Dr Samantha Hettiarachchi who could not attend the meeting. Mr Bailey reminded that Dr Samantha Hettiarachchi has taken over as the acting chair from Dr Srinivasa Kumar Tummala who stepped down as the chair after taking over as Head of the ICG/IOTWMS
Secretariat. 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 and a Task Team for the IOWave16 exercise. He mentioned that the focus of IOTWMS has been on “Mitigation” and tsunami threat in the Makran Region.

21. Mr Bailey 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. The IOTWMS Service Definition Document and User Guide are the key documents that define the IOTWMS services and the products. SOP workshops are done every year at one of the TSPs inviting NTWCs, DMOs and Media to train them about the products and assisting them in preparation of integrated SOPs. The IOTWMS conducts biannual Communications Tests to validate TSP dissemination, NTWCs’ reception, website accessibility and feedback mechanisms.

22. The off-subduction zone earthquake of March 02, 2016 near western Sumatra was the only event in the inter-sessional period which created a minor tsunami. All 3 TSPs generated tsunami threat information for this event and the response of member States is being assessed through a post-event assessment survey.

23. 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 58,000 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.

24. On Tsunami Risk, Community Awareness and Preparedness, Mr Bailey reported that there have been many achievements especially through the activities of the Indian Ocean Tsunami Information Centre (IOTIC) supported by the Government of Indonesia and extra budgetary projects supported by UNESCAP. Activities include capacity building workshops, documenting the impacts of 1945 Makran tsunami, IOWave 16 regional communication platform, etc. The IOTWMS has plans to undertake a baseline assessment, continue capacity development workshops, implement tsunami ready programme, enhance community participation in future IOWave exercises and encourage activities towards World Tsunami Awareness Day. Mr Bailey reminded that the next ICG/IOTWMS session is scheduled in Malaysia during April 18-20, 2017.

25. Mr Bailey concluded by highlighting the successes on the “last mile” activities especially through IOwave16, sharing of best practices, extra-budgetary funding support for capacity development activities as well as excellent coordination by the IOC’s ICG/IOTWMS Secretariat supported by Government of Australia. He highlighted the need to continue annual training workshops, continued performance monitoring and engaging in technical enhancements by incorporating new scientific developments.

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

26. François Schindelé reported on this item on behalf of Prof Ahmet Yalciner, Chair of ICG/NEAMTWS.

27. The major developments under ICG/NEAMTWS since TOWS-IX include: (i) the accreditation of four Candidate Tsunami Service Providers [CENtre d’Alerte aux Tsunamis (France), Istituto Nazionale di Geofisica e Vulcanologia - Centro Allerta Terremoti (Italy),
National Observatory of Athens (Greece) and Kandilli Observatory and Earthquake Research Institute (Turkey)] and these are now labelled Tsunami Service Providers (TSPs); (ii) the decision to carry out a tsunami wave exercise in 2017 (NEAMWAVE 17) between 31st October – 5th November 2017).

28. He further informed that National Tsunami Warning centers are under development in Portugal, Romania and Israel. Other developments include the publication of a booklet 10 Years of the North-Eastern Atlantic, the Mediterranean and Connected Seas Tsunami Warning and Mitigation System (NEAMTWS): Accomplishments and Challenges in Preparing for the Next Tsunami http://unesdoc.unesco.org/images/0024/002473/247393m.pdf.

29. François Schindelé provided an overview of earthquake events during 2012-2016 with potential for Tsunamis and the two particular events where a Tsunami was recorded i.e. 17 November 2015 from a magnitude 6.5 earthquake at SW side of Lefkada Island, Ionian Sea) and 25 January 2016 from a magnitude 6.2 earthquake 50 km north of Al Hoceima (Morocco).

30. He summarized the achievements and future challenges of NEAMTWS in the following points: (i) there is still low awareness in general public and the authorities on the Tsunami risk; (ii) Civil Protection Authorities participation in NEAMTWS has increased but more activities targeted on capacity building and trainings of emergency managers are necessary; (iii) The success of NEAMTWS is also depending on the participation of all countries bordering the Mediterranean and NE Atlantic. However, some countries have not yet nominated TNC and TWFP; (iv) Interoperability among TSPs; (v) Detection networks need to be sustained by national and international funding and targeted activities should be organized for those countries where there are still gaps in the seismic and sea level networks.

31. On item (v) he showed results of simulation studies of the delay in the detection of Tsunamis generated near the Moroccan, Algerian and Tunisian coast as a consequence of lack of real time sea level observations along that coast line. With the existing operational sea level network in NEAMTWS there could be a delay of 75-80 minutes before a Tsunami generated off the coast of Algeria would be detected by the TSPs. This delay could be reduced considerably if existing sea level stations in Algeria and Tunisia were reporting in real time and data exchanged internationally (see also F. Schindelé et al. 2014, Implementation and Challenges of the Tsunami Warning System in the Western Mediterranean, Pure and Applied Geophysics, DOI 10.1007/s00024-014-0950-4).

32. François Schindelé also highlighted the role that research funding from the European Union is contributing to the further development of NEAMTWS (i.e. Astarte - http://www.astarte-project.eu/ ; ARISTOTELE - http://aristotle.ingv.it/ ; TSUMAPS-NEAM - http://www.tsumaps-neam.eu/)

33. In closing François Schindelé provided the following recommendations from ICG/NEAMTWS to TOWS:

- An official information/communication should inform NEAMTWS TSPs are now accredited.
- Member States should be further encouraged to
  - Nominate TNC and TWFPs
  - Participate to NEAMTWS activities
  - Provide sea level data to the TSPs (particular for the southern rim of Mediterranean coast)
  - Implement more tide gauges near Tsunamigenic source area
2.1.4 Pacific Tsunami Warning and Mitigation System (PTWS)

34. Mr Tomoaki Ozaki (Japan), Vice-Chair of the Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System (ICG/PTWS), reported on behalf of Ms Filomena Nelson (Samoa), Chair of the ICG/PTWS. He recalled the Area of Responsibility (AoR) of the ICG/PTWS and its governance structure. He also discussed 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.

35. Mr Ozaki recalled that the ICG/PTWS decided at its 26th session to have a more balanced effort of the ICG/PTWS across: a) risk and hazard assessment; b) warning systems; and c) awareness and preparedness, taking into consideration Member States reporting and targets under the UN World Conference on Disaster Risk Reduction (WCDRR) Sendai Framework 2015-2030. Along these lines he reported on the establishment of a PTWS Task Team on Evacuation Mapping and Planning, to support the development of a new programme aimed at facilitating tsunami resilience through community preparedness, specifically through the preparation of tsunami evacuation maps and associated response plans for tsunami-vulnerable coastal communities. Under the guidance of this Task Team and the leadership of ITIC, a pilot capacity-building course on Tsunami Evacuation Maps, Plan and Procedures (TEMPP) was conducted in Central America during 2015-2016, hosted by Honduras. As a result, Honduras adopted the Tsunami Ready programme, becoming the first country in the PTWS to do this.

36. Mr Ozaki indicated that building on the ICG/CARIBE EWS approved Tsunami Community Preparedness Recognition Programme and its Guidelines for the Tsunami Ready Community Performance-Based Tsunami Recognition Programme, PTWS investigates 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.

37. Mr Ozaki provided information about recent activities of the PTWS regional working groups for the South West Pacific, the South China Sea region and the Central America Pacific region. He indicated that the proposed South China Sea Tsunami Advisory Center (SCSTAC) operation is proceeding, targeting endorsement of SCSTAC operation by the 6th session of the South China Sea region Working Group (March 2017), ICG/PTWS-XXVII (March, 2017) and IOC Assembly (June 2017). Similarly, a Central America Tsunami Advisory Center (CATAC) is enhancing its ability as a potential sub-regional TSP with support by the Japan International Cooperation Agency (JICA).

38. Mr Ozaki reported on a magnitude 7.8 Mw earthquake that hit New Zealand at 11:02, on 13 Nov. 2016 UTC, with a generated a local tsunami (1.47m at Kaikoura) including a sea level drawdown of 2.5m observed in Kaikoura. PTWC issued its first advisory information at 11:12 UTC with Mw7.4, and a second advisory information at 11:43 UTC with Mw7.9. Much difference between hypocenter location and major fault rupture zone made it difficult to estimate tsunami risks. As a result of this earthquake New Zealand decided to improve tsunami warning standard operation procedures and enforce tsunami awareness activities.
39. He indicated that the ICG/PTWS also approved at its 26th session that the Japan Meteorological Agency (JMA) through the NWPTAC will develop and test enhanced forecasts products during 2016-2017 to be introduced officially by 2018. The introduction of enhanced forecasts as an experimental provision will happen in 2017, and a full changeover will take place in 2018.

40. Mr Ozaki recalled bi-annual basin-wide exercises are organized by the PTWS. An exception was Pacific Wave 16, held 1-5 February 2016 focusing on the new NWPTAC trial enhanced products, with a regional exercise involving the 16 countries receiving the NWPTAC products. In February 2017 the PTWS conducted a Pacific-wide exercise involving all PTWS countries as part of the regular bi-annual Pacific Wave exercise conducted since 2006.

41. Mr Ozaki recalled that at the 26th session the ICG/PTWS decided to replace the current Implementation Plan with a PTWS Status Report prepared by the Steering Committee for presentation and review at each session of the ICG/PTWS. It also decided to develop Action Plans of the Working Groups and Task Teams being informed by the Decisions, Recommendations and Action Plans of the ICG/PTWS to address any issues, gaps and identified enhancements identified by the PTWS Status Report. To keep up to date with the status of the system, the ICG/PTWS also decided to establish a Task Team under the Steering Committee to develop Key Performance Indicators (KPIs) with targets to monitor implementation and performance of all components of the warning and mitigation system.

42. He reported that the 27th session of the ICG/PTWS is scheduled on 28-31 March 2017, hosted by France in Tahiti, French Polynesia. In connection with this session an International Tsunami Workshop “Recent tsunamis in the Pacific (2007-2016) - Improving tsunami response” is to be held on 27 March, 2017.

43. WMO reported that it has received communication test reports from the ICG/IOTWMS, which is very helpful to see if there are problems, i.e. if there are delays, how long the delay is, or if the message did not get through at all. WMO expressed that it would be good to also received similar report from other ICGs. Some participants indicated that the higher frequency of events in the Pacific allows for information about communication failures to be obtained out of real events. The group took note of the need of sharing communication test reports with WMO.

### 2.2 REPORT OF NON-IOC BODIES

#### 2.2.1 Report from World Meteorological Organization

44. Edgard Cabrera, Chief, Marine Meteorology and Ocean Affairs and David Thomas, Chief, Information and Telecommunication System Division at WMO provided a report on activities of the World Meteorological Organization (WMO).

45. The 68th session of the WMO Executive Council (EC) was held in Geneva, Switzerland, from 15 to 24 June 2016. Two documents for action/decision were submitted as well as two information documents (attached). The full report is available from the WMO website [http://library.wmo.int/opac/index.php?lvl=notice_display&id=19656](http://library.wmo.int/opac/index.php?lvl=notice_display&id=19656).

46. As main highlights of interest for TOWS, the WMO Executive Council endorsed: (i) The work on marine warnings and forecasts, as enacted through the World-Wide Metocean Information & Warnings Service (WWMIWS) under the auspices of IMO Assembly resolution A.1051(27); and (ii) The formation of a small group of WMO Members to undertake a Technical Assessment of the Marine Meteorology and Oceanography Programme within WMO. This Group aims to align the work of WMO’s Marine Programme...
with the overall WMO Strategic Plan and the users of the marine outputs, including the GMDSS.

47. The WMO Executive Council at its 65th session (2013) endorsed the proposal by JCOMM to review the overall structure of the WMO-No.558 and WMO-No.471, in view of new structures for those mandatory publications to avoid duplication and/or potential conflict in contents. Work has continued to review and update, specifically, WMO-No.558 – the Manual on Marine Meteorological Services, which forms the basis of the meteorological input to the Joint IMO/IHO/WMO Manual on Maritime Safety Information. It is expected that approval for the changes will be received at the 5th Session of JCOMM in October 2017.

48. The Coastal Inundation Forecasting Demonstration Project (CIFDP) is a multi-hazard warning system that promotes an integrated approach in the enhancement and delivery of early warnings, no matter what the causes for coastal inundations are, in line with the concept of impact-based forecasting and the UN Sendai Framework for Disaster Risk Reduction (DRR).

49. The CIFDP is currently underway in four sub-projects (Bangladesh, Dominican Republic, Fiji and Indonesia), one of which is in RA IV. Substantial progress has been made in each of these CIFDP sub-projects from 2013 to date (mostly Phases 1 to 2), and the Caribbean project (Dominican Republic – Haiti) is expected to be completed by the end of 2018;

50. The CIFDP should integrate as much as possible with the existing complementary WMO Programmes, initiatives and activities under the technical commissions (e.g. JCOMM, CHy, CBS). Where possible, it should also integrate with international tsunami forecasting and warning systems (facilitated by the TOWS) and within the implementation of a multi-hazard early warning system, providing integrated and seamless services for reducing disaster risk from different types of hazards. In the case of the Caribbean project, a strong interaction and synergies have been achieved with the ongoing projects, performed by the ICG/CARIBE-EWS.

51. Satcom, the International Forum of users of satellite data telecommunication systems, is a self-funded body jointly sponsored by the WMO and the IOC. It aims to address the requirements of these two Organizations for the timely collection via satellite of environmental data from observing platforms. Details of Satcom are online at https://wiswiki.wmo.int/Satcom. In addition to bringing together users, suppliers and equipment manufacturers and providing guidance on application of satcom systems for users, Satcom is working towards new business and charging models that will benefit users and suppliers. It is also working on special tariff rates for devices supporting early warning systems. A key to these negotiations will be determining the likely number of users and market capability demonstrated by suitable case studies. TOWS-WG is invited to participate in Satcom, including identifying some use cases that would demonstrate the importance of Satcom to tsunami services.

2.2.2 World Tsunami Awareness Day (UNISDR)

52. Jonathan Fowler (UNISDR) reported on the background and commemoration of the first UN World Tsunami Awareness Day (5 November 2016).

53. Why World Tsunami Awareness Day?
- Tsunamis are rare but deadly: the average toll per disaster surpasses any other natural hazard.
• Tsunamis know no borders: international cooperation is key to deepen political and public understanding of risk reduction measures
• Contributes to aims of Sendai Framework for Disaster Risk Reduction: greater risk understanding, management, investment in resilience, enhancing preparedness, reduced mortality, increased early warning, deployment of traditional knowledge and practices, etc.

54. Why 5 November?
• “Inamura-no-hi” (burning of rice sheaves): during the 5 November 1854 Ansei-Nankai earthquake and tsunami in Japan, local leader Hamaguchi Goryo noticed the low tide and set fire to his entire harvest to warn villagers, who fled to high ground. He also funded the “build back better” effort, building an embankment and planting trees to act as a buffer.
• In December 2015 the UN General Assembly Resolution A/70/203 designated 5 November as World Tsunami Awareness Day.

55. Objectives
• The UN Resolution called for observance by all countries, UN organizations, other international and regional bodies, and civil society to observe the day. The resolution requested UNISDR to coordinate and facilitate this.
• Raise awareness of tsunamis and share innovative approaches to reduce tsunami risks
• Highlight the contribution of Sendai Framework to reducing global mortality risks
• Reaffirm interlinkage between disaster risk reduction and Sustainable Development Goals

UNISDR Goals for WTAD 2016

56. The UNISDR Goals for the WTAD 2016 were:
(i) Start the process for WTAD sustainability;
(ii) Build awareness of WTAD itself;
(iii) Maximize buy-in by all countries at risk;
(iv) Maximize inputs and expertise on reducing tsunami risks; and
(v) Partners mobilization.

