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**INFORMATION DOCUMENT**

**PERSPECTIVES FOR THE REGIONAL TSUNAMI WARNING SYSTEMS  
(PTWS, IOTWS, CARIBE-EWS, NEAMTWS), 2013**

Summary. This document has been prepared by the Officers of the Intergovernmental Coordination Groups of the four regional tsunami warning systems (TWS) established under the aegis of the IOC of UNESCO. In this document the ICG Officers identify the challenges the development of each TWS is facing in 2013 and beyond.



## **Pacific Tsunami Warning and Mitigation System (PTWS)**

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The Pacific Ocean and its adjacent seas is the largest, most diverse and most prone to tsunami of all the Earth's oceans. Pacific nations must be prepared to face the danger of distant, regional and local tsunami. Although there has not been an ICG/PTWS meeting since the 26<sup>th</sup> session of the IOC Assembly, considerable progress has been made following the recommendations of the ICG/PTWS-XXIV meeting in Beijing, China in May 2011. This progress and recommendations for continuing actions will be reported, discussed and agreed at the ICG/PTWS-XXV to be held in Vladivostok, Russian Federation, 9–11 September 2013, and are summarised here.

Because of the complexity of the Pacific region, ICG/PTWS is organized with both Regional and Technical Working Groups. A Steering Committee comprising the Officers, Working Group chairs and representatives from the tsunami warning and information centres is charged with overseeing and continuing the activities of the group during the intersessional period. The Steering Committee met in May 2012 in Hawaii to review the progress with the training and exercise programmes, the development of Enhanced Products and to chart activities leading up to ICG/PTWS-XXV. Other important tasks of the Steering Committee involve overseeing the progress of the Implementation Plan derived from the Medium Term Strategy (MTS) and reviewing and updating the associated documents, for presentation at ICG/PTWS-XXV. Harmonisation with other ICGs is a part of this whole process including active participation in TOWS and its Task Teams.

A key focus has been the introduction of the Pacific Tsunami Warning Centre (PTWC) Enhanced Products for tsunami threat assessment based on tsunami forecast models and pre-defined coastal zones. Following PacWave'11 in November 2011 a meeting of the PacWave and Enhanced Products Task Teams in May 2012 reviewed the text and graphical threat products developed by PTWC and recommended that the PTWS Steering Committee endorse them for use in PacWave'13, and for issuance by PTWC on an experimental basis from early 2013. The Enhanced Products were further refined during a large number of training and consultation meetings throughout the Pacific region and were the prime focus of PacWave'13 held during May 2013. The plan is to present a final draft of the Enhanced Products for ratification at ICG/PTWS-XXV with a date in 2014 for full implementation.

Two Pacific-wide tsunami exercises have been held since the last ICG/PTWS meeting. PacWave'11 had the dual purpose of testing Member States standard operating procedures for local and regional tsunami events and providing feedback on the provisional Enhanced Products. PacWave'13 was organised as a "table-top" exercise to provide feedback for a final round of refinements before the Enhanced Products are presented to ICG/PTWS-XXV. Both exercises used survey techniques resulting in formal reports used to gauge progress towards PTWS tsunami warning and mitigation objectives.

Another recommendation of ICG/PTWS-XXIV endorsed in principle the establishment of a tsunami advisory centre for the South China Sea (SCS) region. Progress has been made towards this goal during two Regional Working Group meetings (in December 2011 and October 2012) with an implementation plan being developed, and the recommendation that a PTWS implementation Task Team be formed.

Since ICG/PTWS-XXIV Regional Working Group meetings have been held in all but one region, and a large number of training and consultation workshops have taken place, many focusing on standard operating procedures and the Enhanced Products for tsunami threat assessment. Additionally, several technical Task Teams have met, and Member States have continued tsunami hazard and risk assessment work progressing the goals of the PTWS Implementation Plan. This included involvement with the Global Earth Model project on the characterisation of (potentially tsunamigenic) large subduction zone earthquakes. Several Member States are now using tsunami hazard assessments to inform community-based evacuation zone planning initiatives.

Challenges facing PTWS include ensuring the smooth introduction of the Enhanced Products and their uptake by Member States, securing enough funding to enable ongoing operational training, particularly as the Enhanced Products are introduced and maintaining the current high levels of public tsunami awareness over the long term.

