

JMA Report on NWPTAC Enhanced Products

Tomoaki OZAKI
Japan Meteorological Agency (JMA)

Timeline on NWPTAC Enhanced Product (draft)

Apr. 2015 ICG/PTWS XXVI in Honolulu, Hawaii, USA
- Approval of NWPTAC's Enhanced Products proposal.

Feb. 2016 PacWave16
- Experimental issuance of NWPTAC Enhanced Products.

<Evaluation>

Feb. 2017 PacWave17
- Experimental issuance of NWPTAC Enhanced Products.

<Evaluation>

Mar. 2017 ICG/PTWS-XXVII
- Approval of NWPTAC's Enhanced Products.

xxx 2017 (TBD) Parallel issuance of existing and enhanced products.

xxx 2018 (TBD) Final changeover to NWPTAC Enhanced Products.

Schedule on PacWave16

11 Aug. 2015

Announcement on PacWave16 by IOC to Member States

[Aug.-Nov. 2015

Revision of Forecast points]

14 Jan. 2016

Exercise manual available on PacWave Website

1-5 Feb. 2016

PacWave16

8 Feb.- 2016

Evaluation Survey

xxx 2016

Summary Report

Revision of Forecast Points

- Forecast Points (FPs) used for NWPTA Enhanced Products are planned to be revised from current FPs taking into account;
 - ✓ aligning with PTWC products.
 - ✓ survey results on FP revision for recipient Member States.

- Survey on FP revision was conducted Aug.-Nov. 2016.
 - ✓ 4 Member States requested revision and/or addition.
 - ✓ Basically all requests on FPs are reflected, except for one offshore point. Requests on rename of Coastal Blocks are not reflected because of consistency and continuity.

PROPOSED LIST OF FORECAST POINTS

Note: **Red characters** represent modification after ICG/PTWS-XXVI/3 Annex IV Appendix B

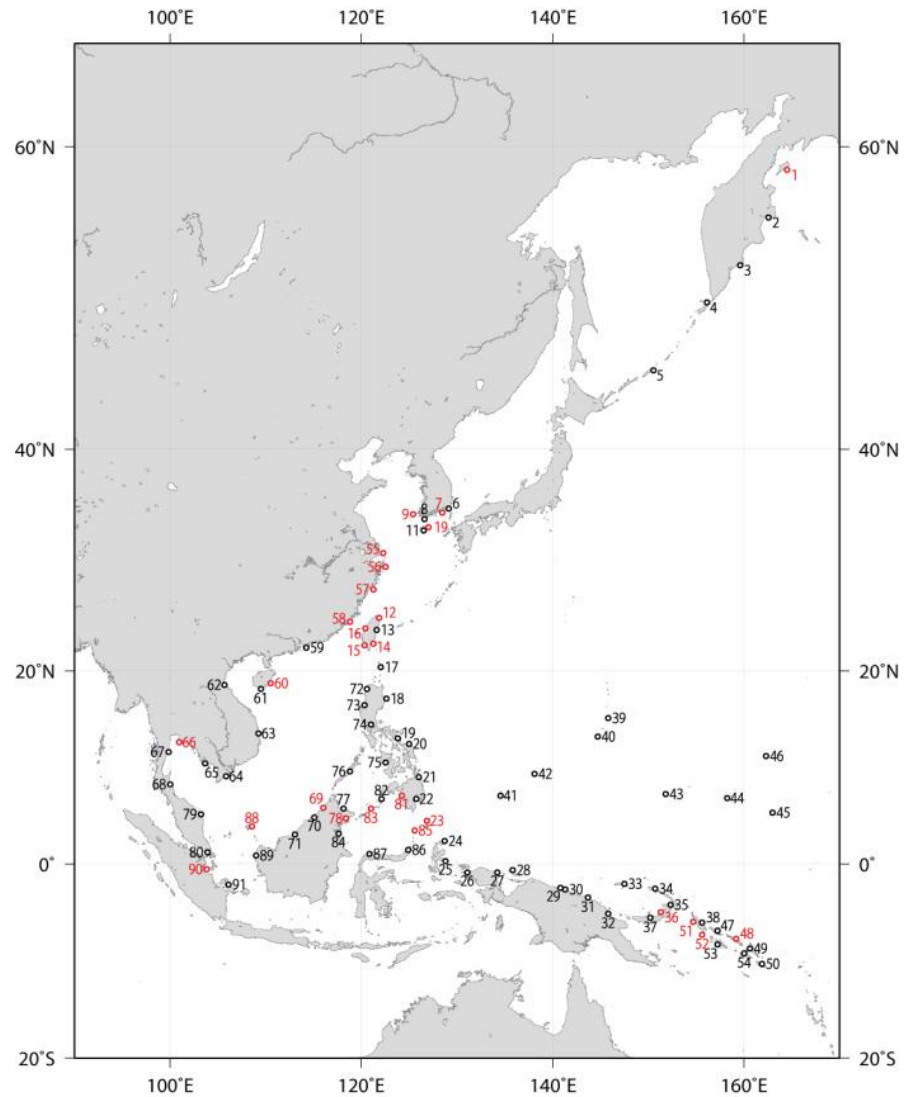
Note: **Green rows** represent additional FPs to the current list