57. Target audiences were:
(i) General public/communities;
(ii) Governments/organizations; and
(iii) Media.

The WTAD 2016 Campaign

58. ISDR has worked with IOC-UNESCO and others on drills and educational programmes, including IOWave16. The WTAD was aligned with the 13 October International Day for Disaster Reduction – and it marked the start of the 2016-2022 “Sendai Seven
Campaign” on each of the 7 Sendai Framework targets: Target 1 is reducing disaster mortality.

59. Several events were organized globally to promote WTAD, including special WTAD session at the Asian Ministerial Conference on Disaster Risk Reduction, an information event at UN Headquarters New York etc. ISDR sent an observer and communication team to Indian and Seychelles to document the IOWave16, 7-8 September 2016.

60. A primary aim of 2016 campaign has been to motivate partners and governments to organize events, workshops and create buzz around 5 November. This has also been done via social media campaign: #TsunamiDay2016 and #switch2sendai, and collected stories and case studies.

61. The tools and materials that were made available for the WTAD 2016 were: (i) Generic video about World Tsunami Awareness Day; (ii) Flyer, banners, posters and print materials; (iii) Press releases, news stories, Op-Eds, social media; (iv) Dedicated Web page (as per www.unisdr.org/2016/tsunamiday); and (v) Coverage of celebrations, case stories, drills and outcomes.

**WTAD 2017**

62. For future WTAD events it is proposed to link to International Day for Disaster Reduction and start commemoration on 13 October and end on 5 November.

63. The WTAD on 5 November 2017 will have a focus on Target (b) of the Sendai Framework:

    *Substantially reduce the number of affected people globally by 2030, aiming to lower the average global figure per 100,000 in the decade 2020–2030 compared to the period 2005–2015*

64. WTAD 2017 will build on approach and material from 2016 commemoration. ISDR welcomes information about new material and planned WTAD 2017 events.

65. Thorkild Aarup added details about the IOC/UNESCO contributions to WTAD 2016 which included the following: (i) Irinia Bokova, Director General of UNESCO, issued a statement at the commemoration of first World Tsunami Awareness Day; (ii) A message was sent out to the UNESCO Associated School Network (about 10,000 schools) highlighting the story “Burning the Rice Sheeves”; (iii) two Tsunami sessions were organized at the Asian Ministerial Conference on Disaster Risk Reduction (New Delhi, 2-5 November 2016); (iv) UNISDR produced a video from the Indian Ocean wave 2016 exercise which featured prominently throughout the AMCDRR; (v) IOC/UNESCO participated in the celebration of WTAD at UN Headquarters (New York, 3 November 2016); (vi) Several countries organised national WTAD events (including Egypt, Turkey, Vanuatu) (See http://www.unesco.org/new/en/tsunami-day).

66. In the ensuing discussion it was recommended that ISDR: (i) establish a process for how to interact regarding planning for WTAD events locally and regionally; (ii) include information about the forecast and warning system in the material for future commemorations of WTAD; and (iii) establish a calendar of events leading up the WTAD 5 November 2017.

67. TOWS recommended that the ICGs should 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 Tsunami Information centers.
3. REVIEW OF PROGRESS

3.1 STATUS OF IMPLEMENTATION OF IOC DECISION IOC/EC-XLIX, Dec.3.4

68. Thorkild Aarup reviewed the actions pertaining to Decision EC-XLIX/3.4 of IOC Executive Council (7 - 10 June 2016, Paris, France; see also http://www.ioc-unesco.org/index.php?option=com_oe&task=viewDocumentRecord&docID=17426).

69. He reminded that the IOC 28th Assembly/Dec.8.2 (June 2015) decided that “in the future all Intergovernmental Coordination Groups for Tsunami Early Warning and Mitigation 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; ……” The UN General Assembly established, at its 69th session (3 June 2015) an open-ended intergovernmental working group, ……, “for development of a set of possible indicators to measure global progress in the implementation of the present [Sendai] Framework”. The Intergovernmental working group worked during 2015/2016 and a report submitted to UN General Assembly on 1 Dec 2016 and subsequently endorsed on 2 February 2017 (http://www.preventionweb.net/files/50683_oiewgreportenglish.pdf). This report should be considered by in the efforts to establish Key Performance Indicators for Tsunami Intergovernmental Coordination Groups.

70. He further reminded that the IOC Decision EC-XLIX/3.4 had noted the adoption by the UN General Assembly to designate 5 November as Word Tsunami Awareness Day and the IOC EC had invited Member States to observe that day. Specific IOC actions on that are reported under item 2.2.

71. He also mentioned that the IOC Decision EC-XLIX/3.4 had included a request to IOC and WMO, working through the Data Buoy Cooperation Panel and TOWS, to develop a regionally relevant education and outreach strategy concerning buoy vandalism for further discussion at the 29th IOC Assembly. This work has advanced and progress has been reported under the TOWS Task Team on Watch Operation.

72. Additional actions and requests pertaining to IOC Decision EC-XLIX/3.4 can be found under the regional ICG reports and the two Task Team reports.

73. Finally in terms of ExB support he acknowledged contributions from Australia, China, Monaco and the Netherlands as well as EU DG ECHO.

4. REPORTS OF THE INTER-ICG TASK TEAMS

4.1 INTER-ICG TASK TEAM ON DISASTER MANAGEMENT AND PREPAREDNESS

74. Mr David Coetze reported on the outcome of the Inter-ICG Task Team on Disaster Management and Preparedness which met on 21 and 22 February 2017 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

75. Mr Charles McCreery reported on the outcome of the Inter-ICG Task Team on Disaster Management and Preparedness which met on 21 and 22 February 2017 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

76. The next meeting of TOWS-WG will take place from 16-17 February 2018 in Paris. This would allow for the proposed symposium (pending formal approval) to take place from 12 to 14 February 2018 (closing at noon), and the TOWS Task Teams to meet from 14 to 15 February 2018. The Chair and Technical Secretary are asked to explore and finalise arrangements.

7. CLOSURE OF MEETING

77. The Tenth meeting of TOWS-WG was closed at 15:00 on 24 February 2017.
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
      2.1.1 Tsunami and Other Coastal Hazards Warning System
            for the Caribbean and Adjacent Regions (CARIBE-EWS)
      2.1.2 Indian Ocean Tsunami Warning and Mitigation System (IOTWMS)
      2.1.3 Tsunami Early Warning and Mitigation System in the North-Eastern
            Atlantic, the Mediterranean and Connected Seas (NEAMTWS)
      2.1.4 Pacific Tsunami Warning and Mitigation System (PTWS)
   2.2 REPORT OF NON-IOC BODIES
      2.2.1 Report from World Meteorological Organization
      2.2.2 World Tsunami Awareness Day (UNISDR)

3. REVIEW OF PROGRESS
   3.1 STATUS OF IMPLEMENTATION OF IOC DECISION IOC/EC-XLIX, Dec.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 Tenth Meeting of the Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems (TOWS-WG-X) was held in Paris, France, on 23-24 February 2017 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-XXVIII/Dec. 8.2 and IOC EC-XLIX/3.4.

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:

- Three exercises carried out (CARIBEWave 2016, IOWAVE 2016, PACWAVE 2017) and regular communication tests
- Accreditation of four TSPs in NEAMTWS
- With regards to Tsunami Evacuation Mapping:
  - The PTWS successfully completed a Pilot Tsunami Evacuation Maps, Plans and Procedures (TEMPP) over two years in Honduras with regional participation
  - The ITIC, CTWP & IOC-UNESCO programme CARIBE EWS built experience with regards to implementation of the TEMPP and are ready to provide guidance to countries that want to implement similar projects
  - The Project identified and references existing best practice evacuation mapping guidelines that countries have developed
  - The PTWS will finalise project documentation and make it available to ICGs, noting the interest of IOTWMS and CARIBE-EWS
- Tsunami Ready Community based performance recognition program achieved in St. Kitts & Nevis and Cedeño (Honduras)
- The progress made by DBCP in developing an educational strategy to address buoy vandalism and endorse the development of the strategy and recommend that each ICG review the strategy

The Group recommended the Assembly to encourage Member States to

- sustain and increase technical and financial support of the tsunami warning systems in their respective regions
- further promote tsunami awareness in communities and among authorities through communication and tsunami wave exercises, training, information, and community preparedness and recognition programmes
- share Tsunami source scenario data as well sea level data relevant to tsunami detection and alerts
- densify sea level networks particularly nearby tsunamigenic sources
extend exercises to community level and include critical infrastructure in exercises (e.g. hospitals, fire stations, police stations, electric power plants, airports, ports and harbors)

The Group recommended the Assembly to instruct ICGs

• to consider piloting the CARIBE EWS Tsunami Ready guidelines and report back to the TOWS-XI with a view to develop harmonized consistent global guidelines
• 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 also use the Common Alerting Protocol (CAP) to facilitate warning messages to be consistently disseminated simultaneously over many warning communication systems to many applications
• to recommend TSPs and NTWCs register with international register of alerting authorities through WMO National Permanent Representative
• 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
• 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
• to encourage NTWCs disseminate tsunami bulletins to ports, harbours and other maritime authorities within their countries
• to share the results of Tsunami exercises and communication tests with WMO to facilitate improved performance of WMO related communication systems

The Group recommended the Assembly to take the following actions

• to conduct a symposium in early 2018 in Paris on enhancing existing TSP and NTWC operational tsunami forecasting to further develop warning products and enhancing timely, accurate, reliable and effective decision-making and community response, involving experts from monitoring networks, seismology, tsunami forecast modelling and warning centres, maritime authorities, and national and local emergency management authorities with advice on product requirements
• 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 Appendix I to reflect work related to enhancements to the accuracy and effectiveness of tsunami forecast information for users.

The Group accepted the reports from the Task Teams on Disaster Management and Preparedness and Watch Operations and instructed the Task Team on Watch Operations
to develop in consultation with WWNWS-SC specific tsunami threat messages for vessels at sea

to consider tsunamis generated by non-seismic sources for integration into Tsunami watch operation

The Group noted the information presented by the World Meteorological Organization (WMO) on the new developments on the WMO Information System and its use for dissemination of Tsunami alerts as well as WIS performance monitoring of messages and particular types of messages.

The Group recommended WMO to explore rendering assistance to CARIBE-EWS concerning usage of GTS and WIS for dissemination of tsunami alerts in the Caribbean region.

The Group recognized that the current financial situation strongly limits the implementation of the tasks of the Group, ICGs and Inter-ICG Task Teams and recommended that the Member States to increase their extra-budgetary contributions to the IOC to provide the needed resources for the priorities identified by TOWS-WG and ICGs.

Appendix 1

Terms of References for TOWS Task Team on Watch Operation

- Provide a mechanism to the ICGs for coordination of tsunami watch operations among the Tsunami Warning Systems;
- Maintain an inventory of current and proposed products and their dissemination methods;
- Recommend and promote harmonized terminology;
- Maintain an inventory of areas of responsibilities, geographical coverage, system architectures, and other relevant characteristics;
- Recommend operational standards, procedures and guidelines for regional and national providers of tsunami forecast information;
- Share and harmonise methods of detection and characterization, forecasting techniques and dissemination to enhance the accuracy and effectiveness of tsunami forecast information for users;
- Monitor status of the regional provision of tsunami forecast information; Report to TOWS-WG.

The representatives to the Inter-ICG Task Team on Tsunami Watch Operations shall be nominated by their respective ICG Chairpersons. The membership shall consist of two representatives from each ICG, and include representatives from the regional providers of tsunami threat information. The IOC Chair will appoint the Chair of the Task Team.
ANNEX III

REPORT OF THE INTER-ICG TASK TEAM ON DISASTER MANAGEMENT AND PREPAREDNESS

21–22 February 2017
Paris, France

Task Team Members

– David Coetzee (Chair) – Ministry of Civil Defence & Emergency Management, New Zealand; ICG/PTWS
– Laura Kong – International Tsunami Information Centre (ITIC), Hawaii, USA; ICG/PTWS
– Harkunti Pertiwi Rahayu – Research Center for Disaster Mitigation, Institute of Technology Bandung, Indonesia; ICG/IOTWMS
– Ardito Kodijat – Indian Ocean Tsunami Information Centre (IOTIC), Indonesia; ICG/IOTWMS
– Gerassimos Papadopoulos – National Observatory of Athens, Greece; ICG/NEAMTWS
– Amir Yahav – National Emergency Management Authority, Israel; ICG/NEAMTWS
– Denis Chang Seng – ICG/NEAMTIC to NEAMSTWS Technical Secretary
– Vacant – Caribbean Tsunami Information Centre (CTIC), ICG/CARIBE-EWS
– Patrick Tyburn – French West Indies Emergency Management Organisation, Prefecture de Martinique (France); ICG/CARIBE-EWS (Apology)
– Bernardo Aliaga – IOC Secretariat

At this meeting the CARIBE EWS was represented by Christa von Hillebrandt-Andrade, Chair of the ICG-CARIBE EWS.

1. 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 organization 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 programs 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), and in February 2016 in Paris (IOC/TOWS-WG/TT2-IV). This report covers the period 2016–2017.

2. UPDATES FROM ICG WORKING GROUPS

The task team collected updates on Disaster Management and Preparedness 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.

2.1 ICG IOTWMS – WG 1 on Tsunami Risk, Community Awareness and Preparedness

The new form of WG1 of ICG/IOTWMS on Tsunami Risk, Awareness and Preparedness has achieved several collaborative works and research during this past one year (2016-2017) on tsunami as well as other coastal hazard risk assessment and mitigation in Indian Ocean region, in line with its new role on bringing science and socio technology into government, society and its related stakeholders in enhancing the awareness and preparedness through structural and non-structural mitigation. Besides, the works achieved were also in-line with its responsibility to ensure the appropriate tsunami risk assessment, preparedness and response measures are taken by Member States of the ICG/IOTWMS, and to coordinate and share the innovative and good practices of tsunami risk assessment, awareness and response initiatives with Working Groups from other ocean basins through the IOC/TOWS-WG-TT on Disaster Management and Preparedness.

The first component of WG1 which Tsunami Risk Assessment has accomplished its works to continue conducting 5 days training workshop on Coastal Hazard Assessment: Applications in Risk Assessment, Management and Mitigation, using the exiting IOC IOTWMS training modules and manuals prepared since the first Tsunami Risk Assessment Training in 2013 and using revised version of IOC Guide no 52 on Tsunami Risk Assessment 2015. The training was conducted in Seychelles on March 2016 under close collaboration among WG1, IOTIC and secretariat of ICG/IOTWMS funded by MFIT (Malaysian Fund in Trust) via IOTIC.

