

**INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION
(of UNESCO)**

**Twenty-Fourth Session of the Intergovernmental Co-ordination Group
for the Pacific Tsunami Warning and Mitigation System (ICG/PTWS)**

24-27 May 2011

Agenda Item 4.1

REPORT OF THE

**TASK TEAM ON
ENHANCING PTWS TSUNAMI WARNING PRODUCTS**

**CHARLES MCCREERY
TASK TEAM CHAIR**

Summary Report and Recommendations of the PTWS Task Team on Enhancing Tsunami Warning Products

Introduction

During the Twenty-second and Twenty-third sessions of the ICG/PTWS, the PTWC Director reported on operational enhancements that are now permitting the PTWC to provide more timely and accurate assessments of tsunami threat, and asked Member States for input on how PTWC can improve its services. In response, Recommendation ICG/PTWS-XXIII.1 (Annex I) established a Task Team on Enhancing Tsunami Warning Products under Working Group on Detection, Warning and Dissemination (WG 2) to review current capabilities, obtain customer feedback, consider best practices, and develop recommendations to improve existing or create new products, and improve dissemination for more effective, functional, and timely delivery.

On March 1, 2011, at the PTWS WG 2 Meeting held in Wellington, New Zealand, a meeting of its Task Team on Enhancing Tsunami Warning Products was held (see PTWS WG 2 Report Annex for March Task Team report). Charles McCreery, PTWC Director, was appointed Task Team Chair and all WG 2 members that were present attended the Task Team meeting. At this Task Team meeting, the Chair presented several ideas regarding changes to PTWC products, based upon enhanced capabilities of PTWC in terms of its speed of response and growing ability to forecast impacts.

To follow-up on these discussions, a further meeting was held in Honolulu, Hawaii on April 11-13, 2011 to coordinate any proposed changes between PTWC and the NWPTAC (Annex II). The last day of the meeting discussed the conduct of Exercise Pacific Wave 2011 (PacWave11) and the coordination between PTWC and NWPTAC. This three-day meeting was attended by the PTWC and ITIC Directors, the Japan Meteorological Agency's Senior Coordinator for International Earthquake and Tsunami Information, Chairs of the PTWS Southwest Pacific and South China Sea Working Groups, and the Deputy Director of the Indonesian Meteorological, Climatological, and Geophysical Agency, and the PTWS Exercises / PacWave11 Co-Chairs. The Chairs of PTWS Working Group 1 (Risk Assessment), Working Group 3 (Awareness and Response), and a representative from the IOC Tsunami Unit joined by teleconference for initial and summary discussions, and provided input by email to notes.

This Report summarizes the meeting discussions on Enhancing Tsunami Warning Products and provides a proposal to the ICG/PTWS for going forward (ICG/PTWS-XXIV Agenda 4.1). The Report on PacWave11 planning is provided in a separate ICG/PTWS-XXIV Working Document (Agenda 4.2)

Background

Over the past decade, PTWC has gone from ingesting data from only about 10 seismic stations outside of Hawaii to over 300 stations now. In addition, its seismic data processing capabilities have become faster and more accurate due to a combination of a better information technology (IT) and communications infrastructure as well as improved science and techniques of its implementation. Within about the past five years, especially since the 2004 Indian Ocean tsunami, the quantity, quality, and timeliness of sea level observations available to PTWC has also increased dramatically. Notably, data are now being received from 38 deep-ocean tsunami gauges in the Pacific that provide measurements of tsunami

waveforms unaltered by non-linear effects near the coast. Lastly, numerical forecast models have been implemented at PTWC over the past several years that have demonstrated, in recent tsunamis, that they are capable of providing more detailed and precise guidance on the expected level of tsunami impacts than is possible under PTWC's current PTWS warning procedures and criteria that are based only on limited historical data and general properties of tsunami generation, propagation and impact. While the predictive capabilities of the forecast models are not perfect, they should be accurate enough to greatly reduce the number of areas warned unnecessarily, while also providing general guidance on the expected levels of impact to areas that are threatened.