Note: **Orange cells** represent modifications from the current list

COASTAL BLOCK	FORECAST POINT	LATITUDE	LONGITUDE
EAST COASTS OF KAMCHATKA PENINSULA	UST_KAMCHATSK	56.1N	162.6E
EAST COASTS OF KAMCHATKA PENINSULA	PETROPAVLOVSK_K	53.2N	159.6E
EAST COASTS OF KAMCHATKA PENINSULA	OSTROV_KARAGINSKIY	58.8N	164.5E
KURIL ISLANDS	SEVERO_KURILSK	50.8N	156.1E
KURIL ISLANDS	URUP_IS.	46.1N	150.5E
SOUTH COASTS OF KOREAN PENINSULA	BUSAN	35.1N	129.1E
SOUTH COASTS OF KOREAN PENINSULA	NOHWA	34.2N	126.6E
SOUTH COASTS OF KOREAN PENINSULA	SEOGWIPO	33.2N	126.5E
SOUTH COASTS OF KOREAN PENINSULA	CHEJU_ISLAND	33.5N	127.0E
SOUTH COASTS OF KOREAN PENINSULA	TONGYEONG	34.7N	128.4E
SOUTH COASTS OF KOREAN PENINSULA	HEUKSANDO	34.6N	125.4E
TAIWAN	HUALIEN	24.0N	121.6E
TAIWAN	CHILUNG	25.2N	121.8E
TAIWAN	TAITUNG	22.7N	121.2E
TAIWAN	KAOHSIUNG	22.5N	120.3E
TAIWAN	HOMEL	24.2N	120.4E
EAST COASTS OF PHILIPPINES	BASCO	20.4N	122.0E
EAST COASTS OF PHILIPPINES	PALANAN	17.2N	122.6E
EAST COASTS OF PHILIPPINES	LEGASPI	13.2N	123.8E
EAST COASTS OF PHILIPPINES	LAOANG	12.6N	125.0E
EAST COASTS OF PHILIPPINES	MADRID	09.2N	126.0E
EAST COASTS OF PHILIPPINES	DAVAO	06.9N	125.7E
NORTH COASTS OF IRIAN JAYA	BEREBERE	02.5N	128.7E
NORTH COASTS OF IRIAN JAYA	PATANI	00.4N	128.8E
NORTH COASTS OF IRIAN JAYA	SORONG	00.8S	131.1E
NORTH COASTS OF IRIAN JAYA	MANOKWARI	00.8S	134.2E
NORTH COASTS OF IRIAN JAYA	WARSA	00.6S	135.8E
NORTH COASTS OF IRIAN JAYA	JAYAPURA	02.4S	140.8E
NORTH COASTS OF IRIAN JAYA	GEME	4.6N	126.8E
NORTH COASTS OF PAPUA NEW GUINEA	VANIMO	02.6S	141.3E