The second component which has having larger task, i.e. community awareness and preparedness, has achieved several capacity building activities which included several Training Workshops, i.e. SOPs, Tsunami Preparedness, and Tsunami Exercise, conducted in Seychelles, Mauritius, Mozambique and Kenya in March and August 2017. The activities were conducted under close partnership among WG1, IOTIC and Secretariat of ICG/IOTWMS funded by MFIT (Malaysian Fund in Trust) via IOTIC. Other activity of WG1 was to support the implementation of IOWave 16 which encouraged the member states to focus on people movement/evacuation. It was about 12 form 28 member states has included community movement during IOWave 16. A lesson learned regional workshop on the implementation of IOWAVE16 was conducted in Bandung Indonesia, which was back to back with Intersessional Meeting of WG1. The 4-day workshop and meeting was implemented under collaboration of Institute Technology Bandung, WG1, IOTIC, ICG/IOTWMS Secretariat, UNESCAP and Government of Japan. The workshop was attended by about 40 participants represented 12 countries, 4 local governments, scientists, national government institutions, and international organization. The workshop provided a platform for Member States not only to share their experiences in IOWave16 and but also came up with specific recommendations towards enhancement of community participation in future IOWave exercises and recommendation for WG1 Work Plan 2017-2019.
The WG1 Intersessional meeting had very full agenda on reports on achievement, review of work plan and fruitful discussion for recommendations, discussed further during Steering Group Meeting in Perth January 2017 and will be forwarded to the ICG/IOFWMS-XI in Kuala Lumpur, 18-20 April 2017. The recommendations include:

1. Conducting a baseline assessment survey on each Member State's tsunami preparedness
2. Conducting integrated capacity development training workshops, which include: Tsunami and Other Coastal Hazard Risk Assessment and Mitigation, SOP of TEWS Development, Tsunami Exercise and Tsunami Evacuation Mapping and Planning.
3. Implementing Tsunami Ready pilots in the Indian Ocean region
4. Enhancing community engagement in future IOWave exercises
5. Adopting recommendation from IOWave 16 Regional Workshop on improving the coordination, preparation, and implementation of IOWave in the future: One year preparation and coordination. The official circular letter notification of IOWave exercise, in addition to being sent to the TNCs, should also be sent to the highest level in the organization, i.e. Minister, and also cc’d to Ministry of Foreign Affairs, Disaster Management Office in the country, UNESCO Permanent Delegates, NatCom, etc. Develop official ICG/IOFWMS and IOTIC promotional video regarding the importance of community activity during IOWave exercises and share this with the member states to be used to promote to other stakeholders in the country. Give special acknowledgement to countries that include community level activities at formal meetings, i.e. the Sessional Meeting of the ICG/IOFWMS. To continue to make use of the IOWave16 portal developed by ESCAP and IOTIC to promote IOWave exercise in the future. Invite countries not doing community activity to see and learn from countries doing community exercise in IOWave. To acknowledge communities that participate in IOWave16 to motivate them to continue to participate in future IOWaves. To widely promote the next IOWave exercise via social media, posters, videos, to assist countries in triggering interest of the community to participate in IOWave exercises.
6. Aligning activities with World Tsunami Awareness Day to increase community awareness and preparedness, this include mutual sharing of awareness and public education materials as part of dissemination and campaign both for WTAD and WG1.
7. Setting up of inter-sessional task team for updating the questionnaires for baseline assessments, future IOWave exercises and ICG member-state national reports and conducting the baseline assessment.

Last but not least, WG1 will collaborate with IOTIC, Secretariat and other potential partners to seek potential funding sources to implement the work plan. On the capacity building, the WG1 will outline such related activities under close partnership of ITB with University of Huddesfield and several other Universities from several Member States of ICG/IOFWMS under CABARET Research Project – Capacity Building in Asia for Resilience Education to implement Tsunami and other Coastal Hazard Disaster Risk Reduction. Other potential partnership which will be seek by WG1 in 2017-2019 is building partnership with RIMES for training on Evacuation Mapping using ESCAPE and with ITIC and IOTIC for TEMPP. Another issue, which was very important to consider, is conducting training workshop for preparedness including SOP for near filed and far field tsunami risk.

2.2 ICG PTWS – WG 3 on Disaster Management, Preparedness and Reduction

The ICG/PTWS-XXV agreed in 2013 to align the previous terms of reference of its Working Group 3 on Awareness and Response (as determined in the PTWS Medium Term Strategy 2009-2013, ICG/PTWS-XXIII, Annex V), with the new terms of reference of the TOWS task
team (as decided by the IOC/TOWS-WG-VI meeting in February 2013), as well as that its title be changed from the “Awareness and Response Working Group” to the “Disaster Management and Preparedness Working Group” so that the PTWS reflects the TOWS direction.

ICG/PTWS-XXVI in 2015 agreed to reconstitute WG3 under the name of “Disaster Management, Preparedness and Risk Reduction”, and to revise its Terms of Reference accordingly, to:

1. Facilitate in collaboration with TOWS Task Team on Disaster Management and Preparedness and organizations such as UNISDR, the exchange of experiences and information on risk reduction and preparedness actions, and matters related to disaster management;
2. Promote preparedness in coastal communities through education and awareness products and campaigns;
3. Facilitate SOP training across regions to strengthen emergency response capabilities of Member States and their Disaster Management Offices;
4. Develop and promote best practice preparedness material, programs and assessment tools;
5. Develop and promote best practice tsunami risk reduction material, programs and assessment tools;
6. Support the ITIC of the ICG.

Liaison with Working Groups of other ocean basins

The PTWS worked with the CARIBE-EWS to deliver the Tsunami Evacuation Mapping and Planning pilot programme through the ITIC’s Tsunami Evacuation Maps, Plans, and Procedures (TEMPP) pilot project, leading to the adoption of Tsunami Ready in Honduras. The recognition is the 1st for the Pacific.

The Working Group also took the Tsunami Ready Guidelines developed in the CARIBE EWS to the ICG-PTWS, and encouraged its member states to pilot the programme in order to identify and evaluate the Caribbean guideline’s applicability for the Pacific.

Training

Operational Tsunami Warning and Emergency Response Standard Operating Procedures Training was held in Vanuatu in April 2016 on the new PTWC products and community response. The training was attended by 30 operational staff and community representatives.

The ITIC Tsunami Training Programme (ITP) was held in Hawaii in September 2016. The training focused on standard operating procedures for warning and emergency and exercise, and was participated by five countries.

Exercises

Exercise Pacific Wave 17 (PacWave17) was held in February; evaluations are underway. The South China Sea Tsunami Advisory Center also introduced its products to SCSTAC member countries as part of PacWave17.

Supporting PTWS regional working groups and task teams

Representatives of the working group attended the meeting of the South West Pacific Working Group of the PTWS in August 2016 in Honiara, Solomon Islands. A Tsunami Ready Task Team was established at this meeting with the support of the Working Group 3
representatives with Samoa taking the lead. Tonga also took the lead in a Task team that was established to enhance response with regards to local source tsunami events. Tonga also took the lead in studying how to best establish tsunami warning centre staff competencies, especially for PIC Meteorological Services that serves as National Tsunami Warning Centres. The working group also agreed that all countries in the region should have tsunami evacuation maps, and it also encouraged focus on public alerting options. As follow-ons to regional trainings in 2014 prior to the PTWC Enhanced Products changeover, Fiji, Niue, Papua New Guinea and Samoa continued to request enhanced products country training, however funding will have to be found. In 2015, ITIC and IOC had met the training requests of Tonga, Solomon Islands, Peru, Cook Islands, and Colombia, and Vanuatu in 2016. It was noted that the World Bank is sponsoring Tsunami Resilience projects in Samoa and Tonga.

**Post-Event Assessment**

There were no post-event assessments after the assessment of the 16 September 2015 M8.3 Northern Chile tsunami since the trigger (forecasts of one or more meters in two or more countries, and tsunami damage). The 16 September 2015 assessment is being completed for the ICG/PTWS-XXVII.

**Guidelines**

The Working Group finalised the IOC Standard Operating Procedures Manual; the Manual was provided to the IOC for publishing.

To support the TEMPP training course, the ITIC translated the Japan Fire & Disaster Management Agency Guideline for Municipalities to Make Tsunami Evacuation Maps and Community Evacuation Planning into English. The Japan Guideline was published in 2013 and takes into the account lessons learned from the 2011 Japan Tsunami.

Working with the IOC, the ITIC completed the Tsunami Glossary in English. The Glossary is now translated into Spanish by UNESCO, while the French and Arabic translations are underway.

New Zealand has updated its Tsunami Evacuation Zone guidelines (*Tsunami Evacuation Zones, DGL 08/16*). The purpose of this guideline is to provide for a nationally consistent approach to developing tsunami evacuation zones, maps, and public information for CDEM Groups and local authorities. The revised version represents better guidance on evacuation mapping and includes information on land use planning and vertical evacuation.

**Preparedness**

The Steering Group of the Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System (ICG/PTWS) agreed in July 2014 that that the next priority of the PTWS after the implementation of the PTWC New Products in October 2014, should be on Preparedness, e.g., that in the end-to-end tsunami warning chain, once a forecast is provided and a warning alert issued, communities must know what to do and where to go. The ‘where to’ answer would be a tsunami evacuation map that has been developed by, and therefore, owned by the community.

The Steering Committee subsequently agreed that ITIC would lead the development of a standardized process and training course to enable the production of reliable and practical community-level tsunami evacuation maps. The Tsunami Evacuation Mapping and Planning (TEMPP) course was subsequently delivered and completed over five sessions from June 2016 to February 2017 in Honduras.
Through the TEMPP process, the PTWS Tsunami Ready guidelines (draft) were met by Cedeño, a small community in the Pacific Gulf of Fonseca, Honduras. On February 16, 2017, UNESCO IOC recognized Cedeño as Tsunami Ready, becoming the first country in the PTWS to do this. Panama, Costa Rica, Nicaragua, El Salvador, Guatemala, and Mexico also participated in the TEMPP process. 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. Costa Rica is preparing Ostional on the Pacific to be Tsunami Ready as an outcome of TEMPP.

New Zealand initiated an enhanced tsunami awareness camping in December 2016. The campaign involves new television, on-line, radio and print advertising as well as posters and leaflets translated into 22 languages. The material can be found here: NZ Tsunami Public Education Campaign

2.3 ICG NEAMTWS – WG 4 Public Awareness, Preparedness and Mitigation

According to the information collected by the ICG/NEAMTWS/WG4 on “Public Awareness, Preparedness and Mitigation”, co-chaired by Mrs Areti Plessa (Institute of Geodynamics, National Observatory of Athens) and Mrs Marzia Santini (Department for Civil Protection, Italy) as well as by national authorities, in the NEAM region several actions were undertaken during 2016.

Exchange of Expert Programme of EU: An Italian Civil Protection delegation visited the Ministry of Security & Justice, Resilience Department in The Netherlands from 5 - 8 October 2016. The topic was to exchange experiences on the technologies used in crisis management including tsunami situations.

The “Maremoto-Io non rischio: Tsunamis-I'm not in Risk” campaign is organized annually by the Italian Civil Protection Department. In 2016 the campaign was held for one weekend in October 2016 with the participation of 270 municipalities and 2,700 volunteers.

A national full-scale tsunami evacuation exercise was organized in Israel by the National Civil Protection Authority. The tsunami centers of INGV (Italy), KOERI (Turkey) and NOA (Greece) contributed by elaborating together the tsunami scenario used in the exercise.

During 2016 the Hellenic National Tsunami Warning Center (National Observatory of Athens, NOA, Greece) launched a Disaster Management & Preparedness Programme in Greece that included tsunami exercises and the development of a Tsunami Educational Platform with four main components: (1) tsunami videos, (2) an interactive tsunami quiz-game, (3) a water-tank to demonstrate in a simplistic mechanical way tsunami generation, (4) printing and dissemination of tsunami posters produced jointly with NEAMTIC and other NEAM country-members. In April 2016 NOA conducted a tsunami evacuation exercise in Heraklion, capital city of Crete, with the participation of 30 volunteers of the local Red Cross Organization. For tsunami public awareness, three public events were organized by NOA on 5-10 April (in Athens), 10-18 September (in Thessaloniki) and 30 September 2016 (in Athens) where hundreds of visitors of all ages had the opportunity to interact with the scientists on the basis of the Tsunami Educational Platform.

Activities planned for 2017 include a European seismic exercise planned by the French Civil Protection and in coordination with the CARIBE WAVE there will be a tsunami exercise for the French Antilles from 21th to 24th March 2017 (funded by DG-ECHO of EU).

Public activities with the Tsunami Educational Platform of NOA are scheduled in Greece for 2017, one of them around International Tsunami Awareness Day (5th November, 2017).
2.4 ICG CARIBE-EWS

The update on disaster management and preparedness and status of the Caribbean Tsunami Information Center was provided by the Christa von Hillebrandt-Andrade, Chair CARIBE EWS and Bernardo Aliaga, Technical Secretary of CARIBE EWS. Mr Patrick Tyburn, the Chair of WG 4 on Preparedness, Readiness and Resilience and the CARIBE EWS representative was not able to attend due to CARIBE WAVE 17 planning activities and at the moment the CTIC is not operational. The Working Group 4 has not been able to meet in person for various years and like other WG in the CARIBE EWS is trying to arrange for virtual meetings.

CARIBE WAVE exercises have been held since 2011, as of 2013 on an annual basis. Since 2013 (44,000 participants) a registration system has been in place to track the participation. CARIBE WAVE 16 took place in March 17, 2016. All Member States participated and according to TsunamiZone.Org, 332,814 people were registered (74% increase from the previous year). The exercise had two scenarios, Venezuela and Northern Hispaniola. Communications and response plans were tested and 73% of the Member States extended their participation beyond the TWFP/NTWC. Thru the hundreds of evacuation exercises, CARIBE WAVE is an opportunity to develop, promote and strengthen a culture of evacuation.

As part of CARIBE WAVE all Member States fill out a Survey as part of the exercise evaluation. The survey also includes other aspects of disaster management which helps give a State of Health of the CARIBE EWS and areas of potential future focus.

CARIBE WAVE 17 will take place on March 21, 2017. There are three scenarios from which each Member State can choose: Costa Rica, Cuba and North eastern Lesser Antilles. The French Antilles secured funding from the European Union to support the exercise.

CARIBE EWS continues to implement the Tsunami Ready recognition programme. Saint Kitts and Nevis was the first Member State to meet all the UNESCO IOC Tsunami Ready guidelines. Puerto Rico was recognized by the United States as TsunamiReady® once all 46 municipalities with tsunami threat met the guidelines, a process that began in 2006.

CARIBE EWS has benefitted and contributed to other ICG activities, including IOWAVE 16 in India, PTWS TEMPP project in Central America, the Tsunami Ready roll out in PTWS and IOTWMS and upcoming training for hotels in Portugal.

In addition to all the evacuation exercises held on the occasion on CARIBE WAVE 16, through a DIPECHO project three community drills were held in Dominican Republic.

3. UPDATES FROM TSUNAMI INFORMATION CENTRES

3.1 INTERNATIONAL TSUNAMI INFORMATION CENTRE (ITIC)

The ITIC continues to be short-staffed with its Senior Science Staff and Tsunami Information Specialist positions still vacant due to delays in the hiring process.

The International Tsunami Information Centre (ITIC) continued to host and deliver training in Hawaii (called ITP-Hawaii) and in-region (called ITP-International) for National Tsunami Warning Centres (NTWCs) and National Disaster Management Offices (NDMO) staff in 2016 to PTWS Member States (see section 2.2 ICG PTWS). The training focused on SOPs for tsunami warning and tsunami emergency response in the context of planning, conducting, and evaluating tsunami exercises as a best practice for increasing country readiness. Specific attention was given to the preparation for tsunami exercises and understanding the
new PTWC tsunami forecast products. The ITIC’s main training effort was the development of the new Tsunami Evacuation Maps, Plans, and Procedures (TEMPP) course; the pilot was concluded in Honduras in February 2017 in Spanish – the Course Development Team will now finalize the materials in English, with feedback from the PTWS Task Team on Evacuation Mapping and Planning.

A set of general awareness materials are available free-of-charge from the ITIC, published in collaboration with the IOC. Low-resolution copies are available from the ITIC web site (www.tsunamiwave.org) and high-resolution copies by DVD from the ITIC. The Tsunami Glossary 2016 was published that includes 2015 updates approved by TOWS WG; it is available in English and Spanish, with French and Arabix versions underway. To support the TEMPP Project and Honduras’ tsunami education and awareness, ITIC and the NOAA Caribbean Tsunami Warning Program (CTWP) created Tsunami Family Emergency Cards – the cards were adapted from the US National Tsunami Hazard and Mitigation Program, and distributed in Spanish prior to the TEMPP Cedeno tsunami drill.

