Intergovernmental Oceanographic Commission
Reports of Meetings of Experts and Equivalent Bodies

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

Fourth Meeting

Paris, France
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IOC/TOWS-WG-IV/3
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EXECUTIVE SUMMARY

The Fourth Meeting of the Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems (TOWS-WG-IV) was held in Paris, France, on 21-22 March 2011, at UNESCO Headquarters, under the chairmanship of Mr Sang-Kyung Byun (IOC Vice-chairman). The meeting evaluated progress in actions and decisions taken by the Governing Bodies, mainly through Resolution XXV-13 and Resolution EC XLIIII.6 and reviewed an advanced draft of the Compendium of definitions and terminology on sea level-related hazards, disasters, vulnerability and risks in a coastal context as well as the joint Report of the International tsunameter Partnership and the DBCP, on Ocean Observing Platform Vandalism.

The Group **agreed** to invite WMO to actively participate in the WAVE exercises run by ICGs to help measure performance of the GTS in delivery of warnings and to contribute to its improvement where needed.

The Group **agreed** to request the IOC Assembly to grant additional time for the TOWS WG to develop Terms of Reference for the studies of data gap analysis and the conduct of these studies by the ICGs.

The Group **agreed** to put forward for the IOC Assembly a final draft of the Compendium of Definitions and Terminology on Sea-Level-Related Hazards, Disasters, Vulnerability and Risks in a Coastal Context, suggesting this becomes a living document that should be updated periodically.

The Group **agreed** that ICGs need to work with the maritime authorities at the country level to look for ways and means of protecting from vandalism observational instruments that provide life-saving data.

The Group **further agreed** on the importance of the early warning data from tsunameters which for certain regions are critical for the confirmation of tsunami generation and prevention of false alarms. Vandalism should not dissuade countries from investing toward the deployment and operation of advanced ocean observation and hazard detection instruments.

The Group **agreed** to forward to the IOC Assembly a Draft Resolution on Ocean Observing System Vandalism (Annex II)

The Group **endorsed** the reports of Inter-ICG Task Teams on Sea Level for Tsunami Purposes, Disaster Management and Preparedness, and on Tsunami Watch Operations and recommended these be forwarded to the ICGs for consideration when updating their Implementation Plans and Operational Users Guides and/or Communications Plans,

The Group **recommended** the IOC Assembly to extend the TOWS-WG for a further intersessional period, with the same mandate and membership.

The Group **encouraged** the Inter-ICG Task Teams on Disaster Management and Preparedness and on Tsunami Watch Operations to continue their work and recommended the IOC Assembly to extend the period of work for the Inter ICG Task Team on Disaster Management and Preparedness, and on Tsunami Watch Operations.

The Group **recommended** the IOC Assembly to dissolve the Task Team on Sea Level as it has completed to the extent possible the work tasks given to it.

The Group **further recommended** that an Inter ICG Task Team on Tsunami Potential Assessment be established by the IOC Assembly with the Terms of Reference proposed under Annex

RESUMÉ EXÉCUTIF

Le Groupe de travail sur les systèmes d'alerte aux tsunamis et aux autres aléas liés au niveau de la mer, et de mitigation a tenu sa quatrième réunion (TOWS-WG-IV) les 21 et 22 mars 2011 au Siège de l'UNESCO, à Paris (France) sous la présidence de M. Sang-Kyung Byun (Vice-Président de la COI). À ladite réunion, le Groupe a évalué les progrès réalisés en ce qui concerne les actions menées et les décisions prises par les organes directeurs, principalement par les résolutions XXV-13 et EC-XLIIII.6, et examiné un avant-projet de Recueil de définitions et de termes sur les aléas, les catastrophes, la vulnérabilité et les risques en milieu côtier ainsi que le rapport commun du Partenariat international pour les tsunamètres et le Groupe de coopération pour les programmes de bouées de mesure (DBCP) sur le vandalisme des plates-formes d'observation de l'océan.

Le Groupe **est convenu** d'inviter l'OMM à participer activement aux exercices WAVE menés par les GIC pour aider à mesurer la performance du GTS quant à l'émission d'alertes et à contribuer, le cas échéant, à l'améliorer.

Le Groupe **est convenu** de demander à l'Assemblée de la COI d'accorder au TOWS-GT davantage de temps pour élaborer le mandat des études relatives à l'analyse des lacunes en matière de données et à la conduite de ces études par les GIC.

Le Groupe **est convenu** de saisir l'Assemblée d'un texte définitif du Recueil de définitions et de termes sur les aléas, les catastrophes, la vulnérabilité et les risques en milieu côtier, soulignant le fait qu'il s'agit d'un document évolutif qu'il faudrait mettre à jour périodiquement.

Le Groupe **est convenu** que les GIC étaient appelés à s'employer avec les autorités maritimes, au niveau national, à déterminer de quelle manière et par quels moyens on pourrait protéger du vandalisme les instruments d'observation qui fournissent des données destinées à sauver des vies humaines.

Le Groupe **est convenu en outre** de l'importance des données d'alerte rapide en provenance des tsunamètres, lesquelles, dans le cas de certaines régions, sont indispensables à la confirmation de la génération d'un tsunami et à la prévention de fausses alertes. Le vandalisme ne devrait pas dissuader les pays de s'investir dans le mouillage et l'exploitation d'instruments de pointe d'observation de l'océan et de détection d'aléas.

Le Groupe **est convenu** de soumettre à l'Assemblée de la COI un projet de résolution sur le vandalisme du système d'observation de l'océan (Annexe II).

Le Groupe **a fait siens** les rapports des Équipes spéciales intergroupes GIC sur le niveau de la mer; la gestion et la préparation en cas de catastrophe, et les opérations de veille aux tsunamis, et a recommandé de les transmettre aux GIC pour qu'ils les examinent lors de la mise à jour de leurs plans de mise en œuvre et de leurs guides des utilisateurs opérationnels/plans de communications.

Le Groupe **a recommandé** que l'Assemblée de la COI proroge le TOWS-GT pour une intersession supplémentaire, avec le même mandat et la même composition.

Le Groupe **a encouragé** les Équipes spéciales intergroupes GIC sur la gestion et la préparation en cas de catastrophe, sur les opérations de veille aux tsunamis à poursuivre leurs travaux et recommandé que l'Assemblée de la COI prolonge leur période de travail.

Le Groupe **a recommandé** que l'Assemblée de la COI dissolve l'Équipe spéciale sur le niveau de la mer, étant donné qu'elle a, dans toute la mesure possible, mené à leur terme les tâches qui lui avaient été assignées.

Le Groupe **a par ailleurs recommandé** que l'Assemblée de la COI crée une Équipe spéciale sur l'évaluation du risque de tsunami, avec le mandat proposé à l'Annexe V.

RESUMEN DISPOSITIVO

La cuarta 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-IV) se celebró en la Sede de la UNESCO en París (Francia), los días 21 y 22 de marzo de 2011, bajo la presidencia del Sr. Sang-Kyung Byun (Vicepresidente de la COI). En esta reunión se pasó revista a los avances relativos a las medidas y decisiones adoptadas por los órganos rectores, particularmente en virtud de las resoluciones XXV-13 y EC XLIIII.6, y se examinó un anteproyecto del documento titulado "Compendium of Definitions and Terminology on Hazards, Disasters, Vulnerability and Risks in a Coastal Context", así como el informe conjunto “Report of the International tsunameter Partnership and the DBCP, on Ocean Observing Platform Vandalism”.

El Grupo **estuvo de acuerdo** en invitar a la Organización Meteorológica Mundial (OMM) a participar activamente en los ejercicios WAVE organizados por los grupos intergubernamentales de coordinación (GIC), con el fin de que brindara su colaboración para evaluar el funcionamiento del Sistema Mundial de Telecomunicación (SMT) para la transmisión de alertas y contribuyera a su mejora, cuando resultara pertinente.

El Grupo **acordó** pedir a la Asamblea de la COI que concediese más tiempo al TOWS-WG para definir el alcance de los estudios relativos al análisis de las insuficiencias de datos y a la realización de dichos estudios por los GIC.

El Grupo **acordó** presentar a la Asamblea de la COI un proyecto definitivo del documento “Compendium of Definitions and Terminology on Sea-Level-Related Hazards, Disasters, Vulnerability and Risks in a Coastal Context”, recomendando que se convirtiese en un documento evolutivo que se debía actualizar periódicamente.

El Grupo **convino** en que los GIC necesitaban trabajar con las autoridades marítimas en el plano nacional, con miras a determinar los medios de proteger del vandalismo los instrumentos de observación que suministran datos destinados a salvar vidas humanas.

El Grupo **convino** asimismo en la importancia de los datos de alerta temprana procedentes de los tsunámetros, que en ciertas regiones eran fundamentales para confirmar el desencadenamiento de un tsunami y evitar falsas alarmas. El vandalismo no debía disuadir a los países de invertir en la instalación y puesta en funcionamiento de instrumentos sofisticados de observación de los océanos y detección de peligros.

El Grupo **acordó** presentar a la Asamblea de la COI un proyecto de resolución sobre el vandalismo contra el sistema de observación de los océanos (Anexo II).

El Grupo **hizo suyos** los informes de los equipos de trabajo de los GIC sobre el nivel del mar en relación con los tsunamis, la gestión de desastres y la preparación, y sobre las actividades de vigilancia de tsunamis, y **recomendó** que se sometieran a la consideración de los GIC cuando se actualizaran sus planes de puesta en marcha y guías operativas para los usuarios y/o planes de comunicación.

El Grupo **recomendó** a la Asamblea de la COI que prorrogara el TOWS-WG por un nuevo periodo entre reuniones, con el mismo mandato y composición.

El Grupo **instó** a los equipos de trabajo de los GIC sobre la gestión de desastres y la preparación y sobre las actividades de vigilancia de tsunamis a proseguir su labor y recomendó a la Asamblea de la COI que prolongara el periodo de trabajo de dichos equipos.

El Grupo **recomendó** a la Asamblea de la COI que disolviera el Equipo de Trabajo sobre el nivel del mar, ya que había cumplido, en la medida de lo posible, las tareas que se le habían asignado.

El Grupo **recomendó** además a la Asamblea de la COI que creara un Equipo de Trabajo de los GIC sobre la evaluación del potencial tsunamigénico, con el mandato propuesto en el Anexo VI

РАБОЧЕЕ РЕЗЮМЕ

Четвертое совещание Рабочей группы по системам предупреждения и смягчения последствий цунами и других опасных явлений, связанных с изменением уровня моря (РГ-СПЦО-IV) состоялось в Париже, Франция, 21–22 марта 2011 г. в Штаб-квартире ЮНЕСКО под председательством г-на Пён Сан Гёна (заместителя Председателя МОК). Участники заседания дали оценку прогрессу, достигнутому в осуществлении мер и выполнении решений руководящих органов, главным образом связанных с резолюцией Ассамблеи XXV-13 и резолюцией Исполнительного совета XLIII.6, сделали обзор проекта Перечня определений и терминов по опасным явлениям, бедствиям, уязвимости и рискам в контексте прибрежной зоны, а также рассмотрели доклад, подготовленный совместно Международным цунамометрическим партнерством и Группой сотрудничества по буям для сбора данных (ДБКП) по вопросу о вандализме в отношении платформ для океанических наблюдений.

Группа **решила** пригласить ВМО принять активное участие в учениях «Волна», проводимом под руководством МКГ в целях оказания содействия установлению эффективности Глобальной системы телекоммуникаций (ГСТ) в отношении рассылки предупреждений и содействия, в случае необходимости, их совершенствованию.

Группа **решила** просить Ассамблею МОК предоставить РГ-СПЦО дополнительное время для подготовки научно-технического задания на проведение исследований по анализу пробелов в данных, а также проведения указанных выше исследований МКГ.

Группа **решила** передать Ассамблее МОК окончательный проект Перечня определений и терминов по опасным явлениям, бедствиям, уязвимости и рискам в контексте прибрежной зоны, выразив мнение о том, что этот документ должен носить постоянно действующий характер и поэтому периодически обновляться.

Группа **решила**, что МКГ необходимо работать вместе с национальными властями, отвечающими за судоходство и рыбный промысел, с целью изыскания путей и средств защиты от вандализма инструментов для океанических наблюдений, которые обеспечивают предоставление данных, способствующих спасению жизней.

Группа **далее решила**, что данные для систем раннего предупреждения, поступающие с цунамометров, имеют для некоторых регионов решающее значение, так как они могут подтвердить возможность возникновения цунами и предотвратить ложные тревожные сообщения. Вандализм не должен мешать странам инвестировать в развертывание и работу оснащенных по последнему слову техники океанических обсерваторий и современных инструментов, служащих задаче выявления опасностей.

Группа **решила** передать Ассамблее МОК проект резолюции по вопросу о вандализме в отношении систем океанических наблюдений (Приложение II).

Группа **одобрила** доклады межсессионных целевых групп МКГ по следующим вопросам: измерение уровня моря для целей, связанных с цунами, предупреждение и ликвидация последствий стихийных бедствий и обеспечение готовности к ним, а также по деятельности, связанной с наблюдением за цунами, и рекомендовала, чтобы эти доклады были направлены на рассмотрение МКГ для обновления планов осуществления и оперативных руководств для пользователей, а также/или планов по коммуникации.

Группа **рекомендовала** Ассамблее МОК продлить деятельность РГ-СПЦО еще на один межсессионный период с тем же мандатом и членским составом.

Группа **призвала** межсессионные целевые группы МКГ по предупреждению и ликвидации последствий стихийных бедствий и обеспечению готовности к ним, а также по

деятельности, связанной с наблюдением за цунами, продолжить свою работу и рекомендовала Ассамблее МОК продлить деятельность Целевой группы по предупреждению и ликвидации последствий стихийных бедствий и обеспечению готовности к ним, а также Целевой группы по деятельности, связанной с наблюдением за цунами.

Группа **рекомендовала** Ассамблее МОК распустить Целевую группу по измерению уровня моря для целей, связанных с цунами, в связи с завершением выполнения поставленных перед ней задач.

Группа **далее рекомендовала** Ассамблее МОК создать общую для всех МКГ Целевую группу по оценке опасности цунами, полномочия которой приводятся в Приложении V

1. OPENING AND WELCOME

1.1 OPENING

The Chair of TOWS-WG, Dr Sang-Kyung Byun opened the meeting of TOWS-IV and recalled the 11 March 2011 M9.0 earthquake off the coast of Miyagi prefecture in Japan that triggered a tsunami that within very short time hit the coasts with tsunami heights of more than 20m in some places, inundating far inland and washing away whole communities. He praised the Japanese Government still struggling against this disaster at the time of this meeting. He expressed on behalf of the Group his deep condolence to Japan for the loss of many lives caused by this earthquake and tsunami. The meeting observed 1 minute of silence for the loss of lives in Japan.

Dr Sang-Kyung provided a brief background on TOWS-WG. He recalled that on December 26, 2004 the Indian Ocean Tsunami caused more than two hundred thousand deaths. This catastrophe made the world as well as the UN system including IOC/UNESCO to realize the importance of Tsunami Early Warning and Mitigation. Immediately after that tragedy IOC started developing tsunami warning systems, in coordination with its Member States and other UN bodies and international organisations which can cover all world oceans by establishing the Working Group on the Global Tsunami and other Ocean-related Hazards Early Warning and Mitigation System (GOHWMS). Based on the GOHWMS framework report and the recommendations of GOHWMS to the IOC Assembly, the Working Group on Tsunami and Other Hazards related to Sea-Level Warning and Mitigation Systems (TOWS-WG) was established in 2007.

Through IOC Resolution XXIV-14 in 2007, TOWS-WG was bestowed the tasks to primarily advise the IOC Governing Bodies on developing comprehensive, harmonised, and systematic approaches to establishing and operating early warning and mitigation systems for tsunami and other hazards related to sea level, through the Intergovernmental Coordination Groups for Tsunami Warning Systems (ICG/TWSs).

The first and second TOWS-WG meetings were held in Paris in 2008 and 2009 respectively, and the 3rd meeting was held in Lisbon in 2010.

According to IOC Resolution XXV-13 in 2009, it was decided, with recognition and reaffirmation of the need for and benefits from the activities of TOWS-WG, to extend the working period of TOWS-WG for two more years and to establish three inter-ICG Task Teams on:

- Sea Level for Tsunami Purposes
- Disaster Management and Preparedness
- Tsunami Watch Operations

These three Task Teams were requested to report their progress to this meeting of TOWS-WG which in sequence will report to the IOC Assembly in June 2011. A joint Inter-ICG Task Teams Meeting was held in Seattle, USA under the auspices of PMEL/NOAA during November 29 – December 1 2010 in order to harmonise and coordinate the work of the three Task Teams

1.2 ADOPTION OF THE AGENDA

The Agenda for this meeting was adopted as indicated in Annex I. During its adoption it was agreed to add an item 5.1 for the representative of Japan Meteorological Agency (JMA) to report about the events and lessons learned in Japan, with the following title: 5.1. JMA REPORT OF PACIFIC COAST OFF TOHOKU EARTHQUAKE AND TSUNAMI, JAPAN, 11 MARCH 2011.

1.3 WORKING ARRANGEMENTS

Mr Bernardo Aliaga, acting Head of the Tsunami Unit welcomed the participants on behalf of IOC/UNESCO and provided logistic details. All documents and presentations delivered at this meeting are available from the following website: http://www.ioc-unesco.org/tows4. The list of participants is provided in Annex VII.

2. REPORTS FROM RELEVANT BODIES

2.1 REPORT FROM THE IOC BODIES

Mr Keith Alverson, Head of the IOC GOOS Office reported on behalf of the Chairperson of GOOS Ms Shaohua Lin and recalled GOOS contributions to Tsunami Warning Systems through the GLOSS programme. He indicated that GOOS strongly supports access, exchange and the use of observation data for costal hazards including tsunamis as GOOS responds to drivers from Members to sustain systems, along with climate monitoring, and other societal needs. Lorna Inniss, Chair ICG/CARIBE EWS inquired about funding and plans to strengthen ocean observational networks in the Caribbean and Srinivas Kumar (Chair Inter ICG Task team 3) reported that in the Indian Ocean there is room for cooperation among the regional body for GOOS (IOGOOS) an the ICG/IOTWS to raise greater awareness of the value of gauges and tsunami buoy stations. It was recommended that the best way to maintain ocean observing systems, both coastal and ocean, is to tap societal benefits. As in previous meetings TOWS-WG members encouraged GOOS Regional Alliances and ICGs to cooperate and approach a larger community within a broader coastal hazards framework. Subsequent discussion emphasized distinguishing sustained climate observations from hazard monitoring systems to raise emphasis on societal benefit and dealing with crises.

Mr Russell Arthurton, Chair of the ICAM Advisory Group recalled the publication the IOC ICAM programme had developed in the area of addressing coastal zone management and multi-hazards. He advised that IOC has a role to play in promoting effective coastal zone risk reduction within the framework of ICAM because lives as well as economic assets and livelihoods are at risk due to coastal hazards.

Dr Lorna Inniss, Chairperson of the ICG/CARIBE EWS reported that tsunami events in Chile and Japan have contributed to raise awareness and political will in the region. She reported that the ICG has made progress in the area of sea level observing network with 31 stations of the 96 core stations in the planned network delivering data to data centres and warning centres in near real time (less than 6 minutes) and has put in place stronger cooperation for real time seismic data sharing with more than 100 stations sharing data in real time across the region. Community preparedness has also received more attention and the planned exercise CARIBE WAVE 11 on March 23rd 2011 will increase awareness and will help to improve preparedness. She indicated that in the experience of the Caribbean, the relation between national warning centres and international and local media are an important aspect for proper warning delivery. In response to this comment the participants suggested that this matter of the role of media may need to be addressed by TOWS in the future, for example in a communication plan.

Dr Francois Schindelé, Chairperson of the ICG/NEAMTWS reported on the status of ICG/NEAMTWS. He indicated that the region has still no warning centre in place. However, four of its Member States are planning to provide tsunami information services as from 2012. NEAMTWS has been focusing on defining its architecture, developing communication tests and reinforcing its TWFPs database. The Secretariat reported that with funding from the European Commission a two-year project to support the North East Atlantic and Mediterranean Tsunami Information Centre (NEAMTIC) has also been launched. This project will help strengthening cooperation with Civil Defence agencies from European countries in particular. Dr David Green

(USA) commented that USA and European Union agencies have met to discuss possibilities of using social media to collect data for warning purposes.

Mr Rick Bailey, Vice Chair ICG/IOTWS reported that works towards launching the Regional Tsunami Watch Providers (RTWPs) scheme has taken much of the efforts of IOTWS with a planned official start of this system by end of 2011. After the October 2010 Mentawai tsunami, the ICG/IOTWS has also discussed the lessons learnt from and the difficulties associated with a slow earthquake capable of generating a destructive tsunami. He also informed that that the Jakarta Tsunami Information Centre (JTIC) based at the UNESCO Jakarta office may expand its geographical coverage to whole Indian Ocean, subject to the approval of the ICG/IOTWS. Dr Francois Schindelé (Chair ICG/NEATMWS) inquired about the interim service for the Mentawai event with respect to Western Indian Ocean islands. Mr Takeshi Koizumi (JMA) indicated that the tsunami advisory service provided for that event included sea level changes forecast for all forecast points including La Reunion and Mauritius.

2.2 REPORT FROM NON IOC BODIES

Mr Edgard Cabrera, Chief, Ocean Affairs Division, World Meteorological Organization (WMO) informed the Group that WMO is willing to participate in tsunami exercises like PACWAVE 11 and CARIBE WAVE 11 to help measure the performance of the GTS for these events as a mean to contribute to the robustness of communications within Tsunami Early Warning Systems. He also indicated that WMO is exploring expansion of the marine warning services provided to ships through the different METAREA to include tsunami and other coastal hazard warnings. In the exchange of views that ensued Mr Cabrera's presentation there was general agreement in the Group that IOC and WMO should reinforce its cooperation towards reaching increased levels of efficiency in the delivery of warnings. The WG also highlighted that ICGs coordinate the work of agencies of different nature (i.e National Hydrometeorological Services (NHMSs), Disaster Preparedness and Civil Defense Agencies, Navy Oceanographic Institutes, seismic institutions among others).

The Group **agreed** to invite WMO to actively participate in the WAVE exercises run by ICGs to help measure the performance of GTS in delivery of warnings and contribute to its improvement where needed.

3. REVIEW OF PROGRESS

3.1 STATUS OF IMPLEMENTATION OF IOC RES.XXV.13 AND RESOLUTION EC XLIII.6

This agenda item was introduced by Mr Bernardo Aliaga, acting Head of the Tsunami Unit. He indicated that:

a) By the end of its fourth meeting TOWS would be able to fulfil the instruction of providing a report and recommendations to the 26th Session of the Assembly on Sea Level for Tsunami Purposes, on Disaster Management and Preparedness and on Tsunami Watch Operations, based on the reports of the respective Inter ICG Task Teams.

b) In addition, TOWS would be able to deliver an advance version of the Compendium of Terms and Definitions in Coastal Disaster Risk Reduction.

c) The Secretariat reported that there has been an increase in nominated Tsunami Warning Focal Points notably in the CARIBE-EWS and in the NEAMTWS region, and there has been a general check and revision of the contact points.

d) Funding has been contributed directly to IOC or in kind from: (i) Australia towards the IOTWS secretariat; (ii) USA towards a phased approach for the establishment

of an international Caribbean Tsunami Warning Center (CTWC); (iii) the European Commission's Sixth Action Plan for Disaster Preparedness in South America Aid department towards a project on tsunami preparedness for coastal communities in Chile, Colombia, Ecuador and Peru, plus Germany has contributed with the secondment of Mr Ulrich Wolf for one year to the Tsunami Unit.

e) An IOC Tsunami website was developed by the Secretariat in four languages, which provides (i) password protected access to Tsunami National Contacts and Tsunami Warning Focal Points; (ii) access to documents and information for the tsunami community.

TOWS WG reviewed all the actions indicated under Resolutions IOC XXV.13 and EC XLIII.6 and concluded that most of them have been fulfilled, in particular those indicated above.

The Group considered it premature to request all ICGs to carry out an analysis of the impact of data gaps on the tsunami detection, forecast, timeliness and accuracy, due to the fact that not all the ICGs have regional centres operating and the networks are evolving rapidly. It also considered that the scientific gaps have not been fully addressed by all ICGs and that data sharing is yet to be analysed by the ICGs

The Group agreed to request the IOC Assembly to consider providing additional time for TOWS WG to develop Terms of Reference for data gap analysis and conduct of these studies by the ICGs.

3.2 REVIEW OF COMPENDIUM OF DEFINITIONS AND TERMINOLOGY ON SEA-LEVEL-RELATED HAZARDS, DISASTERS, VULNERABILITY AND RISKS IN A COASTAL CONTEXT

Mr Russell Arthurton, Chair of the Editorial Team appointed by the Chairman of TOWS-WG reported on progress and recalled the schedule and steps followed by the Editorial Team, supported by a consultant under contract with IOC. In July 2010 a First Draft document (produced by the IOC Consultant and with provisional comments and suggestions by the Chair) was circulated amongst the Editorial Team. From July to September 2010 the Editorial Team considered the draft, making proposals for improvement, considering clarity and relevance to Coastal Disaster Risk Reduction as well as the ease of usage by IOC Member States. In October 2010 a first Revision of the document was agreed by the Editorial Team and submitted to IOC Secretariat and in November 2010 the consultant, taking account of the advice and guidance of the Editorial Team, produced and delivered a Second Draft document to the Secretariat before the meeting of the Inter ICG Task Teams in Seattle. All members of TOWS WG were provided with an advanced copy of the draft Compendium before this meeting. The final steps would be for the Consultant to complete the document, taking account of the findings of the consultation process to the satisfaction and approval of the Editorial Team, and to submit the Final Draft document to the Secretariat.

The Chairman Dr Sang-Kyung Byun and the members of the TOWS WG congratulated the Editorial Team for their work and efficient coordination which has taken the draft Compendium to this stage. An exchange of views ensued on the different options available for dealing with multiple definitions, the choice among different sources, as well as additional references for some specific areas of coastal hazards and related fields.

The Group **agreed** to put forward for the IOC Assembly a final draft of Compendium of Definitions and Terminology on Sea-Level-Related Hazards, Disasters, Vulnerability and Risks in a Coastal Context, suggesting this becomes a living document that should be updated periodically.

3.3 REPORT OF THE INTERNATIONAL TSUNAMETER PARTNERSHIP AND THE DBCP, IN COORDINATION WITH JCOMM, ON OCEAN OBSERVING PLATFORM VANDALISM

This agenda item was introduced by Mr Bernardo Aliaga, acting Head of the Tsunami Unit. He recalled that this report was requested by Resolution EC-XLIII.6. The report submitted by DBCP and JCOMM (DBCP Technical Document No. 41) provides an assessment of the Ocean Observing Platforms vandalism problem and lists a number of recommendations for future action. FAO, IMO, WMO and IOC are suggested to take some pre-emptive actions. The document also addresses the design of buoys and operational deployment issues. Some recommendations go to national bodies including a request to collect more consistent statistics about vandalism. Finally there is a recommendation for international education and outreach in this field involving IOC, WMO and the ICGs, specifically IOTWS.

The report states that vandalism, especially in ocean regions supporting tuna fishing, has had a dramatic impact on network operating costs and data delivery, and the rate is perceived to be increasing. The report suggests that FAO should be involved in all pre-emptive actions related to the fisheries and that awareness raising through fishermen's organisations at the national level is needed. The report indicates also that despite the efforts made to reduce vandalism, the physical hardening of platforms and vandalism avoidance efforts have been the most effective strategy. Clear evidence on the necessity for international education and outreach to reduce vandalism is stressed, involving IOC, WMO and the ICGs, specifically the IOTWS.

The Group considered that coordination with the media to raise public awareness and interest in this subject is advisable. It also considered that at the national level a regulatory framework needs to be in place which applies penalties and sanctions to vandalism. Also in order to conduct prosecutions or equipment recoveries there has to be a political will.

The Group **agreed** that ICGs need to work with the maritime authorities at the country level to look for ways and means of protecting from vandalism observational instruments that provide life-saving data.

The Group **further agreed** on the importance of the early warning data from tsunameters which for certain regions are critical for the confirmation of tsunami generation and prevention of false alarms. Vandalism should not dissuade countries from investing toward the deployment and operation of advanced ocean observation and hazard detection instruments.

The Group **agreed** to forward to the IOC Assembly a Draft Resolution on Ocean Observing System Vandalism (Annex II)

4. REPORTS OF THE INTER-ICG TASK TEAMS

4.1 INTER-ICG TASK TEAM ON SEA LEVEL

Mr Rick Bailey (Australia), Chair of the Inter ICG Task Team on Sea Level presented the report of the Task Team (available under Annex III). He recalled the task team's objectives including the development of guidelines on sea level monitoring requirements for operational purposes, to provide support for tsunami warning systems and the identification of principles and supporting pillars underpinning the guidelines. The report of the Task Team includes:

- Data Requirements for Tsunami Warnings
- Network Design
- Sea Level Station Siting
- Instrumentation

- Data Exchange and Archival/Formats
- Real Time Monitoring Requirements
- Quality Assurance
- Performance Monitoring

A comparison of the sea level measurement requirements across ICGs was made and there is convergence to a common set of requirements. In his presentation Mr Bailey indicated that it has been recommended that the status information of IOTWS/PTWS sea level stations should be updated frequently to inform the tsunami centres, for instance on a monthly basis. Several members of TOWS-WG stated that operational centres do need to know the frequency of the data received and the operational status of the instruments.

Another key point raised during the discussion that followed Mr Bailey's presentation is that sea level networks in support of coastal hazards sustainability/survivability needs to be considered. There is a pay-off between survivability and cost. The question of redundancy (quantity) vs. quality of the sea level instruments was also raised. In some regions there are high design criteria (i.e. requirements that a station can withstand hurricanes of certain strength) and the initial cost of establishing a station (capable of withstanding extreme events) can become high compared to a standard. GLOSS type station. In any case, a minimum core network of stations is required and for both network maintenance is an issue.

It was also highlighted that the sea level network should be denser in the subduction areas as their probability of being destroyed in a tsunami or earthquake is high. The size of the potential tsunami needs to be determined and the equipment should be adapted either for small or big tsunami waves (sensitive to small waves and resistant to big waves) otherwise there is a risk for the gauges to be washed away or easily destroyed.

The Task Team agreed that the transmission of information needs to be redundant and real-time especially near subduction areas where the timely warning is crucial. The format of data for the exchange of information should be standardized.

With respect to multi-hazard monitoring it was mentioned that instruments that cover the full spectrum of sea level hazards would certainly provide benefits, but their cost could outdo the benefit.

The completed Task Team report and its requirements should be forwarded to the GLOSS Group of Experts GE which will meet in November 2011.