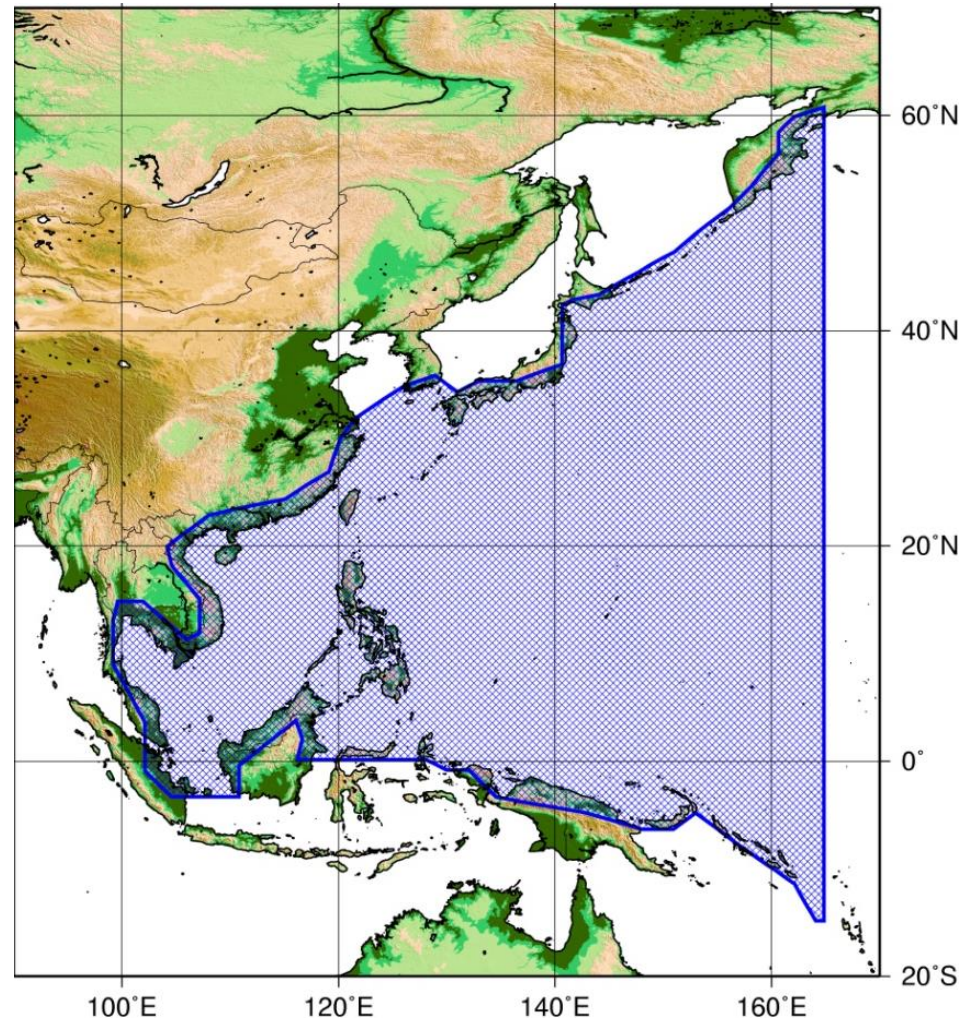
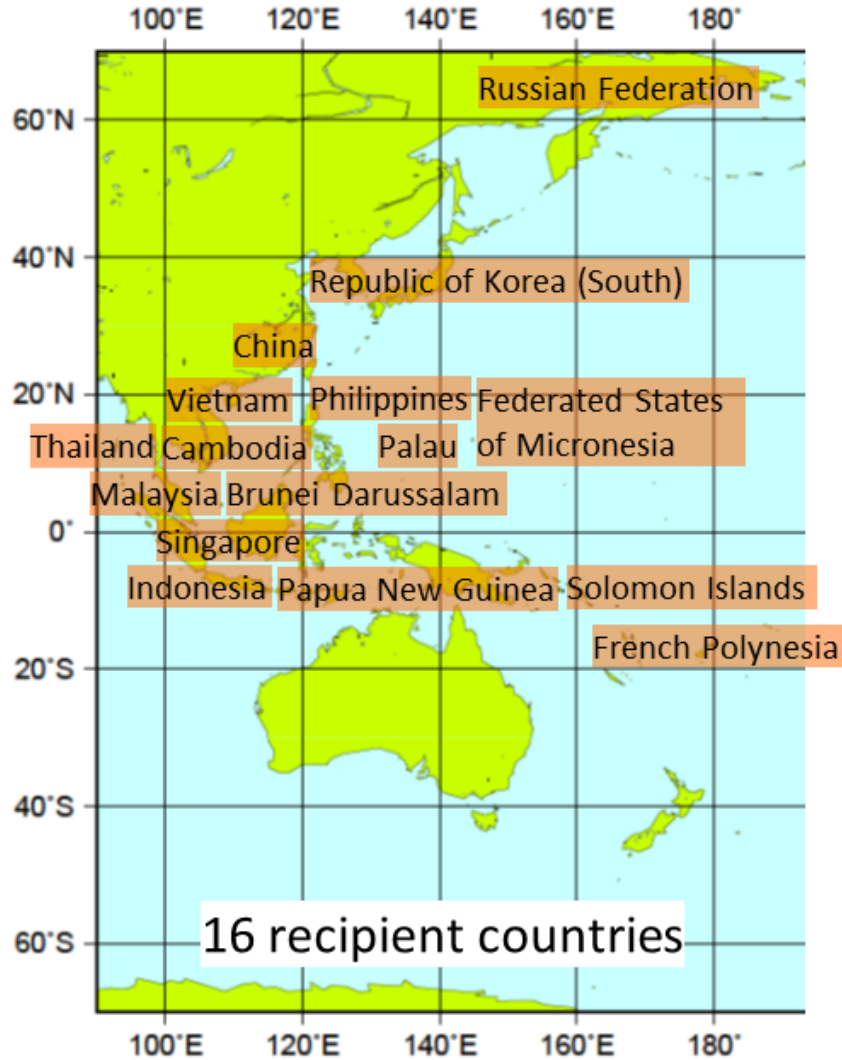
COASTAL BLOCK	FORECAST POINT	LATITUDE	LONGITUDE
NORTH COASTS OF PAPUA NEW GUINEA	WEWAK	03.5S	143.7E
NORTH COASTS OF PAPUA NEW GUINEA	MADANG	05.2S	145.8E
NORTH COASTS OF PAPUA NEW GUINEA	MANUS_IS.	02.0S	147.5E
NORTH COASTS OF PAPUA NEW GUINEA	RABAU	04.2S	152.3E
NORTH COASTS OF PAPUA NEW GUINEA	KAVIENG	02.5S	150.7E
NORTH COASTS OF PAPUA NEW GUINEA	KIMBE	05.6S	150.2E
NORTH COASTS OF PAPUA NEW GUINEA	KIETA	06.1S	155.6E
NORTH COASTS OF PAPUA NEW GUINEA SOLOMON SEA	AMUN	6.0S	154.7E
NORTH COASTS OF PAPUA NEW GUINEA	ULAMONA	5.0S	151.3E
MARIANA ISLANDS	GUAM	13.4N	144.7E
MARIANA ISLANDS	SAIPAN	15.3N	145.8E
PALAU	MALAKAL	07.3N	134.5E
MICRONESIA	YAP_IS.	09.5N	138.1E
MICRONESIA	CHUUK_IS.	07.4N	151.8E
MICRONESIA	POHNPEI_IS.	07.0N	158.2E
MICRONESIA	KOSRAE_IS.	05.5N	163.0E
MARSHALL ISLANDS	ENIWETOK	11.4N	162.3E
NORTH COASTS OF SOLOMON ISLANDS	PANGGOE	06.9S	157.2E
NORTH COASTS OF SOLOMON ISLANDS	AUKI	08.8S	160.6E
NORTH COASTS OF SOLOMON ISLANDS	KIRAKIRA	10.4S	161.9E
NORTH COASTS OF SOLOMON ISLANDS	GHATERE	7.8S	159.2E
SOLOMON SEA	MUNDA	08.4S	157.2E
SOLOMON SEA	HONIARA	09.3S	160.0E
SOLOMON SEA	FALAMAE	7.4S	155.6E
COASTS OF EAST CHINA SEA	SHANGHAI	31.2N	122.3E
COASTS OF EAST CHINA SEA	WENZHO	27.8N	121.2E
COASTS OF EAST CHINA SEA	ZHOUSHAN	29.9N	122.5E
COASTS OF SOUTH CHINA SEA	HONG_KONG	22.3N	114.2E
COASTS OF SOUTH CHINA SEA	SANYA	18.2N	109.5E
COASTS OF SOUTH CHINA SEA	QUANZHOU	24.8N	118.8E
COASTS OF SOUTH CHINA SEA	HAINAN_ISLAND	18.8N	110.5E
COASTS OF GULF OF TONKIN	VINH	18.6N	105.7E
EAST COASTS OF INDO CHINA PENINSULA	QUI_NHON	13.7N	109.2E
EAST COASTS OF INDO CHINA PENINSULA	BAC_LIEU	09.3N	105.8E
GULF OF THAILAND	PRACHUAP_KHIRI_KHAN	11.8N	099.8E
GULF OF THAILAND	SIHANOUKVILLE	10.6N	103.6E
GULF OF THAILAND	NAKHON_SI_THAMMARAT	08.4N	100.0E