Ken GLEDHILL Chair, ICG/PTWS	Patricio CARRASCO Takeshi KOIZUMI Fujiang YU Vice-chairs, ICG/PTWS
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## **Indian Ocean Tsunami Warning and Mitigation System**

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The successful implementation and operationalization on 31 March 2013 of the IOTWS Regional Tsunami Service Providers (RTSPs) of Australia, India and Indonesia, culminated in the transfer of full responsibility for provision of tsunami advisories for the Indian Ocean region from the Interim Advisory Service (IAS) established in 2005 and operated by the United States of America and Japan. The IOTWS is now evolving and adapting to a new phase of monitoring, maintenance and capacity development. At its 9<sup>th</sup> Session in Jakarta, November 2012, the ICG/IOTWS developed a workplan for the inter-sessional period which focuses on training, capacity building and the development and maintenance of core IOTWS documentation. The Terms of Reference of the ICG/IOTWS, as decided by IOC Resolution XXIII-12, remain valid, with more emphasis now on capacity building, monitoring and continual improvement of the system and liaison with other regional TWS through the TOWS-WG. The TOWS-WG is seen as fundamental to the global coordination, interoperability and harmonisation of the global TWS.

The ICG/IOTWS has called for a re-assessment of Member State capacity against the 2005 benchmark assessment, conducted in the immediate aftermath of the December 2004 tsunami. The purpose of this activity would be to check that each IOTWS Member State has developed tsunami warning and emergency response capacity, and in particular has now developed Standard Operating Procedures based on the RTSP threat information products. Where gaps are found, measures can be taken to provide specific training or other forms of capacity building and assistance.

The ICG/IOTWS has identified a number of housekeeping activities that need to be implemented and maintained. These include the need to upgrade and maintain the IOTWS website to better serve the needs of the ICG/IOTWS and its Working Groups, as well as the need to further develop, maintain and publish key IOTWS documentation, such as the Implementation Plan, Medium Term Strategy and User Guide. An Outreach and Communication Plan is being developed to raise public and media awareness of what the IOTWS can and cannot do and to help manage expectations more realistically. Monitoring and assessment of RTSP and IOTWS performance against Key Performance Indicators will be an ongoing and essential activity to ensure the required performance of the overall IOTWS. Performance assessments will be conducted biennially and a formal report will be presented to Member States at each ICG/IOTWS Session.

Capacity building and training is considered vital for the sustainability of the IOTWS and the ICG has committed in its workplan to conduct annual workshops on Standard Operating Procedures for end to end tsunami warning systems involving the RTSPs, the National Tsunami Warning Centres (NTWCs), Disaster Management Organisations (DMOs) and the media. Training in coastal hazard and risk assessment is also considered to be important to frame tsunami risk within an overall multi-hazard context. Such training will further benefit scientific studies of tsunami risk, particularly palaeo-tsunami research, which underpins our understanding of tsunami hazard. The IOC Secretariat has successfully mobilised resources from the UNESCAP Multi-donor Trust Fund for Tsunami, Disaster and Climate Preparedness to support the enhancement of risk assessment guidelines and to develop guidelines for conducting tsunami exercises, considered

essential to maintain awareness and enhance preparedness of all stakeholders in the warning chain. Training modules will be developed to “train the trainers” and facilitate more extensive training at the national level. Support for regional and national training programmes and the development of educational and awareness material will be provided by the Indian Ocean Tsunami Information Centre (IOTIC) in Jakarta, the establishment of which the ICG/IOTWS has endorsed subject to finalisation and agreement on its Terms-of-Reference.

The IOTWS core seismic and sea level monitoring networks are in place and near real time data is available and accessed by most, if not all NTWCs. Looking to the future, there is a vital requirement to sustain these systems and for network densification in some regions, particularly for coastal and deep ocean sea level observations. There is a need to ensure that all available real-time sea level data from all participating Member States is made available on the WMO’s Global Telecommunications System (GTS) to help rapidly verify tsunami threat information. The IOC Secretariat will work with the Member States, GLOSS and the WMO to facilitate this. Sub-regional cooperation between neighbouring Member States to share further seismic data in near real time for near-fields will be encouraged, as this will improve the accuracy and timeliness of earthquake parameter estimates in some regions for locally generated tsunamis with very short arrival times. Sub-regional cooperation will also be promoted to share resources, experience and training requirements specific to certain regions. For example India, Iran, Oman, Pakistan and Yemen are close to the Makran subduction zone in the northern Arabian Sea, which could potentially represent a near-field tsunami hazard to each country in this sub-region.

Going forward into the next biennium, the IOTWS will need to be maintained and monitored to ensure that it continues to meet the needs of its Member States. Regular training programmes will be required to maintain national capacity as systems and RTSP products are enhanced or change, and as national personnel change position or leave their organisations. Regular biannual IOTWS Communications Tests and biennial Indian Ocean Wave exercises will be conducted to keep Member States engaged and ensure a high level of readiness. The ICG/IOTWS will continue to hold its statutory sessions at 2-year intervals and its Steering Group will continue to work via correspondence and meet face-to-face at least annually. Ad hoc inter-sessional meetings of the Working Groups will be held as and when required. The IOC Secretariat has played a vital support role in the development and implementation of the IOTWS thus far and will continue to help coordinate and facilitate all the activities of the IOTWS and support the needs of its Member States.

