Exercise Pacific Wave 2017
PacWave17 Overview

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Exercise Pacific Wave (PacWave)

- IOC-coordinated international tsunami exercises
- PacWave 11, 13, 15 – introduce and test PTWC new enhanced products prior to changeover (1 October 2014), and after
- PacWave 16, 17 - introduce and test JAM NWPTAC new enhanced products prior to changeover (2018)
PacWave 16 and 17 – Overall Goals

Test NWPTAC new products prior to implementation through 2 PacWave exercises

PacWave16
- Small-scale exercise with 16 countries that receive NWPTAC products
- Table-top exercise recommended

PacWave17
- Full-scale exercise with all Member States
- Encourage additional activities over and above table top exercise.
PacWave Planning, Conduct, Evaluation

PacWave Exercises Task Team:

- **Three co-chairs**
  - Laura Kong - ITIC
  - Jo Guard - New Zealand
  - Tomoaki Ozaki - Japan

**Members - same for PacWave16 and 17**

- Viviana Dionicio – Colombia
- Jun-Hee Lee – Korea
- Yuelong Miao – Australia
- Jerome Aucau – New Caledonia
- Dominique Reymond – French Polynesia
- Viacheslav Gusiakov and Tatiana Ivelskaya – Russia
- Chip McCreery – PTWC
Exercise Web Site:  http://www.pacwave.info

Announcement:  
IOC CL 2636 issued 16 August 2016
15-17 February 2017:  
PTWS Exercise Pacific Wave “PacWave17”

Exercise Purpose: 
The aim of PacWave17 is to test the NWPTAC enhanced products and PTWC enhanced products. Proposed new SCSTAC products tested in parallel with PacWave17
PacWave17 – Objectives

1. Test communications from the PTWS PTWC and NWPTAC Tsunami Service Providers to Member States.

2. Test whether the PTWS PTWC and NWPTAC Tsunami Service Provider products are interpreted by Member States accurately and in a timely manner.

3. Test national and regional communication.

4. Test national and regional cooperation.
PacWave17 – 7 Scenarios

All scenarios: Magnitude: M9.0
Depth 20 km (except Manila)

- Manila Trench (Depth 35 km)
- New Britain-San Cristobal Trench (PacWave16)
- New Hebrides Trench (PacWave11)
- Tonga Trench (PacWave11, 15)
- Peru-Chile Trench (PacWave11)
- Colombia-Ecuador Trench (PacWave11)
PacWave17 – Conduct

- **Exercise Date:**
  - Event start live, but may conduct on diff date/time
  - 15 Feb: Colombia-Ecu, Peru-Chile, Tonga
  - 16 Feb: New Hebrides, San Cristobal, Manila

- **Exercise Type and Participants – Recommend:**
  - Tabletop Exercise
  - Minimum participation: NTWC, NDMO
  - Each Country - exercise 1 Tsunami Scenario

- **TSP Messages (on web site):**
  - PTWC, JMA NWPTAC
  - Live ‘Dummy Text’ messages to start
PTWC New Enhanced Products

- Base threat on wave forecast models, not on predetermined magnitude threshold
- Forecasts constrained by EQ mechanism (W-CMT) and sea level readings
- Public Text Msg continues – Summary Information
- Graphical forecasts and Statistics table only to Country Tsunami Warning Focal Points (TWFP):
  - Coastal Tsunami Amplitude Forecast Polygon Map - Overview
  - Deep-Ocean Tsunami Amplitude Forecast Map – Pacific-wide
  - Coastal Tsunami Amplitude Forecast Map – Pacific-wide and Regional, with Tsunami Travel Times
  - Coastal Tsunami Amplitude Forecast KMZ – input to Google Earth
  - Table of Forecast Statistics for Regional Polygons
PTWC New Enhanced Products

- No Warning / Watch Alert Levels

- Instead, issue Threat Levels:
  4 categories based forecast maximum coastal tsunami wave amplitudes