Task Team Recommendations

As a result of the PTWC improvements, the Task Team makes four recommendations.

1. *PTWC will lower its current initial warning threshold from magnitude 7.6 to magnitude 7.1 in order to provide some advance notice of potential local tsunamis.*
A decade ago, when PTWC's initial bulletin was disseminated 30 minutes to an hour after the earthquake, it could not be effective against local tsunamis generated by smaller earthquakes. Now, however, with a response time of 10 minutes or less for many earthquakes, it would be possible to provide advance notice for some local tsunamis. A magnitude 7.1 threshold is already being used by PTWC for potential destructive local tsunamis in the Indian Ocean and Caribbean Sea.
2. *PTWC will begin using tsunami forecast models to classify the level of threat for sections of coast around the Pacific. Five levels of tsunami threat will be established, and supplemental products will be issued.*
The current procedures, putting areas within 1000km of the epicenter in a warning for earthquakes with magnitudes of 7.6 to 7.8, and putting areas within 3 hours of impact in a warning and within 3 to 6 hours in a watch, would be abandoned in place of a classification scheme of warning threat for particular sections of coast that is generally in line with the recommendations put forth by the Inter-ICG Task Team on Tsunami Watch Operations of the UNESCO/IOC Working Group on Tsunamis and Other Hazards related to Sea-Level Warning and Mitigation Systems (TOWS-WG). Based on tsunami forecast model guidance, for each pre-defined section of coast there would be the possibility of four levels of threat and one level of potential threat.
3. *PTWC will revise its suite of text and graphical products to accommodate the changes proposed above, to provide more information, and to make the dissemination of that information more effective. An experimental products phase, with sufficient feedback opportunity and training on the new products, will occur before the final changeover.*
4. *A Task Team on PTWS Experimental Products should be created, or the current Task Team on Enhancing Tsunami Warning Products should be continued.*
The Task Team will provide PTWC with guidance during the inter-sessional period regarding details on the development, implementation, and evaluation of these changed procedures and products.

Implementation Details

Details of the proposed changes and their implementation by PTWC are provided in the outline below.

- 1) PTWC will develop procedures for using its tsunami forecast models (RIFT, SIFT, AFTM) in an experimental mode and targeting introductory use of the models for the PacWave11 Exercise.
 - a. Motivation and Purpose:
 - i. Reduce the area of coast that is warned unnecessarily.
 - ii. Provide estimation for multiple level of impacts
 - iii. Provide threat levels to more finely divided sections of coast
 - b. Provide for the following five levels of tsunami threat
 - i. No threat, or only small sea level changes
 - ii. Coastal and Marine threat (expected maximum amplitude is 0.5 – 1.0m)
 - iii. Land threat (expected maximum amplitude is 1.0 – 3.0m)
 - iv. Major land threat (expected maximum amplitude is > 3.0m)
 - v. Potential threat. Standby as still evaluating. This is provided as a ‘heads up’ that there may be a threat. It should be available before impact - currently, it is termed a ‘watch’ and issued at least 3 hrs in advance of the 1st wave arrival, but the proposal is to make it available as soon as possible.
 - c. Provide threat information by forecast segments
 - i. Information to consist of threat level and arrival time estimate
 - ii. Segments every ~100-300 km depending on location. (NWPTAC uses forecast points, so the PTWC and NWPTAC will need to coordinate on forecasts provided. Forecasts by each will provide range and compliment each other. In case of differences, most conservative estimate should be used fore greatest safety)
 - iii. For islands, use island groups. Subdivide only if islands are too far apart. Also, for very small islands, for coastal forecast, note that the deep ocean value is applicable, as Green’s Law is not applicable.
 - iv. Countries, territories, or other major political entities will be separated.
 - d. Staging of threat level messages as event evolves (for country locations before wave arrival). Describes when and what information is included in messages sent as time evolves.
 - i. The initial message is based on the preliminary seismic parameters and is a conservative application of the forecast. It goes to all countries and cautions that even areas outside the current threat area could be upgraded – provides the potential threat level. (to be issued usually in 5-10 min).
 - ii. The second message is based on updated seismic analysis (magnitude and Centroid Moment Tensor (CMT)) and conservative application of forecast only. (to be issued usually at ~30 min). It may also provide the earliest reading(s) of any tsunami waves.
 - iii. The third and later forecast messages are based on sea-level observation(s) and sea level observations(s)-constrained model forecast (to be issued at ~1 hour and continuing every hour, or more frequently if needed)
 - e. Reduction of threat levels (for country location after wave arrival)
 - i. Based on observations after 1st wave arrival and impact. Usually downgrade one threat level at a time.