COASTAL BLOCK	FORECAST POINT	LATITUDE	LONGITUDE
GULF OF THAILAND	PATTAYA	12.8N	100.9E
NORTHWEST COASTS OF KALIMANTAN	MUARA	05.0N	115.1E
NORTHWEST COASTS OF KALIMANTAN	BINTULU	03.2N	113.0E
NORTHWEST COASTS OF KALIMANTAN	KOTA_KINABALU	6.0N	116.0E
WEST COASTS OF PHILIPPINES	LAOAG	18.2N	120.6E
WEST COASTS OF PHILIPPINES	SAN_FERNANDO	16.6N	120.3E
WEST COASTS OF PHILIPPINES	MANILA	14.6N	121.0E
SULU SEA	ILOILO	10.7N	122.5E
SULU SEA	PUERTO_PRINCESA	09.8N	118.8E
SULU SEA	SANDAKAN	05.9N	118.1E
SULU SEA	LAHAD_DATU	4.9N	118.4E
EAST COASTS OF MALAY PENINSULA	KUARA_TERENGGANU KUALA_TERENGGANU	05.3N	103.2E
EAST COASTS OF MALAY PENINSULA	SINGAPORE	01.3N	103.9E
CELEBES SEA	ZAMBOANGA	06.9N	122.1E
CELEBES SEA	MAIMBUNG	5.9N	121.0E
CELEBES SEA	COTABUTO_CITY	7.3N	124.2E
CELEBES SEA	TARAKAN	03.3N	117.6E
CELEBES SEA	MANADO	01.6N	124.9E
CELEBES SEA	TOLITOLI	01.1N	120.8E
CELEBES SEA	TABUKAN_TENGAH	3.6N	125.6E
NATUNA SEA	SINGKAWANG	01.0N	109.0E
NATUNA SEA	PANGKALPINANG	02.1S	106.1E
NATUNA SEA	KUALA_INDRAGIRI	0.5S	103.8E
NATUNA SEA	KEPULAUAN_RIAU	4.0N	108.5E