4.2 INTER-ICG TASK TEAM ON DISASTER MANAGEMENT AND PREPAREDNESS

The report of the Task Team on Disaster Management and Preparedness (available under Annex IV) was presented by Dr Sam Hettiarachchi (Sri Lanka), on behalf of its Chairman Mrs. Irina Rafliana (Indonesia)

He indicated that the Task Team agreed that a round table should be organized on coastal hazards at the coming Global Platform for Disaster Risk Reduction (GPDRR), Geneva, Switzerland, 10-12 May 2011, including hazard prevention, mitigation and preparedness issues. Mr Hettiarachchi reported that with the support of the Secretariat and in cooperation with WMO a side event on early warning and coastal hazards in Asia is already scheduled for the GPDRR.

The Task Team agreed that Guidelines should be provided to the countries so they can develop their own Standard Operating Procedures (SOP). Linkages between the respective SOPs within countries should be strongly encouraged. While the Member States of each ICG hold full responsibility for issuing and responding to the tsunami alerts, coordination among

national SOPS of neighbours may allow greater efficiencies. To date around 17 SOP regional and national level workshops have been organized by IOC.

Mr Tony Elliott, Technical Secretary ICG/IOTWS recalled that the need for SOP was raised at the Post Indian Ocean Tsunami Assessment organised by IOC and several other partners in 2005. With funding from UNESCAP, two regional and ten national SOP trainings have been conducted within the Indian Ocean and South China Sea regions. Dr Lorna Inniss (Barbados), Chairperson ICG/CARIBE EWS indicated that with the support of USAID/OFDA and CDEMA, SOPs have been developed for tsunami and also for storm surges and applied in several countries in the Caribbean. Mr Rick Bailey (Australia), Vice Chair ICG/IOTWS noted that a similar effort is under development in the South West Pacific. Mr B. Aliaga commented that a critical point in end-to-end warning system is the institutional arrangements because EWS are addressing 4-5 different levels of SOPs, from national warning centres to community based SOPs.

Ms Maryam Golnaraghi from the World Meteorological Organization (WMO) indicated that most developing countries are in post-disaster mode and that little action in terms of preparedness and management is undertaken. However, this area is of extreme importance, and in spite of its difficulty to be standardized, it is important to promote joint action and work between and inside regions and countries through the establishment of Standard Operating Procedures (SOPs) particularly essential to Disaster Management.

Mr Hettiarachchi also pointed out that the Task Team indicated that risk assessment is where the civil defence community and scientists meet. Recent events have shown the importance of the subject and of understanding it. Partnerships between NGOs and agencies all the way down to insurance companies are very important in order to make the projects of risk management sustainable. ICGs need to reinforce the intergovernmental, international and national capabilities on hazard knowledge, exposure, and vulnerability. The geographic areas capable of generating great earthquakes and tsunamis must be identified.

The Task Team recommended that the relevant working group(s) within each ICG conduct a survey of the status of public awareness and response capacity among their Member States through a short questionnaire - to be completed by each Member State.

4.3 INTER-ICG TASK TEAM ON TSUNAMI WATCH OPERATIONS

Dr Srinivas Kumar (India), Chair of the Inter ICG Task Team on Tsunami Watch Operations, presented the report of the Task Team (available under Annex V). The report provides a detailed review of the current operational systems, and recommendations for global harmonization of products and terminologies.

For the IOTWS, the PTWC and JMA are currently the Interim Advisory Service providers but they are scheduled to be replaced by the RTSPs (Regional Tsunami Advisory Service Providers) of Australia, India and Indonesia by end-2011. At this time the RTSPs will take over primary responsibility for providing tsunami advisories to the IOTWS Member States. The ICG/IOTWS will decide on the criteria for the determination of threat status, and not the RTSPs.

At the moment, there are four levels of threat. An extra level could be considered for extreme events. Preparing the NTWCs is important through training workshops, exercises, SOP training. Standardization and harmonization of tsunami operations across the Regional Centres and across the ICGs is highly desirable. At the same time, the system should be flexible enough to include local and regional considerations, both scientific and logistical. Threat levels should be the responsibility of individual countries.

For the first tsunami alert bulletin, it is usually difficult to assess immediately and with accuracy the magnitude of an earthquake. This is why further investigation and local revision of

the earthquake characteristics is required following a seismic event. This seismic information is followed by sea-level observations in a later bulletin. The real-time sea level observations are key elements as they are used to help confirm the existence of a tsunami or cancel a tsunami warning. However, for small basins and other closed areas, there is not always enough time for confirmation or other bulletins. The first bulletin should therefore contain as much information as possible as there will only be time to read one bulletin, in particular the estimated arrival time and warning level at the tsunami forecast points.Timeliness of response of the systems is therefore critical in these areas. Numerical modelling tools should help determining the potential of threat. No earthquake bulletin should be issued for inland earthquakes.

The Group **endorsed** the reports of Inter-ICG Task Teams on Sea Level for Tsunami Purposes, Disaster Management and Preparedness, and on Tsunami Watch Operations and suggested these be forwarded to the ICGs for consideration when updating their Implementation Plans and Operational Users Guides and/or Communications Plans,

The Group **encouraged** the Inter-ICG Task Teams on Disaster Management and Preparedness and on Tsunami Watch Operations to continue their work **and recommended** the IOC Assembly to extend the period of work for the Inter ICG Task Team on Disaster Management and Preparedness, and on Tsunami Watch Operations.

The Group **recommended** the IOC Assembly to dissolve the Task Team on Sea Level as it has completed to the extent possible the work tasks given to it.

The Group **further recommended** that an Inter ICG Task Team on Tsunami Potential Assessment be established by the IOC Assembly with the Terms of Reference proposed under Annex VI.T

5. OTHER ISSUES

5.1 REPORT OF JMA ON THE PACIFIC COAST OFF TOHOKU EARTHQUAKE AND TSUNAMI, JAPAN, 11 MARCH 2011

Takeshi Koizumi from the Japan Meteorological Agency (JMA) made a preliminary report of the tsunami warning operations of JMA during the 2011 off the Pacific coast of Tohoku Earthquake.

Three minutes after the occurrence of the earthquake, JMA issued the first tsunami warning message, followed by several upgraded messages based on both re-calculations of the earthquake magnitude and the real observation of tsunamis. From the first warning message to the last one JMA issued 75 messages, followed by the 76th, which summarized the tsunami observations.

He stressed that there was around 30 minutes at the shortest between the first tsunami warning and the arrival of first significant tsunami waves, and many people were able to evacuate triggered by the tsunami warning messages. At the same time, though, the tsunami took a heavy toll of human lives. He indicated that there is room for further improvement of the whole tsunami warning system including transmission to the end users and evacuation.

He also introduced JMA's website http://www.jma.go.jp/jma/en/2011_Earthquake.html which contains the special pages of the Earthquake as well as tsunami warning messages and other related information.

Following the presentation of Mr Koizumi the Group exchanged views on the extremely short time that very great earthquakes leave for local populations to react. The importance of comprehensive tsunami early warning and mitigation systems as well as tsunami local preparedness and education was once more highlighted. The group found that improvements in

the area of assessment of high impact hazard potential, including identifying the sites of the largest geophysical and social threats, would be a real contribution to all tsunami and related hazard warning systems. This assessment should identify areas that could generate earthquakes of magnitude above 8Mw or slow earthquakes that are capable of generating destructive tsunamis. The purpose of the assessment was described as a means to develop a worse case scenarios and strategies that meet social responsibility.

Due to the lessons learned about cascading damages from such high impact earthquake to infrastructures the Group also discussed about the need to examine the ability to simulate vulnerabilities, risks and pre-calculate potential impacts for these larger events. Assessing the detection capacities for damaging currents and examination of the standard end-to-end sequence of processes for decision making in light of the experience of the 11 March 2011 event may be also recommendable. Members of TOWS-WG reminded that tsunami warnings should not be just about shoreline warnings but also about local inundation potential. It was recommended that hazard assessment identifying all high risk areas and subduction zones, with potential for large magnitude quakes, mega-tsunamis and extreme sea level events, be prioritized to inform science research and improved preparedness, structural mitigation in ports, and integrated coastal planning.

The Group **recommended** that an Inter ICG Task Team on Tsunami Potential Assessment be established by the IOC Assembly with the Terms of Reference proposed under Annex VI.

6. DATE AND PLACE OF THE NEXT MEETING

If the Assembly decides to continue the TOWS-WG it is proposed that the next meeting takes place at UNESCO Headquarters around March/April 2012 and in any case before the 45th IOC Executive Council.

7. CLOSURE OF MEETING

The Chairman thanked all the participants for attending the meeting and for their contributions. He expressed recognition to the IOC Secretariat, Bernardo Aliaga, Thorkild Aarup and Tony Elliott for their support.

ANNEX I

AGENDA

1 OPENING AND WELCOME

1.1 OPENING

1.2 ADOPTION OF AGENDA

1.3 WORKING ARRANGEMENTS

2. REPORTS FROM RELEVANT BODIES

2.1 REPORT FROM THE IOC BODIES

2.2 REPORT OF NON IOC BODIES

3. REVIEW OF PROGRESS

3.1 STATUS OF IMPLEMENTATION OF IOC RES.XXV.13 AND RESOLUTION EC XLIII.6

3.2 REVIEW OF COMPENDIUM OF DEFINITIONS AND TERMINOLOGY ON SEA-LEVEL-RELATED HAZARDS, DISASTERS, VULNERABILITY AND RISKS IN A COASTAL CONTEXT

3.3 REPORT OF THE INTERNATIONAL TSUNAMETER PARTNERSHIP AND THE DBCP, IN COORDINATION WITH JCOMM, ON OCEAN OBSERVING PLATFORM VANDALISM

4. REPORTS OF THE INTER-ICG TASK TEAMS

4.1 INTER-ICG TASK TEAM ON SEA LEVEL

4.2 INTER-ICG TASK TEAM ON DISASTER MANAGEMENT AND PREPAREDNESS

4.3 INTER-ICG TASK TEAM ON TSUNAMI WATCH OPERATIONS

5. OTHER ISSUES

5.1 JMA REPORT OF PACIFIC COAST OFF TOHOKU, JAPAN, 11 MARCH 2011

6. DATE AND PLACE OF THE NEXT MEETING

7. CLOSURE OF MEETING

ANNEX II[1]

DRAFT RESOLUTION ON OCEAN OBSERVING SYSTEM VANDALISM: INCIDENCE, IMPACT AND RESPONSES

Acknowledging that:

- States and the global community increasingly rely on a rapidly expanding ocean observing network of critical infrastructure and essential for sensing the environment and collecting the data needed to detect such marine hazards as storm surge and tsunamis for the protection of human life, communities, and property and used to promote marine-based and terrestrial economic activity, and to improve understanding of weather, climate and ecosystems;
- Ocean data buoy networks are an integral component of a sustainable, integrated, and comprehensive global ocean observing system serving multiple applications; and have proven essential to provide timely and geographically-specific data for decision making;
- Two-thirds of the world's moored ocean buoy stations and 90% of tsunameters have been installed in the last five years, but are especially susceptible to human-caused damage, which has resulted in extensive outages and data gaps in the global tsunami detection, early-warning system and mitigation system as well as marine meteorological and oceanographic services and predictions; and
- Vandalism to or unintentional damage of these ocean observing systems and data stations weaken and destabilize entire observing networks and warning systems, significantly increasing disaster risk that could cause loss of life and long-term negative social, economic and environmental consequences throughout the world especially for vulnerable coastal areas, communities and small island developing states;

Recognizing that the IOC of UNESCO, the WMO, the International Maritime Organization (IMO) and regional fisheries commissions have determined that damage to ocean observing networks takes many forms including ship impact damage, incidental damage (e.g., fouling from fishing lines, nets or cables), damage from direct exploitation of moorings as fish aggregation devices, intentional damage, and theft of entire systems or component parts;

Deeply concerned that the rate of damage is highest in the Indian Ocean, with over half of the 36 tsunameters in the newly established Indian Ocean Tsunami Warning System and Adjacent Seas network suffering at least one damage event in the last four years, resulting in over 18 platform-years of data loss and gaps in early warning coverage across the region;

Aware that damaged ocean observing stations and networks cause loss of critical ocean data, degraded weather and marine forecast capabilities, high cost of repair or replacement, and undermined confidence in the tsunami detection and warning system, which could result in significant loss of life and property, impacts to health and safety, and as well as costly evacuations and delayed response due to insufficient or corrupted data or incomplete information guiding timely or geographically appropriate action to tsunami and related multihazard;

Recalling the 2009 IOC Resolution XXV-13 on Global Coordination of Early Warning and Mitigation Systems for Tsunamis and other Sea-Level Related Hazards recognized the value of collecting and exchanging data and information, called for an: (a) inventory and assessment of

[1] Translations included in the same annex.

the problem of ocean observing platform vandalism globally; (b) an assessment of the impacts of such vandalism, including on the functionality of tsunami warning systems; (c) the annual cost of ocean observing platform vandalism to member States; and (d) recommendations for IOC and Member State action;

Recalling the 2010 WMO 62nd Executive Council Session decision of concern (para 3.4.1.) about the significant occurrence of intentional or unintentional damage to ocean observing systems that urged Members to help promote understanding of the impacts that seriously undermine efforts to establish national and regional ocean hazard warning systems and to coordinate with relevant organizations to take necessary action;

Noting the 2009 UN General Assembly Resolutions on Oceans and Law of the Sea (64/71, para 172) and on Sustainable Fisheries (64/72 para 109) that called on States and appropriate UN agencies to take appropriate action to address intentional and unintentional damage to ocean observing systems;

Encouraged by recent action of the Western and Central Pacific Fisheries Commission, the Inter-American Tropical Tuna Commission, and the Indian Ocean Tuna Commission to protect moored ocean observing systems;

Taking note with appreciation of the Report of the Data Buoy Cooperation Panel and International Tsunameter Partnership on Ocean Data Buoy Vandalism - Incidence, Impact and Responses (DBCP Technical Document No. 41);

Urges Member States and **invites** relevant International and Intergovernmental Organizations:

- In collaboration with educators and the global media, to develop communication plans and raise awareness of the critical value of ocean observation, to place more emphasis on avoiding the impacts of poorly performing ocean observation networks for disaster forecasting and verification, and to manage expectations for performance of early warning and mitigation systems due to vandalism and damage of key assets;
- To invest in strengthening and sustaining observation capacity, and to integrate data boy and tsunameter capabilities into all regional ocean observing systems to ensure data access and use;
- to adopt additional strategies for the hardening of ocean observing networks and systems and other damage prevention and mitigation practices including hardening station and infrastructure design, encourage use of alternative materials, and coordinate operational improvements and maintenance standards;
- To seek market, trade, and other commerce-based mechanisms to discourage transactions in vandalized equipment or derived materials;
- To enable and promote education and outreach, especially with recreational and commercial fisher, to broaden support of community stakeholders, enable proactive engagement at regional and local scales, and raise public literacy for ocean observing network-derived services and disaster risk reduction benefits;

Urges:

- States to make every practicable effort to improve regional network effectiveness, to reduce national and regional warning and information service vulnerability to individual station outages, including accelerated real-time continuous international data exchange and communication from all tsunameter platforms, gauges and related observing capabilities with appropriate data management and warning providers;

- States and maritime and fisheries authorities to address and emphasise vandalism and damage to ocean observing networks and impacts in national statues and legislation, harmonize their approaches and assess penalties based on level of risk and impact to life, health, property, and economies as appropriate, and cooperate to prevent, detect, deter, report, investigate and prosecute such acts of vandalism and damage;
- the Food and Agricultural Organization (FAO) and regional fisheries management organizations and bodies, especially those with the competence to manage highly migratory fisheries and educate and inform stakeholders, to adopt binding measures to prevent and minimize vandalism and damage to ocean observing networks and data systems;
- The FAO to cooperate with IOC and WMO to work regionally and locally through the tsunami ICGs and maritime and fisheries authorities, to develop tools and means to promote effective public awareness campaigns, education and outreach programs, and enforcement of measures adopted by regional fisheries management organizations to protect ocean observing platforms, and to enhance understanding and engagement of fishing communities to address this problem; and
- UN Agencies, including FAO and IMO, to work with IOC, WMO and States/Members regional and local fisheries committees and relate industry, Non-Governmental Organizations, and the media to share information and foster education and outreach to safeguard human lives and property through protecting the ocean observing networks and raising awareness and understanding of the value of ocean observation.

Requests the Executive Secretary of the IOC and **invites** the Secretary-General of WMO:

- To promote collection of more consistent and systematic statistics on vandalism, to increase capture and exchange of damage records and performance measures for ocean observing networks, and to conduct comprehensive cost benefit assessments and risk-value analysis taking into account life, health, social and economic impacts of vandalism and damage to ocean observing networks and data systems;
- To present the Report on Ocean Data Buoy Vandalism – Incidence, Impact and Responses to the United Nations General Assembly and promote an integrated UN approach to address this critical issue.

PROJET DE RÉSOLUTION SUR LE VANDALISME DU SYSTÈME D'OBSERVATION DE L'OCÉAN: FRÉQUENCE, IMPACT ET RÉPONSES

Notant que :

- les États et la communauté mondiale sont de plus en plus tributaires d'un réseau d'observation de l'océan en expansion rapide, dont l'infrastructure est d'une importance cruciale, et qui est indispensable à la surveillance continue de l'environnement et à la collecte des données dont on a besoin pour détecter les aléas marins, tels les ondes de tempête et les tsunamis, aux fins de la protection de la vie humaine, des populations et des biens, et que l'on utilise pour favoriser l'activité économique en milieu marin et à terre, et pour mieux comprendre les conditions atmosphériques, le climat et les écosystèmes,
- les réseaux océaniques de bouées de mesure sont partie intégrante d'un système mondial d'observation de l'océan durable, intégré et complet se prêtant à des applications multiples, et se sont avérés indispensables si l'on veut fournir en temps voulu et en fonction des données géographiquement spécifiques aux fins de la prise de décisions,
- les deux tiers des stations mondiales de bouées de mesure ancrées et 90 % des tsunamètres ont été installés au cours des cinq dernières années, mais sont particulièrement sujets à des dommages anthropiques, qui ont entraîné des interruptions prolongées de service et des données lacunaires dans le système mondial de détection et d'alerte aux tsunamis et de mitigation ainsi que dans les services et prévisions météorologiques maritimes et océanographiques,
- le vandalisme de ces systèmes d'observation de l'océan et stations de données ou les dommages non intentionnels qui leur sont causés affaiblissent et déstabilisent des réseaux d'observation et systèmes d'alerte entiers, augmentant sensiblement le risque de catastrophe qui pourrait entraîner, à travers le monde, des pertes de vies humaines et des conséquences à long terme néfastes sur les plans social, économique et environnemental, et en particulier pour les zones côtières vulnérables, les populations et les petits États insulaires en développement,

Reconnaissant que la COI de l'UNESCO, l'OMM et l'Organisation maritime internationale (OMI), et les commissions régionales des pêches ont établi que les dommages causés aux réseaux d'observation de l'océan se présentent sous de nombreuses formes, y compris le dommage causé par le choc de navires, le dommage occasionnel (par exemple les salissures dues aux lignes, filets ou câbles de pêche), le dommage causé par l'exploitation directe des mouillages en tant que dispositifs de regroupement de poissons, le dommage non intentionnel, et le vol de systèmes entiers ou d'éléments composants,

Profondément préoccupé par le fait que le taux de dommage est le plus élevé dans l'océan Indien, plus de la moitié des 36 tsunamètres dont est doté le réseau nouvellement mis en place du système d'alerte aux tsunamis de l'océan Indien et des mers adjacentes ayant subi au moins un cas de dommage au cours des quatre dernières années, ce qui se traduit par plus de 18 années/plate-forme de perte de données et de lacunes dans les données destinées à la couverture régionale de l'alerte aux tsunamis.

Conscient du fait que les dommages subis par les stations et réseaux d'observation de l'océan entraînent la perte de données océaniques vitales, entament les capacités de prévision météorologique et marine, occasionnent des frais élevés de réparation ou de remplacement, et sapent la confiance placée dans le système de détection et d'alerte aux tsunamis, ce qui pourrait se traduire par de grosses pertes en vies humaines et en biens, par des effets sur la santé et la sécurité, ainsi que par des évacuations coûteuses et une réponse tardive du fait que les données sont insuffisantes ou mutilées ou du caractère incomplet d'une information qui est

censée orienter en temps voulu une action adaptée à la situation géographique face au tsunami et multialéas associés,

Rappelant que la résolution XXV-13 de 2009 sur la coordination mondiale des systèmes d'alerte rapide aux tsunamis et autres aléas liés au niveau de la mer a reconnu l'intérêt de la collecte et de l'échange de données et d'information, et préconisé (a) un inventaire et une évaluation du problème du vandalisme des plates-formes d'observation de l'océan dans le monde ; (b) une évaluation des impacts de ce vandalisme, notamment sur le fonctionnement des systèmes d'alerte aux tsunamis ; (c) le coût annuel du vandalisme des plates-formes d'observation de l'océan pour les États membres ; et (d) des recommandations pour suite à donner de la part de la COI et les États membres,

Rappelant qu'à sa 62^{e} session, en 2010, le Conseil exécutif de l'OMM a exprimé (par. 3.4.1) sa préoccupation au sujet du nombre conséquent de cas de dommages intentionnels ou non intentionnels causés aux plates-formes d'observation de l'océan et exhorté les membres à aider à favoriser la compréhension de l'impact qui sape sérieusement les efforts visant à mettre en place des systèmes nationaux et régionaux d'alerte aux aléas océaniques, et à coordonner avec les organisations compétentes pour engager l'action nécessaire,

Notant que, par les résolutions de 2009 sur les océans et le droit de la mer (64/71, par. 172) et sur les pêches durables (64/2, par. 109), l'Assemblée générale des Nations Unies a demandé aux États et aux organismes compétents des Nations Unies de prendre des mesures appropriées pour combattre les dommages intentionnels et non intentionnels causés aux systèmes d'observation de l'océan,

Encouragé par l'action que la Commission des pêches du Pacifique occidental et central, la Commission interaméricaine du thon tropical et la Commission des thons de l'océan Indien a engagée récemment pour protéger les systèmes ancrés d'observation de l'océan,

Prenant note, en l'appréciant, du rapport du Groupe de coopération pour les programmes de bouées de mesure (DBCP) et du Partenariat international pour les tsunamètres sur le vandalisme des plates-formes d'observation de l'océan – fréquence, impact et réponses (document technique n° 41 du DBCP),

Exhorte les États membres et **invite** les organisations internationales et intergouvernementales compétentes :

- à élaborer, en collaboration avec les éducateurs et les médias mondiaux, des plans de communication et à faire prendre davantage conscience de l'intérêt vital de l'observation de l'océan, à s'attacher davantage à éviter les effets d'un fonctionnement médiocre des réseaux d'observation de l'océan sur la prévision et la vérification des catastrophes, et à gérer les attentes du fonctionnement des systèmes d'alerte rapide et de mitigation imputables au vandalisme et au dommage subi par les biens et avoirs clés ;
- à s'investir dans le renforcement et la pérennisation de la capacité d'observation, et à intégrer les dotations en bouées de mesure et en tsunamètres de tous les systèmes régionaux d'observation de l'océan afin de garantir l'accès aux données et à leur utilisation ;
- à adopter des stratégies supplémentaires pour consolider les réseaux et systèmes d'observation de l'océan et d'autres pratiques de prévention des dommages et de mitigation, y compris la consolidation, au stade de la conception, de la station et de la structure, à encourager l'utilisation de matériaux de rechange, et à coordonner les améliorations opérationnelles et les normes d'entretien ;

- à prospecter le marché, les échanges et d'autres mécanismes à caractère commercial pour décourager les transactions portant sur du matériel vandalisé ou des matériaux en provenant ;
- à permettre et à favoriser l'éducation et la mobilisation des publics, en particulier auprès du pêcheur – celui qui pratique la pêche à des fins récréatives et celui qui la pratique à des fins commerciales, à élargir la base du soutien des parties prenantes de la population, à permettre l'engagement proactif à l'échelle régionale et locale, et à faire mieux percevoir au public les services découlant du réseau d'observation de l'océan et des avantages tirés de la réduction du risque de catastrophe ;

Prie instamment :

- les États de tout mettre en œuvre pour améliorer l'efficacité du réseau régional, réduire la vulnérabilité du service national et régional d'alerte et d'information à des interruptions de service de stations individuelles, y compris l'échange et la communication internationaux, continus, accélérés et en temps réel, des données en provenance de toutes les plates-formes de tsunamètres, marégraphes et capacités d'observations connexes avec les prestataires appropriés de gestion de données et émetteurs d'alertes ;
- les États et les autorités maritimes et autorités des pêches de combattre le vandalisme et les dommages causés aux réseaux d'observation de l'océan, et d'autres effets, et de les mettre au ban dans leur réglementation et législation nationales, d'harmoniser leurs démarches et d'évaluer les sanctions en fonction du niveau de risque et de l'effet sur la vie, la santé, les biens et l'économie, selon le cas, et de coopérer pour prévenir, détecter, dissuader, signaler, enquêter sur et poursuivre en justice ces actes de vandalisme et dommages ;
- l'Organisation des Nations Unies pour l'alimentation et de l'agriculture (FAO) et les organismes et organes régionaux de gestion des pêches, en particulier ceux qui ont une compétence en matière de gestion des pêches fortement migratoires, d'éduquer et d'informer les parties prenantes, d'adopter des mesures contraignantes pour prévenir et réduire à un minimum le vandalisme et les dommages causés aux réseaux d'observation de l'océan et systèmes de données ;
- la FAO de coopérer avec la COI et l'OMM en s'employant, aux niveaux régional et local, par l'intermédiaire des GIC tsunamis et les autorités maritimes et les autorités des pêches, à élaborer des outils et des moyens pour favoriser des campagnes efficaces de sensibilisation du public, des programmes d'éducation et de mobilisation des publics , et la mise en application des mesures adoptées par les organismes régionaux de gestion des pêches pour protéger les plates-formes d'observation de l'océan et pour améliorer la compréhension du problème et l'engagement des milieux de la pêche à s'y attaquer ; et
- les organismes des Nations Unies, y compris la FAO et l'OMM, de travailler avec la COI, l'OMM et les États membres, les commissions régionales et locales des pêches et l'industrie correspondante, les organisations non gouvernementales, et les médias à la mise en commun de l'information, et de favoriser l'éducation et la mobilisation des publics pour sauvegarder les vies humaines et les biens en protégeant les réseaux d'observation de l'océan et en faisant prendre davantage conscience de l'intérêt de l'observation de l'océan et mieux le comprendre ;

Prie la Secrétaire exécutive de la COI et **invite** le Secrétaire général de l'OMM à :

- favoriser la collecte de statistiques plus cohérentes et plus systématiques sur le vandalisme, à augmenter la constitution et l'échange de dossiers de cas de dommage et les mesures de performance des réseaux d'observation de l'océan, et procéder, sous tous les aspects, à des évaluations du coût-avantages et à une analyse des risques et valeur en prenant en compte les effets sur la vie, la santé et sur le plan social et économique, du vandalisme et des dommages qu'il cause aux réseaux d'observation de l'océan et systèmes de données ;
- soumettre le rapport sur le vandalisme des plates-formes d'observation de l'océan – fréquence, impact et réponses à l'Assemblée générale des Nations Unies et encourager une démarche intégrée des Nations Unies face à ce problème, qui est d'une importance cruciale.