ITIC and the ICSU/WDS-MGG/NOAA also created a historical tsunami map for Central America and the adjacent region. Similar regional maps for other Pacific sub-regions were done to support Exercise Pacific Wave 2017m and are available online. The Global Tsunami Sources map was updated from 2014 to 2016 in electronic form. Tsunami historical effects maps were created for American Samoa/Samoa/Tonga, and Hawaii in 2016. ITIC also has collected photos and survivor videos collected during 23 International Tsunami Survey Team science surveys from 1992-2013, as well as historic photos from tsunamis that impacted Hawaii; these will be posted online to a web site to allow the public to assess them.

To assist warning centres and response agencies, ITIC also distributes free-of-charge tsunami warning decision support tools, which include: CISN (earthquake display), Tide Tool (sea level monitoring display), TTT (tsunami travel time calculation software), and TsuDig (global tsunami, earthquake, and volcano offline GIS database tool). In addition, the ITIC hosts the Tsunami Bulletin Board (list serve for tsunami professionals). In 2016-2017, ITIC partnered with the NOAA Pacific Environmental Laboratory (PMEL) to create an offline Tsunami Coastal Assessment Tool to support exercise planning, and warning decision support. TsuCAT v1.0, will be distributed officially at the ICG/PTWS-XXVII, March, 2017.

ITIC also supported Exercise Pacific Wave exercises in 2017 as co-chair of the PTWS Exercise Task Team.

ITIC and NZ finished the IOC Tsunami Warning and Emergency Response SOP Manual and Guide in collaboration the IOC IOTWMS Secretariat.

To support World Tsunami Awareness Day (WTAD), the ITIC distributed its awareness materials at the UN Asian Ministerial Conference for Disaster Risk Reduction (AMCDRR, New Delhi, India, Nov 2016), and at Caribbean World Tsunami Awareness Day (at Special Committee Meeting of the Disaster Risk Reduction and Transport of the Association of Caribbean States, Port of Spain, Trinidad and Tobago, October 20, 2016), and the Japan-sponsored Tsunami High School Summit (Sendair, Japan, November 2016). The ITIC Director participated as a moderator to the Special Tsunami Technical Session on November 2, and as a speaker at the AMCDRR Closing Plenary Session Commemorating the 1st WTAD. ITIC also created a 2-minute explainer video describing what ITIC does that was shown at the High School Summit.

The ITIC shared information on the progress of the US National Tsunami Hazard Mitigation Program in marine preparedness. Overall, State and partners are developing guidelines for the creation of harbour hazard maps based on empirical and modelled current vs. damage
relationships, minimum offshore boat safety water depths, and playbooks for operational planning and response in communities and harbours.

### 3.2 INDIAN OCEAN TSUNAMI INFORMATION CENTER (IOTIC)

#### Development of UNESCAP Proposal

IOTIC, ICG/IOTWMS secretariat, and WG1 jointly developed and submitted a proposal to UNESCAP, titled: Building Knowledge and Awareness to Enhance Tsunami Preparedness in Indian Ocean Coastal Communities. The proposal was submitted in November 2015 and was included in the shortlist by UNESCAP. In April 2016, the proposal was re-submitted based on UNESCAP's request to revise the scope and the amount of budget. In September 2016 the proposal was again re-submitted based on UNESCAP’s request to update the proposal based on comments from the advisory council. Presently, UNESCAP has requested IOC/UNESCO to re-develop the proposal based on additional comments from the advisory council.

#### Conducted Post-Event Assessment of the Performance of the Indian Ocean Tsunami Warning and Mitigation System

The magnitude 7.8 earthquake that occurred to the southwest of Sumatra, Indonesia on the 2nd March 2016, met the criteria established by the IOC Working Group on Tsunami and Other Hazards Related to Sea-Level Warning and Mitigation Systems (IOC/TOWS-WG-VIII/3) and adopted by the Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System (ICG/IOTWMS) to permit a post-event assessment of the performance of the IOTWMS. IOTIC with the support of ICG/IOTWMS secretariat developed a questionnaire for the survey. 14 member states responded to the questionnaires. Only one country (Indonesia) performed some level of evacuation during the event. The report of post-event assessment of the performance is still being developed.

IOTIC also supported the InaTEWS on the evaluation of the role of the media during the event. The report of the role of the media during the 2nd March 2016 has been published and is available for perusal in Bahasa Indonesia.

#### Support to the ICG/IOTWMS SOP Training/Workshop

IOTIC supported and participated in the IOTWMS Regional Pre-IOWave16 Workshop on Standard Operating Procedures for Tsunami Warning and Emergency Response for Indian Ocean Countries, 9-13 May 2016, Bureau of Meteorology, Melbourne, Australia.

#### Building Model Disaster Resilient Cities in Indonesia: Tsunami Hazard

Funded by the Indonesian Fund in Trust, IOTIC implemented the project “Building Model Disaster Resilient Cities in Indonesia: Tsunami Hazard”. This project aimed to address the need to strengthen the capacity of the local government by incorporating disaster risk reduction (DRR) into development planning, with a focus on earthquake and tsunami hazards in Indonesia. This project ended in April 2016. Outputs of the project are:

Capacity building and development of Standard Operating Procedures for Tsunami Warning Chain for the Moluccas Province, Ambon City, Pandeglang District and Local broadcasting media. The project supported in the development of:

1. SOP BPBD Pandeglang (District level) - Local Tsunami
2. SOP BPBD Kota Ambon (City level) - Local and Distance Tsunami
3. SOP BPBD Moluccas Province (Provincial Level) - Local and Distance Tsunami

(The SOP for Ambon city and Moluccas Province is the first Tsunami Warning
Emergency SOP that link between NTWC, DMO at Provincial and City level and the first SOP at DMO level covering Local and Far field tsunami case)

4. Publication on “Tsunami in 3 Villages - Remembering 1950 Tsunami Ambon”, an education, preparedness and awareness materials for Ambon City and the surrounding area, based on eyewitness accounts.

**Support to Indian Ocean Small Island Developing States and African Coast developing countries**

Funded by the Malaysian Fund in Trust, IOTIC implemented the project ‘Fostering Tsunami Preparedness, Response, and Mitigation in the Indian Ocean Small Island Developing States and Developing Countries’. This project aimed at strengthening the capacity of Indian Ocean Member States in tsunami preparedness and their response to the tsunami early warning system, with focus on the Indian Ocean small island developing states and the African coasts developing countries. The training workshop conducted in each of the countries covered: Tsunami Risk Assessment; Tsunami Risk Reduction Policy and Action Plan; Standard Operating Procedures for Tsunami Early Warning and Emergency Response; and Guideline for Tsunami Exercise and Introduction to IOWave16. There were 5 training workshops conducted under this project:

1. **Seychelles 7 – 11th March 2016**: IOTIC supported the ICG/IOTWMS secretariat for Regional Training/Workshop on Coastal Hazard Assessment and Mitigation in Victoria, Seychelles.

2. **Mauritius, 14-18th March 2016**: National Training on Standard Operating Procedures for Tsunami Early Warning and Response in Port Louis, Mauritius.


Under this project, IOTIC is currently working with the Centre for Global Sustainability Studies of the University Sains Malaysia in Penang, to develop education, preparedness and awareness materials on:

a. Tsunami Hazards in Indian Ocean focusing on distance tsunami information;

b. Tsunami Hazard in South China Sea Region, Request from the Malaysian Steering Committee.

This project will end in April 2017.

**IOWave16**

At the IOWave16, IOTIC was requested to be the observer in Indonesia. IOTIC became the observer of the NTWC, NDMO and the media. In addition, IOTIC, in cooperation with UNESCAP, developed a documentation and communication portal on IOWave16 (iowave16.org). The objective of this portal is to collect and compile all information, inclusive of media coverage, photos, and videos from countries conducting community level activities.
during the IOWave16. About 40GB of information was compiled and documented from 9 out of 12 countries participating in the community exercise. At present the portal is closed and will soon be handed over from UNESCAP to IOTIC.

WTAD - Lessons Learnt Workshop on Community Participation at the Indian Ocean Tsunami Wave Exercise 2016, Bandung, 5-6 December 2016

In line with the World Tsunami Awareness Day and as a follow up to the IOWave16 exercise, IOTIC, the ICG/IOTWMS Secretariat, and the Institute of Technology Bandung, supported by UNESCAP, organized a regional Lessons Learnt Workshop on Community Participation in the Indian Ocean Tsunami Wave Exercise 2016. The aim of the workshop was to serve as a platform to share experiences and lessons learned about tsunami emergency response at the Indian Ocean Tsunami Wave Exercise 2016. The objectives of the workshop were:

1. To compile lessons learned from IO member states conducting community level activities at the IOWave16 Exercise.
2. To provide recommendations to working group 1 of the ICG/IOTWMS on sustaining and increasing the number of IO member states participating in community level activities in future IOWave exercises.

The Workshop was held on the 5 – 6th December 2016. 47 participants from 11 member states of the IOTWMS attended the workshop, consisting of Australia, Comoros, India, Indonesia, Iran, Kenya, Mauritius, Oman, Pakistan, Seychelles and Timor Leste. In addition, 4 local governments in Indonesia (Padang, Pandeglang, Pangandaran and Pacitan) and 2 international organizations (RIMES and GIZ) also participated in this workshop.

A report of the workshop has been produced and will be disseminated to WG1 and discussed at the next ICG/IOWMS meeting.

IOTIC participated in the Commemoration Workshop on World Tsunami Awareness Day 2016 – Indonesia, organized by the Government of Japan and the National Agency for Disaster Management. IOTIC and the ICG/IOTWMS secretariat, with the support of UNESCAP, published and handed out flyers on IOWave16.

Partnership Agreement IOC UNESCO and BMKG on the support to IOTIC

IOC-UNESCO and BMKG are now finalizing the Partnership Agreement for the support to IOTIC. BMKG will support the implementation of the programme and activities of IOTIC through its programme budget (approximately USD 80,000 annually) for a five year period. In addition to the programme budget contributed, BMKG will also provide support for the period of 2017 – 2021 in the form of:

A. Staffing
   1. One BMKG staff to work full time to support the programme implementation; preparation and development of new project proposals, studies, concept notes, development reports and reviews; and implementation of activities (at the level of Programme Assistant).
   2. One BMKG staff to work full time to support the updating, maintaining, and managing of the IOTIC Website and other IOTIC social media; developing content, articles and reports for the website and social media; and providing support in graphic design for the IOTIC website and social media (at the level of Communication and Documentation Specialist).
   3. One BMKG staff to work full time to support in administrative duties, office logistics, and secretarial work (at the level of Administrative Assistant).
B. Office Logistics for the period of 2017 - 2021 (in kind)
Covering office space, furniture (set of working tables, chairs, cupboards), Computers
(Set of Computers, monitors and Printers), IOTIC Website (Web Hosting and Domain
name), Office Supplies (paper, toner, etc.) and Utilities (electricity, water, local and
international communication, internet).

Planned Activities 2017-2018

A. Strengthening International Tsunami Ready Recognition (ITRR) Programme for
Indian Ocean Member States (IO Ready)
B. Capacity Building on Indian Ocean Tsunami Preparedness (IO Cap)
C. Annual Programme Support for the World Tsunami Awareness Day (IO-WTAD)
D. Preserve past tsunami information for future preparedness
E. Study, Research and Develop public Tsunami Education (TEAM-IO)
F. Serve as an information resource for Indian Ocean Tsunami Preparedness and
Mitigation
G. Participate in opportunities to enhance and support a fully coordinated tsunami
awareness Programme with the Indian Ocean Tsunami Warning and Mitigation
System coordinated the ICG/IOTWMS and its Steering Group, Working Group, and
Task Teams.

3.3 NEAMTWS TSUNAMI INFORMATION CENTRE

The NEAMTIC received an initial 2–year funding grant from the EU. However, in the last two
years NEAMTIC remains unfunded and un-resourced.

At the ICG/NEAMTWS-XII in Dublin, Ireland 2015 and ICG/NEAMTWS-XIII in Bucharest,
Romania 2016, the Group acknowledged the importance of the NEAM Tsunami Information
Center (NEAMTIC) and invited Member States through funding and secondments to
contribute to its ongoing work, in particular to developing and maintaining the NEAMTIC
website. However, the situation remains unchanged.

In November 2016, the technical secretary of the ICG/NEAMTWS started to update the
NEAMTIC. However, there is a need to find a sustainable solution similar to the other TICs.

3.4 CARIBBEAN TSUNAMI INFORMATION CENTRE

The CTIC has not been operational since Jan. 1, 2016, but in January 2017 the MOA was
signed between Barbados and UNESCO and efforts are underway to bring back Mrs. Alison
Brome. Also funding for CTIC director has been included in the 2018-2020 biennium. For
CARIBE EWS it is important that this post be based in Barbados.

In the absence of the CTIC, DMP activities have been supported by UNESCO Tsunami
Program, NOAA CTWP, ITIC and by Member States.

4. 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 (3)
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 are requested to share exercise questionnaires among exercise coordinators with a view on simplification and standardising evaluation of Wave exercises.

5. TASK TEAM ACTIVITIES REPORT

The Task Team reflected its activities as agreed by the TOWS-WG in February 2016 and the progress against each. The below sub-sections reflect the activities assigned to the Task Team on Disaster Management and Preparedness:

5.1 Finalizing the SOP Manual

The draft SOP Manual has been completed and handed to the IOC for publication. The latest draft includes the comments of the TOWS Task Teams.

The Task Team thanked all contributors to this significant piece of work.

5.2 Development of Tsunami Evacuation Mapping Guidelines

The PTWS successfully completed a Pilot Tsunami Evacuation Mapping and Planning Programme (TEMPP) over two years in Honduras. The training involved the following six trainings:

TEMPP 1: Tsunami Inundation Modeling: ComMIT/MOST tool Inundation modeling training using ComMIT tool and MOST model.

TEMPP 2: Inundation Mapping for Evacuation – process: Create Inundation map for a given community as an ensemble of inundation scenarios. Output results in GIS formats

TEMPP 3: Evacuation Mapping – process, Tsunami Ready: Create Evacuation Map from Inundation Map using GIS and community process; Implement national TR program

TEMPP 4: Response Plans and SOPs, Socialization, Community Exercises: Create Response Plan (warning / evacuation SOPs); Develop Exercise Plan, Create essential awareness materials (signage, map, flyer, card)

TEMPP 5: Official Adoption Ceremony, Functional Exercise: Official Adoption of Maps, Functional Exercise, including evacuation, TR Board approval and recognition, Pilot Wrap-up

The ITIC, CTWP and the UNESCO-IOC Tsunami Programme built experience with regards to implementation of the TEMPP and are ready to provide guidance to countries that want to implement similar programmes.
The Programme identified and references existing best practice evacuation mapping guidelines that countries have developed.

The PTWS will finalise programme documentation and make it available to ICGs, noting the interest of IOTWMS.

5.3 Promote tsunami preparedness recognition programmes

The Task Team considered the history of, and development of the Tsunami Ready Programme developed by the United States (as TsunamiReady®) and its adaption by the CARIBE EWS as Tsunami Ready.

Tsunami Ready is a community based recognition programme consisting of the following elements:

Mitigation:
1. Define Tsunami Hazard Zone
2. Public Display of Tsunami Information

Readiness:
1. Tsunami Evacuation Map
2. Public Education & Outreach Materials
3. Education Outreach Activities
4. Annual community based exercise

Response:
1. Tsunami response plan
2. EOC Operations
3. Multiple Methods to Receive Tsunami Products
4. Multiple methods to disseminate alerts to Public

Guidelines on the above ten elements have been developed by the CARIBE EWS and adapted for the Pacific in English, Spanish, French.

The CARIBE EWS continues with implementation, while the Task Team noted the intent of the IOTWS to implement Tsunami Ready through a project that has been proposed for funding, and that the PTWS agreed to investigate initiating a pilot in the South West Pacific.