Forecast points(FP) of the experimental NWPTAC Enhanced Products for PacWave16. Changed points from current ones are indicated as red symbols. (FP names are listed in the next page)

Recipient Countries and Area of Coverage of NWPTA



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.

Dissemination of Products

Text Products

- GTS
- Email
- FAX

... basically same with the present version

Graphical Products

- Email

... sent to designated IOC Tsunami Focal Points of recipient countries

Forecast Model Description

Numerical Simulation

- JMA uses a tsunami forecast system with a numerical simulation technique based on the nonlinear long wave theory including effects of Coriolis force
(In the procedure for tsunami travel time map, the nonlinear effects are neglected)
- For the Northwest Pacific, grid resolution of 5 arc-min is used

Deep-ocean Maximum Tsunami amplitude

- The system produces a time series of the sea level fluctuations caused by the passing tsunami waves at each model grid point in the ocean
- Shown on the deep-ocean maximum tsunami amplitude forecast map is the maximum amplitude (zero to peak wave amplitude) of those fluctuations

Coastal Maximum Tsunami amplitude

- For each model grid point near the coast, the tsunami amplitude at the coast can be estimated based on Green's Law as follows:

$$A_{coast} = A_{offshore} (D_{offshore} / D_{coast})^{1/4},$$

where A_{coast} is the tsunami amplitude at the coast,
 $A_{offshore}$ is the tsunami amplitude at the offshore grid point,
 $D_{offshore}$ is the depth of the ocean at the offshore grid point, and
 D_{coast} is the depth of the ocean at the coast