PROYECTO DE RESOLUCIÓN SOBRE EL VANDALISMO CONTRA EL SISTEMA DE OBSERVACIÓN DE LOS OCÉANOS: FRECUENCIA, REPERCUSIONES Y RESPUESTAS

Reconociendo que:

- los Estados y la comunidad mundial recurren cada vez más a una red de observación de los océanos en rápida expansión, que cuenta con una infraestructura de gran importancia y resulta esencial para la observación del medio ambiente y el acopio de los datos necesarios para detectar peligros marinos como mareas tormentosas y tsunamis, con el fin de proteger vidas humanas, comunidades y bienes, y que se utiliza para promover actividades económicas marinas y terrestres y mejorar la comprensión sobre las condiciones meteorológicas, el clima y los ecosistemas;
- las redes de boyas para la obtención de datos oceanográficos son parte integrante de un sistema mundial de observación de los océanos sostenible, integrado y global que cumple diversas funciones, y que ha resultado esencial para el suministro de datos oportunos y específicos desde un punto de vista geográfico para la toma de decisiones;
- dos tercios de las boyas ancladas para la obtención de datos oceanográficos del mundo y el 90% de los tsunámetros se han instalado en los últimos cinco años, pero son particularmente vulnerables a los daños causados por el ser humano, lo que provocó interrupciones prolongadas de servicio e insuficiencias de datos en el sistema mundial de detección de tsunamis, de alerta temprana y de atenuación de los efectos, así como en los servicios y predicciones meteorológicos marinos y oceanográficos;
- el vandalismo contra dichos sistemas de observación de los océanos y estaciones para la obtención de datos, o los daños involuntarios que éstos sufren, debilitan y desestabilizan las redes de observación y los sistemas de alerta en su totalidad, lo que incrementa significativamente los peligros de desastres que pueden ocasionar pérdidas de vidas y tener consecuencias sociales, económicas y ecológicas negativas a largo plazo en todo el planeta, en particular en zonas costeras vulnerables, comunidades y pequeños Estados insulares en desarrollo;

Reconociendo que la COI de la UNESCO, la Organización Meteorológica Mundial (OMM), la Organización Marítima Internacional (OMI) y las comisiones regionales de pesca han determinado que el daño a las redes de observación de los océanos reviste diversas formas, entre ellas los daños ocasionados por colisiones de buques, los daños accidentales (por ejemplo, el ensuciamiento causado por líneas, redes o cables de pesca), los daños ocasionados debido a la utilización directa de las boyas como dispositivos de concentración de peces, los daños intencionales, y el robo de los sistemas en su totalidad o alguna de sus componentes,

Manifestando su profunda preocupación por el hecho de que la mayor frecuencia de daños tiene lugar en el Océano Índico, donde más de la mitad de los 36 tsunámetros de la red recientemente creada del sistema de alerta contra tsunamis en el Océano Índico y sus mares adyacentes ha sufrido daños por lo menos una vez en los últimos cuatro años, lo que ha ocasionado una pérdida de un equivalente de más de 18 años de transmisión e insuficiencias de datos en relación con la alerta temprana en la región,

Consciente de que los daños a las estaciones y redes de observación de los océanos ocasionan una pérdida de datos esenciales sobre los océanos, un menoscabo de la capacidad de formular previsiones meteorológicas y marinas, altos costos de reparación o reemplazo y una confianza socavada en la detección y el sistema de alerta contra los tsunamis, que podría resultar en pérdidas importantes de vidas y bienes, repercusiones en la salud y la seguridad, así

como evacuaciones costosas y respuestas tardías debidas a datos insuficientes o defectuosos o al carácter incompleto de una información que es necesaria para orientar en su debido momento una respuesta apropiada desde un punto de vista geográfico frente a un tsunami y los peligros múltiples conexos,

Recordando que en la Resolución XXV-13 de 2009 de la COI sobre la coordinación mundial de los sistemas de alerta temprana contra los tsunamis y otros peligros relacionados con el nivel del mar y atenuación de sus efectos se reconoció la importancia del acopio e intercambio de datos e información, y se encargó que se preparara un informe que comprendiera: a) un inventario y una evaluación del problema del vandalismo contra las plataformas de observación oceánica en todo el mundo; ii) una evaluación de las repercusiones de dicho vandalismo, en particular en el funcionamiento de los sistemas de alerta contra los tsunamis; iii) el costo anual para los Estados Miembros del vandalismo contra las plataformas de observación oceánica; iv) recomendaciones sobre las medidas que han de tomar al respecto la COI y los Estados Miembros,

Recordando la preocupación expresada por el Consejo Ejecutivo de la OMM en su 62ª reunión en 2010 (párr. 3.4.1.) por los casos significativos de daño intencional o no intencional causado a las plataformas utilizadas para la observación de los océanos, en la que instó a los Miembros a que ayudaran a promover la comprensión de los impactos que minan gravemente los esfuerzos destinados a establecer sistemas oceánicos nacionales y regionales de aviso de riesgos y a coordinar con las organizaciones pertinentes la adopción de las medidas necesarias,

Tomando nota de las resoluciones de 2009 de la Asamblea General de las Naciones Unidas sobre los océanos y el derecho del mar (64/71, párrafo 172) y sobre la pesca sostenible (64/72, párrafo 109), en las que se insta a los Estados y organizaciones competentes de las Naciones Unidas a adoptar las medidas necesarias para hacer frente a los daños intencionales o involuntarios que sufren las plataformas utilizadas con fines de observación de los océanos,

Alentada por la acción emprendida recientemente por la Comisión de Pesca del Océano Pacífico Occidental y Central, la Comisión Interamericana del Atún Tropical y la Comisión del Atún para el Océano Indico encaminada a proteger los sistemas fijos de observación de los océanos,

Tomando nota con reconocimiento del Informe del Panel de Cooperación sobre Boyas de Acopio de Datos y el International Tsunameter Partnership titulado “Ocean Data Buoy Vandalism - Incidence, Impact and Responses” (Documento técnico del DBCP Nº 41),

Insta a los Estados Miembros e **invita** a las organizaciones internacionales e intergubernamentales competentes a:

- elaborar, en colaboración con educadores y los medios de comunicación mundiales, planes de comunicación y sensibilizar sobre el valor fundamental de la observación de los océanos, hacer mayor hincapié en evitar las consecuencias que se derivan de deficiencias en el funcionamiento de las redes de observación de los océanos para la previsión y confirmación de desastres, y supervisar las expectativas de funcionamiento de los sistemas de alerta temprana y atenuación afectados por el vandalismo y el daño de elementos esenciales;
- invertir en el refuerzo y mantenimiento de la capacidad de observación, e integrar en todos los sistemas regionales de observación de los océanos capacidades de aprovechamiento de las boyas de acopio de datos y los tsunámetros, a fin de garantizar la accesibilidad y utilización de los datos;
- adoptar estrategias adicionales para fortalecer las redes y sistemas de observación de los océanos y otras prácticas de prevención y atenuación de daños, en

particular dando mayor robustez al diseño de las plataformas e infraestructuras, promover el uso de materiales alternativos y coordinar mejoras operativas y normas de mantenimiento;

- buscar los medios de disuadir las transacciones de equipos vandalizados o materiales procedentes de éstos en los mercados, el comercio y ámbitos afines;
- facilitar y promover las actividades de educación y divulgación, dirigidas especialmente a los pescadores aficionados y profesionales, a fin de ampliar el respaldo de las comunidades interesadas, fomentar una participación dinámica en los planos regional y local, y sensibilizar al público sobre los servicios que prestan las redes de observación de los océanos y los beneficios derivados de la reducción del riesgo de desastres;

Insta a:

- los Estados a que hagan todos los esfuerzos posibles por mejorar la eficacia de las redes regionales, reducir la vulnerabilidad del servicio nacional y regional de alerta e información a las interrupciones de servicio de plataformas individuales, y acelerar el intercambio y la comunicación internacionales, en tiempo real y continuo de datos procedentes de todos los tsunámetros y mareómetros y sus capacidades de observación conexas, con los administradores de datos y proveedores de alertas pertinentes;
- los Estados y autoridades marítimas y pesqueras a que se enfrenten y presten la debida atención en las disposiciones y leyes nacionales al vandalismo y al daño a las redes de observación de los océanos y sus repercusiones, armonicen sus enfoques y evalúen las sanciones sobre la base del nivel de riesgo y las consecuencias para la vida, la salud, los bienes y la economía, según proceda, y cooperen para prevenir, detectar, disuadir, denunciar, investigar y enjuiciar los actos de vandalismo y los daños;
- la Organización de las Naciones Unidas para la Agricultura y la Alimentación (FAO) y las organizaciones y los órganos regionales de ordenación de la pesca, en especial los que tienen las competencias necesarias en materia de gestión de las poblaciones de peces altamente migratorias y educación e información de las partes interesadas, a que tomen medidas vinculantes para prevenir y minimizar el vandalismo y los daños a las redes de observación de los océanos y los sistemas de datos;
- la FAO a que coopere con la COI y la OMM, con miras a trabajar en los planos regional y local por conducto de los GIC dedicados a los tsunamis y las autoridades marítimas y pesqueras, elabore herramientas y establezca medios para promover campañas eficaces de sensibilización pública, programas de educación y divulgación y la aplicación de las medidas adoptadas por las organizaciones regionales de ordenación de la pesca para proteger las plataformas de observación de los océanos, mejorar la comprensión del problema y afianzar el compromiso de las comunidades pesqueras para hacerle frente;
- los organismos de las Naciones Unidas, en especial la FAO y la OMI, a que trabajen con la COI, la OMM y los Estados Miembros, los comités regionales y locales de pesca y la industria conexa, las organizaciones no gubernamentales y los medios de comunicación para intercambiar información y promover la educación y la divulgación, con miras a preservar vidas humanas y bienes, mediante la protección de las redes de observación de los océanos y la sensibilización y concienciación sobre el valor de la observación de los océanos.

Invita a la Secretaria Ejecutiva de la COI y al Secretario General de la OMM a:

- promover el acopio de estadísticas más coherentes y sistemáticas sobre el vandalismo, incrementar la elaboración y el intercambio de expedientes de casos de daños y las mediciones de rendimiento de las redes de observación de los océanos, y realizar evaluaciones completas de costo-beneficio y análisis de riesgos con respecto al valor tomando en consideración la vida, la salud y las repercusiones sociales y económicas del vandalismo, así como los daños que éste ocasiona a las redes de observación de los océanos y los sistemas de datos;
- presentar el informe “Ocean Data Buoy Vandalism - Incidence, Impact and Responses” a la Asamblea General de las Naciones Unidas y promover un enfoque integrado de las Naciones Unidas para hacer frente a esta cuestión crucial.

ПРОЕКТ РЕЗОЛЮЦИИ ПО ВОПРОСУ О ВАНДАЛИЗМЕ В ОТНОШЕНИИ СИСТЕМ ОКЕАНИЧЕСКИХ НАБЛЮДЕНИЙ: РАСПРОСТРАНЕННОСТЬ, ПОСЛЕДСТВИЯ И ОТВЕТНЫЕ МЕРЫ

признавая, что:

- государства и всемирное сообщество во все большей степени полагаются на быстро расширяющуюся сеть океанических наблюдений в качестве ключевой инфраструктуры, играющей важную роль в выявлении состояния окружающей среды и сборе данных, необходимых для установления таких опасностей в морской среде, как штормовые нагоны и цунами, в целях защиты жизни людей, сообществ и имущества, а также в использовании таких данных для содействия экономической деятельности в морской среде и на суше и в совершенствовании понимания погодных условий, климата и экосистем,
- сети буев для сбора океанических данных являются неотъемлемой составной частью устойчиво работающей, комплексной и всеобъемлющей глобальной системы океанических наблюдений, служащей решению многочисленных задач, которая доказала свою важность с точки зрения предоставления своевременных и географически привязанных данных, необходимых для принятия решений,
- за последние пять лет две трети из имеющихся в мире океанских станций заякоренных буев и 90% цунамометров подвергаются угрозе нанесения людьми ущерба, что уже привело к возникновению широкого чувства негодования и возникновению пробелов в данных, необходимых для решения глобальной задачи обнаружения цунами, сбоям в функционировании систем раннего предупреждения и смягчения последствий стихийных бедствий, а также к нарушению работы морских метеорологических и океанографических служб, что отразилось на делаемых ими прогнозах, а также, что
- вандализм в отношении систем океанических наблюдений и станций по сбору данных или непреднамеренное нанесение им ущерба ослабляют и дестабилизируют работу всех сетей наблюдений в целом, а также систем предупреждения об опасных явлениях, что влечет за собой существенное повышение риска ущерба в результате стихийных бедствий, которые могут привести к потере жизней и долгосрочным негативным социальным, экономическим и экологическим последствиям во всем мире, но особенно для сообществ, проживающих в уязвимых прибрежных районах, а также для малых островных развивающихся государств,

признавая, что МОК/ЮНЕСКО, ВМО, Международная морская организация (ИМО) и региональные комиссии по рыболовству пришли к мнению, что ущерб, наносимый сетям океанических наблюдений, имеет многочисленные формы, включая ущерб, наносимый столкновениями с морскими судами, непреднамеренный ущерб (например, ущерб в результате воздействия рыболовных снастей, сетей или кабелей), ущерб в результате закрепления на якоре различных устройств для агрегации рыбы, а также преднамеренный ущерб и даже кража систем полностью или их составных частей,

будучи глубоко озабоченной тем, что наиболее высокий уровень наносимого ущерба отмечается в Индийском океане, в результате которого пострадали – по крайней мере, хотя бы один раз за последние четыре года – более половины из 36 цунамометров, являющихся частью недавно созданной сети, развернутой в рамках Системы предупреждения о цунами в Индийском океане и прилегающих морях, в результате чего было потеряно более 18 платформ-лет данных и возникли пробелы в охвате данного региона системой раннего предупреждения,

сознавая, что ущерб, наносимый станциям и сетям океанических наблюдений, приводит к потере имеющих решающее значение данных об океане, деградации возможностей прогнозирования погоды и состояния моря, высоким расходам на ремонт и замену поврежденного оборудования, а также подрывает доверие к надежности системы обнаружения и предупреждения о цунами, что может привести к существенным потерям жизней людей и ущербу для имущества, воздействовать на здоровье и безопасность людей, а также приводит к необходимости дорогостоящей эвакуации и задержкам в реагировании из-за недостаточности или искаженности получаемых данных или в результате неполной информации, требующихся для принятия своевременных и географически привязанных мер применительно к цунами и другим разнообразным рискам,

ссылаясь на принятую в 2009 г. резолюцию Ассамблеи МОК XXV-13 «Глобальная координация систем раннего предупреждения и смягчение последствий цунами и других опасных явлений, связанных с уровнем моря», в которой признается значение мер по сбору и обмену данными и информацией, и содержится призыв к (a) составлению перечня случаев умышленной порчи платформ для океанических наблюдений и оценке масштабов этой проблемы; (b) проведению оценки воздействия такого вандализма, в том числе на функциональность систем предупреждения о цунами; (c) установлению расходов, которые государства-члены вынуждены нести в связи с умышленной порчей платформ для наблюдений; и (d) разработке рекомендации для действий МОК и государств-членов,

ссылаясь на принятое в 2010 г. 62-й сессией Исполнительного совета ВМО решение (пункт 3.4.1) относительно участившихся случаев нанесения преднамеренного и непреднамеренного ущерба системам наблюдений за океаном, в котором члены ВМО призывались содействовать усилению понимания последствий указанного ущерба, серьезно подрывающего усилия по созданию национальных и региональных систем предупреждения о стихийных бедствиях, и в котором содержится призыв координировать принятие необходимых мер с соответствующими организациями,

принимая к сведению принятые в 2009 г. Генеральной Ассамблеей Организации Объединенных Наций резолюцию по теме «Мировой океан и морское право» (64/71, пункт 172) и резолюцию «Обеспечение устойчивого рыболовства» (64/72, пункт 109), содержащих призыв к государствам и соответствующим учреждениям ООН принять необходимые меры с целью решения вопроса о преднамеренном или непреднамеренном нанесении ущерба системам океанических наблюдений,

будучи воодушевленной недавно принятыми Комиссией по рыболовству в западной и центральной частях Тихого океана, Межамериканской комиссией по тропическому тунцу и Комиссией по тунцу Индийского океана мерами по защите заякоренных систем океанических наблюдений,

принимая к сведению с удовлетворением доклад Группы сотрудничества по буям для сбора данных и Международного цунамометрического партнерства «Вандализм в отношении буев для сбора океанических данных – распространенность, последствия и ответные меры (технический документ № 41 ДБКП),

настойчиво призывает государства-члены и предлагает соответствующим международным и межправительственным организациям:

- в сотрудничестве с работниками образования и средств информации всех стран мира разработать планы по коммуникации и углубить осознание

имеющих непреходящую ценность наблюдений за океаном, делать бóльший акцент на то, чтобы избегать воздействия на сети океанических наблюдений вандализма и ущерба, приводящих к ухудшению прогнозирования ими бедствий и проверки собираемой информации, а также подрыву ожиданий, связанных с эффективностью систем раннего предупреждения о стихийных бедствиях и смягчения их последствий;

- инвестировать в усиление и обеспечение стабильности потенциала наблюдений, а также интегрировать возможности буев по сбору данных и цунамометров во все региональные системы океанических наблюдений с целью обеспечения доступа к данным и их использованию;
- принять дополнительные стратегии по укреплению сетей океанических наблюдений и по предотвращению нанесения им ущерба, включая улучшение проектирования станций и связанной с ними инфраструктуры, содействие использованию альтернативных материалов, а также путем координации оперативных усовершенствований и эксплуатационных норм;
- изыскивать рыночные, торговые и другие основанные на коммерции механизмы, позволяющие предотвращать трансакции с подвергшимся вандализму оборудованием и извлеченными материалами;
- придать эффективность и содействовать проведению образовательных мероприятий, а также информационно-разъяснительной работы, особенно среди предприятий, занимающихся организацией досуга на море и коммерческим рыболовством, с целью расширения поддержки со стороны общинных участников, их активного участия на региональном и местном уровнях и повышения осознания общественностью важности работы служб и сетей океанических наблюдений и той пользы, которую могут приносить меры по уменьшению опасности стихийных бедствий;

настойчиво призывает:

- государства принимать любые практические меры с целью повышения эффективности региональных сетей, уменьшения уязвимости национальных и региональных служб предупреждения и информации об отдельных случаях вандализма в отношении станций наблюдений, включая ускоренный международный обмен данными, получаемыми от всех цунамометров, датчиков и других платформ океанических наблюдений, осуществляемый на постоянной основе в режиме реального времени, с теми, кто отвечает за управление соответствующими данными и обеспечение предупреждений;
- государства, а также организации, отвечающие за судоходство и рыболовство, заниматься вопросами, связанными с вандализмом и ущербом, наносимым сетям наблюдений за океаном, а также их воздействием на национальные нормы и законодательство, гармонизировать свои подходы к этим вопросам и изучить вопрос о санкциях, исходя из уровня риска и воздействия на жизнь, здоровье человека, имущество и экономику, а также сотрудничать между собой с целью предотвращения, выявления, информирования, расследования и преследования тех, кто совершает акты вандализма или наносит ущерб;
- Продовольственную и сельскохозяйственную организацию Объединенных Наций (ФАО), а также региональные рыбохозяйственные организации и органы, особенно тех из них, которые регулируют промысел мигрирующих видов рыб, проводить информационную и разъяснительную работу среди активных участников этих органов и организаций, с целью принятия обязательных к исполнению мер по предотвращению и минимизации ущерба

и вандализма в отношении сетей океанических наблюдений и систем сбора данных;

- ФАО сотрудничать с МОК и ВМО, с тем чтобы совместно работать на региональном и местном уровнях, действуя через МКГ по цунами и учреждения по судоходству и рыболовству с целью разработки инструментов и средств, имеющих целью содействовать проведению эффективных кампаний среди общественности, а также образовательных и информационных программ, включая усиление мер, принимаемых региональными рыбохозяйственными организациями по защите платформ океанических наблюдений, углублять понимание и ангажированность рыболовных сообществ в решении этой проблемы; и
- учреждения ООН, включая ФАО и ИМО, взаимодействовать с МОК, ВМО и региональными и местными комитетами по рыболовству государств-членов и связанным с ними промышленными кругами, неправительственными организациями и средствами информации обмениваться информацией, а также способствовать проведению образовательных и информационных мероприятий, имеющих целью сохранение человеческих жизней и имущества путем охраны сетей океанических наблюдений и углубления осознания и понимания ценности океанических наблюдений;

просит Исполнительного секретаря МОК и предлагает Генеральному секретарю ВМО:

- содействовать сбору более последовательных и систематических статистических данных в отношении вандализма, расширять поступление и обмен данными о наносимом ущербе и мерах по повышению эффективности сетей океанических наблюдений, а также проводить всеобъемлющий функционально-стоимостный анализ рисков для человеческой жизни, здоровья человека, социальных и экономических последствий вандализма и ущерба, наносимого сетям океанических наблюдению и системам по сбору данных;
- представить доклад «Вандализм в отношении буев для сбора океанических данных – распространенность, последствия и ответные меры» Генеральной Ассамблее Организации Объединенных Наций, а также содействовать комплексному подходу со стороны ООН к решению этой имеющей большое значение проблемы

ANNEX III

REPORT OF THE INTER-ICG TASK TEAM 1 ON SEA LEVEL MONITORING FOR TSUNAMI

1 INTRODUCTION

1.1 WORKING GROUP ON TSUNAMI AND OTHER HAZARDS RELATED TO SEA-LEVEL WARNING AND MITIGATION SYSTEMS (TOWS-WG)

IOC Resolution XXIV-14, based on findings of the ad hoc Working Group, approved a proposal for the establishment of a permanent global Working group on Tsunami and other hazards related to Sea-level Warning and Mitigation Systems (TOWS-WG). It comprises representatives of all relevant IOC subsidiary bodies and those from UN sister agencies, like ISDR and WMO, as well as representatives of relevant stakeholders.

IOC charged its Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems (TOWS-WG) to review the governance and organization of the Intergovernmental Coordination Group (ICG) of all Tsunami Warning & Mitigation Systems to ensure common operation explore synergy effects and mainstream in particular the upstream activities, i.e. detection and verification, into existing ocean observing systems

The IOC XXV Assembly adopted Resolution XXV-13 in 2009, which decided to establish the following Task Teams:

- Inter-ICG Task Team on Sea Level for Tsunami
- Inter-ICG Task Team on Disaster Management and Preparedness
- Inter-ICG Task Team on Tsunami Watch Operations

The establishment of these task teams was to meet the need for and the benefit from enhanced coordination, common requirements, and exchange knowledge and information among the ICGs.

1.2 INTER-ICG TASK TEAM ON SEA LEVEL FOR TSUNAMI

Terms-of-Reference:

(i) Develop requirements for tsunami warning system sea-level data, and all characteristics of the data stream including networks and network design, for the information of relevant technical implementation groups, such as Global Sea Level Observing System (GLOSS) and International tsunameter Partnership (ITP) of the Data Buoy Cooperation Panel (DBCP), the ICG working groups and national sea level authorities;

(ii) Review the provision and availability of sea-level data as they pertain to tsunami warning systems and provide advice, as appropriate, to GLOSS, ITP and the ICGs;

(iii) Provide a focus for sea-level issues amongst ICGs;

(iv) Provide a report to TOWS-WG in advance of its 3rd Meeting, in 2010 (now 4th Meeting Feb/March 2011).

Membership of TOWS-WG Task Team 1 on Sea Level for Tsunami:

Rick Bailey (PTWS/Australia) (Chair)

Allison Allen (CARIBE-EWS/USA)

David Farrell (CARIBE-EWS/Barbados)

Begoña Perez (NEAMTWS/Spain)

Ronan Créach (NEAMTWS/France)

Parluhutan Manurang (IOTWS/Indonesia)

Atma (IOTWS/India)

Simon Holgate (GLOSS/UK)

Secretariat – Thorkild Aarup (IOC)

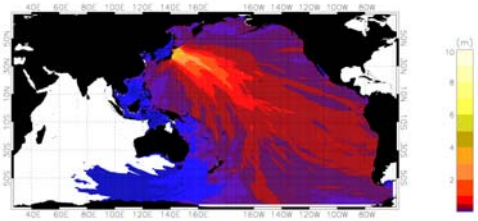
Objectives:

(i) Develop guidelines on sea level monitoring requirements for operational groups (GLOSS and ITP) to provide ongoing support for tsunami warning systems.

(ii) Identify principles and supporting pillars to underpinning the Guidelines.

Core Reference Material:

- ICG Implementation Plans
- ICG WG reports
- ICG/IOTWS RTWP Implementation Plan
- IOC Manual & Guides 14: Manual on Sea Level Measurements & Interpretation Vol 4
- OCEANOBS 09 Paper “Tsunami Resilient Communities”
- ICG Member State national reports and guides



2 SEA LEVEL DATA REQUIREMENTS FOR TSUNAMI WARNINGS

The TOWS-WG Inter-ICG Task Team 3 on Tsunami Watch Operations has recommended the greater use of forecast models to provide enhanced guidance for tsunami warning centres on the likely tsunami threat. This places new requirements on sea level monitoring for tsunami warnings.

Tsunami warning systems that are based mainly on earthquake magnitude and Tsunami Travel Time (TTT) maps require a complete tsunami wavelength to be recorded at a monitoring site to be able to verify tsunami generation. This can use up valuable warning time during an event.

Forecast model-based tsunami warning systems only require preliminary indication of a sea level anomaly for the sea level observations to verify generation of a tsunami as forecast by the models. A measure of the full wavelength can subsequently be utilised by data assimilation or visual comparison techniques to validate or modify the initial tsunami threat forecast.

Given the forecast model requirements, the physical nature of tsunami waves, the different scales of tsunami effects, the timing and the practical requirements for issuing warnings, the following basic requirements were developed for tsunami warnings:

Core Data Requirements:

Sampling
- Coastal tide gauge = <1 min
- Deep ocean tsunameter = 15 sec

Accuracy
- Coastal tide gauge = +/-10 cm (+/- 1 cm for multipurpose)
- Deep ocean tsunameter = +/- 1 mm

Transmission frequency (relative to distance/travel time from source)
= < 1 min (local tsunami) for < 15 min TTT
= < 5 mins for < 1hr TTT or 100km distance from tsunami source
= <15 mins for > 1 hr TTT or 100km distance from tsunami source
where TTT = Tsunami Travel Time

Internal latency = <2-3 mins

3 SEA LEVEL NETWORK REQUIREMENTS

The following principles should be considered when designing and implementing sea level monitoring networks in support of tsunami warning systems:

Scientifically designed

- Utilise optimal design methodologies to minimise tsunami verification time, maximise warning time and resource utilisation
- Must be ocean basin specific, recognising the different tsunami sources and warning time imperatives.

Combination of coastal and deep-ocean monitoring

- Coastal tide gauges can be used to verify generation of a tsunami. They provide information on the local response to a tsunami generated by a source close-by or far-field. They can also be used to monitor when the tsunami threat has passed.
- The local response signal from coastal tide gauges, however, is difficult to use to verify offshore tsunami wave characteristics required for tsunami forecast verification. Hence the requirement and implementation of more deep ocean tsunameters in recent years.
- Deep ocean tsunami detection buoys, commonly referred to as “tsunameters”, provide best information on open ocean tsunami wave characteristics, as the signal has not been conditioned by shallow water bathymetry. The tsunameter sea level information is therefore the most appropriate information for comparison to, or assimilation in numerical tsunami models to forecast wave heights and basin wide propagation characteristics.

Enable verification of tsunami generation at locations close to source

- Warning timeliness dictates a requirement for sea-level measurement sites to be located as close to the source of the seismic event as possible. Delays in monitoring the progress of the wave, due to the wave travelling over shallow water or the choking of harbours, also needs to be avoided. It is important to note that the locations should not be so close to the source that the station could be destroyed by the initiating quake.

Monitor progress of tsunami propagation across an ocean basin

- The warning service needs regular detection of the tsunami as it progresses to refine their warnings and provide the most accurate predictions of impacts.
- One of the most important uses of the sea-level data forecast model verification and data assimilation.
- Inverse modelling of the sea-level data can also be used to verify calculations of the seismic source.

Enable verification of tsunami impacts

- The warning service also requires sites for verification of the impact of a tsunami and post-analysis of the event. These observations are critical to the improvement of the warning service. While the tsunami models are amazingly accurate, there is a lack of detailed bathymetry along the coastline. Therefore, coastal observations are required to facilitate correlation of deep water observations to onshore impacts.

Provide continuity of observations

- The need for prompt availability of data leads to a further requirement for accessibility to communications systems and ease of access for maintenance. For example, if the location is very remote, taking days to reach, then the likelihood of rapid return to service after a failure is compromised.
- Built-in redundancies in monitoring sites can help allow for potential station downtime, which otherwise may have compromised the warning system capability (warning imperative). This is especially the case for deep-ocean tsunameters.

Provide Free and Timely Data Access

- The warning services require a constant flow of reliable and timely data. While tsunami events may be rare, it is essential that the data is available and in good order whenever required. This places high demands on the data collection platforms and communications for a near 100 percent availability of data.
- The warning centres need high frequency data, ideally at 1 second intervals. Such data demands reliable data transmissions. Therefore reliable and economic communications need to be available at sensor locations

4 OCEAN BASIN STATUS

The individual requirements, network design and status of implementation of sea level monitoring networks for each ocean basin can be found in the respective ICG Implementation Plans (see http://www.ioc-tsunami.org/).

The following is a summary of the sampling requirements for each individual ocean basin according to the respective ICGs:

	IOTWS	PTWS	NEAMS-	CARIBE-	Coastal	Deep Ocean

			TWS	EWS	Tide Gauges	Tsunameters	
						Non–event	Event
Sampling	<1 min	<1 min	<=1 min (HF if closer to zones)	<= 1 min	15 secs - 1 min	15 sec/ 15 min averages	15 sec/ 1 min averages
Transmission	5 min (<1hr or 100km)	5 min (<1hr or 100km)	1 min (<1hr or 100km)	<15 mins (I<less if <1hr)	5 – 15 mins	< 6 hours	<=5 min
Internal Latency	< 2 min	< 2 min	< 2 min	< 2 min	< 2 min	< 3 min	< 3 min
Accuracy	+/-10cm	+/- 10cm	+/- 10cm	+/-10cm	+/- 10cm	+/- 1mm	+/- 1mm

The indicative status of transmission frequency of existing real time stations under the four tsunami warning systems (includes both stations that transmit via the WMO Global telecommunication System or via the Internet), as sourced through the IOC Sea Level Monitoring Site during May 2011 (see http://www.ioc-sealevelmonitoring.org/map.php), is shown below for each basin:

Legend: Data transmission interval

Figure III-1. Indian Ocean Tsunami Warning & Mitigation System (IOTWS)

More data needs to be available at the recommended <=1min transmission interval from monitoring sites close to Indonesian and Makran subduction (source) zones.

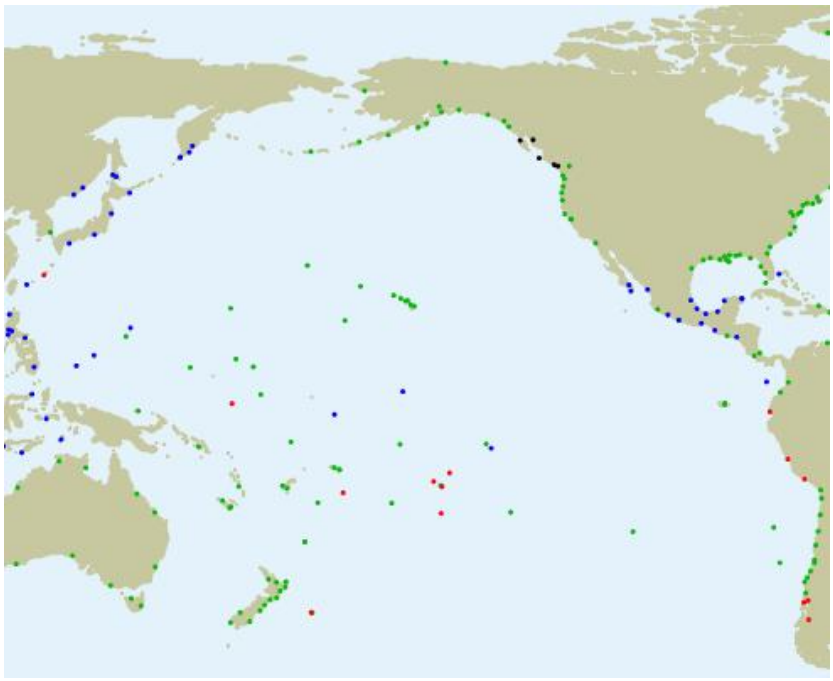


Figure III-2. Pacific Tsunami Warning & Mitigation System (PTWS)

Data is generally available at the recommended <=1min transmission interval from monitoring sites close to subduction (source) zones, except for NW Pacific and parts of SE Pacific.

Figure III-3. Caribbean Tsunami Warning & Mitigation System (CARIBE-EWS)

Data is generally available at the recommended <=1min transmission interval from monitoring sites close to subduction (source) zones.