- ii. Will not go all the way to No Threat level, e.g., will leave at Coast and Marine Threat level. No Threat Cancellation to be issued since local can continue for several more or many hours. It should be the authority of national and local authorities to evaluate when the threat has completely passed for their jurisdictions.
- 2) PTWC will develop procedures for issuing alerts for potential local tsunamis
- a. Establish criteria for the local tsunami threat
 - i. Establish earthquake magnitude threshold to greater than 7.0 (same as for the Indian Ocean and Caribbean Sea)
 - ii. Hypocenter Depth < 100 km (same)
 - iii. Under or near the sea (same). Note: If the computed epicenter is on land but not too far from the sea, then the judgement of the analyst is applied in determining an earthquake's tsunamigenic potential. Considerations include the accuracy of the epicentral computation as well as the potential size of the entire rupture zone which can have lateral dimensions of 100 km or more for great earthquakes.
 - b. Areas of Threat
 - i. Threat-based – very conservative application of the numerical forecast for any marine and/or land threat
 - c. Levels of Tsunami Threat
 - i. Same threat levels as above
- 3) PTWC Message Products
- a. Text products
 - i. Reorganization of content
 - 1. Narrative section with most critical information (feasibility and usefulness of multiple languages?)
 - 2. Tabular section
 - a. ETAs, forecast, observations
 - b. Earthquake parameters (include earthquake fault type after CMT available, e.g., “strike-slip”, “normal fault” or “shallow thrust”?)
 - ii. Public or private
 - 1. GTS text message is public
 - 2. Web can be public and/or private
 - 3. Fax, Email (will contain threat maps - include CMT with beach ball, also include descriptor of “strike-slip” or “normal fault” or “shallow thrust”, other parameters – strike, slip, rake, dip)), SMS private
 - 4. Possibly PTWC W-phase CMT can be provided to technical centers that can use this kind of information
 - b. Web site – public and/or private
 - i. Text Products
 - ii. Map or Maps
 - 1. Travel time
 - 2. Historical earthquakes
 - 3. Historical tsunamis
 - 4. Propagation forecast

5. Coastal forecast (private or public to be decided later)
6. Sea level gauges
- iii. Table or Tables
 1. ETAs (1ST arrival, 1ST wave over threshold, maximum wave, last significant wave)
 2. Coastal forecast values (private or public to be decided later)
- iv. Observations
 1. Map of Coastal and Deep Ocean Gauges
 - a. Maximum wave amplitudes
 - b. Waveforms
 2. Table of maximum wave amplitudes
- c. Email (text plus some of the above-mentioned graphical products) - private

Implementation Timeline

The following timeline is proposed for the coordinated implementation of enhanced tsunami warning products by PTWC and NWPTAC:

2011

May: ICG/PTWS XXIV in Beijing

Report under 4.1. ENHANCING PTWS TSUNAMI WARNING PRODUCTS

- PTWC to propose new enhanced products
- Discussion and Member States approve or request changes.
- PTWS Exercises Task Team briefs Member States on PacWave11
- If approved, PTWC to implement interim procedures (experimental products) for use during PacWave11. Feedback from PacWave11 used to finalize PTWC procedures and products for operations.