- The coastal ocean depth is set to be 1 m

Description of Experimental Products

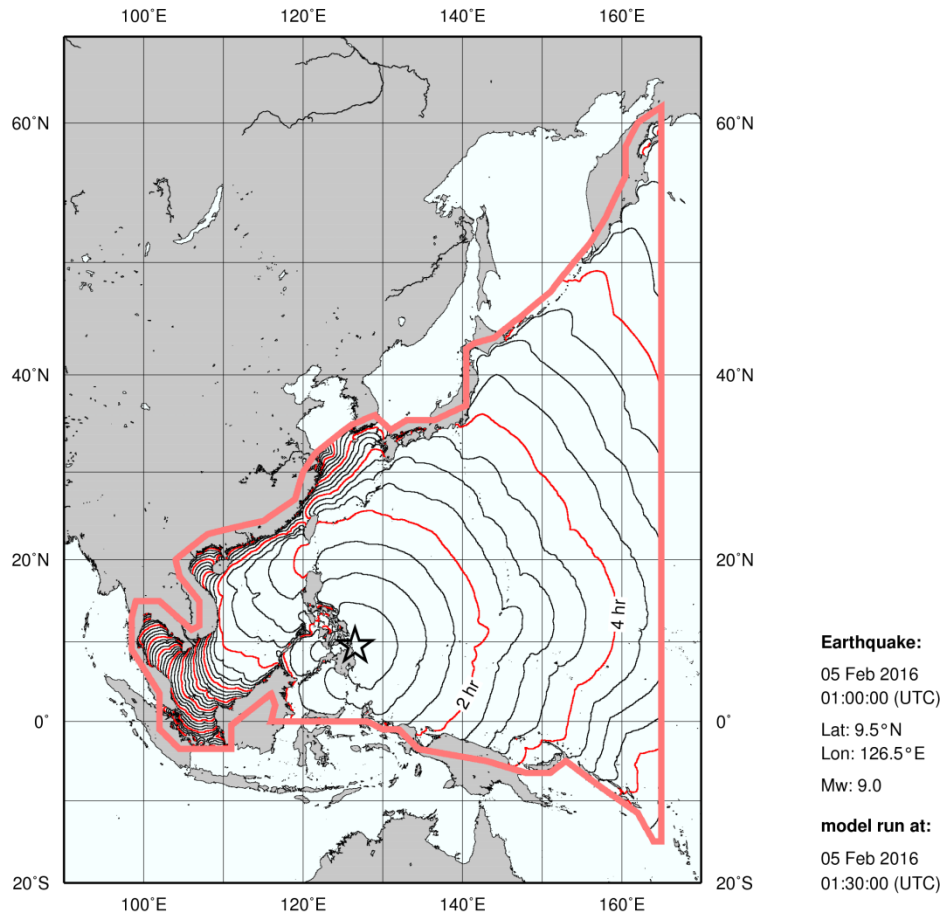
Tsunami travel time map

FOR EXERCISE USE ONLY

NWPTAC Tsunami Travel Time Forecast

Actual arrival times at the coast may vary from forecast arrival times and the initial wave may not be the largest.

Information bulletins 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 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