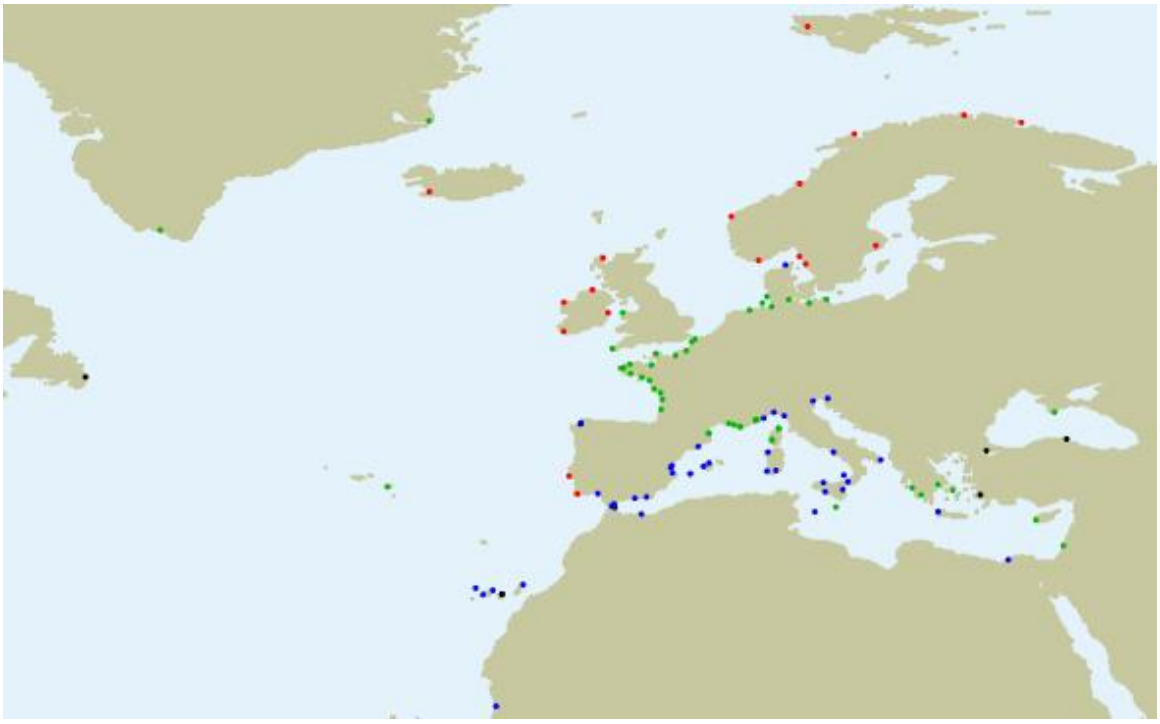


Figure III-4. North East Atlantic & Mediterranean Tsunami Warning & Mitigation System (NEAMS-TWS)

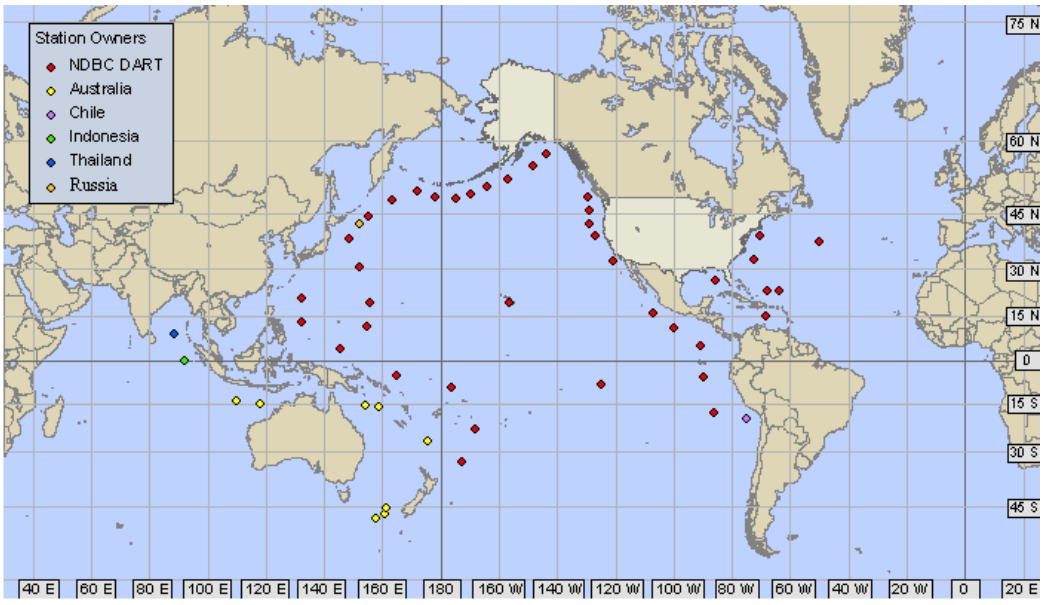


Figure III-5. Global deep ocean tsunameter array (see http://www.ndbc.noaa.gov/dart.shtml).

There are other tsunameters deployed in the Indian Ocean, which are presently not exchanging data in real-time or not yet operational.

5 SITING OF SEA LEVEL STATIONS

The siting of sea level monitoring stations for tsunamis should take into consideration the following "pillars" (also see IOC Manual & Guides No 14 for general sea level station siting advice):

- Contribution to a network which is providing protection to all communities and infrastructure;
- Where possible be mutually beneficial and provide data useful to near neighbours;
- As close as practical to the source of a tsunami, but no closer than 15 minutes;
- If possible facing the source of the threat;
- Together providing a continuous update of the progress of the wave both across the oceans and along the coast;
- Take into account historical observations of tsunamis where available for the location;
- Sufficiently representative and have the bathymetry that allows detection of a 4 cm wave[2] as it propagates toward land;
- Chosen to have minimum sources of nonlinear interference with the wave, e.g. seiching effects;
- Have exposure to the open ocean, but ensuring measurements from coastal tide gauges are not contaminated by local wave climate;
- Chosen to provide verification data of first landfall, at expected extreme inundation locations and near significant infrastructure and population centres,
- Selected to provide a level of redundancy that ensures an effective data availability of 99.8 per cent (for early warning) during an event;
- Accessible for maintenance in a reasonable time;
- Serviced by a reliable communication service;
- Takes appropriate advantage of existing infrastructure;
- Chosen if possible with a variety of other sea-level data users requirements in mind;
- Taking appropriate advantage of existing sea-level monitoring infrastructure, but not allowing the warning service to become totally dependent on other sources of data with other priorities and operational regimes;
- The forecast models require data with the minimum of perturbation by local bathymetry. Deep ocean sites are therefore preferable; however this is not always practical. Therefore the chosen locations for coastal tide gauges should minimise the local response and effects of harbours, cliffs, reefs and the like;
- Provided with detailed metadata for each site to enable warning centres to determine suitability and credibility of observations in warning analysis.

6 INSTRUMENTATION

- See IOC Manual & Guides No 14 Manual on sea Level measurements and Interpretation Vol 4 for description of the different technologies and recommended procedures for sea level monitoring in general (including but not limited to monitoring of tsunamis).

[2] Tsunami waves propagate following the rules of a shallow water wave. This means that the wave height (H_s) in shallow water (h_s) is related to its wave height (H_d) in deep water (h_d) by the following formula. $H_s = H_d(h_d/h_s)^{0.25}$.

- Instrumentation must be robust in design to sustain possible impact of a tsunami. Consideration should be given to higher redundancy of coastal sea level monitoring stations in close proximity to tsunami sources to allow for higher potential for damage;
- Redundancy of power supply (batteries, solar panels) should be included. Stations should be able to run for a minimum of 48hrs without external power.
- The sea level station shall function independently of other equipment that may be installed in the vicinity (i.e. meteorological or other oceanographic equipment).
- The proposed station should have sufficient built in redundancy to function under conditions that can be expected in the region. Without being prescriptive, it is expected that a typical station configuration will consist of a primary tide gauge, one or two under water pressure sensors (secondary tide gauges), data logger, DCP geostationary satellite transmitter, modem, battery backup, solar panel, cables, mountings.
- Redundant data transmission channels (e.g. Internet or alternative (i.e. via Inmarsat BGAN or similar), as well as via dial-in modem access) should be implemented where possible. The redundant transmission can either be connected directly to the DCP/Data logger for the primary water level sensors, or it can be a separate transmission unit connected to a second water level sensor. DCP timing should be continuously controlled via GPS or Internet, especially important for satellite transmission.
- The dynamic measuring range of sea level monitoring stations must take into account the potential range of tsunami wave amplitudes for any given location.
- Measurement time should be GMT with at least +/- 1 min accuracy, and if possible GPS controlled.
- Sensors must be periodically calibrated in accordance with the accuracy required.

7 DATA EXCHANGE AND ARCHIVAL/FORMATS

- Member States are encouraged to exchange their sea level data with the tsunami warning centres according to the UNESCO/IOC Oceanographic Data Exchange Policy and the Mauritius Declaration adopted at the intergovernmental coordination meeting held at Grand Baie, 14–16 April 2005 (IOC Workshop Report No 198) to openly share and exchange tsunami-relevant real-time observational data.
- Sea level stations that are part of the tsunami warning system should freely and timely exchange their data through the GTS.
- For each sensor at the station site, observations shall be transmitted on the GTS in real-time using the WMO CREX formats for sea level data (see Appendix I and II).
- Data can be put on the GTS via a DCP transmitter from the tide gauge or tsunameter to selected centres that have the ability to push the data onto the GTS (e.g. IOC Sea Level Station Monitoring Facility, National Meteorological Services, National Data Buoy Centre (NDBC) of NOAA, etc).
- British Oceanographic Data Centre (BODC) and University of Hawaii Sea Level Center under the auspices of GLOSS and National Geophysical Data Centre (NGDC) of NOAA will be responsible for long-term archive arrangement of high-frequency coastal and deep-ocean sea level data, not excluding the role of national and regional archive centres
- Metadata must be included when archiving the data.

8 REAL-TIME MONITORING

- Automatic alerting of events (implementation of tsunami detection algorithms) for coastal and deep ocean sensors should be implemented where possible. This will help detect and warn for tsunamis not necessarily generated by earthquake subduction zones, such as submarine landslides, meteorites, etc.
- 24/7 support is required for real-time sea level monitoring systems and visualization tools.

9 QUALITY ASSURANCE

- It is preferable not to have data quality control in real-time, to avoid accidental flagging or filtering of real events.
- Only qualified personnel should receive and interpret sea level signals for tsunami watch/warning.
- For data archiving existing well proved standard quality control procedures should be applied for flagging spikes, filling gaps, datum changes, etc. Data should be flagged and not deleted, to ensure real events are not removed.
- QC-controlled data should be archived for research applications.
- New instrumentation should be fully evaluated against existing instrumentation with know performance and characteristics.

10 PERFORMANCE MONITORING

- Network performance: a data base of network status, including existing and planned stations, must be maintained quarterly and available to tsunami warning centres.
- Station performance: latency, continuity and accuracy of reported data should be monitored continuously for each station:
    - Automatic notification of performance problems should be sent for manual inspection of the data
    - KPI (Key Performance Indicators):
        - Sampling
        - Reporting
        - Frequency
        - Average delay for the last 24 hours
        - Observations percentage for the last 24 hours and for the last 7 days (minimum 95%)
        - Continuity (stations repaired within two weeks)
        - Percentage of bad data (less than 1%)
- An operational unit should be given the responsibility for monitoring global sea level network performance on a routine basis.
- Tsunami warning centres must routinely evaluate the impact/value of independent sea level observations on development of tsunami threat guidance during events, providing feedback to the sea level monitoring operators.

APPENDIX I:

WMO BUFR/CREX TEMPLATES FOR REPORTING TIME SERIES OF TIDE DATA

The design of any new templates for tidal elevations is focused in meeting the flexibility of a minimum number of cohesive common descriptors which can be grouped together while avoiding a long common sequence that requires a higher bandwidth for data transmission. Locations of sea level stations can be very remote and the data communication cost for transmitting high resolution data, e.g. 1-minute data for storm surge or tsunami warning purposes can be very expensive.

The following common sequences can be used for reporting sea level tide data for single and multiple sensors with the options of reporting ancillary meteorological data. Items in red are new descriptors suggested for review and incorporation in the WMO Manual on Codes.

3 06 011			**Sequence for representation of tide station identification, method of transmission, time the message is transmitted and reference time for reports in a time series**
	3 01 021	0 05 001	Latitude (high accuracy)
		0 06 001	Longitude (high accuracy)
	0 01 075		Tide station alphanumeric ID (5 characters)
	0 02 147		Method of transmission to collection centre
	3 01 011	0 04 001	Year (Time the message is transmitted to the collection centre)
		0 04 002	Month
		0 04 003	Day
	3 01 013	0 04 004	Hour
		0 04 005	Minute
		0 04 006	Second

3 06 012			**Sequence for representation of sensor type, significance qualifier for sensor and status of operation**
	0 02 007		Type of sensor for water level measuring instrument
	0 08 015		significance qualifier for sensor
	0 08 032		Status of operation
	3 06 029	0 25 170	Sampling interval (seconds)
		0 25 171	Sample averaging period (seconds)
		0 25 172	Number of samples

3 06 029			**Sequence for representation of sampling information for water levels in the time series report**
	0 25 170		Sampling interval (seconds)
	0 25 171		Sample averaging period (seconds)
	0 25 172		Number of samples

3 06 013			**Sequence for representation of water level and residual in the time series**
	3 06 012		sensor type, significance qualifier for sensor and status of operation
	3 01 011	0 04 001	Year)
		0 04 002	Month)
		0 04 003	Day) Reference date/time for the time series
	3 01 013	0 04 004	Hour)
		0 04 005	Minute)
		0 04 006	Second)
	0 22 120		Tide station automated water level check
	0 22 121		Tide station manual water level check
	0 04 015		Time increment added to reset the reference time
	0 04 065		Time increment added to each data value in the time series
	1 02 000		Delayed replication of 2 descriptors
	0 31 001		Delayed replication factor
	0 22 038		Tidal elevation with respect to local chart datum
	0 22 040		Meteorological residual tidal elevation (surge or offset)

3 06 014			**Sequence for representation of water level in the time series, similar to 306013 but with no residual**
	3 06 012		Sensor type, significance qualifier for sensor and status of operation
	3 01 011	0 04 001	Year)
		0 04 002	Month)
		0 04 003	Day) Reference date/time for the time series
	3 01 013	0 04 004	Hour)
		0 04 005	Minute)
		0 04 006	Second)
	0 22 120		Tide station automated water level check
	0 22 121		Tide station manual water level check
	0 04 015		Time increment added to reset the reference time
	0 04 065		Time increment added to each data value in the time series
	1 01 000		Delayed replication of 1 descriptor
	0 31 001		Delayed replication factor
	0 22 038		Tidal elevation with respect to local chart datum

3 06 016			**Sequence for representation of ancillary meteorological data associated with water level data**
	3 01 011	0 04 001	Year)
		0 04 002	Month)
		0 04 003	Day) Reference date/time for the time series
	3 01 013	0 04 004	Hour)
		0 04 005	Minute)
		0 04 006	Second)

3 06 016			**Sequence for representation of ancillary meteorological data associated with water level data**
	0 10 004		Station level pressure
	0 10 050		Mean sea level pressure
	3 02 032	0 07 032	Temperature and humidity data
		0 12 101	Dry bulb temperature
		0 12 103	Dew point temperature
		0 13 003	Relative humidity
		0 07 032	Height of sensor above local ground
		0 02 002	Type of instrument for wind measurement
		0 08 021	Time significance = 2 (time averaged)
		0 04 025	Time period, e.g. = 1 for 1-minute, = 10 for 10-minute
		0 11 001	Wind direction
		0 11 002	Wind speed
		0 04 025	Time period in minutes
		0 11 043	Maximum wind gust direction
		0 11 041	Maximum wind gust speed
		0 25 026	AWS battery voltage
		0 12 060	AWS enclosure internal temperature

Practical use of the new templates:

Using the proposed BUFR/CREX templates 306011, 306012, 306013, 306014, 306016 and 306029 some practical implementations can be encoded as follows in CREX:

Single sensor with no ancillary meteorological data:

```
CREX++
T0002061400 A001030 P00001000 U00 S001 Y20080901 H0651 D06011 D06013++
-1042940 10566940 46290 07 2008 09 01 06 51 00
03 1 00 60 60 60 2008 09 01 06 44 00 11 07 0000 01 0006
00261 -0083 00256 -0085 00205 -0134 00296 -0041 00166 -0169 00285 -0047++
7777
```

Stations with two sensors can choose to add a fixed replication descriptor or a delayed replication descriptor. The following example is an example of fixed replication of two sensors:

```
CREX++
T0002061400 A001030 P00001000 U00 S001 Y20080901 H0651 D06011 R01002 D06013++
```

Two sensors with ancillary meteorological data

```
CREX++
T0002061400 A001030 P00001000 U00 S001 Y20080901 H0651 D06011 R02002 D06013 D06016++
```

Additional Code Tables and BUFR/CREX Table B Entries proposed:

0 02 007
Types of sea level sensor

Code Figure	
00	Reserved
01	Shaft encoder float system
02	Ultrasonic
03	Radar
04	Pressure (single transducer)
05	Pressure (multiple transducer)
06	Pressure (in stilling well)
07	Bubbler pressure
08	Acoustic (with sounding tube)
09	Acoustic (in open air)
10-14	Reserved
15	Missing value
15-99	Not used in CREX

0 01 147
Method of data transmission to collection centre

Code Figure	
00	Reserved
01	Direct leased circuit
02	Dialled up connection
03	Internet ISP
04	DCP via Satellite (MTSAT, METEOSAT, etc.)
05	VSAT
06	GAN, BGAN
07	Thiss terminal
08	Iridium satellites
09	Mobile telephony
10-14	Reserved
15	Missing value

0 08 015

Significance qualifier for sensor

Code Figure	
0	Single sensor
1	Primary sensor
2	Secondary sensor (Backup)
3-6	Reserved
7	Missing value
7-9	Not used in CREX

0 08 032

Status of operation for the water level report

Code Figure	
00	Routine operation
01	Event triggered by storm surge
02	Event triggered tsunami
03	Event Triggered manually
04	Installation testing
05	Maintenance testing
06-14	Reserved
15	Missing value

TABLE REFERENCE			TABLE ELEMENT NAME	BUFR				CREX		
F	X	Y		UNIT	SCALE	REFERENCE VALUE	DATA WIDTH (Bits)	UNIT	SCALE	DATA WIDTH (Characters)
0	02	007	Type of sensor for water level measuring instrument	Code table	0	0	4	Code table	0	2
0	02	147	Method of transmission to collection centre	Code table	0	0	7	Code table	0	2
0	08	015	Significant qualifier for sensor	Code table	0	0	3	Code table	0	1
0	08	032	Status of operation	Code table	0	0	4	Code table	0	2
0	12	060	AWS enclosure internal temperature	K	1	0	12	°C	1	3
0	25	170	sampling interval (time)	Second	0	0	10	Second	0	4
0	25	171	sample averaging period	Second	0	0	10	Second	0	4
0	25	172	Number of samples	Numeric	0	0	10	Numeric	0	4

APPENDIX II

WMO BUFR/CREX TEMPLATES FOR TSUNAMETER DATA AND DART BUOY SYSTEM MESSAGES

DATA DESCRIPTORS FOR VARIOUS DEEP-OCEAN TSUNAMETER SYSTEM MESSAGES (DART BUOYS)

The common and specific items required for the various types of tsunameter system messages are described as follows. Descriptors in red are not available in the WMO Manual on Codes.

Item	Description	Available/ Possible Descriptors
Common items for all tsunameter system messages 306027		
Station ID	5-digit buoy / platform ID e.g. 23401, 55401	0 01 005
Platform transmitter ID	Code table 1-character indicator P=Primary S=Secondary	0 01 050 numeric(6) 0 01 051 character(12) or new code table 0 01 052
Deep-ocean tsunameter platform type / manufacturer	DART II (PMEL) DART ETD SAIC Tsunami Buoy (STB) GFZ-Potsdam INCOIS (India) InaBuoy (Indonesia)	New code table required for type / manufacturer of deep-ocean tsunameters 0 02 047
Time transmitted to the ground systems	Year, month, day hour, minute, second when the standard hourly reports are transmitted. The day, hour and minute are used in the abbreviated header label (YYGGgg)	3 01 011 3 01 013
Specific Items for Tsunameter Surface Buoy Position Daily Report 306028		
Report observation time	Reference time for the values reported in the time series - year, month, day, hour, minute, second	3 01 011 3 01 013
Latitude and longitude (high accuracy)	Latitude and longitude up to 5 decimals	3 01 021

Item	Description	Available/ Possible Descriptors
Common Items for Standard Hourly and Tsunami Event Reports 306029		
Water column height sampling interval (seconds)	Time interval in which water column height samples are integrated and reported, e.g. for the PMEL DART II systems, standard hourly reports are 15-sec samples reporting every 15 minutes at HH+15, 30, 45 and 60 minutes so sampling interval is 900 sec (15 minutes) Tsunami event first and second reports are 15-sec, other reports are 1-minute samples of 4 15-sec average values so sampling intervals are 15 sec and 60 sec respectively Extended tsunami event reports are 1-minute samples of 4 15-sec average values so sampling interval is 15 sec	New descriptor required 0 25 170
Water column height sample averaging period (seconds)	For the PMEL DART II systems, the sample averaging period is 15 sec for the standard hourly reports, 15 sec for the tsunami event first and second reports, 60 sec for the other reports, 60 sec for the extended event reports	New descriptor required 0 25 171
Number of samples	For averaged samples the number of samples collected during the sampling period	New descriptor required 0 25 172
Specific Items for Standard Hourly Reports 306030 (normally six hourly messages of four 15-second observations at 15-minute intervals are reported in one transmission block)		
Delayed replication	Usually six replications of hourly reports but it may be less if tsunami event occurs or more if transmission blocks are interrupted	1 11 000
Quality information for message status	Code table 1-character indicator 0=Message intact 1=Message corrupt	Code table 0 33 002 Quality Information
Report observation time	Reference time for the values reported in the time series - year, month, day, hour, minute, second	3 01 011 3 01 013
Battery voltage	BPR CPU voltage, normal range is 13.9 to 17.9 volts	0 25 025
Battery voltage	Acoustic modem DSP voltage, normal range is 4.0 to 4.3 volts	0 25 025
Battery voltage (large value)	Acoustic modem voltage, normal range is 34 to 48 volts	0 25 026
BPR transmission count	Number of transmission attempts to deliver BPR data	New descriptor required 0 22 185
Time increment to each data value in the time series	The time increment in minutes to be added to each data values in the time series to determine the time stamp of each report	0 04 065
Fixed replication	Replicate 1 descriptor 4 times	1 01 004
Water column height	Fixed replications 4 times of water column heights in mm at HH+15 ,H+30 ,H+45 and H+60	New descriptor required

Item	Description	Available/ Possible Descriptors 0 22 182
Specific Items for Tsunami Event Reports 306031		
Tsunami event report message ID	2-digit sequence number allocated to the report for each tsunami event	New descriptor required 0 01 053
Common Items for Tsunami Event Reports and Extended Tsunami Event Reports 306031		
Quality information for message status	Code table 1-character indicator 0=Message intact 1=Message corrupt	Code table 0 33 002 Quality Information
Time of tsunami	Time when tsunami is detected according to the tsunami trigger algorithm	3 01 011 3 01 013
Reference time for the time series	Reference time for the time series. This is the first data value time stamp for the for the DARTII systems tsunami event data messages.	3 01 011 3 01 013
BPR transmission count	Number of transmission attempts to deliver BPR data	New descriptor required 0 22 185
Water column height	Water column height reference value (m), for restoring the actual value from the deviations	New descriptor required 0 22 182
Time increment to reset the reference time	Time increment in seconds to be added to the reference time before the time series processing	0 04 016
Time increment to each data value in the time series	The time increment in seconds to be added to each data values in the time series to determine the time stamp of each report	0 04 066
Delayed replication	Delayed replication of 1 descriptor of water column height deviations 3 replications for the first Tsunami event report 15 replications for all other Tsunami event reports 119 replications for Extended tsunami event reports	1 01 000
Water column height deviation from the reference value	Water column height deviation from the reference value, Deviation = Actual value – Reference value	New descriptor required 0 22 184

BUFR/CREX TEMPLATE FOR TSUNAMETER DATA AND DART BUOY SYSTEM MESSAGES

Items in red are new descriptors suggested for review and incorporation in the WMO Manual on Codes.

3 06 027			**Sequence for representation of DART buoy identification, transmitter ID, type of tsunameter and the time the message is transmitted to the ground system**
	0 01 005		Buoy/platform identifier
	0 01 052		Platform transmitter identifier
	0 02 047		Deep-ocean tsunameter platform type/manufacturer
	3 01 011	0 04 001	Year (Time the message is transmitted to the ground system)
		0 04 002	Month
		0 04 003	Day
	3 01 013	0 04 004	Hour
		0 04 005	Minute
		0 04 006	Second

3 06 028			**Sequence for representation of time of observation and DART buoy position daily report**
	3 06 027		Buoy ID, transmitter ID, platform type, message transmission time
	3 01 011	0 04 001	Year)
		0 04 002	Month)
		0 04 003	Day) Observation time
	3 01 013	0 04 004	Hour)
		0 04 005	Minute)
		0 04 006	Second)
	3 01 021	0 05 001	Latitude (high accuracy)
		0 06 001	Longitude (high accuracy)

3 06 029			**Sequence for representation of tsunameter sampling information for water column heights in the time series report**
	0 25 170		Sampling interval (seconds)
	0 25 171		Sample averaging period (seconds)
	0 25 172		Number of samples

3 06 030			**Sequence for representation of DART buoy standard hourly report**
	3 06 027		Buoy ID, transmitter ID, platform type, message transmission time
	3 06 029		Tsunameter sampling information
	1 11 000		Delayed replication of 11 descriptors
	0 31 001		Delayed replication factor
	0 33 002		Quality information (for message status)
	3 01 011	0 04 001	Year)
		0 04 002	Month)
		0 04 003	Day) Reference date/time for the time series
	3 01 013	0 04 004	Hour)

3 06 030			**Sequence for representation of DART buoy standard hourly report**
		0 04 005	Minute)
		0 04 006	Second)
	0 25 025		Battery voltage for BPR CPU
	0 25 025		Battery voltage for acoustic modem DSP
	0 25 026		Battery voltage for Acoustic modem
	0 22 185		BPR transmission count
	0 04 015		Time increment added to reset the reference time
	0 04 065		Time increment added to each data value in the time series
	1 01 004		Replicate 1 descriptor 4 times
	0 22 182		Water column height

3 06 031			**Sequence for representation of DART buoy tsunami event reports and extended tsunami event reports**
	3 06 027		Buoy ID, transmitter ID, platform type, message transmission time
	3 06 029		Tsunameter sampling information
	0 01 053		Tsunameter report sequence number triggered by a tsunami event
	0 33 002		Quality information (for message status)
	3 01 011	0 04 001	Year)
		0 04 002	Month)
		0 04 003	Day) Time when tsunami is detected
	3 01 013	0 04 004	Hour)
		0 04 005	Minute)
		0 04 006	Second)
	3 01 011	0 04 001	Year)
		0 04 002	Month)
		0 04 003	Day) Reference date/time for the time series
	3 01 013	0 04 004	Hour)
		0 04 005	Minute)
		0 04 006	Second)
	0 22 185		BPR transmission count
	0 22 182		Water column height reference for determination of actual value reported in the time series
	0 04 016		Time increment added to reset the reference time
	0 04 066		Time increment added to each data value in the time series
	1 01 000		Delayed replication of 1 descriptor
	0 31 001		Delayed replication factor
	0 22 184		Water column height deviation from the reference value

Encoding DART buoy data using the CREX tsunameter template:

Using the proposed CREX templates D06028, D06030 and D06031 the PMEL DART II system messages can be encoded as follows:

Conversion of DART buoy daily position report to CREX data sequence D06028

```
SZIO01 KWNB 271219
^^DD23401S 240121901
D$0 08/27/2008 01:13:04 0854.4827 N 08833.1062 E* 13 00-0NN  00E
```

Expanding D06028
D06027 D01011 D01013 D01021

Expanding D06027
B01005 B01052 B02047 D01011 D01013 D01011 D01013 D01021

Data sequence fully expanded
B01005 B01052 B02047 B04001 B04002 B04003 B04004 B04005 B04006 B04001 B04002 B04003 B04004 B04005 B04006 B05001 B06001

```
SZIO02 KWNB 271219
CREX++
T0002061400 A031007 P00008000 U00 S001 Y20080827 H1219 D06028++
23401 0 01 2008 08 27 12 19 01 2008 08 27 01 13 04 0890805 08855177++
7777
```

Conversion of DART buoy standard hourly report to CREX data sequence D06030

```
SZIO01 KWNB 260018
^^DD23401P 239001832
D$1I 08/25/2008 18:15:00 1474142 3466543 3466565 3466588 3466611  1* 37
D$1I 08/25/2008 19:15:00 1474142 3466635 3466659 3466675 3466694  1* 34
D$1I 08/25/2008 20:15:00 1474142 3466711 3466728 3466739 3466747  1* 38
D$1I 08/25/2008 21:15:00 1474142 3466754 3466758 3466766 3466770  1* 31
D$1I 08/25/2008 22:15:00 1474142 3466774 3466770 3466766 3466759  1* 31
D$1I 08/25/2008 23:15:00 1474142 3466752 3466737 3466723 3466708  1* 32 00-0NN  00E
```

Expanding D06030
D06027 D06029 R11000
B033002 D01011 D01013 B25025 B25025 B25026 B22185 B04015 B04065 R01004 B22182

Data sequence fully expanded

B01005 B01052 B02047 B04001 B04002 B04003 B04004 B04005 B04006 B25170 B25171 B25172 R11000 B033002 B04001 B04002 B04003 B04004 B04005 B04006 B25025 B25025 B25026 B22185 B04015 B04065 R01004 B22182

```
SZIO02 KWNB 260018
CREX++
T0002061400 A031007 P00008000 U00 S001 Y20080826 H0018 D06030++
23401 0 01 2008 08 26 00 18 32 0900 0015 0001 0006
0 2008 08 25 18 15 00 147 041 420 001 -0015 15 3466543 3466565 3466588 3466611
0 2008 08 25 19 15 00 147 041 420 001 -0015 15 3466635 3466659 3466675 3466694
0 2008 08 25 20 15 00 147 041 420 001 -0015 15 3466711 3466728 3466739 3466747
0 2008 08 25 21 15 00 147 041 420 001 -0015 15 3466754 3466758 3466766 3466770
0 2008 08 25 22 15 00 147 041 420 001 -0015 15 3466774 3466770 3466766 3466759
0 2008 08 25 23 15 00 147 041 420 001 -0015 15 3466752 3466737 3466723 3466708++
7777
```

Conversion of DART buoy tsunami event reports to CREX data sequence D06031

A tsunami event triggered first report

```
SZPN01 KWNB 301854
^^DD46407P 121185436
D$2I 00 tt 18:53:30 ts 18:52:45 3266896
00000065006701* 27
 00-0NN  00E
```

Expanding D06031
D06027 D06029 B01053 B033002 D01011 D01013 D01011 D01013 B22185 B22182 B04016 B04066 R01000 B22184

Data sequence fully expanded

B01005 B01052 B02047 B04001 B04002 B04003 B04004 B04005 B04006 B25170 B25171 B25172 B01053 B033002 B04001 B04002 B04003 B04004 B04005 B04006 B04001 B04002 B04003 B04004 B04005 B04006 B22185 B22182 B04016 B04066 R01000 B22184

```
SZPN02 KWNB 301854
CREX++
T0002061400 A031007 P00008000 U00 S001 Y20080430 H1854 D06031++
46407 0 01 2008 04 30 18 54 36 0015 0015 0001
00 0 2008 04 30 18 53 30 2008 04 30 18 52 45 3266896 -0015 0015 0003
0000 0101 0103 0001++
7777
```

A tsunami event triggered second report

```
SZPN01 KWNB 301857
^^DD46407P 121185741
D$2I 01 tt 18:53:30 ts 18:52:45 3266896
00000065006700660063006400 61fffcfffbfff7fff4fff4fff4fff3fff201* 25
 00-0NN  00E
```

```
SZPN02 KWNB 301857
CREX++
T0002061400 A031007 P00008000 U00 S001 Y20080430 H1857 D06031++
46407 0 01 2008 04 30 18 57 41 0015 0015 0001
01 0 2008 04 30 18 53 30 2008 04 30 18 52 45 0001 3266896 -0015 15 0015
0000 0101 0103 0102 0099 0100 0097 -0004 -0005 -0009 -0012 -0012 -0012 -0013 -0014++
7777
```

Additional table entries in Common Code Table C-13 for the tsunameter data sequence:

Regulation 95.3.1.2 for CREX Edition 2 requires a six-digit table indicator (nnnmmm) preceded by the letter A. The first three digits (nnn) define the data category referred to in CREX Table A. The next 3 digits (mmm) indicates the sub-category of the data from Common Code Table C-13.