In view of the strong support across ICGs for the Tsunami Ready Programme, the Task team agreed to recommend the following to the TOWS-WG:

- That the IOC provides oversight of the programme and maintain records, and to emphasise its UNESCO-IOC status, the programme be called the “UNESCO-IOC Tsunami Ready (UNESCO-IOC TR) Community based tsunami recognition programme”.

- That depending on the more applicable option, the assessment process be conducted either at regional or national level by a regional or national assessment board, with representation from the relevant ICG in either case.

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1 A national/territorial/local government entity that has the authority and ability to adopt the recognition guidelines within its jurisdiction (CARIBE EWS Guideline).
- That recognition is valid for four years, where-after the community has to apply for re-assessment.

- Successful implementation and sustainability of the programme is subject to identification of appropriate funding.

5.4 KPIs

Following a discussion by the Task Team at its 2016 meeting about the development of consistent KPIs for ICGs, the Task Team was requested by TOWS-WG IX to consider development of Key Performance Indicators in line with the Sendai Framework and to facilitate reporting by ICGs to the IOC Governing Bodies in line with XXVIII Dec 8.2.

A joint discussion with the Task Team on Tsunami Watch Operations (TTTWO) was held in this regard on 22 February 2017 and a recommendation in this regard was put to the TOWS-WG by the TTTWO.

5.5 Business Continuity Planning (BCP)

The Task Team acknowledged that BCP is part of the normal arrangements of critical infrastructure and is also very specific to the particular service and its vulnerability. Guidance on BCP is well established and developed, both in a generic sense and more specifically for the respective industries. Therefore the Task Team agreed that rather than focussing on specific BCP guidelines, critical infrastructure and industry must be included in wider Disaster Risk Management and Resilience planning resilience planning in countries, with a specific focus on economic recovery. To support this approach, the Task Team recommends that critical infrastructure must also be included in tsunami exercises.

5.6 Maritime and Ports Guidance

The TT noted the Maritime Planning & Preparedness Guidelines for harbours and ports developed by the US National Tsunami Hazard Mitigation Programme (in draft). Methodology applied is a useful reference for other countries. The draft is available from ITIC. The TT also noted modelling conducted in the Ports of Honolulu and Charlotte Amalie (Saint Thomas- US Virgin Islands), and agreed that this topic is also relevant to the TTTWO. For Honolulu, port evacuation procedures use numerical modelling results providing maximum elevation, drawdown, currents, and vorticity from credible tsunami scenarios around the Pacific.

6 OTHER MATTERS CONSIDERED BY THE TASK TEAM

6.1 Tsunami Source Data

The Task Team noted that countries do not always have access to, or are aware of the existence of tsunami seismic source data that can support reduction and evacuation response planning. The TOWS-WG will therefore be requested to encourage regions to share tsunami source scenario data, building towards a database of source scenarios.

6.2 Adaptation of UNESCO/IOC awareness materials

The Task Team considered that while on-going customisation of UNESCO/IOC material is highly valued by countries, there is a need to ensure quality and consistency with the original documents. Noting the TICs terms of reference include awareness education as well as current capacity issues with CARIBE EWS TIC and NEAMSTIC, the ITIC and IOTIC to take the lead in ensuring consistency.
6.3 World Tsunami Awareness Day

A joint discussion was held with the TTTWO on enhancing the focus on World Tsunami Awareness Day (WTAD). The discussion was put on hold pending a similar discussion at the TOWS-WG meeting, facilitated by the representative of the UNISDR.

The UNISDR representative subsequently suggested aligning WTAD activities with International Day for Disaster Reduction (13 October). The meeting was informed that the focus in 2017 will be on Target (b) of the Sendai Framework. UNISDR has a suite of tools and material available for use by countries. #tsunamiday2017

7. RECOMMENDATIONS TO THE TOWS WG-X

The Task Team recommends that the TOWS WG-X:

7.1 Notes the Task Team has met on 21 & 22 February 2017 and considered:
   a) reports from the respective ICG working groups and TICs
   b) progress with regards to activities agreed in March 2016
   c) activities for the next year

7.2 Notes with regards to Wave exercises, the Task Team:
   a) encourages ICGs to note the value taken from extending these exercises to community level
   b) Identified a need for greater consistency in exercise evaluation, and therefore request exercise coordinators in the respective ICGs to share exercise questionnaires with a view on simplification and standardising evaluation of Wave exercises.

7.3 Notes that the draft SOP Manual has been completed and was handed to the IOC for publication. The latest draft includes the comments of the TOWS Task Teams.

7.4 Notes with regards to Tsunami Evacuation Mapping:
   i) The PTWS successfully completed a Pilot Tsunami Evacuation Mapping and Planning Project (TEMPP) over two years in Honduras with regional participation.
   j) The ITIC, CTWP and UNESCO-IOC Tsunami Programme built experience with regards to implementation of the TEMPP and are ready to provide guidance to countries that want to implement similar projects.
   k) The Project identified and references existing best practice evacuation mapping guidelines that countries have developed.
   l) The PTWS will finalise project documentation and make it available to ICGs, noting the interest of CARIBE-EWS and IOTWMS.

7.5 Notes that the Task Team considered the history of, and development of the Tsunami Ready Programme developed by the United States (as TsunamiReady®) and its adaption by the CARIBE-EWS as Tsunami Ready, and that in view of the strong support across ICGs for the Tsunami Ready Programme, the Task Team agreed to recommend the following to the TOWS-WG:
   a) ICGs are to consider piloting the CARIBE-EWS Tsunami Ready guidelines and report back to the next TOWS-WG with a view to develop global guidelines.
   b) Verification be conducted either at regional or national level, with representation from the relevant ICG.
   c) That recognition is valid for four years, after which the community needs to seek renewal.
d) Successful implementation and sustainability of the programme is subject to identification of appropriate funding.

e) That the IOC provides the administrative oversight of the programme and maintain records.

7.6 Notes that with regards to business continuity planning, the Task Team recommends that critical infrastructure must also be included in tsunami exercises.

7.7 Notes that with regards to maritime and ports guidance, the Task Team has noted the Maritime Planning & Preparedness Guidelines for harbours and ports developed by the US National Tsunami Hazard Mitigation Programme (in draft, available from ITIC) is a useful reference for other countries. The Task Team also noted the modelling conducted in the Ports of Honolulu and Charlotte Amalie (Saint Thomas - US Virgin Islands), and agreed that this topic is also relevant to the TTTWO.

7.8 Notes that countries do not always have access to, or are aware of the existence of tsunami seismic source data that can support risk reduction and evacuation response planning. The TOWS-WG is therefore requested to encourage regions to share tsunami source scenario data, building towards a database of source scenarios.

7.9 Notes the Task Team considered that while on-going customisation of UNESCO/IOC awareness and education material is highly valued by countries, there is a need to ensure quality and consistency with the original documents. Noting the TICs terms of reference include awareness education as well as current capacity issues with CARIBE-EWS TIC and NEAMTIC, the ITIC and IOTIC will take the lead in ensuring consistency.

7.10 Notes that the focus of World Tsunami Awareness Day (WTAD) follows the seven targets of the Sendai Framework, therefore the focus in 2017 will be on Target (b) on reducing the numbers of affected people. The Task Team invites the TOWS-WG to encourage ICGs to advocate WTAD among member states and advise them of the availability of material from the UNISDR in this regard, and sharing their activities and materials with UNISDR and TICs.

7.11 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.
ANNEX IV

REPORT OF THE INTER-ICG TASK TEAM
ON TSUNAMI WATCH OPERATIONS

21-22 February 2017
Paris, France

1. OPENING AND MEETING ORGANISATION

Dr Charles (Chip) McCreery, the Chair of the Task Team on Tsunami Watch Operations (TTTWO) welcomed the participants to the meeting (list of participants in Appendix 2). He introduced the provisional meeting agenda and informed that there is a request from Data Buoy Cooperation Panel (DBCP) to make a presentation over Skype on “Data Buoy Vandalism—Education & Outreach Strategy”. This was included under Agenda Item 12 and there being no further comments from participants, the modified agenda was adopted as attached in Appendix 1.

2. REVIEW OF ACTION ITEMS FROM THE PREVIOUS MEETING

Dr McCreery reviewed the outstanding recommendations and actions from the TTTWO meeting held in Paris, France, February 23-24 2016 (ref: Summary Report, TOWS-WG, Ninth Meeting, Annex IV, Section 9.2, page 46). He noted that the following recommendations to the TOWS-WG and actions were either completed or were in progress: adoption of revised maps, inclusion of Kep Performance Indicators (KPIs) for Tsunami Service Providers (TSP), National Tsunami Warning Centres (NTWC) & Tsunami Warning Focal Points (TWFP) operations in the Global Service Definition Document (GSSD), clarifying language at the beginning of TSP products, tsunameter equipment performance standards, adoption of GSSD, extension of the Task Team tenure, providing the examples of TSP products & list of TSPs to Mr Peter Doherty, prior intimation to NAVAREA coordinators regarding wave exercises and providing comments on the Standard Operating Procedures (SOP) manual. He noted that the action on preparation of templates for tsunami bulletins for mariners is included for discussion in the current meeting and inputs from IMO/IHO/WMO sub-committee on the World Wide Navigational Warning Service (WWNWS-SC) have just been obtained to facilitate this discussion.

A detailed discussion ensued regarding the recommendation on modified Greens law for tsunami warning. It was felt that there is a need to take stock of latest developments in Seismology, Tsunami Forecast Modelling, Global Navigation Satellite System (GNSS) applications, etc. with focus on enhancing operational tsunami forecasting by the TSPs and NTWCs to improve decision making and community response.

Mr Rick Bailey suggested organising a symposium with focus on enhancing operational tsunami forecasting involving about 50–60 participants from warning centres, seismic & sea level monitoring networks, tsunami modellers as well as users such as maritime authorities and emergency management authorities to advise on the requirements. Dr Thorkild Aarup, Head of IOC-UNESCO Tsunami Unit suggested that it would be useful to generate a concept note for such a symposium to be held back-to-back with the meetings of the Task Teams and TOWS-WG in February 2018 at IOC. Mr Rick Bailey and François Schindelé agreed to develop the concept note along with Dr Aarup and representatives from the Task Team on Disaster Management and Preparedness (TTDMP) and International Union of Geodesy and Geophysics (IUGG).
**Recommendation 1 to the TOWS-WG** on the conduct of a symposium:

Recommends conduct of a symposium in early 2018 in Paris on enhancing existing TSP and NTWC operational tsunami forecasting to further develop warning products and enhancing timely, accurate, reliable and effective decision-making and community response, involving experts from monitoring networks, seismology, tsunami forecast modelling and warning centres, maritime authorities, and national and local emergency management authorities with advice on product requirements.

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

Dr McCreery listed the 5 requests made by TOWS-WG to TTTWO during the last meeting held in Paris France, February 23-24 2016 (Summary Report, TOWS-WG, Ninth Meeting, Annex II, page 14). These relate to working with WWNWS-WC on maritime products, considering the response to tsunamis from non-seismic sources, the optimal design of sea-level monitoring networks, continuing to update GSSD and reviewing the potential use of GNSS data for tsunami watch operations. He reminded that all these requests are currently being considered by the Task Team as agenda items in the current meeting as well as in the planned symposium in 2018. Dr Schindelé suggested revisiting the ToRs of the TTTWO to ensure they fully reflect the range of activities being addressed by the Task Team, especially those related to enhancement of tsunami watch operations. After detailed discussion, the TTTWO came up with a recommendation to extend the tenure of the task team with revised ToRs as follows:

**Recommendation 2 to the TOWS-WG** on the tenure of the task team and revised ToRs

- Recommends extension of the tenure of the TTTWO for a further period with modification to the ToRs of the TTTWO to reflect work related to enhancements to the accuracy and effectiveness of tsunami forecast information for users. The revised ToRs are:
  
  o Provide a mechanism to the ICGs for coordination of tsunami watch operations among the Tsunami Warning Systems;
  o Maintain an inventory of current and proposed products and their dissemination methods;
  o Recommend and promote harmonized terminology;
  o Maintain an inventory of areas of responsibilities, geographical coverage, system architectures, and other relevant characteristics;
  o Recommend operational standards, procedures and guidelines for regional and national providers of tsunami forecast information;
  o Share and harmonise methods of detection and characterization, forecasting techniques and dissemination to enhance the accuracy and effectiveness of tsunami forecast information for users
  o Monitor status of the regional provision of tsunami forecast information; Report to TOWS-WG.

The representatives to the Inter-ICG Task Team on Tsunami Watch Operations shall be nominated by their respective ICG Chairpersons. The membership shall consist of two representatives from each ICG, and include representatives from the regional providers of tsunami threat information. The IOC Chair will appoint the Chair of the Task Team.
4. **TSUNAMI WATCH OPERATIONS - CURRENT STATUS AND PLANS**

4.1 **CARIBE-EWS**

Dr Jean-Marie Saurel gave a presentation on the status of the CARIBE-EWS. He noted that 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 except one having designated TWFP and TNC. He described the tectonic setting of the region and noted that the community-centred service model was adopted at the ICG-XI together with a document describing the key requirements for TSPs including KPIs. Pacific Tsunami Warning Centre (PTWC) is now referred as the CARIBE-EWS TSP and is no longer the interim TSP. Enhanced PTWC products for the CARIBE-EWS have been operational since 2016 and further integration of the US-NTWC and PTWC is in progress with Puerto Rico, the US Virgin Islands, and the British Virgin Islands soon coming under the PTWC Area of Responsibility (AoR). Dr Saurel described the service model which involves TSPs providing products to regional TSPs as well as to NTWCs/TWFPs of the member states. The NTWCs/TWFPs inform the communities, which are also trained to react to natural warning signs. The reaction time for earthquake to issuance of first bulletin is <5 minutes.

Dr Saurel described the monitoring networks which 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. 4 DART buoys including 1 in the Gulf of Mexico and 1 in the eastern Caribbean Sea are currently operational. Real-time GNSS networks are also being developed in the region. Regular communications tests and wave exercises are conducted, with the latest wave exercise in 2016 involving all Member States and 300,000 participants.

4.2 **NEAMTWS**

Dr Schindelé 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. Currently, at least two centres monitor each sub-basin except the Black Sea. Tsunami bulletins are sent to the Member States on a subscription basis. Dr Schindelé mentioned that some Member States have not yet subscribed to receiving bulletins from any of the TSPs. He described seismic and sea level networks in the region and mentioned that a private telecommunication network is being used by CENALT for seismic and sea level data exchange with other centres to ensure high data availability. The sea-level network in the Ligurian Sea allows for first detection of tsunami wave within 35 minutes, while the detection times are much higher for regions in the South Mediterranean coastal region due to non-availability of data. Maps of station density and event detection times for the region are prepared on a daily basis.

Since July 2012, CENALT disseminated 23 alerts (earthquake magnitude threshold of 5.5) out of which two events triggered minor tsunamis. In 2016, INGO (Italy) sent bulletins for 4 events, CENALT for 9 events, Greece (NOA) for 4 events and Turkey (KOERI) did not issue any bulletins.

4.3 **PTWS**

Dr Charles McCreery, Director of the Pacific Tsunami Warning Centre and Chair of the TTTWO, provided a status report on behalf of the PTWC. He reminded that XXVII session of the ICG/PTWS is scheduled during 28-31, March 2017 in Papeete, Tahiti and the meeting of
the sub regional working group for the South China Sea during March 01-03, 2017 in Shanghai. He noted that the sub regional working groups for the South East Pacific and the South West Pacific regions are engaged in enhancing the sea-level networks in their respective regions. The Central America Tsunami America Tsunami Advisory Centre (CATAC) is also being established. The PTWC website is being combined with the US national tsunami warning website after which all the international products for the PTWS and CARIBE-EWS will end up on an integrated website. The PTWS steering group also formalised the process for making changes to TSP products. Dr McCreery also pointed out that the PTWS Working Group on Tsunami Detection Warning & Dissemination requested the TOWS-WG consider Common Alerting Protocol (CAP) as a format for dissemination of tsunami warnings. He also mentioned that the PTWS Steering Group requested international tsunami related projects such as Global Earthquake Model (GEM), Global Tsunami Model (GTM), GNSS Service Project be linked to the IOC Tsunami Programme. Dr Aarup clarified that IOC tsunami unit keeps track of the developments in these projects and hence the linkages already exist.