Create PTWC Experimental Products Task Team, or continue Enhancing Tsunami Warning Products Task Team

Terms of Reference:

- Develop evaluation methodology to be used in PacWave exercises in coordination with the PTWS Exercises Task Team
- Provide feedback to PTWC on its experimental products, and further improvements
- Recommend and report to ICG/PTWS-XXV on the implementation of the PTWC products

Members:

- Regional WG Chairs
- WG 1, WG 2, WG 3 Chairs
- Directors of National Tsunami Warning Centers (NTWCs) from interested-Member States
- PTWC and NWPTAC, as ex-officio members
- ITIC, as ex-officio member

9-10 November: PacWave11**November to ICG/PTWS-XXV - Experimental phase
PTWC****Before PacWave11**

- Continue to Issue messages in the existing format and same content
- PTWS User Guide updated to include enhanced PTWC products for PacWave11
 - Explain: Threat levels, Forecasts, Local tsunami threat, Format,
 - Explain: Staging, Graphics, Dissemination
 - Examples of messages and products

During PacWave11

- New message format
- New Threat Levels
- Supplemental forecast information (RIFT propagation and coastal)

After PacWave11 (in 'shadow' mode)

- Continue with 'old' products using normal communications methods
- Continue with interim procedures and experimental products made available in another communications method. (to issue by email through rest of intersessional period)

NWPTAC (JMA) – Before, During, and After PacWave11

- Continue to issue messages in the existing format and same content
- Investigation for the improvement of NWPTA

2012**9 Feb (due 90 days after PacWave11): PacWave11 Evaluation Questionnaire**

- Member States and TWFPs comment and evaluate interim PTWC procedures and experimental products through PacWave11 evaluation questionnaire

May (6 months after PacWave11): PTWS Exercise Task Team, PTWS Experimental Products Task Team Meeting (PTWC-JMA Coordination Meeting included) and PTWS Steering Committee

- Task Team analysis of the Evaluation Questionnaire responses from MS
- PTWC provides report on its implementation issues and feedback for new procedures/products
- PTWC to finalize procedures and experimental products for operations
- Plan another PacWave (in 2012 or 2013) exercise using PTWC experimental products before official changeover. This exercise should be used to validate the new PTWC products and procedures.
- NWPTAC reports the status of the investigation for their enhanced product
- PTWS Steering Committee to endorse new PTWC products and procedures, and ask that PTWC finalize its products and procedures operations for final approval at ICG/PTWS-XXV and changeover shortly afterward.

May – ICG/PTWS-XXV

- PTWC New Enhanced Tsunami Products Workshop – training to inform Member States on new products; done each Region in coordination with Regional WG

2013

Mar (tentative): PTWS Experimental Products Task Team Meeting (PTWC-JMA Coordination Meeting included), PTWS Exercises Task Team

- NWPTAC propose enhanced NWPTA product and procedures
- Planning for PacWave that will use NWPTAC enhanced new products in experimental mode

Apr - May (tentative): ICG/PTWS-XXV

- PTWC new products and procedures approved; Implementation date agreed
- NWPTAC (JMA) proposes enhanced new tsunami warning products
- Discussion and Member States approve or request changes for NWPTAC.
- NWPTAC to implement interim procedures (experimental products) for use during next PacWave exercise. Feedback from PacWave used to finalize NWPTAC procedures and products for operations.

Annex I.**Recommendation ICG/PTWS-XXIII.1
ENHANCING TSUNAMI WARNING PRODUCTS**

The Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System,

Noting that some Member States have expressed a need to review the current content, format and dissemination of the international tsunami warning messages,

Further noting that the tsunami forecasting capabilities of the international Tsunami Warning Centers (TWCs) will continue to improve in speed, accuracy, and resolution,

Considering the existing body of social science knowledge regarding effective hazard warning,

Further considering the diversity of the Member States and their tsunami warning requirements,

Acknowledging and appreciating the willingness of the international TWCs to consider changes to their products and dissemination that will improve their effectiveness and functionality,