Tsunameter data belong to 'Oceanographic Data' in the Data Category, code figure=031 for (nnn) but there is no code figure in the International Data Sub-category for 'Tsunameter data'. Code figure=007 for (mmm) is proposed.

Additional Code Tables and BUFR/CREX Table B entries for the tsunameter data sequence:

0 01 052
Platform transmitter identifier

Code Figure	
0	Primary
1	Secondary
2	Reserved
3	Missing value

0 02 047
Deep-ocean tsunameter platform type/manufacturer

Code Figure	
00	Reserved
01	DART II (PMEL)
02	DART ETD
03	SAIC Tsunami Buoy (STB)
04	GFZ - Potsdam
05	INCOIS (India)
06	InaBuoy (Indonesia)
07-14	Reserved
15	Missing value

Additional BUFR/CREX Table B entries for the DART buoy templates

TABLE REFERENCE			TABLE ELEMENT NAME	BUFR				CREX		
F	X	Y		UNIT	SCALE	REFERENCE VALUE	DATA WIDTH (Bits)	UNIT	SCALE	DATA WIDTH (Characters)
0	01	053	Tsunameter report sequence number triggered by a tsunami event	Numeric	0	0	7	Numeric	0	2
0	02	047	Deep-ocean tsunameter type	Code table	0	0	7	Code table	0	2
0	01	052	Platform transmitter ID	Code table	0	0	3	Code table	0	1
0	25	170	sampling interval (time)	Second	0	0	10	Second	0	4
0	25	171	sample averaging period	Second	0	0	10	Second	0	4
0	25	172	Number of samples	Numeric	0	0	10	Numeric	0	4
0	22	182	Water column height (see Note 9)	m	3	0	23	m	3	7
0	22	184	Water column height deviation from the reference value	m	3	2000	12	m	3	4
0	22	185	BPR transmission count	Numeric	0	0	10	Numeric	0	3
0	04	066	Short time increment	Second	0	-128	8	Second	0	2

Footnote for BUFR TABLE B Class 22 – Oceanographic elements

Notes:
(9) The maximum deployment depth of deep-ocean tsunameters such as the PMEL Deep-Ocean Assessment and Reporting of Tsunamis (DATT II) is about 6000 m.

ANNEX IV

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

1 PURPOSE OF MEETING

The Task Team 2 on Disaster Management and Preparedness (TT2) had submitted its preliminary report to the TOWS Meeting held on 5-6 May 2010 in Lisbon, Portugal. That report, however, mainly contained the points which each ICGs had reported to TT2 in relation to disaster management, risk reduction, warning dissemination and emergency response. The report did not include development of action plans related to the TT2 Terms of Reference (Annex 7.1), due to the very limited time for the team to submit its report to the TOWS, after the task team's formation. During the meeting in Lisbon, it was decided, that a task team meeting, and presumably an inter-task team meeting, would be beneficial for the purpose of propelling the functioning of global warning systems for ocean related hazards. An offer was made by the US Government, through NOAA, to host the meeting in Seattle.

Some overarching issues were discussed among Task Team chairs, and these were put to the floor on the first day of the meeting. The Task teams need to discuss and liaise among task teams and working groups from other ICGs for effective information sharing to ensure:

- Warning outputs meet community needs, expectations, and the assessed risks,
- Proper public & media understanding of different services/products from NTWCs and RTWPs,
- Capacity enhancements of Member States (NTWCs and DMOs) in using warning products to develop their own tsunami warning chain and decide on evacuation orders, (SOPs)
- Sea-level monitoring networks meet the requirements of the warning systems.

The meeting was held over three days (29 November – 1 December 2010). The first two days were dedicated to the respective task teams to allow in-depth discussions, and a plenary meeting on the third day was arranged to allow interactions and discussions with Task Teams 1 and 3, addressing the critical issues arising.

2 MEMBERS ATTENDING

IOTWS	Irina Rafliana (Indonesia) – Chair
IOTWS	Sam Hettiarachchi (Sri Lanka)
PTWS	David Coetzee (CDEM, NZ)
PTWS	Laura Kong (ITIC)
CARIBE-EWS	Julie Leonard (USA)
NEAMTWS	Russell Arthurton (United Kingdom)
Task Team Secretariat:	Bernardo Aliaga (IOC UNESCO)

Stacey Edwards (CARIBE-EWS) had prepared to attend this meeting, but due to illness at the last minute before departure, she could not attend and had to cancel her travel, but continued maintaining communication.

3 MEETING NOTES

3.1 TASK TEAM 2 MEETING, 29-30 NOVEMBER 2010

The combined Task Team meeting and break group followed a plenary introduction and welcoming address from IOC UNESCO and NOAA-PMEL.

The TT2 meeting, with an introduction and agenda setting, Chaired by Irina Rafliana, and facilitated by Bernardo Aliaga. All team members agreed the agenda proposed, with no additional suggestions. Due to the absence of UN ISDR representatives, presentation and discussion with this organization did not happen. Nevertheless, the group discussed ways to approach international organizations to address preparedness issues and also seek support through ICGs.

All respective ICGs had already sent their reports to TT2, and forwarded to the TOWS meeting. Nevertheless, the team sensed the need to share and present progresses made by each ICGs as represented by the members of the team. This would allow discussion on the strengths and opportunities, as well as burning issues addressed in each region/basin. The team would also think about a further joint monitoring system for community preparedness initiatives, with more systematic approaches. Therefore, each ICG was given time to present updates and issues to be discussed in the meeting.

3.1.1 Caribe ICG Presentation and Discussion, presented by Julie Leonard

The Caribe ICG had pointed out three good examples on preparedness, in Puerto Rico, Nicaragua, and Venezuela. The Caribe put particular concerns in the SOP development in receiving warning and understanding warning products down to the last mile of the system. It is currently developing protocols and SOPs including manuals for 4 pilot sites. Issues among others are that Meteorological Departments, which are the NTWCs, are not required to serve 24/7. Warning products however, will reach the respective Member States' Tsunami Focal Point (which is the Meteorological Department or CDEMA). The ICG had maintained good communication with the disaster managers in respective countries.

The Caribe ICG had conducted workshops on sharing best practices, including a Tsunami Ready Summit. Nicaragua and Puerto Rico had championed in participatory work developing Tsunami Ready communities, with 9 out of 44 Districts established as a Tsunami Ready Community.

A Caribbean Tsunami Information Center (CTIC) is established, with support from UNDP and the Government of Italy, with some issues on the requested operational costs for sustainability, and Barbados is committing a good amount of resources in terms of office space, support staffs and services. The Caribe TWS is elaborating Tsunami Smart programmes, which emphasis self reliance and pro-activeness.

CARIBE EWS suggest wider ITP (International Training Programme) including real-time conference/internet-based programmes (webinars) to broaden engagement and means of dissemination.

3.1.2 NEAMS ICG Presentation and Discussion, presented by Russell Arthurton

NEAMS is a collection of sub-basins, and it is not feasible to have a single Regional Tsunami Watch Centre for its mostly local tsunami potential. To date, there are no NTWCs operating in NEAMS although the France NTWC is expected to be established in 2011. The involvement by North African countries in NEAMTWS is generally weak and needs to be encouraged.

Operational guidance in NEAMS is so far restricted to RTWCs, with an Operational Users Guide now adopted by the ICG. While this Guide includes decision matrices for disaster managers, it is acknowledged that more work is needed on the development of SOPs for NTWCs and disaster management responders. This was particularly the case for those countries in NEAM where existing civil protection organization and provision is relatively weak. The production (by ICG/NEAMTWS WG4) of a draft guidance manual for the benefit of civil protection authorities (disaster management organizations) has been welcomed by the ICG. This manual, reviewed by UN-ISDR, provides guidance for authorities in risk assessment, reduction and management and includes a full description of the structure and operation of the NEAM tsunami warning system from end-to-end. The manual (provided as a document for this meeting) includes case input from Member States across the region.

The NEAMTIC (NEAMS Tsunami Information Center) is to be established in 2011, with support from the European Union.

3.1.3 PTWS ICG Presentation and Discussion, presented by David Coetzee and Laura Kong.

The PTWS Medium Term Strategy rests on three pillars which are reflected in its working group structure: Risk Assessment and Reduction, Warning Detection, Monitoring and Dissemination, and Awareness and Response. The Awareness and Response working group (WG) includes Public Education, Emergency Management Planning and Response. The WG is circulating a survey to assess current capacities of Member States in awareness and response. The PTWS has also emphasized the development of Tsunami Response Plans and SOPs by Member States as the key to successful response, and through ITIC and its partners, developed training materials on SOPs. PTWS urges consistency in approach.

The WG has had limited response from the Member States to nominate WG members; currently, they are New Zealand, China and Japan. ITIC (International Tsunami Information Center) is a default member.

As the oldest system among the 4 basins, the PTWS and ITIC has continued to receive requests for training, but ITIC resources have been limited in terms of funding, time and the number of people it can reasonably train in any year. The ITP-Hawaii typically can train a maximum of 15 persons at a time, and uses Hawaii as a working example of an end-to-end system. In contrast, the ITP-International goes to countries where it can reach wider audiences and find relevance to each different localized context. There are requests by the PTWS-SC for ITIC to develop a train-the-trainer program in order to build regional expertise to better meet the demand. The PTWS seeks funds to meet these requests. A US DHS/FEMA National Disaster Preparedness Training Center Certified 1-day Tsunami Awareness Course for First Responder was developed by the ITIC in 2010 for the US domestic audience, and has been adapted for international audiences. The next courses by ITIC under US DHS/FEMA will be on Managing Tsunami Risk and Conducting Tsunami Exercises.

Exercises are underpinned as an essential part of preparedness. SOPs should be tested and the post-exercise evaluation/de-brief and resulting corrective action plan should form an essential part of the activity. The PTWS intends to develop guidance on conducting exercises. Consistent methodologies by countries that will participate in the international Wave Exercises is deemed important. Pacific Wave Exercise 2011 will take place in November 2011, and will be lead by a PTWS Task Team that will work and plan in coordination with the other PTWS working groups.

3.1.4 IOTWS ICG Presentation and Discussion, presented by Irina Rafliana

Post tsunami 2004, Member States were active in developing preparedness initiatives, namely in Seychelles, Bangladesh, Sri Lanka, India, Malaysia, Thailand, Pakistan and Indonesia. It is understandably difficult for Member States to continue prioritizing tsunami hazard to deal with, in regards with its long return period. It needs to consider mainstreaming to larger Disaster Risk Reduction (DRR) framework, such as the UN ISDR Hyogo Framework of Action which is ratified by most of the Member States. It was suggested by the task team to quote 'tsunami' in its mainstreaming effort.

The Working Group was initially including wide scope of work, e.g. governance and community resilience. The ICG restructured the initial working group set ups, which initially consist of 6 working groups. Now the IOTWS adapt PTWS structure, with working 3 working on Awareness and Response. Interactions were made not only among working groups (Risk Assessment & Reduction, and Warning Dissemination), but also other ICGs particularly with NEAMS in relation with the development and training on Indian Ocean Tsunami Risk Assessment Guideline, lead by Working Group Risk Assessment (WG 1). The birth of this guideline is imperative to allow Member States to have complete idea on how to develop policies and preparedness strategy based on risk profile and assessment. A regional training was conducted in Bangkok in 2009. Trial trainings were conducted in two Member States, Sri Lanka and Indonesia in 2010. Indonesia had elaborated and derived a National Tsunami Risk Assessment Guideline, which in 2011 will be implemented by local governments. An assessment tool in measuring preparedness is also available, developed in 2006 by Indonesian Institute of Science, with UNESCO and ISDR. This assessment is incorporated within the risk assessment, particularly when measuring local capacities to come up with the risk formulation and index. It also allows measurement in government capacities and communities' level of self help (resources mobilization capacities).

Indian Ocean Wave Exercise 2009 was conducted as the first ever End-to-end Exercise in the basin, with good number of Member States participating and engage public evacuation drill, such as Tanzania, Pakistan, and Indonesia.

A project of educational materials repositories is made under the coordination of the Jakarta Tsunami Information Center (JTIC), among Indonesia, Thailand, Philippines and Timor Leste.

Current initiatives, programs and good practices are intended to be captured in a document produced by the working group on taking preparedness to the last mile. The documentation is lead by Pakistan.

Between 2008 and 2011, the UNESCAP project on Strengthening Tsunami Warning and Emergency Responses: Training Workshops on the Development of Standard Operating Procedures for Indian Ocean and Southeast Asian Countries, UNESCO IOC conducted 2 regional workshops for IOTWS and PTWS Southeast Asia countries, and also multi-visit country missions to Pakistan, Myanmar, Vietnam, and the Philippines. The ITIC

helped to develop the SOP course materials and within each training, participants took part in a near real-time tsunami table top exercise.

On the 2nd day of the meeting, the team discussed and prepared drafts for 6 recommended action (Annex 7.3),), each with a designated person(s) in charge. The actions focus on specific issues that the Task team believes will support enhanced disaster management and preparedness, and are a collection of existing initiatives in the 4 ICGs:

- Stock Take of ICGs Status of Awareness and Response. Person in Charge: David Coetzee.
- Inter and Intra Regional (ICGs) Sharing of Community-based Best Practices (BP). Persons in Charge: Julie Leonard and Bernardo Aliaga.
- Discussion with ISDR, ECHO, UN Regional Organizations and Other Relevant Donors Including on the Use of CBDRR/CBDRM Platforms. Persons in Charge: Sam Hettiarachchi and Julie Leonard.
- Development of Basic Standard Operating Procedures on Warning Dissemination and Emergency Response from NTWCs to DMOs. Persons in Charge: Russell Arthurton and Irina Rafliana.
- Development of Generic Guidelines for Tsunami Wave Exercise. Persons in Charge: Laura Kong and David Coetzee.
- Tsunami Training and Capacity Building. Person in Charge: Laura Kong.

3.2 INTER-TASK TEAM MEETING, 1 DECEMBER 2010

At Day 3 of the meeting, all task teams met in plenary. All task teams chairs reported briefly on the outputs of each teams' discussion. TT2 reported on the shared lessons learnt, best practices and gaps, as well as issues among ICGs within their related working groups in awareness and response. TT2 reported the agreed recommendations, to be brought up to each ICG. An inter-task team discussion took place, to address cross-cutting issues, particularly related to the warning system product harmonization which links TT2 with TT3.

Points that were highlighted by Task Team 2 in this plenary meeting were among others:

The clear line and area of work for TT2 were defined as from the NTWC to the end of the system (community at risk), engaging the Disaster Management Authorities.

- The defined role of TT3 is from the international/regional (RTWP/C) point to NTWC.
- TT3 discussed their area of responsibility and also the need to underpin authorized earthquake monitoring agencies which may make better quality information available.
- The warning services and products discussed within TT3 were that the first bulletin will announce earthquake parameters. This will be sent out to RTWPs. As the time goes; follow-up bulletins will contain threat levels in specific countries. It is the country's decision to request information or warning services to the RTWP/C.
- NTWC is expected to disseminate warning/evacuation order; to evacuate, get out of water or off threat, on alert a need to wait more, or there are no threat for the country/community.

- Countries at national level should decide on the thresholds and criteria for response and evacuation.
- The last bulletin disseminated to Member States/countries to be forwarded as cancellation/all clear through each respective emergency offices.
- The issue may rise when the cancellation status may not be applicable to all countries at the same time.
- TT2 will provide feedback to TT3 on the guiding points on how to make clear such issues, to be part of the proposed matrix produced by TT3.
- The TT2 emphasizes the need to mainstream its tsunami preparedness practices to existing global frameworks and forums, to allow wider audience to support, for example, promoting “Make Our Coastal Community Safe” at the upcoming Global DRR forum under ISDR.
- The TOWS WG task to develop a Compendium Document related to tsunami and other related hazards also underlined the importance of having inputs from all task teams on the agreed terms to be put in the Compendium.

4 RECOMMENDATION

The team recommended key issues to be addressed in a global context in relation to warning dissemination:

(iii) The ICGs are to agree on an overarching concept of operation. The concept should promote the development of national plans for Tsunami Warning and SOPs.

(iv) Agree that consistent terminologies used by regional watch/warning centres globally, e.g. Warning, Watch, Bulletin, Advisory, Alert.

(v) Building on existing good practices, recognizing the existing effective SOPs already developed and evaluated within parts of ICGs, extending these practices more universally throughout ICGs.

(vi) Develop basic templates for SOPs for all relevant levels, building on the experiences of e.g. PTWS and IOTWS.

(vii) Encourage effective linkages between the respective SOPs within countries.

(viii) Review and test SOPs through exercises and document the improvement processes.

(ix) Encourage Member States to review and revise plans based on their exercises.

Thus, the Member States of each ICG hold full responsibility for issuing and responding to the warning.

5 WAY FORWARD

Each person in charge for the proposed activities will continue leading the team with each of the respective ideas and initiatives, and finalizing the terms of references. All members of the task team are expected to share the recommendations with each ICG.

Working Group 3 of the ICG/PTWS and Working Group 3 of the ICG/IOTWS welcomes the opportunity to share its resources and experience with those of other regional ICGs in order to meet the objectives of TOWS Task Team 2.

The team proposed to meet to work on particular issue(s) that may not be sufficiently communicated through emails, e.g. developing Tsunami Wave Exercise Guideline. A suggestion of venue and timing is in Jakarta, Indonesia, on the first quarter of 2011. This will benefit the advanced preparations prior 2011 Wave exercises.

6 CLOSING REMARKS

The task team would like to convey gratitude for the hospitality of the US Government and NOAA in hosting the meeting, enabling a productive and stimulating meeting. The team also benefitted from the visit to NOAA PMEL facilities, allowing better understanding of the contribution of NOAA in to the global tsunami and other sea-related hazard warning systems.

DRAFT CONCEPT NOTES ON TASK TEAM 2 PROPOSED ACTIVITIES

TOR 1

STOCK-TAKE ON ICG STATUS OF PUBLIC AWARENESS AND NTWC/NDMO RESPONSE **Person in Charge:** **David Coetzee**	
BACKGROUND	The respective regional Intergovernmental Coordination Groups (ICGs) have all established an number of specialist working groups, one of which with an 'Awareness and Response' focus (in some cases the focus extends to 'Reduction' and 'Assessment'). None of the working groups with an 'Awareness and Response' focus currently possess over a comprehensive view of the status of awareness and response among their Member States. An assessment of current capacity is therefore required within each ICG to inform the focus of the working groups.
RECOMMENDATION	It is recommended that the relevant working group(s) within each ICG conduct a survey of the status of public awareness and response capacity among their Member States in the form of a short questionnaire - to be completed by each Member State.

PROPOSED SURVEY FORMAT CONTENT	1. Surveys should comprise two parts: A: Public Awareness Status B: Response Status, with separate parts for: a. National Tsunami Warning Centre (NTWC) b. National Disaster Management Office (NDMO) 2. Surveys are to be conducted in a 'checkbox' table format to provide for all options in a consistent manner. Besides surveying all methods, types of materials and SOPs used for the respective areas, it must also allow opportunity for Member States to indicate in which areas they require support, or are in a position to offer support. 3. Surveys must be kept short, simple and easy to complete. They can be offered either via an email attachment (MSWord format) or via the web using for instance 'Survey Monkey'. 4. A draft template is attached and can be adjusted or added upon to suit the focus of the particular working group.
EXPECTED RESULT	The working group will collate all returned questionnaires and compile an assessment of the status of awareness and response in the region. The assessment is to be used to develop a work plan for the working group, which is to be presented to and approved by their ICG.

TOR 2

INTER AND INTRA-REGIONAL (ICG) SHARING OF COMMUNITY-BASED EWS BEST PRACTICES (BP) **Persons in Charge:** **Julie Leonard and Bernardo Aliaga**	
BACKGROUND	1. There are many examples of community-based EWS from around the world. In order to promote continued implementation in vulnerable communities, i.e. reaching the last mile, BP meetings should be promoted to share experiences. There are a variety of formats which could be used. 2. ICG-CARIBE-EWS implemented a BP meeting in August 2008 that brought 30 practitioners from 15 countries to share experiences in implementing CB-EWS. This meeting was judged by the practitioners as a successful way to discuss and share approaches to problem identification; methodology and strategy implementation; results achieved; and sustainability and transferability, as well as community participation, gender and media considerations. Participants requested more opportunities to learn from and visit active CB EWS projects. Two opportunities were supported: 1) a visit to Masachapa, Nicaragua, linked to a meeting of the CAWG

	(PTWS) in November, 2009; 2) TsunamiReady Summit in Mayaguez, PR, where 20 reps from CAM and CAR MS met with TsunamiReady practitioners in Puerto Rico and visited a TR community. Participation was supported by IOC and other donors. Additionally, presentations on both experiences were made at the ICG-V meeting in Managua, 2010. In the PTWS…, in the IOTWS …
ACTIVITIES	TT2 recommends to WGs to support a similar activity or activities as part of a CB EWS program to promote the implementation of community-based EWS, i.e., reaching the last mile.
EXPECTED RESULT	X number of "best practices" meetings at regional and/or national level to share experiences in implementing community-based EWS.

TOR 3

DISCUSSION WITH ISDR, ECHO UN REGIONAL ORGANIZATIONS AND OTHER RELEVANT DONORS, INCLUDING ON THE USE OF CBDRR/CBDRM PLATFORMS **Persons in Charge:** **Sam Hettiarachchi and Julie Leonard**	
BACKGROUND	The Hyogo Framework for Action, global DRR campaigns as well as National DRR Platforms are existing means for building bridges between the tsunami EWS and DRR practitioners, in the context of building effective multi-hazard prevention, mitigation and preparedness programs.
ACTIVITIES	1. Organize a round table on coastal hazards including (emphasizing on) tsunami prevention, mitigation and preparedness at Third Session of the Global Platform for DRR, 8-13 May 2011, Geneva, Switzerland. 2. Designation of “Tsunami Aware Communities” as part of DRR day. 3. Campaign on “Make my coastal community safe/resilient», including public awareness activities, memorials, etc. 4. Encourage ICGs to promote and MS to actively pursue linkage with national DRR platforms.
EXPECTED RESULT	1. Creation/inclusion of a program on “make my coastal community safe/resilient”, similar to “one million safe hospitals and safe schools campaign” program and the “making cities safe campaign” (2010-11). 2. Tsunami and other coastal related hazards are included within HFA reporting process 3. Incorporation of tsunami awareness into global DRR day.

TOR 4

BASIC FRAMEWORK FOR STANDARD OPERATIONAL PROCEDURES IN TSUNAMI WARNING DISSEMINATION **Persons in Charge:** **Russell Arthurton and Irina Rafliana**	
DEFINITIONS	A set of written instructions describing a routine or repetitive activity to be followed by an organization. The instructions are stakeholder agreed-upon steps that will be used in coordinating the Who, What, When, Where, and How aspects of the activity. A mechanism for operating effective and reliable coordinated warning systems and disaster management systems. The NTWC SOP must be linked at all levels from international through national to local institutions. It must be simultaneously connected to the corresponding DMO SOP, and vice versa.
BACKGROUND	• What and Why? The aim is to provide a basic understanding of the core early warning features of a TWS. These provide an "end-to-end" system of event detection, information processing and messaging which is designed to provide warnings and related information to people at risk in the shortest possible time after a potentially tsunami-generating earthquake. The system depends on the interoperability of its component parts. The management of each part (regional watch centres (providers), national warning centres, disaster management organisations and related emergency agencies) is governed by its specific standard operating procedures so that their operators know precisely what actions are to be taken in an emergency, even if such an emergency is a very rare event. • Who needs them? • For What? o Current state of development in ICGs o Formal and Informal ▪ Informal SOP: Users manual in NEAMS o Where are the gaps o Useful presentation tools ▪ Flow charts/templates o Basic Principles: ▪ Information flow through the system should be pragmatic and depend on specific national and local capacities o Basic roles and responsibilities in each part of the TWS

	▪ RTWP ▪ NTWC ▪ DMO/EOC ▪ Community at Risk
OBJECTIVES	1. To promote common approach and harmonization in the development of SOPs to the End-to-End Tsunami Warning System to all stages of operations, from detection to dissemination 2. The SOP discussed here include those for real-time emergency operation centres and pre-event activities (Regional Watch Centres/Providers, National Warning Centres, and Disaster Management Offices/Organizations) 3. SOPs should accommodate specific circumstances of lead to different lead times, resources and capacities available 4. SOPs should reflect back clearly on how first responders (emergency response officers/DMOs) and communities should be prepared 5. SOPs at the local level should clearly reflect what and how community should react and respond to the warning
RECOMMENDATION	1. The ICGs are to agree on an overarching concept of operation. The concept should promote the development of national plans for Tsunami Warning and SOPs. 2. Agree consistent terminologies used by regional watch/warning centres globally. 3. Warning, Watch, Bulletin, Advisory, Alert. 4. Building on existing good practices, recognizing the existing effective SOPs already developed and evaluated within parts of ICGs, extend these practices more universally throughout ICGs. 5. Develop basic templates for SOPs for all relevant levels, building on the experiences of e.g. PTWS and IOTWS. 6. Encourage effective linkages between the respective SOPs within countries. 7. Review and test SOPs through exercises and document the improvement processes. Encourage Member States to review and take action plans based on their exercises.

TOR 5

TSUNAMI WAVE EXERCISES GUIDELINE **Persons in Charge:** **Laura Kong & David Coetzee**	
BACKGROUND	Regional and national tsunami warning systems in the Pacific and globally must maintain a high level of readiness so as to be able to efficiently and effectively act to provide for the public's safety during fast-onset and rapidly-evolving natural disasters such as tsunamis. To maintain this high state of operational readiness and especially for infrequent events such as tsunamis, tsunami warning centres and emergency agencies must regularly practice their response procedures to ensure that vital communication links work seamlessly, and that agencies and response personnel know the roles that they will need to play during an actual event. The purpose of an exercise is to evaluate the ability of countries and their national and local organizations to respond to a tsunami, whether local or distant. Exercises provide an opportunity for countries to exercise their operational lines of communications, review their tsunami response procedures, and at the same time, promote emergency and tsunami preparedness. Regular regional tsunami exercises have become a permanent fixture of all Intergovernmental Coordination Groups (ICGs). To date, the PTWS has conducted 2 Pacific-wide exercises (2006, 2008) and will conduct its next exercise in the 4th quarter of 2011. The IOTWS conducted an Indian Ocean-wide exercise in the 3rd quarter 2009, and the CARIBE-EWS will conduct an exercise in the 1st quarter of 2011. The preparation, conduct and evaluation of these exercises present significant challenges. The challenges apply to: 1. Resource commitment for exercise planning/preparation 2. The extensive scope of exercise participation 3. The absence of consistent and independent evaluation at each participant level 4. The responsibilities for exercise typically crosses working groups within an ICG and/or within Member States It is also noted that there is no generic and consistent guideline available for ICGs about the development and management of regional tsunami exercises.

RECOMMENDATION	Inter-ICG task team be established to compile a consistent set of guidelines for regional tsunami exercise development, management and evaluation and among others, consider: 1. The focus to be on the exercise of SOPs of NWCs and DMOs. 2. Options for sharing of exercise planning, management and evaluation resources across ICGs.
EXPECTED RESULT	1. Generic and consistent guidelines on exercise development, management and evaluation that will apply to both exercise coordinators and exercise players (watch & warning centres as well as disaster management agencies) and that can be used by all ICGs. 2. A process or system whereby ICGs can support each other in the development, management and evaluation of exercises.

TOR 6

TSUNAMI TRAINING AND CAPACITY BUILDING **Person in Charge:** **Laura Kong**	
BACKGROUND	Training classes, workshops, forums, or other mechanisms that bring stakeholders together to increase their knowledge base and improve job skills. For tsunamis, this specifically includes skills to be able to design, implement, and sustain mitigation programs in hazard risk assessment, warning, and awareness and response.
GOALS AND TARGETS	To increase the skills of responsible tsunami stakeholders, and their customers, to respond effectively to tsunamis. This includes the: 1. Provision of background information on the phenomena and its implications, 2. Technical skills to be proficient at utilizing tools to accomplish their jobs, 3. Communication skills to be able to convey information to customers (decision-makers to last mile public).
SERVICE PROVIDERS	Training and Outreach has traditionally been conducted by many different organizations (both government and private sector) internationally, nationally, and locally. As part of its mandate and functions under IOC Resolution X-23 (1977), the ITIC assists countries in establishing warning centres and improving tsunami preparedness, and for decades has annually conducted a training program. As an international centre, ITIC also works to monitor and improve warning services globally, and serves as an information resource for tsunami events (with WDC-MGG tsunamis), clearinghouse for education and awareness materials, and encourages research that will improve mitigation practices. The ITIC Training Program consists of a Hawaii-based training (ITP-Hawaii) where Hawaii is used as a working example of an end-to-end system of warning, response, and preparedness for both distant and local tsunamis, and an International training (ITP-Intl) where ITIC organizes a regional or country-specific training. The ITP-Hawaii emphasizes small classes where the actual practitioners can answer questions and share real-life experiences. The ITP-Intl allows for international experts to visit a tsunami-prone country to engage a much larger and broader set of stakeholders. Since the 2004 Indian Ocean tsunami, the ITIC has conducted more than 60 multi-day trainings around the world.