Mr Tomoaki Ozaki, Vice Chair of the ICG/PTWS followed up with a presentation on NWPTAC enhanced products, which were tested during the Pacific Wave 17 exercise. Mr Ozaki described the forecast model and numerical simulation technique, which includes a deep ocean propagation model with Green's law used to estimate coastal maximum tsunami amplitude at 1m water depth. The Coastal Forecast Points and coastal blocks have been updated based on coordination with the recipient countries. He presented examples of the text and graphical products (travel time map, coastal tsunami amplitude forecast map, deep ocean tsunami amplitude forecast map) as well as timelines for issuance of the products. Mr Ozaki also presented the schedule for changeover to the NWPTAC enhanced products by 2018 and informed that there is a plan for revision of the Area of Service upon request from a few Member States. He also provided information about the S-net and DONET cable-type ocean bottom pressure gauges owned and operated by National Research Institute for Science & Disaster Reduction (NIED), Japan for use in its national tsunami warning operations.

4.4 IOTWMS

Mr Rick Bailey, former Chair of the ICG/IOTWMS provided an update on the status of IOTWMS. He presented the map of sea-level stations and informed that the IOTWMS Secretariat updates the database of seismic & sea-level stations regularly. The IOTWMS has a Service Definition Document and the NTWC User Guide. IOTWMS has 3 TSPs (Australia, India and Indonesia) with all the three covering the entire Indian Ocean. The TSPs don’t issue warnings directly for other countries but issue inter-operable potential threat information to the NTWCs on password-protected websites. The NTWCs then issue national warnings to their coastal areas and report back their status to the TSPs for display on the public webpages.

Mr Bailey described the models used by the TSPs, products and threat thresholds. Standard Operating Procedure (SOP) workshops are held annually to educate NTWCs and DMOs on TSP products and also assist them in developing integrated SOPs. Mr Bailey displayed the KPIs of the IOTWMS TSPs for events in 2015 and 2016, with the elapsed time for detection of earthquakes by the TSPs improving gradually over the years. Communications tests are done every 6 months and a running log of issues is maintained to resolve any communication issues with the NTWCs. Access to the TSP websites by the NTWCs and the reporting back of threat status by the NTWCs has been improving. IOWave16 was conducted in September 2016 with 2 scenarios covering the Sunda and Makran subduction zones. All 24 active IOTWMS Member States participated in the exercise with 12 of them involving 59,000 people, mostly in India, involved in community evacuations. SurveyGizmo is being used by the Secretariat for online evaluation. A Post IOWave-16 evaluation workshop
was organised in December 2016 in Indonesia to discuss lessons learned and ways to enhance community participation in future exercises.

Mr Mike Angove enquired whether IOTWMS bulletins are publicly available. Dr McCreery mentioned that the PTWC does not have access to the password protected websites of the IOTWMS TSPs and they would like know the guidance issued by the IOTWMS TSPs for events in the Indian Ocean to be able to advice domestic users contacting PTWC for events in the Indian Ocean. Mr Bailey clarified that TSP India and TSP Indonesia have public pages which display national threat status of countries as reported back by their NTWCs and suggested that IOTWMS should publicise the availability of this information.

**Recommendation 3 to the TOWS-WG on use of Common Alerting Protocol (CAP)**

Recommend that TSPs and NTWCs also use Common Alerting Protocol to facilitate warning messages to be consistently disseminated simultaneously over many warning communication systems to many applications.

5. **SIGNIFICANT OPERATIONAL EVENTS IN THE INTER-SESSIONAL PERIOD**

Dr 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 TSPs. The list of events is attached as Appendix 3.

Mr Bailey made a brief presentation on the M 7.8 earthquake off the South west of Sumatra on March 02, 2016. He mentioned that this is a non-subduction, strike slip event which did not match any pre-run scenarios in the TSP databases run assuming worst-case parameters. The variability in TSP forecasts for this event and the performance of TSPs against the KPIs was explained. Dr Rahayu added that the community response for the event varied from coast to coast which highlights the importance of streamlining the SOPs of Disaster Management Organisations (DMOs). Dr Tummala mentioned that a post-event assessment was conducted by the Secretariat and Indian Ocean Tsunami Information Centre (IOTIC), for which 13 Member States responded. Public evacuation was done in some communities in Australia and Indonesia. The actual tsunami observations ranged from 5 – 10 cms on tide gauges and 1 cm on the DART buoys. Dr Schindelé mentioned that, in La Reunion MeteoFrance received the TSP messages and since 40 cms wave amplitude was predicted for Rodrigues which is very near to La Reunion, authorities in La Reunion were concerned whether coastal evacuation is required. Upon consultation with Dr Schindelé and noting that the earthquake was a strike-slip fault, no evacuation was done. He mentioned that it is important to work on enhancing the accuracies of tsunami forecasts, threat threshold and SOPs at the national level.

Dr McCreery summarised that for such events which occur in the non-subduction zone and the TSP scenario databases are built on worst-case scenario, it is very difficult to quantify the errors in estimates and observation. The other issue is that several events may not cause land inundation threat, but could generate currents which result in significant damages in ports and harbours. It is difficult for the TSPs to predict such currents accurately and provide guidance to ports and harbours. Dr Tummala reminded that the IOTWMS requested the TOWS-WG to provide guidance on handling non-subduction zone earthquake events. It was concluded that uncertainties surrounding such events could be discussed in the symposium planned in 2018.

Dr McCreery explained the action taken for the remaining Pacific events. He pointed out that the PTWC initial Mwp estimates of earthquake magnitude (estimated in less than 10 minutes)
vary more than the W-phase CMT solutions (estimated in 25 minutes) that averaged less than 0.1 magnitude units difference when compared with the final USGS estimates.

For the M 6.9 Earthquake off Vanuatu on April 03, 2016, PTWC issued the first bulletin in 9 minutes and the final bulletin in 48 minutes. This event did not trigger any tsunami. For the M 7.8 earthquake off Ecuador on April 16, 2016 PTWC issued the first threat bulletin in 5 minutes, second bulletin with a threat forecast between 0.3 to 1 m for Ecuador in 31 minutes and the final bulletin in 2 hr 57 minutes after wave observations of 14 cm at La Libertad.

Dr McCreery went on to describe the M 7.8 earthquake off New Zealand on November 13, 2016 which was a very unusual event. The initial magnitude was underestimated as M 7.4 with the epicentre estimated to be on land based on which a no threat bulletin was disseminated in 9 minutes by PTWC. Dr McCreery explained that the reason for underestimation of initial magnitude was because the maximum moment release for this event occurred 70 seconds after the event, while the estimates of initial magnitude are based on seismic waveforms measured in the first few tens of seconds. He also mentioned that the propagation of the rupture extended far north of the epicentre and extended offshore making it a very complex event. PTWC followed up with an information statement after 40 minutes upon monitoring the tide gauge Kaikoura Wharf which showed a drop in sea-level due to partly to co-seismic uplift and partly due to local tsunami wave action.

Dr David Coetzee followed up with a detailed presentation. He mentioned that the GNS (New Zealand Institute of Geological and Nuclear Sciences Limited, abbrev. GNS) initial estimate for this event was M 6.4 and further based on the information from PTWC, a no-threat was put out by GNS. After tsunami wave measurements at Kaikoura almost one hour after the event, a tsunami warning was issued. A tsunami amplitude of 2 m was observed at Kaikoura, 0.2 m at Christchurch, 0.5 m at Wellington and 0.1 m at Napier. A co-seismic uplift of 2 m was observed. The main event was followed by more than 8,000 aftershocks. Dr Coetzee highlighted damage to buildings in Wellington that were built on reclaimed land. On tsunami warning response, most coastal areas triggered local warning mechanisms and subsequently evacuated but the actions were inconsistent. Some communities undertook self-evacuations. Information dissemination was an issue since local radio stations were closed at night. The public was generally content with evacuation. There was criticism in the media about the time delay in issuing a warning and also with issuing no tsunami threat initially. This event also highlighted the unique setting of New Zealand wherein there is a possibility of land-based earthquakes generating tsunamis. New tsunami evacuation maps are being developed for local sources based on earthquake magnitudes to facilitate consistent response. Dr Coetzee mentioned that funding was received to set up 24x7 monitoring & assessment at GeoNet, for a cell broadcast alerting system and for enhancing public awareness.

Dr Schindelé mentioned that this event proved the importance of having tide gauges in the near field regions, since the first evidence of co-seismic displacement came from the observations at the Kaikoura gauge. It is useful to have tide gauges every 40-50 kms along the coasts of active global subduction zones to monitor the deformation. Real-time GNSS data is also very useful for a direct measurement of the deformation.

Mr Ozaki presented the action taken by Japan Meteorological Agency (JMA) during the M 6.9 earthquake off Fukushima on November 21, 2016. Initial Mjma estimated by JMA was 7.3, which was downgraded to 6.9 after 15 minutes based on CMT estimates. JMA issued a tsunami warning for Fukushima and advisory for a few other prefectures. After 2 hours, a warning was issued for Miyagi. All warnings were cancelled 6 hours after the earthquake. The Sendai Ko tide gauge recorded a maximum tsunami amplitude of about 1.4 m. This event generated a local tsunami with no serious damage. Mr Ozaki mentioned that local authorities issued evacuation orders based on information from JMA and that the public evacuated from threatened coastal areas without any confusion. Dr McCreery mentioned that
PTWC issued its first threat bulletin in 8 minutes based on the initial magnitude of JMA followed by a threat forecast of 0.3-1 m for Japan and a final bulletin 2 hours after the earthquake with wave observations of 1.4 m at Sendai. He mentioned that this was also an unusual event due to the fact that the observed tsunami amplitude was considerably higher compared to that expected from an Mw 6.9 earthquake.

For the Mw 8 earthquake off the Solomon Islands on December 08, 2016, PTWC issued the first threat bulletin in 8 minutes, followed by threat forecast of 1-3 m for Papua New Guinea (PNG) & Vanuatu and issued the final bulletin 2 hours after the earthquake with a wave observation of 12 cm at Honiara. Dr Shindele mentioned that the authorities in New Caledonia initially decided to evacuate, but the final message issued by PTWC created some confusion.

Dr Laura Kong mentioned that the Mw 7.2 earthquake off Fiji on January 03, 2017 caused quite a bit of confusion in Fiji between the warning centre and the DMO, highlighting the need for capacity development.

After detailed discussion of the events, it was decided that all significant earthquake/tsunami events handled by the ICGs during the inter-sessional period are 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 is to be compiled in the report of the TTTWO.

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

Mr Bailey introduced this item. He reminded the three major pillars of the end-to-end tsunami warning and mitigation systems: 1) Risk assessment, 2) Detection, warning and dissemination, and 3) disaster management, preparedness and risk reduction. Performance measures should be instated such that KPIs are developed for each goal and outcome to track progress. The goals and outcomes should be linked to international frameworks (e.g. Sendai Framework for Disaster Risk Reduction 2015-2030); regional programmes (e.g. Pacific Risk Resilience Program); IOC programmes (e.g. capacity development); and projects (e.g. tsunami evacuation maps, plans and procedures). He listed the 7 global targets of the Sendai framework including multi-hazard early warning systems and the 4 priorities. The ultimate goal for tsunami warning and mitigation systems should be that, all countries are recognised as Tsunami Ready. The goals for 3 pillars could be: 1) all countries assess and are aware of the tsunami risk to their coastlines; 2) at risk coastal communities of all countries receive timely and effective warnings for all types of tsunamis; 3) at risk coastal communities of all countries are aware of the tsunami threat and ready to respond effectively and reduce the risk of tsunami impacts, as well as enhanced international cooperation and coordination. Mr Coetzee followed up with a presentation on the priorities for action developed under the 4 priority areas of the Sendai framework and mapping them to goals of tsunami warning and mitigation systems. He mentioned that many of these elements align with the requirements of “Tsunami Ready”.

Dr Aarup brought to the notice of the meeting, the report of the open-ended intergovernmental expert working group on indicators and terminology relating to disaster risk reduction finalised by the United National General Assembly He mentioned that it will be valuable to get inputs from the ICGs for upward reporting by UNESCO on Sendai indicators.

After detailed discussions it was felt that the Sendai targets e, f & g (e) substantially increase the number of countries with national and local disaster risk reduction strategies by 2020, (f) substantially enhance international cooperation to developing countries through adequate and sustainable support to complement their national actions for implementation of the present Framework by 2030 & (g) substantially increase the availability of and access to
multi-hazard early warning systems and disaster risk information and assessment to people by 2030 closely align with the goals of tsunami warning & mitigation systems. It was also noted that there is already discussion in the IOTWMS and PTWS regarding KPIs for measuring the performance of the regional tsunami warning systems and it will add value to align them as closely as possible with the Sendai Framework. It was decided that the PTWS continue to work on these aspects and share them with the other ICGs for consideration of the Member States.

**Recommendation 4 to the TOWS-WG on Key Performance Indicators**

Following up on the IOC XXVII Assembly Decision 8.2, recommend that the PTWS continue their 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.

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

Dr McCreery initiated this discussion reminding that November 05 was designated as the World Tsunami Awareness Day WTAD by UN General Assembly. The event is being coordinated by UNISDR and the purpose of this discussion is to decide how the ICGs and IOC-UNESCO can engage with the upcoming WTAD. Dr Aarup reminded the Task Team regarding activities undertaken for the WTAD 2016 and mentioned that Mr Jonathan Fowler from UNISDR will make a presentation in the TOWS-WG meeting.

There was a discussion on whether the ICGs could rotate tsunami drills amongst the ICGs or if communication tests could be conducted to coincide with the WTAD, but it was not found to belogically feasible. It was decided that it is not practical to do something uniform in the ICGs to coincide with the WTAD, but each ICG should inform Member States to take up activities on the occasion of the WTAD to raise awareness among the public. It was also decided to wait for the presentation from Mr Fowler in the TOWS-WG meeting to decide the way forward.

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

Dr McCreery initiated the discussion and it was decided that there are no changes proposed to the maps in this meeting. Mr Ozaki reminded that there is a proposal for NWPTAC to expand its Area of Service (AoS) but those changes will be advised on in the next meeting.

9. **HANDLING OF TSUNAMIS FROM NON-SEISMIC SOURCES**

Mr 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. These meteo-tsunamis cannot be characterised by models used for storm surges or swells. Submarine mass failures and volcanic eruptions are other possible sources that need to be considered from an operational tsunami warning perspective. Mr Angove concluded that the US tsunami warning system has minimal resources dedicated to operationally address non-seismic source tsunamis and does not take responsibility for alerting the public to non-seismic source tsunamis. However, upon detection of meteo-tsunamis, they propose to
support weather forecast office with arrival times and wave amplitudes, and work with the storm surge community on modelling. NOAA is also exploring the use of existing HF Radar data to detect meteo-tsunamis.

Dr Aarup drew the attention of the Task Team to a publication by Ivica Vilibic on “Global mapping of non-seismic sea-level oscillations at tsunami time scales” which gives an account of meteo-tsunamis and propose that this could be a topic of discussion in the planned symposium in 2018.

This was followed by a discussion on pragmatic approaches for tsunami warning centres to incorporate procedures to handle tsunamis from non-seismic sources in their existing operational procedures. It was decided that the TTTWO continue to consider methods to handle tsunamis from earthquakes in non-subduction zones and non-seismic sources (eg., meteo-tsunamis) taking into account the ongoing efforts in the US and other recent studies.