Agrees that a Task Team composed of representatives from recipient Member States with PTWC and other regional warning centres be formed under the Working Group on Detection, Warning and Dissemination to:

1. Review the capabilities and plans of the international TWCs with respect to their operational products and product dissemination for the PTWS
2. Gather feedback from Member States regarding international TWC current and planned product content, format, and dissemination
3. Consider best practices based on social science as well as the experiences of the Member States
4. Consider the global harmonization of tsunami warning products and terminology
5. Develop recommendations to improve current products and /or develop new products

Requests the Task Team Chair to provide a report on the recommendations and any implementations at ICG/PTWS-XXIV.

Financial implications: None

Task Team Members:

Charles McCreery (USA-PTWC) – Chair, Tomoaki Ozaki (Japan-JMA), Chris Ryan (Australia-JATWC), Daniel Jaksa (Australia-JATWC), Ken Gledhill (New Zealand-GNS), Dominique Reymond (France-CPPT), Mathew Moihoi (PNG-PMGO), Mala Finau (DMR-Fiji), Indonesia (pending), SE Pacific (pending), and Laura Kong (ITIC)

Other Members expressing interest during the intersessional period and/or the invitation of the Chair,

Annex II.
PTWC – JMA Coordination Meeting
11-13 April 2011, Honolulu, Hawaii

Participants:

Dr. Charles McCreery, Director, PTWC; PTWS Enhanced Tsunami Warning Products Task Team Chair
 Takeshi Koizumi, Senior Coordinator for International Earthquake and Tsunami Information, JMA; NWPTAC
 Dr. Ken Gledhill, GEONET Project Director, GNS, New Zealand; SW Pacific WG Chair
 Dr. Mohd Rosaidi Che Abas, Director, Geophysics and Tsunami Division, Malaysia Meteorological Dept.; South China Sea WG Chair
 Dr. Prih Hardjadi, Deputy Director, BMKG, Indonesia
 Dr. Laura Kong, Director, ITIC; PTWS Exercises Task Team Co-Chair
 Ed Young, Deputy Director, US NWS Pacific Region; PTWS Emergency Communications Task Team Co-Chair
 Brian Yanagi, ITIC; PTWS Exercises Task Team Member
 Jo Guard, MCDEM, New Zealand; PTWS Exercises Task Team Co-Chair (April 13 only)
 By Teleconference: David Coetzee (Manager, Operations, MDEM, New Zealand; PTWS WG 3 Chair), Dr. François Schindel  (CEA/DASE, France; PTWS WG1 Chair), Masahiro Yamamoto (Senior Advisor, IOC TSU)

Agenda

	Monday, April 11	
09:00-10:30	Welcome Introductions, Local Arrangements Overview of Meeting Purpose, Agenda finalization Teleconference with Francois Schindele, Masahiro Yamamoto	NWS PR Kong McCreery
11:00-12:00 13:30-14:00	Lesson Learned and Challenges for Local and Distant Tsunami Warning – JMA, Indonesia, PTWC, New Zealand, Malaysia, and others' experiences	Koizumi, Harjadi, McCreery, Gledhill, all
14:00-16:30	Tsunami Warning Products – Existing and Enhanced Existing problems and issues and their solutions What will be improved and how? Country customer requests and feedback	McCreery
	Tuesday, April 12	
09:00-11:00 14:00-17:00	Enhanced Tsunami Warning Products Discussion, Improvements, Implementation, Coordination Teleconference with David Coetzee	McCreery, Koizumi
	Wednesday, April 13	
09:00-10:30	Planning for PTWS-XXIV – Dates, Documents, Deadlines Teleconference with François Schindel� and Masahiro Yamamoto	All
10:45 -12:00 13:30 - 17:00	Exercise Pacific Wave 2011 Important Dates, Scenarios, Conduct (Message Coordination) Exercise Manual and Exercise Conduct and Evaluation Guidance Teleconference with David Coetzee	Kong, Guard