	To assist the development of a functional global tsunami warning and mitigation system, the IOC endorses the establishment of Tsunami Information Centers (TIC) in each ICG region to serve as an information resource, and specifically act as a focal point for awareness and the identification of country capacity building activities requirements. To date, Indonesia is served by the Jakarta Tsunami Information Center, and CARIBE-EWS starting in 2011 by the Caribbean Tsunami Information Center, and NEAMTWS by the NEAM Tsunami Information Center. TICs should engage and coordinate and/or collaborate with the relevant regional organizations to meet country needs. The ITP-Hawaii is an example where a TIC (ITIC) works closely with its Regional TWC (PTWC) and its local emergency response and preparedness groups (Hawaii State and County Civil Defense and Pacific Tsunami Museum) to conduct a training focused on practical and real-life sharing on the operational aspects of warning and response. Participants are nominated by their country through IOC Circular Letter, and selection is based on country/regional need and commitment. The training emphasizes stakeholder coordination, and as such, ideally brings simultaneously warning centre and the disaster management staff from one country to the same training.
CONTENT	Training curricula have varied in their formats and in their standards for achieving competency. Methods have ranged from high-level briefings for decision-makers to hands-on training to duty and field staff on detection and threat evaluation hardware/software technologies and alert dissemination, and to informal community gatherings to convey and decide on warning, response, and evacuation. Depending on the target audience, appropriate teaching materials and methodologies have been developed and used. In order to support the establishment and strengthening of reliable tsunami early warning systems and an effective end-to-end warning, trainings have focused on the development of tsunami warning and emergency response standard operating procedures (SOPs).These SOPs are considered to be essential for rapid and efficient response. For an effective Tsunami Early Warning and Mitigation System (TEWS) National or Sub-National Tsunami Warning Centres (TWC) need to quickly disseminate consistent and reliable tsunami threat information in an understandable and concise manner. Disaster Management Organizations (DMO), or their Emergency Operations Centres, that are responsible for public safety during natural or man- made disasters, then need to assess the threat to their local populations based on all available information including local knowledge, and when

	appropriate, disseminate safety information and instructions, and initiate public coastal evacuations. These actions comprise an "End-to-End" TEWS response (monitoring and warning, alert dissemination, emergency response, public action). To be successful, Tsunami Warning Centres and Disaster Management Organizations at all levels of government (national, provincial, district and local) require pre-event development of protocol and procedures documents describing their roles, responsibilities, responses, and actions. These responses and actions should be well coordinated and practiced (exercised) within their organizations, in conjunction with external agencies.
RECOMMENDATION	1. A consistent set of trainings be provided to all regions on the essential components of tsunami early warning. 2. Further tailoring is done by each ICG. ICGs should survey the training needs of its Member States to identify priorities in topic and/or location. Capacity building may cross-cut across Working Groups/Task Teams and involve a broad set of stakeholders, or be specific to a WG. 3. Design and implement a framework for regional capacity building modelled after the ITIC ITP-Hawaii and International training programs, and a strategy that will ideally build region-based training centres and expert trainers. Elaborate these in the ICG's Medium Term Strategy. 4. Coordination amongst service providers, regional organizations, and donors is strongly encouraged Consistency across ICG regions is required.
EXPECTED RESULT	1. Regionally-specific trainings that involve RTWC and RTICs. 2. Implemented and accountable mitigation programs, including the provision of well-understood coordinated warnings to a prepared population. 3. Shared best practice protocols that will facilitate the development of a standard approach for all practitioners in a region. 4. Cadre of regional trainers that is fully knowledgeable and capable to provide a globally consistent approach to tsunami warning and mitigation. 5. See Activities below.
ACTIVITIES	1. Study visits of best practices examples (such as ITP-Hawaii) – annual with ICG input on participants. 2. Regional trainings of nearby countries (annual). 3. Country trainings specific to the needs of a country (tsunami-prone are highest priority, but upon the interest

	of each country). 4. Train-the-trainer trainings to build in-region trainers as knowledge experts on an end-to-end system (at least 1 set of regional trainer/ICG).

ANNEX V

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

CONTENTS

1. INTRODUCTION

The IOC Tsunami Programme, through the coordination of regional meetings, capacity building activities and the support of national and regional projects is a key stakeholder for tsunami risk reduction at global level. Four Intergovernmental Coordination Groups (ICGs) corresponding to the regions Pacific, Caribbean, Indian Ocean and Mediterranean have been established to address particular regional needs.

1.1 WORKING GROUP ON TSUNAMI AND OTHER HAZARDS RELATED TO SEA LEVEL WARNING AND MITIGATION SYSTEMS (TOWS-WG)

IOC Resolution XXIV-14, based on findings of the ad hoc Working Group, approved a proposal for the establishment of a permanent global Working group on Tsunami and other hazards related to Sea-level Warning and Mitigation Systems (TOWS-WG). It comprises representatives of all relevant IOC subsidiary bodies and those from UN sister agencies, like ISDR and WMO, as well as representatives of relevant stakeholders.

IOC charged its Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems (TOWS-WG) to review the governance and organization of the ICG's of all Tsunami Warning Systems to ensure common operation explore synergy effects and mainstream in particular the upstream activities, i.e. detection and verification, into existing ocean observing systems.

The IOC XXV Assembly adopted Resolution XXV-13 in 2009, which decided to establish the following task teams:

- Inter-ICG Task Teams on Sea Level for Tsunami Purposes
- Inter-ICG Task Team on Disaster Management and Preparedness
- Inter-ICG Task Team on Tsunami Watch Operations

The establishment of these task teams was to meet the need for and the benefit from enhanced coordination, common requirements, and exchange knowledge and information among the ICGs.

1.2 INTER-ICG TASK TEAM ON TSUNAMI WATCH OPERATIONS

The current Task Team on Tsunami Watch Operations is working towards harmonization of methods and standards issuance of tsunami advisories, advise on modalities of operation and develop guidelines for the requirements of Regional Warning Systems. The detailed Terms of Reference of this Task Team include:

- provide a mechanism to the ICGs for coordination of tsunami watch operations among the Tsunami Warning Systems;
- document current and proposed products and their dissemination methods, working through existing ICG working groups or their equivalents;
- review terminology and recommend harmonized terminology;
- document areas of responsibilities, geographical coverage, system architectures, and other relevant characteristics;
- develop consensus on uniform standards, procedures and guidelines for tsunami watch operations, including a process for verifying the operational status of Regional Tsunami Watch Providers;
- develop guidelines for the review of tsunami watch operations.

1.3 MEMBERS OF THE TASK TEAM:

Sl No.	TWS	Member
1.	IOTWS	Srinivasa Kumar, Chair
2.	IOTWS	Charles Ngunjiri
3.	PTWS	Chip McCreery
4.	PTWS	Takeshi Koizumi
5.	CARIBE-EWS	Christa von Hillebrandt
6.	CARIBE-EWS	Emilio Talavera
7.	NEAMTWS	Luis Matias
8.	NEAMTWS	Gerassimos Papadopoulos
9.	Secretarial Support	Tony Elliott

The task team conducted its work through email and during the Inter-ICG Task Team meeting held at Seattle during November 29 – December 01, 2010. The Task Team also benefitted from the numerous documents and publications brought out by different ICGs and other international organizations. Important reference documents are listed as Annexure-3.

2. REVIEW OF CURRENT OPERATIONAL SYSTEM

2.1 THE INDIAN OCEAN TSUNAMI WARNING MITIGATION SYSTEM (IOTWS):

The Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System (ICG/IOTWS) was formed in response to the tragic tsunami on December 26th 2004, in which over 250,000 lives were lost around the Indian Ocean region. The IOC Assembly, during its twenty-third Session (21-30 June 2005), formally established the ICG/IOTWS through Resolution IOC-XXIII-12. The main objective of the IOTWS is to identify and mitigate the hazards posed by local and distant tsunamis. The goal is to create a fully integrated end-to-end warning system comprising three key components: hazard detection and forecasting; threat evaluation and alert dissemination; and community preparedness and response. The work of the IOTWS is conducted by three working groups and a Task Team whose members are experts in their fields, responsible for establishing standards and for developing work plans. They report their recommendations to the ICG for endorsement and implementation.

- Working Group 1 - Tsunami Risk Assessment and Reduction
- Working Group 2 - Tsunami Detection, Warning and Dissemination
- Working Group 3 - Tsunami Awareness and Response
- Task Team on Regional Tsunami Watch Providers

2.1.1 Operational Centres, System Architecture and Area of Responsibility

PTWC and JMA as Interim Advisory Service Providers: An interim IOTWS was declared operational in July 2006, the backbone of which at the regional level is the Interim Advisory Service (IAS), which provides tsunami advisory and watch information directly to the 24/7 National Tsunami Warning Centres (NTWC) of the IOTWS Member States (MS). The PTWC and JMA are providing such Interim Advisory Services (IAS) to Indian Ocean region. While PTWC & JMA have no authority or responsibility to issue tsunami warnings outside their regions of responsibility, they have been acting as a backbone and providing tsunami-relevant information to Indian Ocean nations on an interim basis.

RTSPs (by mid-2011): By the target date of mid-2011, the responsibility of providing tsunami advisories to the IOTWS Member States will be taken over by a number of Regional Tsunami Advisory Service Providers (RTSP) located in the Indian Ocean region. Tsunami advisories will be disseminated from each IOTWS RTSP to the TWFPs & other RTSPs as an interoperable system of systems, with the IAS centres acting as a backup. Several countries in the IOTWS region such as Australia, India, Indonesia and others have established RTSP capabilities.

Geographical coverage of IOTWS includes the Indian Ocean Region as depicted in Figure 1

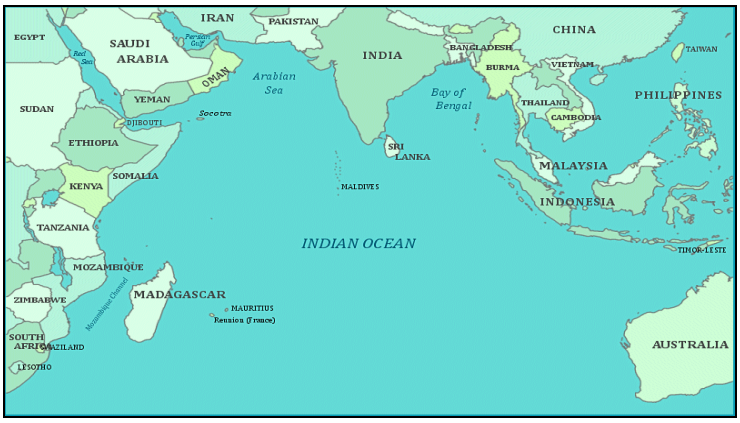


Figure V-1. Indian Ocean Geographical Coverage Area

2.1.2 Operational Procedure:

Interim Service provided by JMA and PTWC for the IOTWS are based on Earthquake source information to determine potential tsunami threat and travel times. The criterion used by PTWC & JMA for generation of tsunami advisories is tabulated below:

Sl No	Criteria	Product
1.	Mw: 6.5 – 7.0	Tsunami Information Bulletin with Potential destructive tsunami threat very small or none.
2.	Mw: 7.1 – 7.5	Local Tsunami Watch with Potential or confirmed destructive tsunami threat to coasts within about 200 km of the earthquake epicentre.
3.	Mw: 7.6 – 7.8	Regional Tsunami Watch with Potential or confirmed destructive tsunami threat to coasts within about 1000 km of the earthquake epicentre.
4.	Mw: 7.9 – 9.9	Indian Ocean wide Tsunami Watch with Potential or confirmed destructive tsunami threat to all coasts bordering the Indian Ocean.

2.1.3 Current Products:

Interim Advisory Service: PTWC

- Tsunami Information Bulletins
- Local, Regional or Indian Ocean-Wide Tsunami Watch Bulletins

Interim Advisory Service: JMA

- Local, Regional or Indian Ocean-Wide Tsunami Watch Information

2.1.4 Dissemination Methods:

The tsunami advisory bulletins are disseminated to TWFPs of the IOTWS Member States by FAX, Email, Web and GTS.

2.1.5 Proposed Products:

RTSPs will provide services in two forms: PUBLIC Services and ADVISORY (Exchange) Services. RTSPs will issue more specific tsunami information for NTWCs such as Estimated Wave Amplitude (EWA), Estimate Time of Arrival (ETA), Potential threat zones etc generated from forecast models. The proposed products will be categorized as Bulletin-1, Bulletin-2, Bulletin-3, Bulletin-... and Final Bulletin

2.2 PACIFIC TSUNAMI WARNING SYSTEM (PTWS):

The Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System (ICG/PTWS) first convened in 1968. The system, initially designed as a central system for far-field tsunamis is addressing the requirements for near-field sources and regional sub-systems. The work of the PTWS is conducted by three sessional working groups, four regional working groups and two task teams

- Working Group 1 - Tsunami Risk Assessment and Reduction
- Working Group 2 - Detection, Warning and Dissemination
- Working Group 3 - Awareness and Response
- Regional Working Group on the South China Sea
- Working Group for the South West Pacific
- Working Group for the South East Pacific
- Working Group for Central America
- Task Team on Pacific Wave Exercise
- Task Team on Pacific Emergency Communications

2.2.1 Operational Centres, System Architecture and Area of Responsibility:

Tsunami information and warning products are disseminated from PTWC, WCATWC, and NWPTAC to TWFPs of their respective areas of responsibility within the Pacific region. The AORs of individual centres for the PTWS is described below:

- PTWC - PTWC's area of responsibility (AOR) for issuing PTWS warnings and other messages includes all coasts in the Pacific Ocean except those covered by WC/ATWC (Alaska, British Columbia, Washington, Oregon, and California) as illustrated on Figure 2.
- WC/ATWC – WC/ATWC's area-of-responsibility (AOR) within the PTWS is the Pacific coasts of the U.S. States of Alaska, Washington, Oregon, and California as part of the US National Tsunami Warning System, as well as the Pacific coast of Canada thru a bilateral agreement. WC/ATWC collaborates with the

Pacific Tsunami Warning Center PTWC to provide tsunami warning services, and mutual backup, to tsunami threatened areas throughout the United States and the PTWS. See Figure 2.

- NWPTAC (JMA) – The Northwest Pacific Tsunami Advisory Centre's area-of-responsibility includes the northwestern and a portion of the southwestern Pacific and, on interim basis, the South China Sea regions as represented on Figure 3.

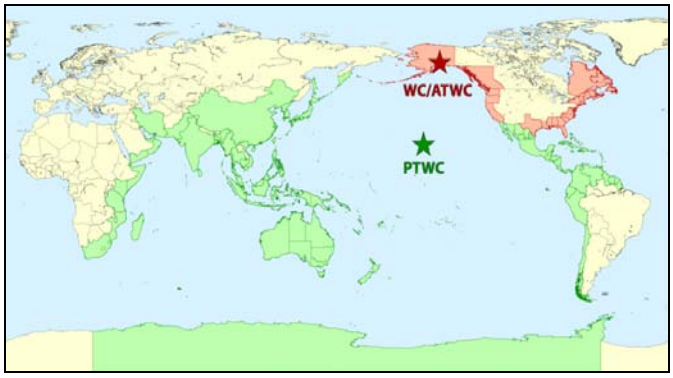


Figure V-2. PTWC & WC/ATWC Geographical Coverage Area

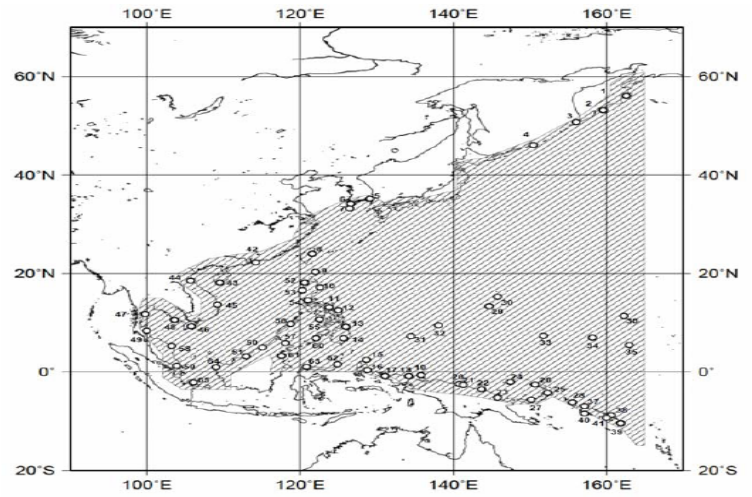


Figure V-3. NWPTAC (JMA) Geographical Coverage Area

2.2.2 Operational Procedure:

Earthquake source information is used to determine potential tsunami threat and travel times. The criterion used by PTWC, WC/ATWC & NWPTAC for generation of tsunami advisories for the PTWS is tabulated below:

PTWC

Sl No	Criteria	Product
1.	Mw: 6.5 – 7.5	Tsunami Information Bulletin with evaluation that a widespread destructive tsunami was not generated
2.	Mw: 7.6 – 7.8	Regional fixed Tsunami Warning Bulleting for coastal areas within 1000km of the epicentre.
3.	Mw > 7.8	Regional Expanding Tsunami Warning & Watch Bulletin putting areas within 3 hours tsunami estimated time of arrival (ETA) into a Warning and area within 3-6 hours tsunami ETA into Watch.
4.	Confirmed Tsunami with destructive potential far from the source	Pacific wide Tsunami Warning Bulleting putting all coastal areas in a Warning.

WC/ATWC

Sl No	Criteria	Product
1.	Ms < 6.5	Alaska, British Columbia, West Coast Of U.S. Issue information message if appropriate
2.	Ms = 6.5 and less than warning Thresholds	Alaska, British Columbia, West Coast Of U.S. Issue Tsunami Information Bulletin
3.	Ms = 6.5 & ≤ 7.5	Pacific Basin Outside Of Alaska And Canada/U.S. West Coast Issue Tsunami Information Bulletin
4.	Ms > 7.0	Alaska West Of Unimak Pass (165w) 1. Issue a warning to area within 3 hours travel time of the expected bulletin issuance. 2. Issue a watch to the area within 3 and 6 hour travel time. 3. Monitor tide gages.
5.	Ms > 7.0	Alaska Bering Sea Only 1. Issue a warning to Alaska's Pribilof Island and Aleutian Islands from Attu to False Pass only. 2. There is no watch area. 3. Monitor tide gages.
6.	Ms > 7.0 & ≤ 7.5	Alaska East Of Unimak Pass, U.S./Canada West Coast 1. Issue a warning to area within two hours

Sl No	Criteria	Product
		travel time of the expected bulletin issuance. 2. Issue a watch to the area within 2 and 3 hour travel time. 3. Monitor tide gages.
7.	Ms > 7.5	Alaska East Of Unimak Pass, U.S./Canada West Coast 1. Issue Tsunami warning to area within 3 hours travel time of the expected bulletin issuance. 2. Issue a watch to the area within 3 and 6 hour travel time. 3. Monitor tide gages.
8.	Ms > 7.5	Pacific Basin Outside Of Alaska And Canada/U.S. West Coast 1. If the epicentre is within 6 hours tsunamis travel time of any part of the WC/ATWC area of responsibility: a. Issue a warning to the area within 3 hours travel time of expected bulletin issuance. b. Issue a watch to the area within 3 and 6 hours travel time. c. Monitor tide gage data. 2. If the epicentre is more than six hours travel time from any part of the WC/ATWC area of responsibility, issue a Tsunami 3. Advisory Bulletin.

WCATWC also issues products for Puerto Rico, US and British Virgin Islands

NWPTAC

Sl No	Criteria	Product
1.	6.5<M*<7.0	NWPTA** with evaluation that very small possibility of a destructive local tsunami.
2.	7.0<M*<7.5	NWPTA** with evaluation that possibility of a destructive local tsunami within 100 km of the epicentre.
3.	7.5<M*<7.8	NWPTA** with evaluation that possibility of a destructive regional tsunami within 1,000 km of the epicentre.
4.	M*>7.8	NWPTA** with evaluation that possibility of a destructive ocean-wide tsunami.

M*: Mw or Mjma
NWPTA**: North West Pacific Tsunami Advisory

2.2.3 Current Products

PTWC

- Tsunami Information Bulletin
- Regional Fixed Tsunami Warning Bulletin
- Regional Expanding Tsunami Warning and Watch Bulletin
- Pacific-Wide Tsunami Warning Bulletin

Northwest Pacific Tsunami Advisory Center - NWPTAC

- Local, Regional, northwest and portion of southwest Pacific Tsunami Advisories

West Coast/Alaska Tsunami Warning Center (WC/ATWC)/PTWC Domestic Products

- Information Statement
- Tsunami Warning Message
- Tsunami Advisory Message
- Tsunami Watch Message

2.2.4 Dissemination Methods:

GTS; AFTN; EMWIN; Fax; Email; Web; AWIPS; NWW; NAWAS; HAWAS; IDN.

2.3 TSUNAMI AND OTHER COASTAL HAZARDS WARNING SYSTEM FOR THE CARIBBEAN SEA AND ADJACENT REGIONS (CARIBE-EWS):

The Intergovernmental Coordination Group for the Tsunami and other Coastal Hazards Warning System for the Caribbean and Adjacent Regions (ICG/CARIBE EWS) was established in 2005 as a subsidiary body of the IOC-UNESCO with the purpose of providing efficient assistance on tsunami risk reduction to Member States in the Caribbean region. The work of the CARIBE-EWS is conducted by four working groups.

- Working Group 1 – Monitoring and Detection Systems, Warning Guidance
- Working Group 2 – Hazard Assessment
- Working Group 3 – Warning Dissemination and Communication
- Working Group 4 – Preparedness, Readiness and Resilience

2.3.1 Operational Centres, System Architecture and Area of Responsibility

Currently, tsunami information and watch products are disseminated from PTWC to the TWFPs of all countries of the Caribbean and adjacent regions, except Puerto Rico, US and British Virgin Islands which are currently covered by WCATWC. Future plans are for these tsunami products to be disseminated from a Caribbean Tsunami Warning Center.This system will be interoperable within the Caribbean basin and as well as with other regional and global TWC's and RTWP.

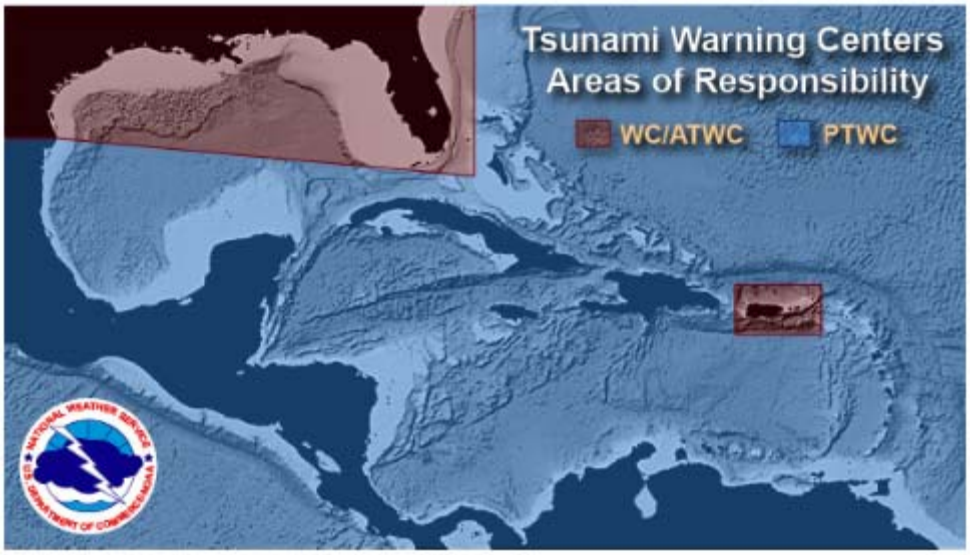


Figure V-4. CARIBE-EWS Current Geographical Coverage Area and distribution of Areas of Responsibility for issuing tsunami products

2.3.2 Operational Procedure

Earthquake source information is used to determine potential tsunami threat and travel times. The criterion used by PTWC & WC/ATWC for generation of tsunami advisories for the CARIBE-EWS is tabulated below

Sl No	Criteria	Product
1.	Mw: 6.5 – 7.0 (Caribbean)	Tsunami Information Statement with evaluation that a very small possibility of a destructive local tsunami.
2.	Mw: 6.5 – 7.8 (Atlantic)	Tsunami Information Statement with evaluation that a very small possibility of a destructive ocean-wide tsunami.
3.	Mw: 7.1 to 7.5 (Caribbean)	Local Tsunami Watch with evaluation that Potential for destructive local tsunami.
4.	Mw: 7.6 – 7.8 (Caribbean)	Regional Tsunami Watch Bulletin with evaluation that Potential for a destructive regional tsunami.
5.	Mw > 7.9 (Caribbean & Atlantic)	Ocean-wide Tsunami Watch with evaluation that Potential for a destructive ocean-wide tsunami.

2.3.3 Current Products

Interim Advisory Service: PTWC

- Tsunami Information Statement
- Local, Regional and Caribbean-wide Tsunami Watch

West Coast/Alaska Tsunami Warning Center (WC/ATWC)

- Information Statement
- Tsunami Warning Message
- Tsunami Advisory Message
- Tsunami Watch Message

2.3.4 Dissemination Methods:

Fax; NWW; Email; SMS; AWIPS; Web; RSS feed; EMWIN.

2.3.5 Proposed Products:

- Tsunami Information Statement
- Tsunami Warning Message
- Tsunami Advisory Message
- Tsunami Watch Message

2.4 THE TSUNAMI EARLY WARNING AND MITIGATION SYSTEM IN THE NORTH EASTERN ATLANTIC, THE MEDITERRANEAN AND CONNECTED SEAS (NEAMTWS):

The Intergovernmental Coordination Group for the Tsunami Early Warning and Mitigation System in the North-Eastern Atlantic, the Mediterranean and connected seas (ICG/NEAMTWS) was formed in response to the tragic tsunami on 26 December 2004. The IOC Assembly, during its twenty-third Session (21-30 June 2005), formally established the ICG/NEAMTWS through Resolution IOC-XXIII-14. The work of the NEAMTWS is conducted by four working groups and three task teams

- Working Group 1 - Hazard Assessment and Modelling
- Working Group 2 - Seismic and Geophysical Measurements
- Working Group 3 - Sea Level Data Collection and Exchange, Including Offshore
- Tsunami Detection and Instruments
- Working Group 4 - Public Awareness, Preparedness and Mitigation
- Task Team on the Regional Tsunami Warning System Architecture
- Task Team on Communication Test and Tsunami Exercises
- Task Team on the Multi-hazard Approach to Coastal Inundation

2.4.1 Operational Centres, System Architecture and Area of Responsibility

NEAMTWS area includes North-Eastern Atlantic, The Mediterranean and connected seas (Marmara Sea and Black Sea) as depicted in Figure 4. There is currently no tsunami warning centre providing services to this region. The system is in the building-up stage with the improvement of instrumental and telecommunication infrastructure, while test communications for message exchanges were successfully performed by national centres

during 2010 and scheduled to repeat within 2011. Currently the architecture of the system is under design.

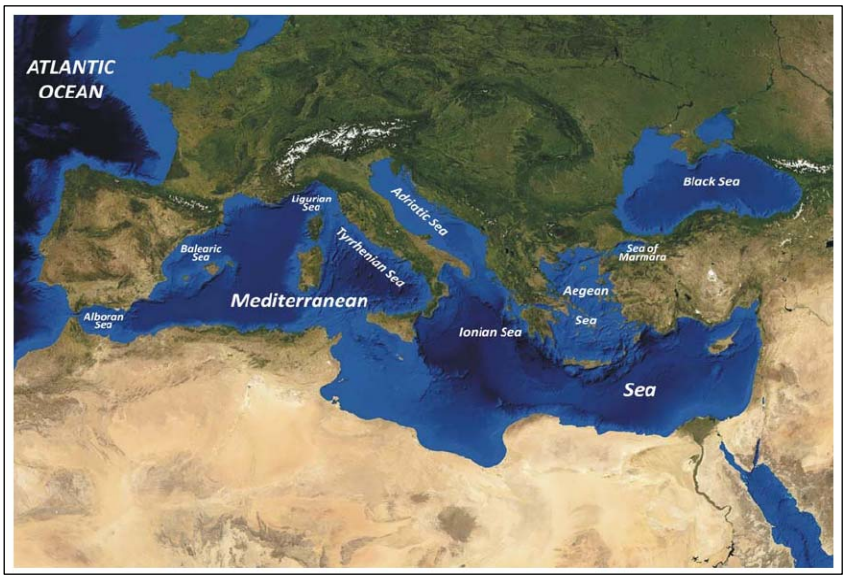


Figure V- 5. NEAMTWS Geographical Coverage Area

2.4.2 Proposed Products:

- Tsunami Watch Message
- Tsunami Advisory Message
- Tsunami Information Message

3. RECOMMENDATIONS FOR GLOBAL HARMONIZATION

Considering the heterogeneous ways of data management, communication, warning and mitigation practices in tsunami and other ocean hazard warning systems, it is recommended to work towards developing and exploiting synergies amongst all regional warning systems. In order to identify the potential gaps in the present systems, particularly where no system exists, providing an outline for the development of a strategy for tsunami is very important.

All four systems are now focusing on optimizing and improving their performance. They also improve the levels of consistency between participating members and among them, particularly in the detection and verification parts. For the production, formulation and dissemination of advisories, alerts, alarms and nationally mandated warnings, common procedures are to be developed, and performance measures introduced. The development and implementation of interoperable systems for tsunamis can only be achieved through close consultation, coordination and cooperation among all stakeholders.

Standardization and harmonization of tsunami operations across the Regional Centres and across the ICGs is highly desirable. At the same time, the system should be flexible enough to include local & regional considerations, both scientific & logistical.

The recommendations of this Task Team are expected to be a starting point towards bringing in the much needed harmonization and synergy between different regional systems

and result in a global “System-of-systems” for delivery of tsunami advisories for all the global coastlines threatened by tsunami.

3.1 AOR AND SYSTEM ARCHITECTURE

Regional Tsunami Warning Systems operating in each ICG (viz. IOTWS, PTWS, NEAMTWS, CARIBE EWS) are the building blocks of a global TWS. Global coverage of the four ICGs is shown in figure-6. It may be noted that there are some coasts that are not covered by any Regional TWS but are covered by a National TWC that is in turn part of one or more Regional TWS.

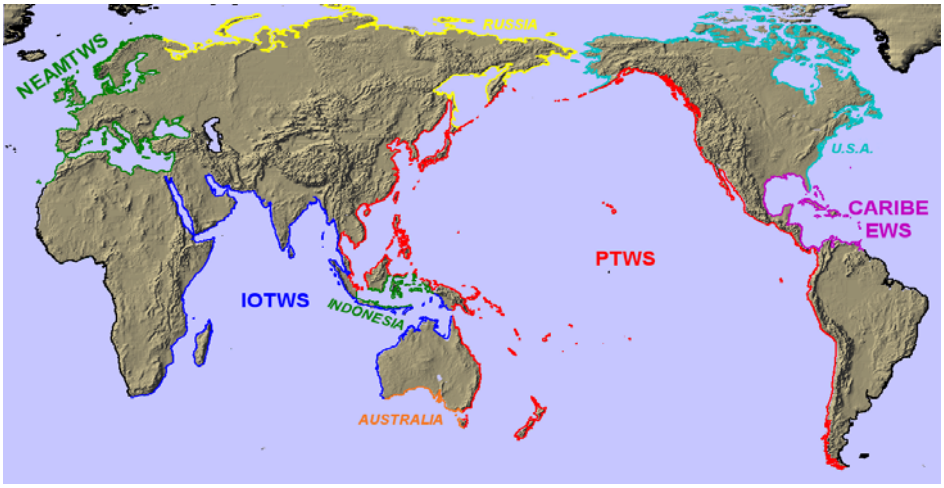


Figure V-6. Global coverage of the four TWSs is shown in this picture. Some coasts are not covered by a TWS but are covered by a national TWC that is part of one or more TWSs

It is proposed that the coverage of each regional tsunami warning system and the AOR of RTSPs operating within a regional tsunami warning system should be decided by the respective ICGs. While addressing the above aspects, it is to be ensured that these systems should offer coverage to the coastal regions of all IOC as well as non IOC Member States that are vulnerable to a tsunami.