10. PRODUCTS FOR THE MARITIME COMMUNITY

Dr McCreery briefed the background of this agenda. As a follow up on the actions from the last meeting of the TTTWO and the TOWS-WG, examples of TSP products were sent by the Secretariat to Mr Peter Doherty with a view to obtaining feedback from the WWNWS-SC on their requirements for tsunami bulletins to the mariners. Dr McCreery briefed on the responses received from Mr Doherty. Regarding the format of the bulletins, the requirement is for messages to be very clear, concise and provided with a geographic reference. Mr Doherty also provided specific suggestions on the sample messages of PTWC and CENALT, followed by examples of preferred messages for the mariners. The preferred communication channel for reaching TSP tsunami bulletins to the NAVAREA coordinators and to the maritime community is over the SafetyNET. If the NAVAREA coordinators do not have SafetyNET, the next preferred mode of dissemination is by email. He further mentioned that it should be the responsibility of the NTWCs within each country to send tsunami bulletins to the ports within that country so that ships heading to those ports could be informed of any tsunami threat.

Dr Aarup referred to the Joint IMO/IHO/WMO Manual on Maritime Safety Information (Manual 53) published in 2016 which also contains example of navigational warnings for tsunamis and other natural phenomena, such as abnormal changes to sea level. These messages were reviewed and it was decided that the Task Team come up with a template that closely conforms to these examples, which can then be used by the TSPs in each ICG to prepare bulletins for mariners. It was also decided that the NTWCs in each ICG be requested to disseminate tsunami bulletins to ports, harbours and other maritime authorities within their countries.

Recommendation 5 to the TOWS-WG

TTTWO continue to consult with WWNWS-SC for developing specific tsunami threat messages for vessels at sea.

ICGs to recommend NTWCs disseminate tsunami bulletins to ports, harbours, and other maritime authorities within their countries.

11. GLOBAL PUBLIC ACCESS TO TSUNAMI THREAT INFORMATION

Dr McCreery led the discussion with a view to explore the possibility of having 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.

The discussion focussed on the current status of public tsunami messages in each ICG and the roles of TSPs, NTWCs and DMOs in issuing warnings to the public. In many countries, it is the DMOs/Civil Protection Agencies (CPAs) which issue warnings to their public based on the information received from the NTWCs/TWFPs. There is no mechanism for the TSPs in an ocean basin to know the national threat status of each country under its Area of Service in real-time. Dr Tummala demonstrated the web-based system setup in the IOTWMS wherein there is a mechanism for the NTWCs to report back to the TSPs on the status of their national threat. This summary of feedback reported by the NTWCs is linked to the public bulletins issued by the IOTWMS TSPs. Mr Angove mentioned about the initiative in the US to integrate international and domestic alerts issued by PTWC and the WCATWC under one common website http://tsunami.gov. Dr Schindelé highlighted challenges regarding the NEAMTWS TSPs/NTWCs not being able to provide public warnings since this is a responsibility of the CPAs. Dr Carrilho drew the attention of the Task Team to a web-based service, Meteoalarm which warns people travelling in Europe of severe weather by sourcing information from the weather prediction agencies.

After detailed discussions on the complexities involved, Dr Aarup suggested to start with having a unified acknowledgement of the IOC-UNESCO tsunami programme and its role in establishing regional tsunami warning systems on each of the ICG TSP websites. It was decided to draft a common wording to reflect the contribution of IOC-UNESCO, translate it into 4 IOC languages and request the TSPs to use the agreed information page on their websites. Further, the TTTWO will continue to work on an 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.

**Recommendation 6 to the TOWS-WG** on global public access to tsunami threat information

Recommend 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.

**12. OTHER HARMONIZATION ISSUES**

**12.1 Data buoy vandalism – education and outreach strategy**

Mr Shannon McArthur, Vice Chair of the Data Buoy Cooperation Panel (DBCP) made a presentation to the TTTWO by skype. He informed that buoys are vandalized primarily due to fishing activity since the buoys aggregate fishes. Vandalism increases cost of operations and loss of data impacts several societal-benefit areas such as Marine transportation, climate, coastal & marine hazards & disasters, etc. There is now an increasing understanding of buoy vandalism by collecting information and developing tools to determine geographic hot spots, identify and confirm vandalism, inform engineering approaches and inform enforcement actions. The DBCP is making efforts to address vandalism by developing a holistic strategy focussed on a 3-pronged approach – Engineering, Education (awareness & outreach) and Enforcement (working through Regional Fishery Management Organisations). In June 2016, IOC and WMO adopted coordination resolutions on buoy vandalism. The DBCP was charged with developing a regionally relevant outreach and education strategy to reduce damage to data buoys in coordination with the TOWS WG and to be jointly implemented by IOC, WMO, Food and Agriculture Organisation (FAO), Regional Fishery Management Organisations (RFMOs), Member States, commercial fisheries sector and other relevant organisations.
DBCP agreed to 4 education and outreach goals: (i) develop regionally & nationally relevant education materials, (ii) enhance national, regional and international coordination and cooperation, (iii) identify key stakeholder groups and enhance education and outreach efforts to those stakeholders, and (iv) implement education and awareness to build compliance and support enforcement. The next step is to (i) request TTTWO propose recommendations for the TOWS-WG to endorse the development of an education and outreach strategy and request TOWS and ICG review the strategy which will be distributed to March and (ii) request via TOWS-WG that ICGs share any existing education and outreach materials and/or programs/initiatives.

Dr McCreery reminded that the ICG/PTWS, ICG/OTWMS and ICG/CARIBE-EWS meetings are coming up very soon and requested that DBCP share the strategy for consideration at the ICGs. Mr Bailey offered to provide inputs to the draft strategy of behalf of the TOWS-WG before finalisation. In the backdrop of recent vandalism instances of 2 tsunami buoys operated by TSP-India in the Bay of Bengal and North Arabian Sea, Dr Tummala enquired if DBCP has informed the stations operators regarding “hot spots” of vandalism. Mr McArthur mentioned that the strategy will identify key stake holders to be engaged in such education and outreach. After discussions, the following recommendations were made:

**Recommendation 7 to the TOWS-WG on Data Buoy Vandalism**

- **Noting** the importance of data buoys for tsunami warnings and the consequences that data buoy vandalism has on tsunami warning operations
- **Appreciating** the efforts of the DBCP in developing a regionally relevant education and outreach strategy to reduce damage to and loss of ocean data buoys from negative interactions (“the strategy”)
- **Requests** the TOWS-WG endorse the development of the strategy and recommend that each ICG review the strategy. In addition, the TOWS-WG should recommend that each ICG consider contributing any education or outreach materials related to data buoy vandalism to the DBCP for inclusion in the tool kit of regionally relevant materials

12.2 Optimal Design of Sea-level networks

Dr Schindelé made a presentation regarding the analysis done in NEAM TWS region to identify optimal locations of tide gauges to be installed in Belares and Sardinia & Sicily to reduce the tsunami detection time for tsunamis originating from 13 assumed earthquake sources. He also mentioned it is also possible to decide upon the location which will have the best tsunami signal and least delay by modelling the wave propagation. This can also be decided based on the recording of tsunami amplitudes for historical events. Mr Schindelé mentioned that CENALT generates such maps on a daily-basis to get a picture of the network health and prioritise maintenance of the stations.

Dr McCreery followed up with a presentation of the analysis done by the PTWC to identify tsunami detection times for all the subduction zones in the pacific for one/two/three sea level gauges to detect and transmit data. A quarter-cycle of tsunami wave (~5 minutes) is added to the travel time and transmission time to calculate the detection latency while making this analysis. A comparison was also made to show how the detection times have improved in 2016 as compared to 2005. Similar analysis is also done for seismic stations. Mr Bailey suggested that this topic could also be discussed in the symposium planned in 2018. Mr Aarup suggested that a global map could be generated after the symposium to come up with a snapshot of the overall global networks and to identify the gaps. Such maps can also be useful to work with satellite operators to optimise the transmission time which in turn can enhance detection times.
After discussion it was decided that Dr McCreery & Dr Schindelé will 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 and also incorporated in the next revision of the Global Service Definition Document.

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

13.1 Recommendations:

(See main body of the report for full recommendations)

Recommendation 1 to the TOWS-WG on conduct of a symposium

Recommendation 2 to the TOWS-WG on the tenure of the task team and revised ToRs

Recommendation 3 to the TOWS-WG on use of Common Alerting Protocol (CAP)

Recommendation 4 to the TOWS-WG on Key Performance Indicators

Recommendation 5 to the TOWS-WG on products for maritime community

Recommendation 6 to the TOWS-WG on global public access to tsunami threat information

Recommendation 7 to the TOWS-WG on Data Buoy Vandalism

13.2 Actions:

Action 1: Rick Bailey, François 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.

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.

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.

Action 4: 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

Action 5: Continue to consider methods to handle tsunamis from earthquakes in non-subduction zones and non-seismic sources (eg. meteo-tsunamis) taking into account the ongoing efforts

Action 6: Chip McCreery & François 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.

Action 7: Rick Bailey & 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
Action 8: Rick Bailey to provide feedback to DBCP on the draft strategy for data buoy vandalism

Action 9: To incorporate revised/new procedures into the next revision of the Global Service Definition Document as required

14. CLOSE OF MEETING

Dr McCreery closed the meeting at 5:30 pm and thanked the participants for their contribution to a highly productive meeting.
## AGENDA

### Day 1: Tuesday, February 21, 2017

<table>
<thead>
<tr>
<th>Item</th>
<th>Time</th>
<th>Topic</th>
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| 1    | 0900-0915 | Opening and Session Organization  
- Registration  
- Overview of meeting logistics, introduction of participants, review of the agenda, etc. |                                                                         | Chip McCreery             |
| 2    | 0915-0945 | Review of Action Items from the Previous Meeting  
| 3    | 0945-1030 | Review the Status of Implementation of the TOWS-WG Requests to the TTTWO | Summary Report, TOWS-WG, Ninth Meeting, Annex II, page 14 | Chip McCreery, ICG-Representatives |
|      |         | Break                                                      |                                                                         |                          |
| 4    | 1100-1230 | Tsunami Watch Operations - Current Status and Plans |                                                                         | ICG-Representatives      |
|      |         | Lunch                                                      |                                                                         |                          |
| 5    | 1400-1530 | Significant Operational Events Since Last Meeting  
- Actions Taken  
- Lessons Learned  
- Recommendations | See Attached Table                                                                 | ICG-Representatives, Joint Session with Task Team on Disaster Management and Preparedness |
|      |         | Break                                                      |                                                                         |                          |
| 7    | 1700-1730 | World Tsunami Awareness Day |                                                                         | Joint Session with Task Team on Disaster Management and Preparedness |
Day 2: Wednesday, February 22, 2017

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<th>Time</th>
<th>Session</th>
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<tr>
<td>08:00</td>
<td>Updates to Area of Coverage and ESZ Maps of the ICGs</td>
<td>Summary Report, TOWS-WG, Ninth Meeting, Annex IV, page 40</td>
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<td>09:45</td>
<td>Handling of Tsunamis from Non-Seismic Sources: Meteorological, Landslide, Volcanic, Bolide and Non-subduction Zone Earthquakes</td>
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<td>10:00</td>
<td>Products for Maritime Community</td>
<td>Summary Report, TOWS-WG, Ninth Meeting, Annex IV, Section 9.2, page 47</td>
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<td>11:00</td>
<td><strong>Lunch</strong></td>
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<td>Global Public Access to Tsunami Threat Information</td>
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<td><strong>Break</strong></td>
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<td>12:00</td>
<td>Other Harmonization Issues</td>
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<td>• Optimal Design of Sea-level networks</td>
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<td>Shannon McArthur, DBCP</td>
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<td>• Data Buoy Vandalism – Education &amp; Outreach Strategy</td>
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<td>13:00</td>
<td>Recommendations and Actions for Reporting to the TOWS-WG</td>
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<td>14:00</td>
<td>Conclusion</td>
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SIGNIFICANT OPERATIONAL EVENTS IN THE INTER-SESSIONAL PERIOD