Rick BAILEY  
Chair, ICG/IOTWS

Srinivas KUMAR TUMMALA  
Prih HARJADI  
Vice-Chairs, ICG/IOTWS

### **Tsunami and other Coastal Hazards Warning System for the Caribbean and Adjacent Regions**

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The Caribbean and Adjacent Regions are quite familiar with natural threats like hurricanes, tropical storms and even earthquakes which strike quite regularly. Tsunamis, until recently were considered a “forgotten hazard”, despite the fact that in the past 500 years, over 75 tsunamis have been documented in the Region and since 1842, at least 3510 people perished to these killer waves. Although the tsunamis generated by the 2010 Haiti earthquake claimed the lives of several people, the most recent devastating events were the 1946 tsunamis of the Dominican Republic, with upwards of 1800 victims. Since then, there has been an explosive increase in residents, visitors, infrastructure and economic activity along our coastlines. It is acknowledged that the potential for human and economic loss is severe. It has been estimated that on any day upwards

of 500,000 people could be in harm's way just along the beaches<sup>1</sup>, with hundreds of thousands more working and living in the tsunamis hazard zones.

Eight years ago, in the wake of the Indian Ocean Tsunami and after advocating without success for a Caribbean Tsunami Warning System since the mid-90s, the Intergovernmental Oceanographic Commission of UNESCO established the Intergovernmental Coordination Group for the Tsunami and other Coastal Hazards Warning System for the Caribbean and Adjacent Regions (CARIBE-EWS). Its purpose is to advance an end-to-end to tsunami warning system that serves regionally and delivers locally, saving lives and protecting economic prosperity. CARIBE-EWS includes 32 Member States and 16 territories and commonwealths which extend from Bermuda to Brazil and those whose coasts border the Caribbean and Gulf of Mexico and observers. Meetings have been held annually since 2006 to report, discuss and coordinate monitoring and warning capabilities, hazard and risk studies, communication infrastructure and the public awareness, education and resilience efforts. The most recent gathering was April 29–May 1, 2013.

In 2006, when the CARIBE-EWS met for the first time, there were just a dozen seismic stations, a handful of sea level stations, some tsunami inundation maps, a few educational resources, one tsunami warning focal point and no evacuation maps, exercises, TsunamiReady™ communities or a tsunami warning or information centre in the region. Thanks to regional collaborations and funding from within and outside the region, the advances of the system have been significant:

- 112 seismic stations (85% of those proposed) and 52 sea level stations (44% of those proposed) are contributing to the system for the effective analysis of earthquakes and improved detection and forecasting of the tsunami waves.
- The US National Weather Service (NWS) Tsunami Warning Centers in Alaska and Hawaii continue providing interim tsunami warning services and in 2010 the NWS established the Caribbean Tsunami Warning Program in Puerto Rico as part of its phased approach towards the potential establishment of a Warning Center.
- 94% of CARIBE-EWS nations and territories have designated Tsunami Contact and Warning Focal Points for the coordination and warning within their areas of responsibility.
- CARIBE-WAVE Regional exercises in 2011 and 2013 documented progress of regional thru local alerting and response capabilities, with almost 50,000 people participating in the March 2013 exercise.
- Although still few countries have tsunami hazard and evacuation maps, several more now have the infrastructure for inundation and evacuation modeling.
- Over 30 coastal communities have been recognized as TsunamiReady, with the exception of Anguilla, the first non US TsunamiReady community recognized jointly by UNESCO and the NWS, all are located in Puerto Rico.
- In 2013 a Caribbean Tsunami Information Center was established in Barbados to further support education, preparedness and outreach in a culturally and language sensitive manner.

In order to reach the goal of a fully interoperable and sustainable tsunami warning system, in 2013 the CARIBE-EWS recommended:

- Further strengthening of the geophysical and oceanographic monitoring, including integration of Global Position Systems.

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<sup>1</sup> Proenza, X. W. and Maul, G., 2010. *Tsunami hazard and total risk in the Caribbean*, *Science of Tsunami Hazards*, Vol. 29, No. 2.