Each Regional Tsunami Warning System will ideally comprise of National Tsunami Warning Centres (NTWC)/ National Tsunami Warning Focal Points (NTFPs) in each country receiving tsunami advisories from one/more Regional Tsunami Advisory Service Providers (RTSP).

The RTSPs will distribute the products to NTWCs / NTFPs and to other RTSPs operating within the ocean basin. Ultimately it is the NTWCs/NTFPs, operating within the legal framework of the sovereign nation in which they reside and serve, that provide warnings, watches, and advisories to their citizens, public and private agencies. These warnings are based either on the NTWC’s own analysis of the situation, on the advisory messages received from RTSPs, or on a combination of all.

As a backup to service for each region, there should be more than one RTSP operational and share information with each other and NTWCs via, for example, GTS, web sites, RSS feeds, fax, emails, etc, in standard formats. Not only with the RTSPs of same ocean basin, they should be interoperable with other ocean basin RTSPs, i.e. use common and agreed formats for information exchange, address service requirements, follow agreed, high-level operating Standard Operating Procedures (SOPs), share information on procedures and processes. The global TWS therefore operates as a “System-of-systems”.

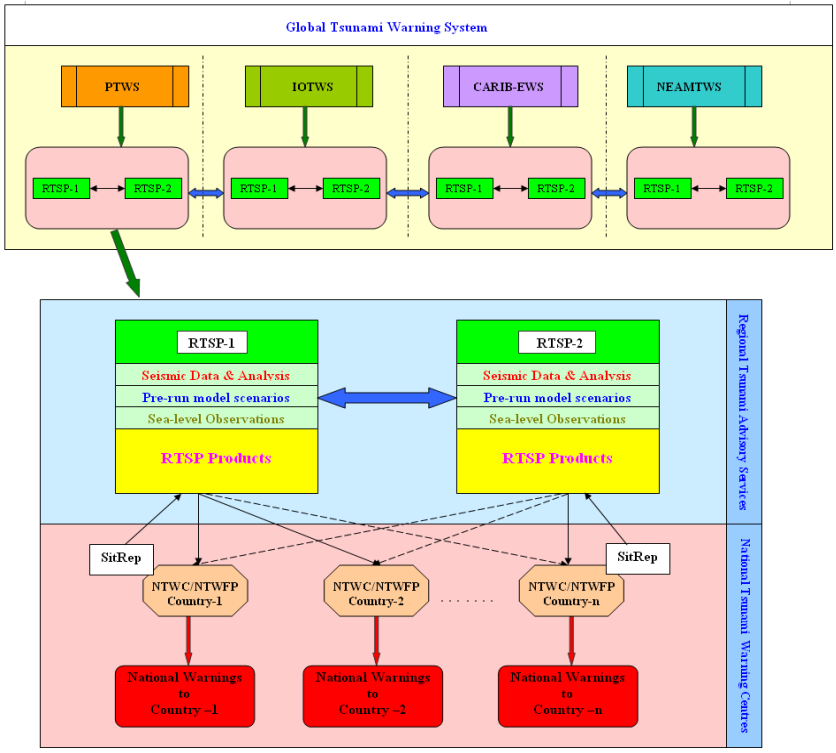


Figure V-7. Proposed System Architecture

3.2 OPERATIONAL ELEMENTS OF A REGIONAL TWS:

At the heart of a regional tsunami warning system are the NTWCs & RTSPs operating 24 hours per day, 7 days per week. An RTSP should do two things as fast as possible: locate any moderate or larger sized earthquake, and assess its magnitude. Once that is accomplished, they can begin to assess any potential tsunami threat to the regions in its area of responsibility (AOR). The first tsunami bulletin issued by a RTSP is usually based on seismic information. Later bulletins follow up model based forecasts and/or with sea-level observations. The real-time sea level observations are key element as they are used to help confirm the existence of a tsunami or cancel a tsunami warning. However, for the areas which are very close to the source, the time for confirmation may not exist. In such cases, the use of numerical modelling to determine the potential run-ups and inundation from a local or distant Tsunami is recognized as useful and important tool. Models can be initialized with potential worst case scenarios for the Tsunami sources or for the waves just offshore to determine corresponding impact on nearby coast. This information then forms the basis for creating Tsunami inundation & evacuation maps and procedures. Hence the operational elements of an RTSP include Seismic data analysis, Sea level data analysis, tsunami modeling and forecasting, tsunami advisory preparation as well as dissemination.

3.2.1 Regional Tsunami Advisory Service Provider (RTSP)

A Regional Tsunami Advisory Service Provider will provide tsunami forecasts and other information to the NTWCs of another or several other countries in a particular region or oceanic basin. An RTSP may also serve a dual role as the NTWC for the country in which it resides. Roles and Responsibilities of a RTSP are described below:

- Determine and provide timely initial earthquake information

- Determine more specific threat information using output from scenario databases produced by tsunami models, using earthquake source information and verified by sea level information.
- Provide timely tsunami advisories for use in preparation and issuing of national tsunami warnings by NTWCs.
- Monitor tsunami propagation and provide updated information (observed tsunami amplitude measurements) in priority.
- Provide timely standardized Situation Reports (SitReps) for use by other RTSPs and NTWCs.
- Serve as a backup centre to other RTSPs.
- Serve as an NTWC for the country in which it resides.

2.1.6 National Tsunami Warning Centre (NTWC)

A National Tsunami Warning Centre (NTWC) operates within the legal framework of the sovereign nation in which it resides and serves. It provides warnings, watches, and advisories to its citizens and public and private agencies according to its national mandate. Recommended roles and responsibilities of a NTWC are described below:

- Responsible for making decisions, using RTSP advice of their choice, and issuing tsunami warnings to its communities.
- Provide timely standardized Situation Reports (SitReps) for use by other NTWCs and RTSPs, including the status of their warnings.
- Consult with and provide information to RTSPs on forecast point locations.
- Work out arrangements with RTSPs for advice on how to utilize RTSP products to determine local impacts/threats.
- Establish threat levels and develop SOPs for the corresponding jurisdictions. Utilize RTSP products for initializing inundation model output/selecting inundation scenarios.
- Conduct hazard mapping and risk assessments using source hazard information (e.g. historic/potential earthquakes, volcanoes) inundation models/maps and vulnerability assessment.
- Provide information/warnings and work with emergency management authorities on how to determine threat zones and develop/select appropriate evacuation maps.

3.3 STANDARD OPERATING PROCEDURES:

To be interoperable, the RTSPs need to have a common high-level SOP. However, each individual RTSP needs to create more detailed SOPs to reflect their site specific operating environment. Figure 8 shows the three stages of tsunami advisory activities, including the roles and interactions, typical input and output information between RTSPs and NTWCs. The three stages are:

- Stage 1: Identify Threat
- Stage 2: Threat Information Exchange and Dissemination
- Stage 3: Update Advice

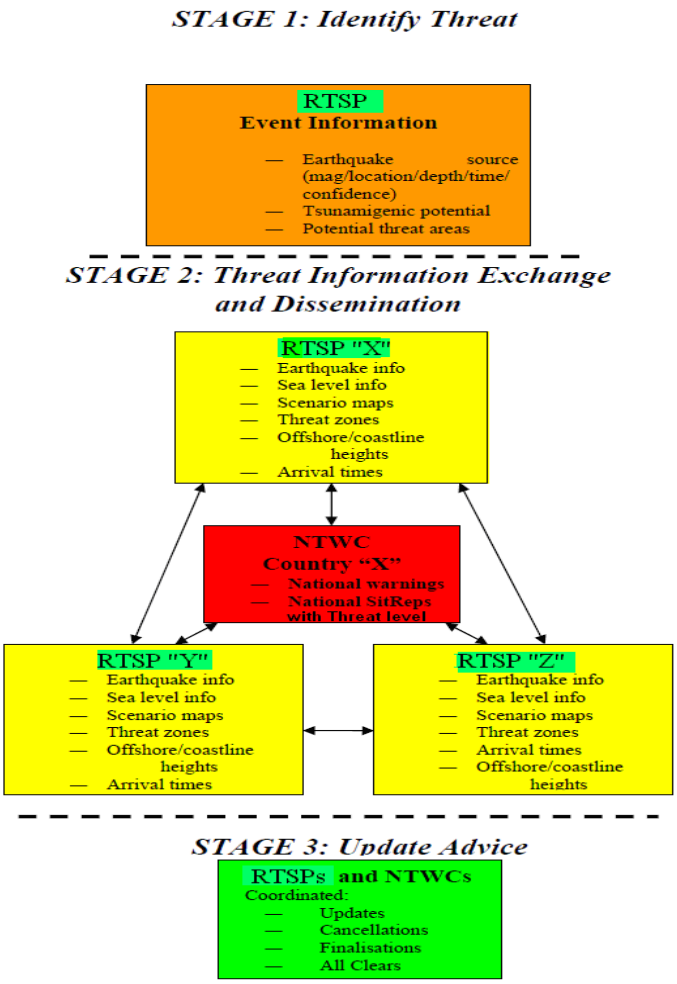


Figure V-8. RTSP's SOP

3.4 HARMONIZED PRODUCTS AND TERMINOLOGIES

NTWCs and RTWPs should strive to adhere to internationally agreed-upon products in interoperable formats. If these products are similar in name and content from one centre to the next, confusion among users will be minimized.

Harmonized products for the regional tsunami watch providers are proposed for the UNESCO IOC Tsunami Warning Systems. The proposal is summarized in Table 1. The scheme is based on the different response actions that would be recommended by the National Authorities. The scheme also recognizes that it is the responsibility of the National stakeholders to issue tsunami warning products, while the regional centres provide the information necessary to facilitate the decision making process. Unlike for most other disasters, tsunamis have a very rapid onset and therefore leave little time for coordination between the stakeholders.

The main stakeholders in the tsunami notification scheme are:

- Civilians/Public.
- National authorities responsible for public safety.
- National tsunami warning centers or National Tsunami Warning Focal Points which will establish the threat level for the corresponding jurisdictions.
- Regional Tsunami Advisory Service Providers that will provide guidance to the National Tsunami Warning Centers and Focal Points.

Four different level of emergency response were identified:

- Evacuation of areas of potential tsunami inundation.
- Clearance of beaches, marine infrastructure and coastal waters due to expected strong currents and oscillations in sea level.
- On alert in the event that there exists the potential of a tsunami, but given the travel time of the waves, no immediate action is required until more information is available.
- No action necessary, this is in the case of a distant tsunami or a tsunami in another basin which will have no impact on the local area.

Four different levels of threat will represent the potential impact of the tsunami on the jurisdictions. The decision on the level of threat will be determined by the National Tsunami Warning Centers or Focal Points, who in turn will report these back to the Regional Tsunami Advisory Service Providers.

Threat Level	Potential Impact
0	No impact expected, no flooding, no currents.
1	There is a potential for tsunami impact, but given the travel time, no response of the public is necessary at the moment.
2	Threat to coastal marine areas due to strong currents and oscillations in sea level.
3	Threat of tsunami inundation.

The Regional Tsunami Advisory Service Providers will generate two types of bulletins: Public Tsunami Bulletins and Tsunami Exchange Bulletins.

(i) **Tsunami Public Bulletins**: These bulletins will be widely distributed in various formats and through public and private communication systems (GTS, Email, Fax, Web, SMS, etc.) necessary to facilitate a broad reception, including the global media. There will be the first bulletin, and in the case of a potential threat, updates will be issued.

a. Bulletin 1. Will include earthquake parameters (latitude, longitude, depth, magnitude) and indicate if there is the potential for a destructive tsunami for a certain area. The potential for a destructive tsunami will be defined as potential, undetermined potential (for situations where the travel

time is greater than 2 or 3 hours) or no potential. These bulletins will be issued within minutes of the earthquake

b. Bulletin 2, 3, 4…: These bulletins will provide an update on the earthquake parameters (latitude, longitude, depth, magnitude, and origin time), the threat level as reported by the National authorities to the Regional Tsunami Watch Providers

(ii) **Tsunami Exchange Bulletins**: These bulletins will be issued by the RTSP to the NTWC/NTWFP. The distribution of the bulletins will be private and websites with the products will be password protected. There will be the first bulletin, and in the case of a potential threat, updates will be issued.

a. Bulletin 1. Will include earthquake parameters (latitude, longitude, depth, magnitude), level of tsunami threat, estimated times of arrival and estimated wave amplitude/inundation information. These bulletins will be issued within minutes of the earthquake.

b. Bulletin 2, 3, 4… These bulletins will provide an update on the earthquake parameters (latitude, longitude, depth, magnitude), the recorded/reported wave amplitudes, estimated and observed wave arrival times, run-up, maximum positive wave amplitude at shoreline (inundation).

c. Final Bulletin: This will be the last bulletin issued by the RTSP for an event, indicating that the threat has passed, based on pre-defined criteria. This will form the basis for issue of Threat Cancellation or All Clear by the concerned authorities.

Products should be made available as both text and graphics in all possible formats, as required by the NTWCs.

Table 1: Harmonization of Products to be Issued by Regional Tsunami Advisory Service Providers (RTSPs) for the UNESCO IOC TWS

RTSP Service	**RTSP to Public (Tsunami Public Bulletins)**			**RTSP to NTWC (Tsunami Exchange Bulletins)**			**NTWC to Public/National/Local Authorities/RTSPs (Threat Categorization)**			**NTWC Service**
Bulletin Types	**Bulletin 1**	**Bulletin 2, 3, 4…**	**Final Bulletin**	**Bulletin 1**	**Bulletins 2, 3, 4….**	**Final Bulletin**	**Threat level**	**Potential Impact**	**Public Response**	
Contents of the Bulletins	EQ Parameters, **Potential for Destructive Tsunami** (within certain distance from epicenter)	EQ Parameters, **Potential for Destructive Tsunami**, Threat Level as reported by NTWC, Tsunami Observations	--	EQ Parameters, **Tsunami Threat** , ETA, EWA	EQ Parameters, **Tsunami Threat**, ETA, EWA	--	3	**Inundation Threat**	**Evacuate based on maps or criteria**	**Actions issued by National/ Local Authorities for Public Response**
							2	**Coastal Marine Threat**	**Out of water/off boats**	
	EQ Parameters, **Undecided Tsunami Threat** (due to travel time greater than 2/3 hours)	EQ Parameters, **Undecided Tsunami Threat**, Threat Level as reported by NTWC, Tsunami Observations		EQ Parameters, **Undecided Tsunami Threat** ETA, EWA	EQ Parameters, **Undecided Tsunami Threat** ETA, EWA, Tsunami Observations		1	**Potential Land/Marine Threat (2/3 hours away)**	**On alert/Wait for more information**	
	EQ Parameters, **Slight Fluctuations (or) No Potential for Destructive Tsunami**	--		**EQ parameters No Threat**	**--**		0	**No Threat**	**No Action**	
			Threat Passed			**Threat Passed**	0	**Threat Cancellation**	**All Clear**	
Dissemination Modes	**RTSPs -> Public**: GTS, Email, Fax, Web Site, SMS **RTSPs -> NTWCs**: Private distribution by Password Protected Sites						**NTWC -> RTSPs**: Email, Telephone, Fax, Web **NTWC -> Public**: Email, SMS, Web sites, TV/Radio, Loudspeakers, sirens, traditional methods			

Note:

- **Earthquake parameters** to be included in the Public & Exchange bulletins include: Latitude, Longitude, Magnitude, Depth, Time of Occurrence.
- **Tsunami Parameters** to be included in the Exchange Bulletins include: Threat Status for different Coastal Forecast Zones/Points, Expected Time of Arrival (ETA), Expected Wave Amplitude (EWA), Tsunami Observations from Tide Gauges and Tsunameters as and when available.
- The Criteria for determination of Threat Status to be used by the RTSPs in the Tsunami Exchange bulletins and the coastal zones/points to be used for issue of bulletins will be decided by each ICG in consultation with its Member States.
- The criteria for determination of Threat Level at the National level and any action to be taken in response will be decided by the NTWCs of the respective Member states in consultation with their National/Local authorities.

3.5 COMMON SPATIAL DATASET AS A TOOL FOR INTER-OPERABILITY BETWEEN RTSPS

The level of risk posed by tsunami is well determined by understanding of complex spatial and temporal dependence among multiple datasets. It is unreasonable to expect individuals involved in disaster response management to analyze these complex interactions under emergency conditions without errors. When multiple centres are involved for the analysis, the possibility of misinterpretation increases due to multiple ways of data handling.To ensure interoperability between the multiple centres it is important to use a common spatial data for delivery of tsunami advisories.

RTSPs can use this common spatial dataset for generation of public bulletins as well as detailed exchange bulletins. The NTWCs can use the information provided for each of its coastal regions to formulate its own national bulletins during an event. Use of common spatial data will not only facilitate inter-RTSP performance comparisons but also enable NTWCs to realistically compare RTSP products. Each element in the common spatial dataset represents a specific point/region along the coast that is well known to emergency managers and the populace. Each element is provided with model-derived information such as Expected tsunami amplitude, Expected time of arrival, threat level, etc which enables the NTWCs to make a decision during the event. This common spatial dataset is to be finalized in consultation with the NTWCs.

3.6 DISSEMINATION METHODS

NTWCs and RTSPs should use all possible means of communication available to them to reach the target groups. The most widely used means for dissemination of tsunami advisories/alerts in different ICGs are GTS, AFTN, FAX, email, Web, SMS, RSS, CAPS, AWIPS, NWW, NAWAS, HAWAS, IDN, CISN, etc. These dissemination methods are detailed in Annexure-II. In addition to the above, the following methods may be most suitable for dissemination of public and exchange bulletins to specific target groups:

- RTSPs to Public: Tsunami Public bulletins could be disseminated by GTS, Email, FAX, SMS, Websites
- RTSPs to NTWCs: Detailed Tsunami Exchange bulletins could be privately disseminated by password protected websites. A brief notification alerting the NTWCs to the issue of a detailed bulletin could be sent by GTS, Email, FAX, SMS, etc.
- NTWCs to RTSPs: SITREPS or Warning Status reports from NTWCs to RTSPs could be sent by Email, Telephone, FAX, Websites, etc.
- NTWCs to Public: Public alerting could be done through Email, SMS, Websites, TV/Radio, Loudspeakers, Sirens and other traditional methods.

3.7 GUIDELINES FOR THE REVIEW OF OPERATIONS

2.1.7 Capability Requirements

In order to provide required service and undertake agreed SOPs, Regional TWS should come up with a set of capability requirements that each of the RTSPs will need to demonstrate. A few important ones are listed below:

- Access to real time data sources and capability to produce standardized seismic and sea level parameters

- Appropriate historical database of earthquakes and tsunamis
- Maintain or have access to benchmark, pre-calculated numerical model scenarios
- Revise advisories in light of additional seismic and sea level data.
- Provide timely and effective Tsunami advisory to respective NTWCs
- Provide products in globally standard formats.
- Exchange warnings freely and timely on the GTS and Internet and all other possible means of communication
- Adequate trained and experienced staff, utilities, and resources to operate functionally 24 hours per day, seven days per week (24/7).
- Adequate infrastructure and back-up facilities to continue operating during power cuts and national emergencies such as all critical equipment on 30-min UPS, generator or alternative power backup (with 1 day of back-up capability), all critical equipment operating in duplicate and all critical communications circuits with backup
- Staff should be able to communicate in English and at least one more of the local languages.

2.1.8 Performance Indicators

The following performance indicators are proposed, to measure performance of the RTSPs. The target values mentioned against each of the parameter are only indicative and detailed investigation in both scientific and sociological means should be further conducted to arrive at the exact values. These parameters could vary between different ICGs, based on the local seismotectonic settings, available warning times, etc. It should be noted that there are no absolute measures for criteria such as earthquake magnitude, and that accuracy can only be best gauged in some cases by comparing analyzed values amongst agencies (i.e. absolute accuracy may not be known).

Elapsed time from earthquake to earthquake information issuance (local)	10 min
Elapsed time from earthquake to earthquake information issuance (distant)	15 min
Elapsed time from any product issuance to potential receipt by NTWC/TWFPs	5 min
Percent of countries issued a timely product as defined above	100%
Probability of Detection of earthquakes with Mw>=6.5	100%
Accuracy of earthquake hypocenter location	30km
Accuracy of earthquake hypocenter depth	25km
Accuracy of earthquake Mw magnitude	0.2
Accuracy of the tsunami forecast amplitude/height	factor of 2
Reliability of RTSP operations (power, computers, communications)	99.5%
Contact information updated and communications systems successfully tested quarterly	

2.1.9 Process for verifying the operational status of RTSP and review of tsunami watch operations

It is extremely important to have a formal process for verifying the operational status of RTSPs and review the tsunami watch operations. Each ICG pursues its mandate, through Working Groups and Task Teams addressing different aspects of Tsunami Warning & Mitigation. The capability requirements and performance indicators defined by each ICG

serve as guidelines to verify the operational status of an RTSP and review its tsunami watch operations.

Once an RTSP assumes service, its performance is compared against the performance indicators set forth by the respective ICG. Discussions in some ICGs (eg. ICG/IOTWS) concluded that a formal accreditation process would be too difficult to implement and hence acceptance should be by peer review of comparative performance, which would require complete transparency to provide confidence in the service. To make the process transparent, it was proposed that the performance indicators of each RTSP will be uploaded automatically to a website which could be used by the NTWCs to monitor the RTSP performance. This entire process is guided by the working groups and a task team within the ICG. Other ICGs are also in the process of coming up with guidelines.

While further discussions are needed to come up with concrete recommendations, the following are a couple of possible options:

- Yearly review by a Task Team within each ICG.
- Review by an external review panel with other ICGs and experts outside the ICG.

2.1.10 Mechanism to ICGs for the coordination of Tsunami Watch Operations

There currently is no mechanism, other than TOWS and this Task Team, for addressing the issue of coordination of tsunami watch operations among the four Tsunami Warning Systems (TWSs), yet the operational centres of the PTWS, IOTWS, CARIBE-EWS and NEAMTWS, face many common challenges. These include the rapid detection, monitoring and forecasting of tsunamis, the reliable and effective communication of operational tsunami products, and the management of information during crisis operations. While there are certain differences between the tsunami hazard, tsunami vulnerability, size and shape of the potentially affected bodies of water, number of countries, local culture and language, and available resources for each centre and its area of responsibility, there are also many commonalities that can best be addressed through a coordinated approach among all the systems and centres. Further, a system of systems that is globally coordinated is more likely to be effective.

A perpetual body, composed of 2 representatives from each ICG should be formed. Its terms of reference should include the development and maintenance of standards and guidelines for:

- Operational procedures and methodologies.
- Operational products.
- Coordination of product content during crisis operations.
- Product dissemination.
- Product terminology.
- Documentation.
- Coordination of products among the TWS’s.

The TOR should also include the development of centre performance standards, and procedures for monitoring and reporting on centre performance. The body should specifically work towards globally harmonizing the above to the extent possible.

Within the four systems and their ICGs there are mechanisms for addressing some of these issues, but these are often overlapping and redundant efforts with inconsistent results. None address global harmonization and coordination.

3.8 DOCUMENTATION REQUIREMENTS

To be effective, an NTWC or RTSP requires documentation that clearly states the centre's mandate, authority, and relationship to other government agencies. Equally important are references that document the centre's concept of operations, standard operating procedures, and agreements with partners and customers. In June 2007, the UNESCO IOC Tsunami Coordination Unit recommended that NTWCs and RTSPs include, at a minimum, the following documentation.

NTWC/RTSP Concept of Operations (CONOPS): This is a document that is global, basin-wide, or countrywide in scope, depending upon the AOR of the centre. It should be a high-level document for decision makers and describe the system and how it functions in general terms. It should identify who is involved and clearly define their roles and responsibilities.

Operations Manual: This document details how a particular NTWC or a Disaster Management Office's Emergency Operations Center (EOC) works to carry out its roles and responsibilities. The manual should be designed to be used by the duty people at that centre. It should include information on emergency management plans and standard operating procedures (SOP), such as criteria for action, data streams, communications links, analysis software, messaging software, notification and dissemination methods, and general troubleshooting.

Operations Troubleshooting Manual: This document should provide details on what actions to take when a system has failed. This can be computer hardware failure, communications link failure, a software problem, etc. It should be maintained by the NTWC or RTWP as appropriate.

Tsunami Warning System Users Guide: This guide should contain general information for customers on tsunamis and the tsunami threat, tsunami warning centre procedures, and the criteria for action, along with sample messages. It should include a general description of that centre's system: seismic data, sea level data, warning centre message dissemination, public safety actions, and public responses, including evacuation. It should also include guidance on what the user or customer can expect from the tsunami warning centre, including how to interpret messages for action, definitions of terms, and what to do when warnings are issued. For RTSPs the document may be maintained by the IOC. For a national system, it should be maintained jointly by the NTWC and partners.

NTWC/RTSP Stakeholder Contacts: This document generally comprises contacts responsible for overall tsunami mitigation, for tsunami warning operations, and for tsunami emergency response operations. For RTSPs these are Tsunami Warning Focal Points (TWFP) or ICG Tsunami National Contacts (TNC). For NTWCs, the document should be similar but involve emergency response as well.

Tsunami Warning System Directives: This is a collection of official, authoritative documents covering national or local procedures and responsibilities. Descriptions are in more detail than CONOPS, but less detail than operations manuals. Directives describe the authority, coordination, roles, and responsibilities of services and organizations involved.

Tsunami Emergency Response Plans (TERP): NTWCs and their National Disaster Management Office (NDMO) partners must create and customize written Tsunami Emergency Response Plans (TERP) to meet their specific needs.

4. CONCLUSION

The task of harmonization of tsunami watch operations within and among regional tsunami warning systems is a complex task. The suggestions and recommendations put forth in this document are based on best-practice and intend to serve only as a broad guidance to the ICGs in planning and development of their systems. While the specific requirements of each region will continue to drive the evolution of each ICG, following a common framework, as put forth in this document, will ensure that operations within and among different regional systems become seamless and interoperable. The task of harmonization of tsunami watch operations is a continuing one and as proposed in this document, is to be driven by representatives of the major stakeholders, i.e. all the ICGs.

APPENDIX 1

CURRENT TERMINOLOGIES FOLLOWED FOR TSUNAMI WATCH OPERATIONS

Interim Tsunami Advisory Service: The Tsunami Advisory Service being provided by PTWC & JMA to the Indian Ocean region, until regional capacity is developed. While PTWC and JMA have no authority or responsibility to issue tsunami warnings outside their regions of responsibility, they have provided tsunami-relevant information to Indian Ocean nations since April 2005 on an interim basis. At national level, each Member State is responsible for issuing warnings to its own citizens through their NTWC.

NTWC: National Tsunami Warning Centre is the agency/organization established for acting on few procedures/protocols in a way to save lives and reduce property damage in case of tsunami. NTWCs, through bilateral arrangements, will be able to choose the RTWPs from which they wish to access tsunami watch information from (IOTWS).

Tsunami Warning Focal Point (TWFP): The 7x24 contact person, or other official point of contact or address, is available at the national level for rapidly receiving and issuing tsunami event information (such as warnings). The Tsunami Warning Focal Point either is the emergency authority (civil defence or other designated agency responsible for public safety), or has the responsibility of notifying the emergency authority of the event characteristics (earthquake and/or tsunami), in accordance with national standard operating procedures. The Tsunami Warning Focal Point receives international tsunami warnings from the PTWC, WC/ATWC, the JMA NWPTAC, or other regional warning centres. (PTWS/NWPTAC/WCATWC/CARIBE-EWS/IOTWS/NEAMTWS)

Tsunami National Contact (TNC): The person designated by a Member State to an Intergovernmental Coordination Group (ICG) to represent his/her country in the coordination of international tsunami warning and mitigation activities. The person is part of the main stakeholders of the national tsunami warning and mitigation system. The person may be the Tsunami Warning Focal Point, from the national disaster management organization, from a technical or scientific institution, or from another agency with tsunami warning and mitigation responsibilities. (PTWS/NWPTAC/WCATWC/NEAMTWS)

Tsunami Potential: Tsunamigenic potential of an earthquake is evaluated according to the magnitude of an earthquake (PTWS/CARIBE-EWS/IOTWS)

Tsunami Warning: The highest level of tsunami alert. Imminent threat (usually within the next three hours) of a tsunami from a large undersea or near shore earthquake; or 2) following confirmation that a potentially destructive tsunami is crossing the Pacific that may destructively impact coasts along part or all of the named areas. They may initially be based only on seismic information as a means of providing the earliest possible alert. Warnings advise that appropriate actions be taken in response to the tsunami threat. Warnings are updated at least hourly or as conditions warrant to continue, expand, restrict, or end the warning. (PTWS/CARIBE-EWS when CTWC is established)

Tsunami Watch: The second highest level of tsunami alert. Watches are issued by the TWCs based on seismic information without confirmation that a destructive tsunami is underway. It is issued as a means of providing an advance alert to areas that could be impacted by destructive tsunami waves. Watches are updated at least hourly to continue them, expand their coverage, upgrade them to a Warning, or end the alert. A Watch for a particular area may be included in the text of the message that disseminates a Warning for another area. (PTWS)

Tsunami watch is issued to alert emergency management officials and the public of an event which may later impact the watch area. The watch area may be upgraded to a warning or advisory - or cancelled - based on updated information and analysis. Therefore, emergency management officials and the public should prepare to take action. Watches are normally issued based on seismic information without confirmation that a destructive tsunami is underway (CARIBE EWS when CTWC is established)

Tsunami wave height greater than 0.5m and/or tsunami run-up greater than 1m; coastal inundation expected. (NEAMTWS)

Local Tsunami Watch – A message issued to advice participants of the Potential or confirmed destructive tsunami threat to coasts within about 100 km of the earthquake epicentre (Interim Service provided by PTWS outside their AOR)

Regional Tsunami Watch – A message issued to advice participants of the Potential or confirmed destructive tsunami threat to coasts within about 1000 km of the earthquake epicentre (Interim Service provided by PTWS outside their AOR)

Ocean/Sea-Wide Tsunami Watch – A message issued to advice participants of the Potential or confirmed destructive tsunami threat to all coasts bordering the Ocean/Sea basin (Interim Service provided by PTWS outside their AOR)

Tsunami Advisory: The third highest level of tsunami alert. Advisories are issued to coastal populations within areas not currently in either warning or watch status when a tsunami warning has been issued for another region of the same ocean. An Advisory indicates that an area is either outside the current warning and watch regions or that the tsunami poses no danger to that area. PTWC will continue to monitor the event, issuing updates at least hourly. As conditions warrant, the Advisory will either be continued, upgraded to a watch or warning, or ended. (PTWS)

Issued due to the threat of a potential tsunami which may produce strong currents or waves dangerous to those in or near the water. Coastal regions historically prone to damage due to strong currents induced by tsunamis are at the greatest risk. The threat may continue for several hours after the arrival of the initial wave, but significant widespread inundation is not expected for areas under an advisory. Appropriate actions to be taken by local officials may include closing beaches, evacuating harbours and marinas, and the repositioning of ships to deep waters when there is time to safely do so. Advisories are normally updated to continue the advisory, expand/contract affected areas, upgrade to a warning, or cancel the advisory. (CARIBE EWS when CTWC is established)

Tsunami wave height less than 0.5m and/or tsunami run-up less than 1m; currents, Bore, recession, damage in harbours, small inundation on beaches expected. (NEAMTWS)

The status of all bulletins issued by NWPTAC is Tsunami Advisory.