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ANNEX V

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TOWS-WG-X

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# ANNEX VI

## LIST OF ACRONYMS

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BCP</td>
<td>Business Continuity Planning</td>
</tr>
<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>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>CTIC</td>
<td>Caribbean Tsunami Information Center</td>
</tr>
<tr>
<td>CTWP</td>
<td>Caribbean Tsunami Warning Programme</td>
</tr>
<tr>
<td>DBCP</td>
<td>Data Buoy Cooperation Panel</td>
</tr>
<tr>
<td>DG ECHO</td>
<td>European Commission Directorate General–Humanitarian Aid &amp; Civil Protection</td>
</tr>
<tr>
<td>EC</td>
<td>Executive Council</td>
</tr>
<tr>
<td>GEM</td>
<td>Global Earthquake Model</td>
</tr>
<tr>
<td>GIZ</td>
<td>German Society for International Cooperation</td>
</tr>
<tr>
<td>GMDSS</td>
<td>IMO Global Maritime Distress and Safety System</td>
</tr>
<tr>
<td>GNSS</td>
<td>Global Navigation Satellite System</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>
<tr>
<td>Abbreviation</td>
<td>Full Form</td>
</tr>
<tr>
<td>--------------</td>
<td>-----------</td>
</tr>
<tr>
<td>IHO</td>
<td>International Hydrographic Organization</td>
</tr>
<tr>
<td>IMO</td>
<td>the International Maritime Organization</td>
</tr>
<tr>
<td>INGV</td>
<td>Istituto Nazionale di Geofisica e Vulcanologia, Italy</td>
</tr>
<tr>
<td>IOC</td>
<td>Intergovernmental Oceanographic Commission</td>
</tr>
<tr>
<td>IOTIC</td>
<td>Indian Ocean Tsunami Information Centre</td>
</tr>
<tr>
<td>IPMA</td>
<td>Instituto Português do Mar e da Atmosfera</td>
</tr>
<tr>
<td>ITB</td>
<td>Institut Teknologi Bandung</td>
</tr>
<tr>
<td>ITIC</td>
<td>International Tsunami Information Center</td>
</tr>
<tr>
<td>ITP</td>
<td>ITIC Training Programme</td>
</tr>
<tr>
<td>IUGG</td>
<td>International Union of Geodesy and Geophysics</td>
</tr>
<tr>
<td>JCOMM</td>
<td>Joint Technical Commission for Oceanography and Marine Meteorology</td>
</tr>
<tr>
<td>JICA</td>
<td>Japan International Cooperation Agency</td>
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<tr>
<td>JMA</td>
<td>Japan Meteorological Agency</td>
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<td>KOERI</td>
<td>Kandilli Observatory and Earthquake Research, Turkey</td>
</tr>
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<td>KPI</td>
<td>Key Performance Indicators</td>
</tr>
<tr>
<td>MFIT</td>
<td>Malaysia Fund in Trust</td>
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<tr>
<td>NDMO</td>
<td>National Disaster Management Offices</td>
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<tr>
<td>NEAMTIC</td>
<td>Tsunami Information Centre for the North-Eastern Atlantic, the Mediterranean and Connected Seas</td>
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<tr>
<td>NOAA</td>
<td>National Observatory of Athens, Greece</td>
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<tr>
<td>NOAA</td>
<td>National Oceanic and Atmospheric Administration</td>
</tr>
<tr>
<td>NWPTAC</td>
<td>North West Pacific Tsunami Advisory Center</td>
</tr>
<tr>
<td>NTWC</td>
<td>National Tsunami Warning Center</td>
</tr>
<tr>
<td>PTWC</td>
<td>Pacific Tsunami Warning Centre</td>
</tr>
<tr>
<td>PTWS</td>
<td>Pacific Tsunami Warning and Mitigation System</td>
</tr>
<tr>
<td>SC</td>
<td>Steering Committee</td>
</tr>
<tr>
<td>SOP</td>
<td>Standard Operating Procedure</td>
</tr>
<tr>
<td>TEMPP</td>
<td>Tsunami Evacuation Maps, Plans and Procedures</td>
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<tr>
<td>Abbreviation</td>
<td>Description</td>
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<tr>
<td>--------------</td>
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<tr>
<td>TIC</td>
<td>Tsunami Information Centres</td>
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<tr>
<td>TNC</td>
<td>Tsunami National Contact</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>
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<tr>
<td>TSU</td>
<td>Tsunami Unit</td>
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<tr>
<td>TT</td>
<td>Task Team</td>
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<td>TT-DMP</td>
<td>Task Team on Disaster Management and Preparedness</td>
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<td>TTT</td>
<td>Tsunami Travel Time</td>
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<td>TT-TRP</td>
<td>Task Team on Tsunami Recognition Programme</td>
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<td>TT-TWO</td>
<td>Task Team on Tsunami Watch Operations</td>
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<tr>
<td>TWFP</td>
<td>Tsunami Warning Focal Points</td>
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<tr>
<td>UNDP</td>
<td>United Nations Development Programme</td>
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<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>UNGRD</td>
<td>Unidad Nacional para la Gestión del Riesgo de Desastres</td>
</tr>
<tr>
<td>UNISDR</td>
<td>United Nations Office for Disaster Risk Reduction</td>
</tr>
<tr>
<td>UN-OCHA</td>
<td>United Nations Office for the Coordination of Humanitarian Affairs</td>
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<tr>
<td>UN-WCDRR</td>
<td>UN World Conference on 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>
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<tr>
<td>WCATWC</td>
<td>West Coast/Alaska Tsunami Warning Center</td>
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<tr>
<td>WIS</td>
<td>WMO Information System</td>
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<tr>
<td>WMO</td>
<td>World Meteorological Organization</td>
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<tr>
<td>WWMIWS</td>
<td>World-Wide Metocean Information &amp; Warnings Service</td>
</tr>
<tr>
<td>WWNWS-SC</td>
<td>World-wide Navigational Warning Service Sub-Committee</td>
</tr>
<tr>
<td>WTAD</td>
<td>World Tsunami Awareness Day</td>
</tr>
</tbody>
</table>
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 IOC-UN(OETB) Guiding Group of Experts on the Programme of Ocean Science in Relation to Non-Living Resources
5. First Session of the IOC-UN(OETB) Guiding Group of Experts on the Programme of Ocean Science in Relation to Non-Living Resources
6. First Session of the Editorial Board for the International Bathymetric Chart of the Mediterranean and Overlay Sheets
7. First Session of the Joint CCOP(SOPAC)-IOC Working Group on South Pacific Tectonics and Resources
8. First Session of the IOCARIBE Group of Experts on Marine Information Management
9. Tenth Session of the Joint CCOP-IOC Working Group on Post-IDOE Studies in East Asian Tectonics and Resources
10. Sixth Session of the IOC-UNEP Group of Experts on Methods, Standards and Inter calibration
11. First Session of the IOC Consultative Group on Ocean Mapping (Also printed in French and Spanish)
12. Joint 100-WMO Meeting for Implementation of IGOSS XBT Ships-of-Opportunity Programmes
13. Second Session of the Joint CCOP/SOPAC-IOC Working Group on South Pacific Tectonics and Resources
14. Third Session of the Group of Experts on Format Development
15. Eleventh Session of the Joint CCOP-IOC Working Group on Post-IDOE Studies of South-East Asian Tectonics and Resources
16. Second Session of the IOC Editorial Board for the International Bathymetric Chart of the Mediterranean and Overlay Sheets
17. Seventh Session of the IOC-UNEP Group of Experts on Methods, Standards and Intercalibration
18. Second Session of the IOC Group of Experts on Effects of Pollutants
19. Primera Reunión del Comité Editorial de la COI para la Carta Batimétrica Internacional del Mar Caribe y Parte del Océano Pacifico frente a Centroamérica (Spanish only)
20. Third Session of the Joint CCOP/SOPAC-IOC Working Group on South Pacific Tectonics and Resources
21. Twelfth Session of the Joint CCOP-IOC Working Group on Post-IDOE Studies of South-East Asian Tectonics and Resources
22. Second Session of the IOCARIBE Group of Experts on Marine Information Management
23. First Session of the IOC Group of Experts on Marine Geology and Geophysics in the Western Pacific
24. 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)
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26. Eighth Session of the IOC-UNEP Group of Experts on Methods, Standards and Intercalibration
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28. Second Session of the IOC-ILO Guiding Group of Experts on the Programme of Ocean Science in Relation to Living Resources
29. First Session of the IOC-ILO Guiding Group of Experts on Standards and Reference Materials
30. First Session of the IOCARIBE Group of Experts on Recruitment in Tropical Coastal Demersal Communities (Also printed in Spanish)
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36. First Consultative Meeting on RNODCs and Climate Data Services
37. Second Joint IOC-WMO Meeting of Experts on IGOSS-IDOE Data Flow
38. Fourth Session of the Joint CCOP/SOPAC-IOC Working Group on South Pacific Tectonics and Resources
39. Fourth Session of the IOCARIBE Group of Experts on Technical Aspects of Data Exchange
40. Fourteenth Session of the Joint CCOP-IOC Working Group on Post-IDOE Studies of East Asian Tectonics and Resources
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44. Third Session of the IOC-UN(IALOS) Guiding Group of Experts on the Programme of Ocean Science in Relation to Non-Living Resources
45. Ninth Session of the IOC-UNEP Group of Experts on Methods, Standards and Intercalibration
46. Second Session of the IOC Editorial Board for the International Bathymetric Chart of the Caribbean Sea and the Gulf of Mexico
47. Cancelled
48. Twelfth Session of the Joint IOC-IHO Guiding Committee for the General Bathymetric Chart of the Oceans
49. Fifteenth Session of the Joint CCOP-IOC Working Group on Post-IDOE Studies of East Asian Tectonics and Resources
50. Third Joint IOC-WMO Meeting for Implementation of IGOSS XBT Ship-of-Opportunity Programmes
51. First Session of the IOC Group of Experts on the Global Sea-Level Observing System
52. Fourth Session of the IOC Editorial Board for the International Bathymetric Chart of the Mediterranean
53. First Session of the IOC Editorial Board for the International Chart of the Central Eastern Atlantic (Also printed in French)
54. 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)
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/IGOSS 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 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 Inter calibration
65. First Meeting of the Working Group on Oceanographic Co-operation in the ROPME Sea Area
66. Sixth 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 IGOSS XBT Ship-of-Opportunity Programmes
70. ROPME-IOC Meeting of the Steering Committee on 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-IOC-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. Fifth Session of the IODE Group of Experts on Technical Aspects of Data Exchange
76. ROPME-IOC 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 IODE Group of Experts on Technical Aspects of Data Exchange
79. Fourth Joint IOC-WMO Meeting for Implementation of IGOSS XBT Ship-of-Opportunity Programmes
80. Fourteenth Session of the Joint IOC-IHO Guiding Committee for the General Bathymetric Chart of the Oceans
81. Fifth Joint IOC-WMO Meeting for Implementation of IGOSS XBT Ship-of-Opportunity Programmes
82. Second Meeting of the UNEP-IOC-ASPEI Global Task Team on the Implications of climate Change on Coral Reefs
83. Seventh Session of the JSC Ocean Observing System Development Panel
84. Fourth Session of the IODE Group of Experts on Marine Information Management
85. Sixth Session of the IOC Group of Experts on the Global Level Observing System
86. Sixth Session of the Joint IOC-JGOFS Panel on Carbon Dioxide
87. First Session of the IOC Editorial Board for the International Bathymetric Chart of the Western Pacific
88. Eighth Session of the JSC Ocean Observing System Development Panel
89. Ninth Session of the JSC Ocean Observing System Development Panel
90. Sixth Session of the IODE Group of Experts on Technical Aspects of Data Exchange
91. First Session of the IOC-FAO Group of Experts on OSLR for the IOCINGWIO Region
92. Fifth Session of the Joint IOC-JGOFS CO, Advisory Panel Meeting
93. Tenth Session of the JSC Ocean Observing System Development Panel
94. First Session of the Joint CMM-IGOSS-IODE Sub-group on Ocean Satellites and Remote Sensing
95. Third Session of the IOC Editorial Board for the International Chart of the Western Indian Ocean
96. Fourth Session of the IOC Group of Experts on the Global Sea Level Observing System
97. Joint Meeting of GEMSII and GEEP Core Groups
98. First Session of the Joint Scientific and Technical Committee for Global Ocean Observing System
99. Second International Meeting of Scientific and Technical Experts on Climate Change and the Oceans
100. First Meeting of the Officers of the Editorial Board for the International Bathymetric Chart of the Western Pacific
101. Fifth Session of the IOC Editorial Board for the International Bathymetric Chart of the Caribbean Sea and the Gulf of Mexico
102. Second Session of the Joint Scientific and Technical Committee for Global Ocean Observing System
103. Fifteenth Session of the Joint IOC-IHO Committee for the General Bathymetric Chart of the Oceans
104. Fifth Session of the IOC Consultative Group on Ocean Mapping
105. Fifth Session of the IODE Group of Experts on Marine Information Management
106. IOC-NOAA Ad hoc Consultation on Marine Biodiversity
107. Sixth Joint IOC-WMO Meeting for Implementation of IGOSS 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-JGOFS C02 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 (GEBCO), 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 IODE 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 (OCGM), 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 (GECBO), United Kingdom, 1997
134. Fourth Session of the IOC Editorial Board for the International Bathymetric Chart of the Western Indian Ocean (IOC/EB-IBCWO-I3), 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. Fifth 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 IODE 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 IOCE-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 (OCGM), Monaco, 1999
152. Sixth Session of the IOC Group of Experts on the Global Sea level Observing System (GLOSS), Republic of Korea, 1999
153. Seventeenth Session of the Joint IOC-IHO Guiding Committee for the General Bathymetric Chart of the Oceans (GECBO), Canada, 1999
154. Comité Editorial de la COI para la Carta Batimétrica Internacional del Mar Caribe y el Golfo de México (IBCCA), Septima Reunión, México, 1998
155. IOC Editorial Board for the International Bathymetric Chart of the Caribbean Sea and the Gulf of Mexico (IBCCA), Seventh Session, Mexico, 1998
156. Initial Global Ocean Observing System (GOOS) Commitments Meeting, IOC-WMO-UNEP-ICSIU/Impl-II/3, France, 1999
157. First Session of the ad hoc Advisory Group for IOCARIBE-GOOS, Venezuela, 1999 (also printed in Spanish and French)
158. Fourth Session of the IOC-WMO-UNEP-ICSIU Coastal Panel of the Global Ocean Observing System (GOOS), China, 1999
162. Eighth Session of the IODE 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-ICSIU Coastal Panel of the Global Ocean Observing System (GOOS), Poland, 2000
166. Second Session of the ad hoc Advisory Group for IOCARIBE-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)
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 IOCARIBE-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
231. First Meeting of the Inter-ICG Task Team 2 on Disaster Management and Preparedness (Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems (TOWS-WG), Seattle, USA, 29 November–1 December 2010

232. First Meeting of the Inter-ICG Task Team 3 on Tsunami Watch Operations (Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems (TOWS-WG), Seattle, USA, 29 November–1 December 2010

233. Primera Reunión del Grupo de Trabajo Regional para América Central del Grupo Intergubernamental de Coordinación del Sistema de Alerta contra los Tsunamis y Atenuación de sus Efectos en el Pacífico (ICG/PTWS), San Salvador (El Salvador) del 28 al 30 de septiembre de 2011 (Resumen dispositivo en español e inglés)

234. Segunda Reunión del Grupo de Trabajo Regional para América Central del Grupo Intergubernamental de Coordinación del Sistema de Alerta contra los Tsunamis y Atenuación de sus Efectos en el Pacífico (ICG/PTWS), San Salvador (El Salvador) del 4 al 6 de noviembre de 2009 (Resumen dispositivo en español e inglés)

235. First Session of the Joint IODE-JCOMM Steering Group for the Global Temperature-Salinity Profile Programme (SG-GTSPP), 16–20 April 2012, Ostend, Belgium

236. Ad hoc Session of the Joint JCOMM-IODE Steering Group for the Ocean Data Standards Pilot Project (SG-ODSPP), 23–25 April 2012, Ostend, Belgium

237. First Meeting of the Regional Working Group on Tsunami Warning and Mitigation System for the South China Sea Region (SCS-WG), Sanya, China, 12–14 December 2011

238. First Meeting of the IODE Steering Group for OceanDocs (SG-OceanDocs), 24–27 January 2012, Ostend, Belgium

239. Fifth Session of the Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems (TOWS-WG), Tokyo, Japan, 15 February 2012 (Executive Summary in English, French, Russian and Spanish included)


241. Twelfth Session of the IODE Group of Experts on Marine Information Management (GE-MIM), Miami, USA, 22–25 January 2013

242. Twelfth Session of the IOC Group of Experts on the Global Sea level Observing System (GLOSS), Paris, 9–11 November 2011 (electronic copy only)

243. Meeting of the Pacific Tsunami Warning System Working Group 2 on Detection, Warning and Dissemination Task Team on PacWave11, Honolulu, USA, 21 May 2012 (electronic copy only)

244. Sixth Session of the Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems (TOWS-WG), Paris, 20–21 February 2013 (Executive Summary in English, French, Russian and Spanish included)

245. Second Meeting of the Regional Working Group on Tsunami Warning and Mitigation System for the South China Sea Region (SCS-WG), Petaling Jaya, Malaysia, 16–18 October 2012 (electronic copy only)

246. Seventh Meeting of the Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems, UNESCO, Paris, 12–13 February 2014 (Executive Summary in English, French, Russian and Spanish included)

247. Third Meeting of the Regional Working Group on Tsunami Warning and Mitigation System for the South China Sea Region (SCS-WG), Hong-Kong, China, 6–7 April 2014 (electronic copy only)

248. Tercera Reunión del Grupo de Trabajo Regional para América Central del Grupo Intergubernamental de Coordinación del Sistema de Alerta contra los Tsunamis y Atenuación de sus Efectos en el Pacífico (ICG/PTWS), Managua, Nicaragua, del 29 al 30 de septiembre de 2014 (Resumen dispositivo en español e inglés)

249. Workshop on Tsunami Modelling and Mitigation of the ICG/CARIBE-EWS Working Group 2: Tsunami Hazard Assessment, 1–3 December 2014, Cartagena de Indias, Colombia (electronic copy only)

250. Fourth meeting of the Regional Working Group on Tsunami Warning and Mitigation System for the South China Sea Region (SCS-WG), Jakarta, Indonesia, 11–12 February 2015 (electronic copy only)

251. Eighth Session of the Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems (TOWS-WG), Jakarta, Indonesia, 11–12 December 2014 (electronic copy only)

252. Ninth Meeting of the Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems, UNESCO, Paris, 25–26 February 2016 (Executive Summary in English, French, Russian and Spanish included)

253. Fifth Meeting of the Regional Working Group on Tsunami Warning and Mitigation System for the South China Sea Region (SCS-WG), Manila, Philippines, 2–3 March 2016 (electronic copy only)

254. Second Meeting of the Regional Working Group for the North West Indian Ocean (WG-NWIO), Tehran, Islamic Republic of, 27–28 February 2017 (electronic copy only)

255. Sixth Meeting of the Regional Working Group on Tsunami Warning and Mitigation System for the South China Sea Region (SCS-WG), Shanghai, China, 1–3 March 2017 (electronic copy only)

256. Ninth Session of the Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems (TOWS-WG), Paris, 23–24 February 2017 (Executive Summary in English, French, Russian and Spanish included)