  - < 0.3m (no Threat)
  - 0.3 to < 1m
  - 1 to 3m
  - > 3m
  - Other: Forecast not yet computed
Developed and tested – PacWave16, 17
Implement 2018 with ICG/PTWS approval

NWPTA Forecast Points: revised to align with PTWC products, and meet Member States requests

Text Products – continue as before

Graphical Products – sent by email
  • Travel Time Map
  • Coastal Tsunami Amplitude Forecast Map
  • Deep-ocean Tsunami Amplitude Forecast Map
NWPTA Recipient Countries, Area Coverage

NWPTA will be issued to 16 recipient countries when the NWPTAC detects occurrence of an earthquake of magnitude 6.5 or greater in the blue-shaded area.
NWPTAC Products: Tsunami Travel Time

- This map shows the estimated travel time based on determined earthquake location (hypocenter or centroid) and magnitude.

**Limitations**

Actual arrival time at the coast may vary from forecast arrival time due to many reasons including:

- Uncertainties in tsunami source (the area of seafloor deformation is assumed from earthquake location and magnitude)
- Uncertainties in bathymetry especially in the vicinity of the observation point
- Nonlinear effects on tsunami propagation which is not taken into account in estimating travel time (the nonlinear effects may be important especially in shallow water)
- Difficulty in measuring the first wave arrival from observed sea level data
Coastal Tsunami Amplitude Forecast

This map shows the larger maximum coastal amplitudes of two different forecasts based on a conjugate fault set obtained by CMT analysis. The amplitudes are shown in meters from the undisturbed sea level to the crest. Actual coastal amplitudes at the coast may vary from forecast coastal amplitudes due to uncertainties in the forecast and local features. Information bullets provided by the Northwest Pacific Tsunami Advisory Center (NWPTAC) should not be construed as official warnings or evacuation notices for the areas concerned. The issuance of actual evacuation notices is the responsibility of individual local authorities.

- This map shows the individual coastal points colored according to the forecast tsunami amplitude at each point.
- The larger of two different forecast amplitudes based on a conjugate fault set obtained by CMT analysis is used as a forecast tsunami amplitude at each point.

Limitations

Actual tsunami amplitudes at the coast may vary from forecast amplitudes due to many reasons including:

- Uncertainties in tsunami source (two rectangular faults are assumed based on the result of CMT analysis)
- Uncertainties in the way that the tsunami interact with the coast (a general approximation, Green’s Law, is used)

The results can vary easily by a factor of two because of the uncertainties written above.
This map shows the maximum tsunami amplitude at each place in the deep ocean.

- It shows how the tsunami is directed away from the tsunami source, how it is focused and defocused by the shape of the seafloor, and how it diminishes by spreading.

- Two different maps based on a conjugate fault set obtained by CMT analysis will be provided.

**Limitations**

Actual deep-ocean tsunami amplitude may vary from forecast amplitudes mainly due to uncertainties in tsunami source (two rectangular faults are assumed based on the result of CMT analysis).

This map should not be used to estimate coastal tsunami amplitudes or impacts.
PacWave17 - Documents

PacWave17 web site: www.pacwave.info

- Exercise Messages (PTWC, JMA/NWPTA)
- PacWave Exercise Manual (IOC TS 131, 2016)
- User’s Guide to PTWC Enhanced Products for the PTWS (IOC TS 105, revised, 2014)
- PacWave17 Summary (this ppt)
- How to Plan, Conduct, and Evaluate IOC Tsunami Wave Exercises (IOC M&G 58 2013)
- PacWave17 Announcement (IOC CL 2636, 16 Aug 2016)
Post-Exercise Evaluation