- USA to continue with its approach towards a Tsunami Warning Center in the region, as well as other Member States strengthening their warning capabilities.
- Conduct of additional hazard assessments considering also non seismic sources like landslides and volcanoes.
- A Strategy for Public Awareness and Education (PAE), the first for any ICG, which will need to be implemented at the regional, national and local levels.
- The 2013–2017 Implementation Plan was approved that incorporates risk assessment and reduction, GIS and capacity development.
- Organization of CARIBE-WAVE regional exercises annually instead of every two years, the next to be held on March 20, 2014 based on Gulf and Portugal events and will be coordinated with sister ICG/NEAMTWS.
- Strengthening of the Caribbean Tsunami Information Center in support of and with the support of the Member States and other partners, and
- Establishment of task teams for specific items and reduced the number (4 to 3) working groups.

These are monumental tasks, especially in the light of the current challenging fiscal situations. Nevertheless, in memory of the tens of thousands of lives that were lost and livelihoods that were disrupted Chile, Haiti, India, Indonesia, Japan, Thailand, Samoa, Sri Lanka and many others in recent years and knowing the enormous impact a tsunami could have when it next strikes the Caribbean and Adjacent regions, the efforts must continue. The infrequency of the tsunamis cannot disarm the nations and territories, like was the case of the still recent tragic events of Indian Ocean and Haiti, the risk is just too high. Indeed, its full implementation will continue to require a multi-disciplinary and multi sector community of policy makers, emergency and disaster managers, educators and social and physical scientists engaged with the local stakeholders.

Christa G. von HILLEBRANDT-ANDRADE Chair, ICG/CARIBE-EWS	Dawn FRENCH VÍCTOR H. CANO PACHECO Philippe SARRON Vice-Chairs, ICG/CARIBE-EWS
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### **Tsunami Early Warning and Mitigation System in the North-Eastern Atlantic, the Mediterranean and Connected Seas**

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The ICG/NEAMTWS-IX session was held in Southampton in September 2013. The main achievements were:

- The start of the operational activities of 3 national tsunami warning centers and candidate tsunami watch providers (CENALT, France ; NOA, Greece ; KOERI , Turkey)
- The adoption of the criteria and procedure for the accreditation process of the candidate tsunami watch provider (CTWP).
- The organization of the NEAMWave12 exercise end of November 2013.

The challenge in the NEAM region is to be ready before the next large earthquake and tsunami. Such a program needs active participation of the ICG tsunami national contacts and tsunami warning focal points, of the tsunami operation centers, civil protection agencies, national authorities, scientists and the public.

The current moderate seismic activity in the NEAM region is helping to increase focus on implementing the NEAMTWS and of enhancing the different components.

Nevertheless, the awareness of the public and also of the authorities is still very low, despite the various awareness campaigns organised by several member states. The main reason is that most of the national authorities consider that the tsunami hazard and risk are very low in this region.

It must be re-emphasized that the vulnerability of the Mediterranean coast is high due to modern numerous infrastructures implemented on the coastline, in particular the harbours, marinas and hotel resorts. And concerning the lives, during the summer time, more than one million people use the beaches, several of which are located in seismic zones where tsunami waves reach the shoreline at less than 15 minutes. Information on a potential tsunami should be disseminated very rapidly.

Most of the people living in Europe and in the Mediterranean region still do not imagine that a large earthquake could induce a large tsunami that could have a severe impact along several hundred kilometers of coastline.

The challenge is that the NEAMTWS should be operating and validated frequently even in the absence of large triggers. Tsunami exercises should be organized frequently at international, national and local levels.

The NEAM region has of the opportunity to participate in collaborative tsunami research programmes that were or are financed by the European Commission. Other early warning and preparedness programmes involve also the civil protection agencies. The ICG organized several workshops and prepared the NEAMWave12 exercise in cooperation with the NEAMTIC and PPRD-South projects.

At national and international levels, the success of the system is depending on the close cooperation between the tsunami centres and the civil protection agencies. Knowledge on the tsunami phenomena and on the NEAMTWS is contributing to the system.

The sustainability of the components of the system should be analysed annually. Several networks have been implemented for other purposes: seismic network for seismic monitoring and sea level networks for tide or storm surge monitoring. The financial support for such networks should be national and international, to guarantee continuous operation and monitoring.

The success of the NEAMTWS is also depending on the participation of all countries bordering the Mediterranean Sea and North-eastern Atlantic Ocean. Given that the NEAMTWS is now operational, there is an expectation that more Members States will participate in NEAMTWS activities; in particular, there is a need for all members that have not already done so to nominate their tsunami national contact and their 24/7 tsunami warning focal point.

NEAMTWS continues to work with other ICGs. In the past year some members of the Caribbean and NEAMTWS groups have benefited from attending each other's ICGs. Ideas for future joint activities will be explored, in particular joint international tsunami exercises.

François SCHINDELÉ  
Chair, ICG/NEAMTWS

Ahmet Cevdet YALÇCINER  
Trevor GUYMER  
Vice-Chairs, ICG/NEAMTWS