Interim Service provided by PTWS outside their AOR is also known Tsunami Advisory Service.

Tsunami Information Statement/Bulletin: A message issued to advise IOTWS participants of the occurrence of a major earthquake with an evaluation that there is either: a) no widespread tsunami threat but the small possibility of a local tsunami or b) there is no tsunami threat at all because the earthquake is located inland or deep inside the earth. A supplement or higher level of alert will be issued if tsunami waves are observed on nearby sea level gauges. (PTWS/CARIBE-EWS/IOTWS)

Tsunami Information: A message issued to advise the NEAM recipients of the occurrence of a major earthquake in the area but with an evaluation that there is no tsunami threat (NEAMTWS)

Warning Cancellation: A cancellation indicates the end of the damaging tsunami threat. A cancellation is usually issued after an evaluation of sea level data confirms that a destructive tsunami will not impact the warned area. A cancellation will also be issued following a destructive tsunami when sea level readings indicate that the tsunami is below destructive levels and subsiding in most locations that can be monitored by PTWC (PTWS), CARIBE EWS.

ALL CLEAR: An “All Clear”, or its equivalent, is usually issued by local authorities following any type of near or actual disaster to inform the public that it is safe to re-enter evacuated areas and resume normal activities.

Tsunami Arrival Time: Time when the tsunami appears on the record. (PTWC/NWPTAC/WCATWC)

Time of the Measurement: Time when the centre measured tsunami amplitude showed in its bulletin. (PTWC/NWPTAC/WCATWC)

Period: Period of time in minutes from one crest to the next. (PTWS/IOTWS)

Amplitude: For the PTWC and WC/ATWC tsunami amplitude is measured relative to normal sea level. On the other hand, the NWPTAC reports amplitude in 0.1 meter unit by measuring half of trough to crest height. (PTWS/CARIBE-EWS/IOTWS)

Coastal Forecast Zones: To ensure interoperability between the RTWPs and NTWCs, it was decided that all the Indian Ocean RTWPs will use a common spatial data set of specific “coastal forecast zones” for providing tsunami advisories. Every coastal forecast zone in the spatial data shall be provided with attributes such as max_beach, max_deep, depth, threat category, travel times (T1, T2, T3, T4). (IOTWS)

Coastal Forecast Points: Off shore points selected at a certain sea depth till where estimated tsunami amplitude is calculated by the equation of hydrodynamics. Usually, tsunami wave height at coast is calculated by Green's law using the values on these points.

THREAT/NO THREAT: A country is considered under THREAT when a predicted positive wave amplitude ≥ 0.5 metre at the coast at any location in that country. Otherwise, the country is under NO THREAT. (IOTWS)

Threat Passed: 120 minutes after the last exceedance of 0.5 M threat threshold at last Member State of that ocean basin (IOTWS)

Service Levels: Three Service Levels are proposed in association with the phased implementation and maturity of the RTSP “system-of-systems” of IOTWS

- **Service Level 1**: Interim Service provided currently by JMA and PTWC for ICG/IOTWS which contain Earthquake source information to determine potential tsunami threat and travel times. (IOTWS)
- **Service Level 2**: RTSPs issue more specific tsunami watch information for NTWCs. The information contains the results of forecast model which provides

Estimated Wave Amplitude (EWA), Estimate Time of Arrival (ETA), Threat levels based on model simulations. (IOTWS)

- **Service Level 3**: RTSPs will develop and implement enhanced tsunami warning information using Inundation mapping and Risk and Hazard assessments for NTWCs in association with RTWPs. (IOTWS)

Max_beach: Maximum positive wave amplitude at the shore-line (IOTWS)

Max_deep: Maximum positive wave amplitude in deep water in each coastal zone (IOTWS)

T1: Time of arrival of the minimum detectable positive amplitude wave (IOTWS)

T2: First exceedance of the threat threshold (IOTWS)

T3: Time of arrival of max_beach (IOTWS)

T4: Time when the last exceedance of the Threat Threshold is forecast (IOTWS)

Final Bulletin: RTSP services shall conclude for a specific event when the expected time for the last IO country Threat Threshold to be no longer exceeded has passed + 2 hrs. This bulletin shall be called a FINAL BULLETIN for the event. (IOTWS)

Double Amplitude: Wave amplitude from a trough to crest or a crest to trough. (PTWS/WCATWC)

Estimated Amplitude of Tsunami: The highest estimated crest relative to normal sea level (NWPTAC)

Initial Estimated Arrival Times: Computed from the epicentre of the earthquake to each forecast point using the physics principle that a wave will travel from point A to point B over whatever path in the ocean gets it there the fastest. (PTWC/NWPTAC/WCATWC/CARIBE-EWS/IOTWS)

Tsunami current velocity: The velocity of sea water current caused by tsunami wave, usually referred to those in a bay or harbour. Tsunami with negative amplitude below normal sea level may also cause damage to facilities like rafts for oyster farming, etc. because of its high current velocity.

Earthquake magnitude: The magnitude used is the moment magnitude, Mw. It is more accurate for large earthquakes than the more common Richter magnitude. The moment magnitude determined by PTWC for initial products is Mwp, based on the first arriving seismic P waves. Subsequent estimates of Mw may be made by methods based on later arriving seismic waves. (PTWS/CARIBE-EWS/IOTWS)

Depth: Focal depth of the earthquake. Seismogically, earthquakes occurring at a depth of 100km or more considered not to generate tsunami regardless of its magnitude. (PTWS/ CARIBE-EWS/IOTWS)

Location: Latitude and longitude of the earthquake. Tsunami is not generated by earthquakes occurring in inland areas. However, possibilities are not excluded if its epicentre is located very close to the sea. (PTWS/CARIBE-EWS/IOTWS)

APPENDIX 2

DESCRIPTION OF DISSEMINATION METHODS

Global Telecommunications System (GTS): The GTS is operated by the World Meteorological Organization (WMO). This is a dedicated circuit connected to the National Meteorological and Hydrological Centers (NMHCs) of most countries around the globe. Since the national tsunami warning responsibility of many countries resides with their national meteorological agency and since their NMHCs typically have 24x7 operations, this is an effective means for alerting for a tsunami threat with a text message. Shortcomings of the GTS are that it doesn't reach some of the more remote countries like certain Pacific island states or countries where the tsunami warning responsibility resides with another agency such as the Navy. Also, the GTS doesn't widely support the higher bandwidth required for disseminating graphical products such as tsunami travel time maps or tsunami forecast energy distribution plots.

Aeronautical Fixed Telecommunications Network (AFTN): AFTN is a dedicated circuit that goes to airfield facilities around the world. Its primary use is for communication of information related to airfield operations. However, this circuit is often also connected to NMHCs because they provide airfields with weather information. Through the AFTN, tsunami products are received by either a 24x7 airfield facility or the NMHC to trigger tsunami protection actions when necessary. AFTN is currently used only in the PTWS and CARIBE-EWS.

Fax: Most of the NTFPs have designated one or more fax numbers for receiving products from the operational centres. Limitations are that fax machines may be busy or turned off or out of order when faxes are disseminated. Faxes also need a way to be quickly recognized when they come in. Also, faxes are best for text messages or simple black and white graphics.

Email: Most of the NTFPs have designated one or more email addresses for receiving products from the operational centres. Limitations are that email servers are sometimes down and that email needs a way to be quickly recognized when it comes in. However, email can support both text and graphical products.

Web: All of the current operational centres have websites that are used for displaying their current products and for displaying additional graphical products. Websites are not practical for alerting NTFPs to an event, but are an excellent way to provide key information about an event once the event is known. Tsunami Exchange bulletins could be disseminated to designated NTWCs using password protected websites. To access the website effectively, a TWFP needs internet access with a reasonable speed. In addition, the website must be capable of handling the millions of hits that can occur during a major tsunami event.

SMS: Short text messages via Short Message Service (SMS) could be sent out to mobile phones of authorized users drawing their attention to the occurrence of an earthquake or issue of a tsunami advisory. SMS could also be broadcast warnings to public.

RSS: Really Simple Syndication (RSS) includes full or summarized text, plus metadata. RSS feeds benefit publishers by letting them syndicate content automatically. They benefit readers who want to subscribe to timely updates from favoured websites or to aggregate feeds from many sites into one place. This could be effectively used for Tsunami Bulletin dissemination.

CAPS: Common Alerting Protocol (CAP) is an XML-based data format for exchanging public warnings and emergencies between alerting technologies. CAP allows a warning message to be consistently disseminated simultaneously over many warning systems to many applications. CAP increases warning effectiveness and simplifies the task of activating a warning for responsible officials.

AWIPS: The advanced Weather Information Processing System (AWIPS) is operated by the U.S. National Weather Service (NWS) to exchange weather information and products between its offices throughout the country. PTWCs products are entered into AWIPS though U.S. National Weather Service Telecommunications Gateway (NWSTG) in Silver Spring Maryland. NWS Weather Forecast Offices that play an important role in the timely dissemination of tsunami products to the local communities receive U.S TWC products via AWIPS.

NWW: The NOAA Weather Wire is a satellite broadcast service maintained by the NWS to disseminate weather products domestically in the U.S. PTWC has both uplink and downlink capabilities on the NWW system.

NAWAS: The National Warning System is a nationwide dedicated vice telephone system connecting selected national defence, emergency management and coast guard agencies. PTWC uses NAWAS only when it is action as a backup for WC/ATWC.

HAWAS: The Hawaii Warning system is a state-wide dedicated voice telephone system connecting selected State Civil Defence, National Guard, Law Enforcement and NWS offices.

IDN: Hawaii State Civil Defence maintains the Interisland Data Network, an email service utilizing a private TCP/IP circuit that connects PTWC with all Hawaii State and County Civil Defence offices.

CISN: Web-based tool for first responders, emergency managers, and critical lifeline organizations to provide reliable access to earthquake information from the CISN and other networks.

APPENDIX 3

REFERENCE DOCUMENTS

(i) Report of the Second Meeting of the TOWS WG, March 2009, Paris, France.

(ii) Report of the Third Meeting of the TOWS WG, May 2010, Lisbon, Portugal.

(iii) IOTWS Implementation Plan, April 2010.

(iv) PTWS Implementation Plan, February 2009.

(v) PTWS mid-term strategy, February 2009.

(vi) PTWS Reference Guide, January 2009 .

(vii) CARIBE EWS Implementation Plan, March 2008.

(viii) CARIBE EWS Communication Plan for the Interim Tsunami Advisory Information Service, December 2007.

(ix) Technical, logistical and administrative requirements of the Regional Tsunami Warning Centre for the CARIBE EWS, March 2009, Fort de France.

(x) NEAMTWS Implementation Plan, October 2009.

(xi) Interim Operational Users Guide for the Tsunami Early Warning and Mitigation System in NEAMTWS, version 1.9, March 2011.

(xii) Tsunami Warning Center Reference Guide, US IOTWS, 2007

ANNEX VI

TERMS OF REFERENCE OF THE INTER-ICG TASK TEAM ON TSUNAMI POTENTIAL ASSESSMENT

The Inter-ICG Task Team on Tsunami Potential Assessment, taking into account the progress achieved by relevant working groups within the ICGs, shall:

(i) develop a comprehensive list of active subduction zones and other seismotectonic zones around the globe having potential of generating great tsunamigenic earthquakes (~8.0 to 9.0);

(ii) develop a comprehensive list of « tsunami earthquake » zones (slow earthquakes capable of generating large tsunamis in comparison to their magnitude);

(iii) explore mechanisms to enhance our knowledge about the potentially tsunamigenic areas as per items (i) and (ii) provide a report to TOWS-WG in advance of its 5th Meeting in 2012.

The representatives to the Inter-ICG Task Team on Tsunami Potential Assessment shall be nominated by their respective ICG Chairpersons, and appointed by the IOC Chair, who will also appoint the chair of the task team. The IUGG Tsunami Commission will be invited to nominate two appointed members to this Task Team.

ANNEXE VI

MANDAT DE L'ÉQUIPE SPÉCIALE INTER-GIC SUR L'ÉVALUATION DU POTENTIEL TSUNAMIGÈNE

L'Équipe spéciale inter-GIC sur l'évaluation du potentiel tsunamigène, prenant en compte les progrès réalisés par les groupes de travail compétents au sein des GIC, s'acquittera des tâches suivantes :

(i) établir une liste complète des zones de subduction active et d'autres zones sismotectoniques du globe qui peuvent, potentiellement, générer de forts séismes tsunamigènes (~8.0 à 9.0) ;

(ii) établir une liste complète de zones « à séismes tsunamigènes » (séismes lents capables de générer des tsunamis de grande ampleur par rapport à leur magnitude) ;

(iii) explorer les mécanismes permettant d'améliorer notre connaissance des zones potentiellement tsunamigènes visées aux alinéas (i) et (ii) ci-dessus et soumettre un rapport à TOWS-GT à l'avance, avant sa cinquième réunion, en 2012.

Les représentants à l'Équipe spéciale inter-GIC sur l'évaluation du potentiel tsunamigène seront désignés par les présidents de leurs GIC respectifs et nommés par le Président de la COI, lequel nommera aussi le Président de l'Équipe spéciale. La Commission de l'UGGI sur les tsunamis sera invitée à désigner deux membres nommés pour faire partie de l'Équipe special

ANEXO VI

MANDATO DEL EQUIPO DE TRABAJO DE LOS GIC SOBRE LA EVALUACIÓN DEL POTENCIAL TSUNAMIGÉNICO

El Equipo de Trabajo de los GIC sobre la evaluación del potencial tsunamigénico, tomando en consideración los progresos alcanzados por los grupos de trabajo competentes de los GIC:

(i) elaborará una lista completa de las zonas de subducción activas y otras zonas sismotectónicas del mundo, que puedan ocasionar seísmos tsunamigénicos de gran magnitud (de entre 8,0 y 9,0);

(ii) elaborará una lista completa de zonas “de seísmos tsunamigénicos” (seísmos lentos que pueden generar grandes tsunamis en relación con su magnitud);

(iii) estudiará los mecanismos que permitan mejorar nuestros conocimientos sobre las zonas potencialmente tsunamigénicas señaladas en los apartados i) y ii), y presentará un informe al TOWS-WG antes de su quinta reunión en 2012.

Los representantes que formarán parte del Equipo de Trabajo de los GIC sobre la evaluación del potencial tsunamigénico serán designados por los presidentes de sus respectivos GIC y nombrados por el Presidente de la COI, que nombrará también al presidente del Equipo de Trabajo. Se invitará a la Comisión de la IUGG sobre Tsunamis a nombrar a dos de sus miembros para integrar este Equipo de Trabajo.

ПРИЛОЖЕНИЕ VI

КРУГ ВЕДЕНИЯ ЦЕЛЕВОЙ ГРУППЫ МКГ ПО ОЦЕНКЕ ПОТЕНЦИАЛЬНОЙ ОПАСНОСТИ ЦУНАМИ

Целевая группа МКГ по оценке потенциальной опасности цунами, принимая во внимание прогресс, достигнутый соответствующими рабочими группами в рамках МКГ, обеспечивает:

(i) (i) составление охватывающего весь земной шар всеобъемлющего перечня активных зон субдукции и других сейсмотектонических зон, обладающих потенциалом генерирования крупных цунамиобразующих землетрясений (с магнитудой 8,0–9,0);

(ii) (ii) разработку всеобъемлющего перечня зон «землетрясений с цунами» (медленных землетрясений, способных генерировать крупные цунами по сравнению с их магнитудой);

(iii) изучение механизмов по расширению знаний относительно потенциальных цунамиобразующих зон применительно к пунктам (i) и (ii) и представить доклад РГ-СПЦО заблаговременно до проведения ее пятого совещания в 2012 г.

Кандидатуры представителей в Целевую группу МКГ по оценке потенциальной опасности цунами предлагаются соответствующими председателями целевых групп МКГ и назначаются Председателем МОК, который также назначает председателя этой Целевой группы. Комиссии по цунами Международного союза геодезии и геофизики (МСГГ) будет предложено назначить со своей стороны двух членов в данную Целевую группу.

ANNEX VII

LIST OF PARTICIPANTS

TOWS-WG MEMBERS

CHAIR

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ANNEX VIII

LIST OF ACRONYMS

CARIBE-EWS	Tsunami and other Coastal Hazards Warning System for the Caribbean and Adjacent Regions
CTBTO	Comprehensive Test Ban Treaty Organisation
DBCP	Data Buoy Cooperation Panel
GLOSS	Global Sea-Level Observing System
GOOS	Global Ocean Observing System
GTS	Global Telecommunication System
ICAM	Integrated Coastal Area Management Programme
ICG	Intergovernmental Coordination Group
I-GOOS	Intergovernmental IOC-WMO-UNEP Committee for GOOS
IHO	International Hydrographic Office
IODE	IOC International Oceanographic Data and Information Exchange
IOTWS	Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System
ISDR	Un International Strategy for Disaster Reduction
JCOMM	WMO-IOC Joint Technical Commission for Oceanography and Marine Meteorology
NEAMTWS	Tsunami Early Warning and Mitigation System in the North-Eastern Atlantic, the Mediterranean and Connected Seas
NTWC	National Tsunami Warning Center
NTWFP	National Tsunami Warning Focal Point
PTWS	Pacific Tsunami Warning and Mitigation System (formerly ITSU)
RTWC	Regional Tsunami Warning Centre
TSU	Tsunami Coordination Unit
TOWS-WG	Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems
TWFP	Tsunami Warning Focal Point
TWS	Tsunami Warning System
WG	Working Group
WMO	World Meteorological Organization

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
2. Fourth Meeting of the Central Editorial Board for the Geological/Geophysical Atlases of the Atlantic and Pacific Oceans S. Fourth Session of the Joint IOC-WMO-CPPS Working Group on the Investigations of 'El Niño' ***(Also printed in Spanish)***
4. First Session of the IOC-FAO Guiding Group of Experts on the Programme of Ocean Science in Relation to 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 IODE 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 Intercalibration
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 lntercalibration
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 lnternacional del Mar Caribe y Parte del Océano Pacífico 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 IODE 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)***
25. Third Session of the IOC Group of Experts on Effects of Pollutants
26. Eighth Session of the IOC-UNEP Group of Experts on Methods, Standards and lntercalibration
27. Eleventh Session of the Joint IOC-IHO Guiding Committee for the General Bathymetric Chart of the Oceans ***(Also printed in French)***
28. Second Session of the IOC-FAO Guiding Group of Experts on the Programme of Ocean Science in Relation to Living Resources
29. First Session of the IOC-IAEA-UNEP 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)***
31. Second IOC-WMO Meeting for Implementation of IGOSS XBT Ship-of-Opportunity Programmes
32. Thirteenth Session of the Joint CCOP-IOC Working Group on Post-IDOE Studies of East Asia Tectonics and Resources
33. Second Session of the IOC Task Team on the Global Sea-Level Observing System
34. Third Session of the IOC Editorial Board for the International Bathymetric Chart of the Mediterranean and Overlay Sheets
35. Fourth Session of the IOC-UNEP-IMO Group of Experts on Effects of Pollutants
36. First Consultative Meeting on RNODCs and Climate Data Services
37. Second Joint IOC-WMO Meeting of Experts on IGOSS-IODE Data Flow
38. Fourth Session of the Joint CCOP/SOPAC-IOC Working Group on South Pacific Tectonics and Resources
39. Fourth Session of the IODE 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
41. Third Session of the IOC Consultative Group on Ocean Mapping
42. Sixth Session of the Joint IOC-WMO-CCPS Working Group on the Investigations of 'El Niño' (***Also printed in Spanish)***
43. First Session of the IOC Editorial Board for the International Bathymetric Chart of the Western Indian Ocean
44. Third Session of the IOC-UN(OALOS) 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 lntercalibration
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 IOC-IAEA-UNEP Group of Experts on Standards and Reference Materials
64. Joint Meeting of the Group of Experts on Pollutants and the Group of Experts on Methods, Standards and Intercalibration
65. First Meeting of the Working Group on Oceanographic Co-operation in the ROPME Sea Area
66. Fifth Session of the Editorial Board for the International Bathymetric and its Geological/Geophysical Series
67. Thirteenth Session of the IOC-IHO Joint Guiding Committee for the General Bathymetric Chart of the Oceans ***(Also printed in French)***
68. International Meeting of Scientific and Technical Experts on Climate Change and Oceans
69. UNEP-IOC-WMO-IUCN Meeting of Experts on a Long-Term Global Monitoring System
70. Fourth Joint IOC-WMO Meeting for Implementation of IGOSS XBT Ship-of-Opportunity Programmes
71. ROPME-IOC Meeting of the Steering Committee on Oceanographic Co-operation in the ROPME Sea Area
72. Seventh Session of the Joint IOC-WMO-CPPS Working Group on the Investigations of 'El Niño' ***(Spanish only)***
73. 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)***
74. UNEP-IOC-ASPEI Global Task Team on the Implications of Climate Change on Coral Reefs
75. Third Session of the IODE Group of Experts on Marine Information Management
76. Fifth Session of the IODE Group of Experts on Technical Aspects of Data Exchange
77. ROPME-IOC Meeting of the Steering Committee for the Integrated Project Plan for the Coastal and Marine Environment of the ROPME Sea Area
78. Third Session of the IOC Group of Experts on the Global Sea-level Observing System
79. Third Session of the IOC-IAEA-UNEP Group of Experts on Standards and Reference Materials
80. Fourteenth Session of the Joint IOC-IHO Guiding Committee for the General Bathymetric Chart of the Oceans
81. Fifth Joint IOG-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 Editorial Board for the International Bathymetric chart of the Mediterranean and its Geological/Geophysical Series
86. Fourth 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 IOCINCWIO 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 GEMSI 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
118. Joint Scientific Technical Committee for Global Ocean Observing System (J-GOOS), Fourth Session, USA, 1997
199 First Session of the Joint 100-WMO IGOSS Ship-of-Opportunity Programme Implementation Panel, South Africa, 1997
120. Report of Ocean Climate Time-Series Workshop, Joint GCOS-GOOS-WCRP Ocean Observations Panel for Climate, 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 (CGOM), Monaco, 1997

129. Sixth Session of the Tropical Atmosphere - Ocean Array (TAO) Implementation Panel, United Kingdom, 1997

130. First Session of the IOC-WMO-UNEP-ICSU Steering Committee of the Global Ocean Observing System (GOOS), France, 1998

131. Fourth Session of the Health of the Oceans (HOTO) Panel of the Global Ocean Observing System (GOOS), Singapore, 1997

132. Sixteenth Session of the Joint IOC-IHO Guiding Committee for the General Bathymetric Chart of the Oceans (GEBCO), United Kingdom, 1997

133. First Session of the IOC-WMO-UNEP-ICSU-FAO Living Marine Resources Panel of the Global Ocean Observing System (GOOS), France, 1998

134. Fourth Session of the IOC Editorial Board for the International Bathymetric Chart of the Western Indian Ocean (IOC/EB-IBCWIO-IW3), South Africa, 1997

135. Third Session of the Joint GCOS-GOOS-WCRP Ocean Observations Panel for Climate (OOPC), France, 1998

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

138. Implementation of Global Ocean Observations for GOOS/GCOS, Second Session, France, 1998

139. Second Session of the IOC-WMO-UNEP-ICSU Coastal Panel of the Global Ocean Observing System (GOOS), Brazil, 1998

140. Third Session of IOC/WESTPAC Co-ordinating Committee for the North-East Asian Regional - Global Ocean Observing System (NEAR-GOOS), China, 1998

141. Ninth Session of the Joint IOC-WMO-CPPS Working Group on the Investigations of 'El Niño', Ecuador, 1998 ***(Spanish only)***

142. Seventh Session of the IOC Editorial Board for the International Bathymetric Chart of the Mediterranean and its Geological/Geophysical Series, Croatia, 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 IOC-WMO-UNEP-ICSU Coastal Panel of the Global Ocean Observing System (GOOS), Ghana, 1999

147. Fourth Session of the GCOS-GOOS-WCRP Ocean Observations Panel for Climate (OOPC); Fourth Session of the WCRP CLIVAR Upper Ocean Panel (UOP); Special Joint Session of OOPC and UOP, USA, 1999

148. Second Session of the IOC-WMO-UNEP-ICSU-FAO Living Marine Resources Panel of the Global Ocean Observing System (GOOS), France, 1999

149. Eighth Session of the Joint IOC-JGOFS CO2 Advisory Panel Meeting, Japan, 1999

150. Fourth Session of the IOC/WESTPAC Co-ordinating Committee for the North-East Asian Regional – Global Ocean Observing System (NEAR-GOOS), Japan, 1999

151. Seventh Session of the IOC Consultative Group on Ocean Mapping (CGOM), Monaco, 1999

152. Sixth Session of the IOC Group of Experts on the Global Sea level Observing System (GLOSS), France, 1999

153. Seventeenth Session of the Joint IOC-IHO Guiding Committee for the General Bathymetric Chart of the Oceans (GEBCO), Canada, 1999

154. Comité Editorial de la COI para la Carta Batimétrica Internacional del Mar Caribe y el Golfo de Mexico (IBCCA), Septima Reunión, Mexico, 1998

IOC Editorial Board for the International Bathymetric Chart of the Caribbean Sea and the Gulf of Mexico (IBCCA), Seventh Session, Mexico, 1998

155. Initial Global Ocean Observing System (GOOS) Commitments Meeting, IOC-WMO-UNEP-ICSU/Impl-III/3, France, 1999

156. First Session of the *ad hoc* Advisory Group for IOCARIBE-GOOS, Venezuela, 1999 ***(also printed in Spanish and French)***

157. Fourth Session of the IOC-WMO-UNEP-ICSU Coastal Panel of the Global Ocean Observing System (GOOS), China, 1999

158. Eighth Session of the IOC Editorial Board for the International Bathymetric Chart of the Mediterranean and its Geological/Geophysical Series, Russian Federation, 1999

159. Third Session of the IOC-WMO-UNEP-ICSU-FAO Living Marine Resources Panel of the Global Ocean Observing System (GOOS), Chile, 1999

160. Fourth Session of the IOC-WMO-UNEP-ICSU-FAO Living Marine Resources Panel of the Global Ocean Observing System (GOOS). Hawaii, 2000

161. Eighth Session of the IODE Group of Experts on Technical Aspects of Data Exchange, USA, 2000

162. Third Session of the IOC-IUCN-NOAA Consultative Meeting on Large Marine Ecosystems (LME), France, 2000

163. Fifth Session of the IOC-WMO-UNEP-ICSU Coastal Panel of the Global Ocean Observing System (GOOS), Poland, 2000

164. Third Session of the IOC-WMO-UNEP-ICSU Steering Committee of the Global Ocean Observing System (GOOS), France, 2000

165. Second Session of the *ad hoc* Advisory Group for IOCARIBE-GOOS, Cuba, 2000 ***(also printed in Spanish and French)***

166. First Session of the Coastal Ocean Observations Panel, Costa Rica, 2000

167. First GOOS Users' Forum, 2000

168. Seventh Session of the Group of Experts on the Global Sea Level Observing System, Honolulu, 2001

169. First Session of the Advisory Body of Experts on the Law of the Sea (ABE-LOS), France, 2001 ***(also printed in French)***

170. Fourth Session of the IOC-WMO-UNEP-ICSU Steering Committee of the Global Ocean Observing System, Chile, 2001

171. First Session of the IOC-SCOR Ocean CO_2 Advisory Panel, France, 2000

172. Fifth Session of the GCOS-GOOS-WCRP Ocean Observations Panel for Climate (OOPC), Norway, 2000 ***(electronic copy only)***

173. Third Session of the *ad hoc* Advisory Group for IOCARIBE-GOOS, USA, 2001 ***(also printed in Spanish and French)***

174. Second Session of the Coastal Ocean Observations Panel and GOOS Users' Forum, Italy, 2001

175. Second Session of the Black Sea GOOS Workshop, Georgia, 2001

176. 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

177. Second Session of the Advisory Body of Experts on the Law of the Sea (IOC/ABE-LOS), Morocco, 2002 ***(also printed in French)***

178. Sixth Session of the Joint GCOS-GOOS-WCRP Ocean Observations Panel for Climate (OOPC), Australia, 2001 ***(electronic copy only)***

179. *Cancelled*

180. Second Session of the IOC-SCOR Ocean CO_2 Advisory Panel, Honolulu, Hawaii, U.S.A, 2002 ***(electronic copy only)***

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

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

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

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

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

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

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

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

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

190. Third Session of the Coastal Ocean Observations Panel and GOOS Users' Forum, Vietnam, 2002

191. Eighth Session of the IOC Consultative Group on Ocean Mapping, Russian Federation, 2001

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

193. Extraordinary Session of the Joint IOC-WMO-CPPS Working Group on the Investigations of 'El Niño', Chile, 1999 ***(Spanish only; electronic copy only)***

194. Fifth Session of the IOC-WMO-UNEP-ICSU Steering Committee of the Global Ocean Observing System, France, 2002

195. Sixth Session of the IOC-WMO-UNEP-ICSU Steering Committee of the Global Ocean Observing System, South Africa, 2003

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

197. First Session of the JCOMM/IODE Expert Team On Data Management Practices, Belgium, 2003 *(also JCOMM Meeting Report No. 25)*

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

215. Eighth Meeting of the IOC Advisory Body of Experts on the Law of the Sea (IOC/ABE-LOS), Paris, 21–25 April 2008 ***(bilingual English/French)***

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

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

218. Ninth Meeting of the IOC Advisory Body of Experts on the Law of the Sea (IOC/ABE-LOS), Paris, 30 March–3 April 2009 ***(bilingual English/French)***

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

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

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

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

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

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

225. Eleventh Session of the IOC Group of Experts on the Global Sea level Observing System (GLOSS), Paris, 13–15 May 2009 ***(electronic copy only)***

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

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

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