- Due 10 March 2017
- Preliminary Results available for ICG/PTWS-XXVII, 28-31 March 2017
- Online: https://www.surveymonkey.com/s/pacwave17_eval
<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 Nov 2016</td>
<td>Nominate PacWave17 National Contact</td>
</tr>
<tr>
<td>1 Dec 2016</td>
<td>Exercise manual (incl scenarios) on <a href="http://www.pacwave.info">www.pacwave.info</a></td>
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<tr>
<td>31 Jan 2017</td>
<td>Exercise messages posted</td>
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<tr>
<td>15-17 Feb 2017</td>
<td>PacWave17</td>
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<tr>
<td>18 Feb - 10 Mar 2017</td>
<td>Countries complete and submit evaluation survey online</td>
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<tr>
<td>28 - 31 Mar 2017</td>
<td>Draft Preliminary Results discussed at ICG/PTWS-XXVII</td>
</tr>
<tr>
<td>21 Apr 2017</td>
<td>Draft PacWave17 Preliminary Report available to Member States</td>
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Exercise Pacific Wave, 2006-2016: A decade of reflection
Exercise Purpose:
To test, exercise, evaluate and review the operational lines of communication within the Pacific Tsunami Warning and Mitigation System’s area of responsibility

Participants: 44 countries

Scenarios: 1
PacWave6: Objectives

1. Validate the Tsunami Warning Centres’ dissemination process of issuing tsunami watch and warning bulletins to Pacific basin countries;
2. Validate the process for countries to receive and confirm tsunami bulletins;
3. Validate dissemination of warning messages to relevant agencies within a country, provinces and local jurisdictions;
4. Validate the organisational decision making process about public warnings and evacuations;
5. Identify the modes that would be employed to notify and instruct the public; and
6. Assess the elapsed time until the public would be notified and instructed.
Exercise Purpose:
The purpose of the exercise was to evaluate and improve the effectiveness of the PTWS, its operational Tsunami Warning Centers, and its Member States in responding to a destructive tsunami.

Participants: 40 countries

Scenarios: 1
PacWave8: Objectives

1. Validate the international Tsunami Warning [or Advisory] Centers’ dissemination process of issuing Tsunami Watch and Warning Bulletins to Pacific countries;

2. Validate the process of countries receiving and confirming Tsunami Bulletins through their designated focal point;

3. Validate dissemination of warning messages to relevant agencies within a country;

4. Validate the organizational decision making process about public warnings and evacuations;

5. Identify the methods that would be used to notify and instruct the public;

6. Assess the elapsed time until the public would be notified and instructed.
Real Tsunami events: 2009-2011

- **M8.0 Samoa - 29 September 2009**
  - Samoa – 149 deaths, -20% GDP impact
  - American Samoa – 34 deaths, $90 million damage
  - Niuatoputapu Island, Tonga – 9 deaths, airport inoperable (debris), so at 1st only ship access

- **M8.8 Chile – 27 February 2010**
  - 156 deaths, $600 million damage
  - Civil court cases (ONEMI, SHOA liable)

- **M9.0 Japan – 11 March 2011**
  - ~18,000 dead or missing, $6 billion damage
  - Civil court cases (Ishinomaki, school liable, 74 school-children died)
Improving Exercise Conduct

- How to Plan, Conduct and Evaluate UNESCO/IOC Tsunami Wave Exercises (IOC, Manual & Guides 58, 2013, English, Spanish)
- NZ Ministry of Civil Defence and Emergency Management, ITIC collaboration
- Draft used PacWave11
Exercise Purpose:
To improve local and regional source tsunami warning and response capability in the Pacific.

Participants: 35 countries

Scenarios: 10
PacWave11: Objectives

1. To exercise and evaluate operations of the current PTWS, including:
   • Validate the issuance of tsunami advice from PTWC, JMA/NWPTAC and WCATWC
   • Validate receipt of this tsunami advice by Pacific Country TWFP

2. To begin a process of exposure to an initial test version of PTWC experimental products that were being developed to provide a more rapid and quantitative forecast of tsunami impacts:
   • Review and evaluate PTWC experimental products that will be available in parallel with existing PTWC products for each scenario exercised.
   • Provide feedback on the staging, format, and content of the experimental products.

3. To validate the readiness of Member States to respond to a local/regional source tsunami:
   • Validate the operational readiness of the National Tsunami Warning Centre (NTWC), or similar in-country function, and/or the National Disaster Management Office (NDMO).
   • Improve operational readiness. Before the exercise, ensure appropriate tools and response plan(s) have been developed,
     • including public education materials.
   • Validate dissemination of warnings and information/advice by NTWC to relevant in-country agencies and the public is accurate and timely.
   • Validate the organisational decision-making process about public warnings and evacuations.
   • Validate the methods used to notify and instruct the public are accurate and timely.
Exercise Purpose:
The aim of PacWave13 is to validate the understanding and use of the PTWC Enhanced Products.

1. Evaluate the format and content of the PTWC Enhanced Products for each scenario exercised

2. Provide feedback that a country is prepared to officially receive and implement and utilize the PTWC Enhanced Products

3. Provide feedback that a country’s stakeholder agencies will be informed on the PTWC Enhanced Products so as to make appropriate future changes to their Standard Operating Procedures.

Participants: 34 countries
Scenarios: 3
Exercise Purpose: 
To test the new PTWC Enhanced Products

1. Test communications from the PTWS Tsunami Service Providers to Countries.

2. Test whether the PTWS PTWC Tsunami Service Provider products are interpreted by countries accurately and in a timely manner.

3. Test national and regional cooperation.

Participants: 41 countries

Scenarios: 6
Majority received messages in timely manner without issues.

Majority ranked the text message as most useful product

KMZ file least useful product

Format and content of products clear and easy to interpret

Respondents understand the contents of the enhanced products

Information provided assists with decision making
Countries open to receiving higher resolution products

NTWC/NDMOs have activation and response processes

Respondents used national tsunami experts to help assess threat messages

40% of respondents have tsunami related curriculum programmes in all levels of education

Stakeholder agencies have a better understanding of their goals, responsibilities and roles in tsunami emergencies.
Tsunami Warning Focal Point contact data

**Issue:** TWFP contact information needs to be 100% accurate 100% of the time

**Recommendation:** Countries to routinely review contact information, inform IOC (who will then forward to Tsunami Service Providers)
Exercise Planning

**Issue:** Insufficient time provided to fully prepare for the exercise

**Recommendation:**
- IOC to announce future PacWave activities at least 6 months prior
- Exercise manual to be published 3 months prior
- Tsunami Service Providers to provide products at least 1 month prior.
Community Preparedness

**Issue:** 35% of countries do not have evacuation maps, signs, routes, assembly areas etc. This hampers a community to plan for tsunami response.

**Recommendation:**
- IOC and Member States should support preparedness efforts as highest priority.
- All communities should have tsunami evacuation maps.
Routine exercising

Issue: 35% of countries do not conduct annual, routine tsunami exercises.

Recommendation: Countries are encouraged to conduct annual tsunami exercises (starting with small, controllable coastal school drills).
Conduct of future exercises

**Issue:** Past PacWave exercises have been conducted in controlled, moderately-paced timelines, in a table-top format. Many countries are now ready to move towards more realistic exercise response timeline.

**Recommendation:** Future PacWave exercises should be conducted in real time, initially during the daytime working hours with full staffing. Later, consideration should be given to real time exercises simulating minimal staff during night time or weekend hours.
PacWave16: 1-5 February 2016

Exercise Purpose:

The aim of PacWave16 is to evaluate experimental NWPTAC Enhanced Products and identify necessary modifications.

1. Evaluate the format and content of experimental NWPTAC Enhanced Products.

2. Determine whether countries are prepared to officially receive and utilize the NWPTAC Enhanced Products.

Participants: 12 countries

Scenarios: 6
Thank You

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