Description of Experimental Products

Coastal tsunami amplitude forecast map

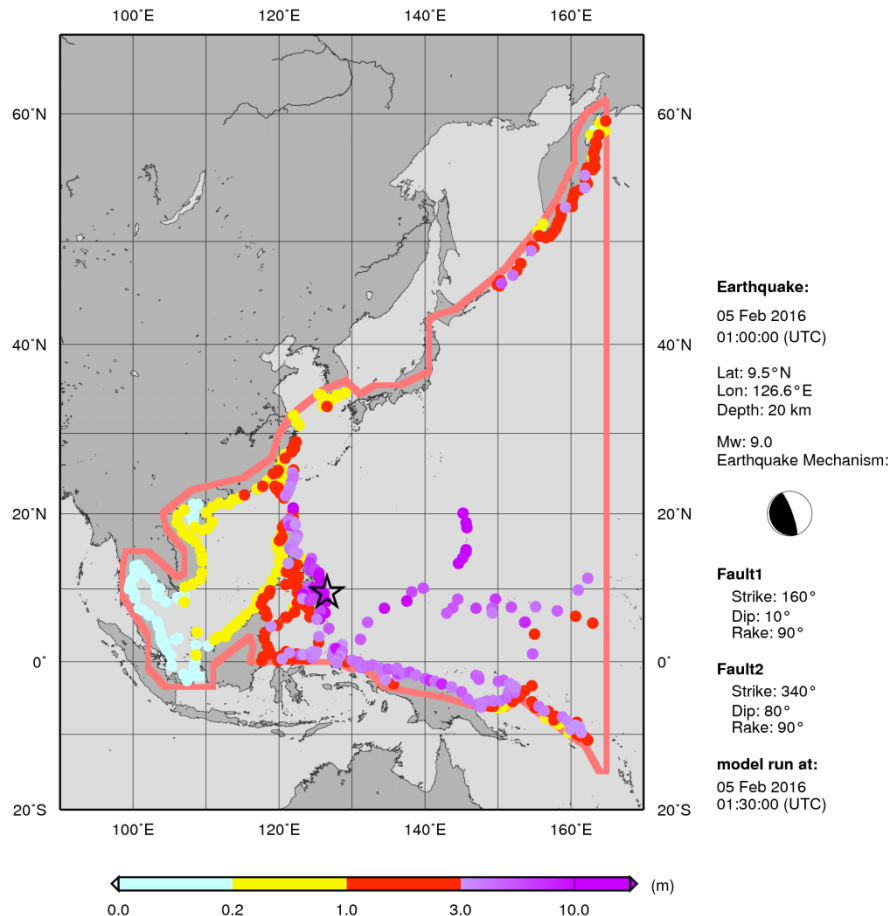
FOR EXERCISE USE ONLY

NWPTAC 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 bulletins 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.

Description of Experimental Products

Deep-ocean tsunami amplitude forecast map

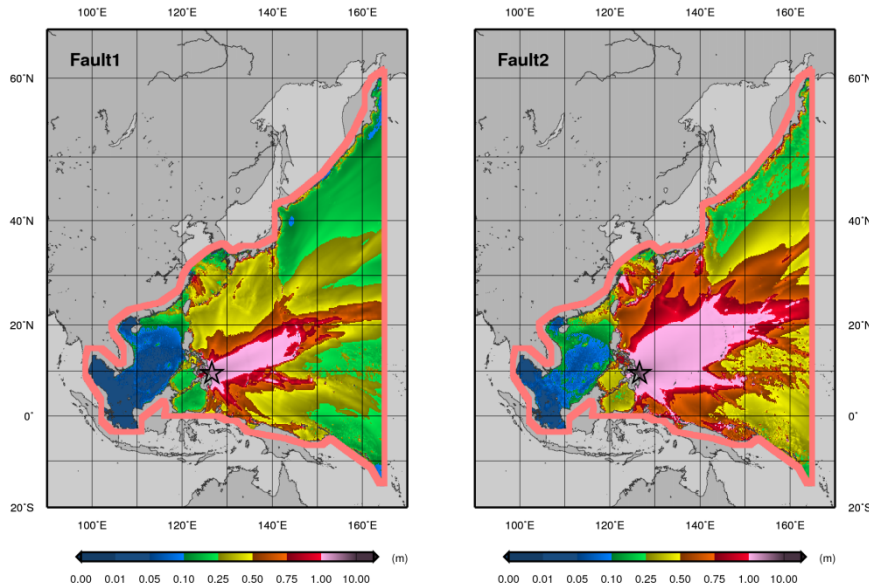
FOR EXERCISE USE ONLY


NWPTAC Deep-Ocean Tsunami Amplitude Forecast

The amplitudes shown in these maps are the maximum amplitudes in meters from the undisturbed sea level to the crest.

These maps should not be used to estimate coastal tsunami amplitudes or impacts. Deep-ocean tsunami amplitudes are usually much smaller than coastal amplitudes.

Information bulletins 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.



Earthquake: 05 Feb 2016 01:00:00 (UTC)
Lat: 9.5°N, Lon: 126.6°E, Depth: 20 km
Mw: 9.0
Earthquake Mechanism: 
Fault1 Strike: 160°, Dip: 10°, Rake: 90°
Fault2 Strike: 340°, Dip: 80°, Rake: 90°

model run at: 05 Feb 2016 01:30:00 (UTC)

- 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.

Tentative Evaluation of PacWave16

- 12 Total responses. (Vietnam, Malaysia, Hong Kong (China), Papua New Guinea, Russia, Indonesia, China, Singapore, French Polynesia, Samoa, Solomon Islands, South Korea)
- Basically, NWPTAC Enhanced Products are regarded as useful in helping to assess national tsunami threat.
- Among NWPTAC Enhanced Products, text message is regarded as the most useful product.
- Preparation to utilize NWPTAC Enhanced Products is ongoing.

To do list

- Preparation of User's Guide

Currently, NWTPAC users guide is published as SECTION 6 of “Operational Users Guide for the Pacific Tsunami Warning and Mitigation System (PTWS)”. We are planning to publish a new separate edition of Users Guide for NWPTAC Enhanced Products as with PTWC.

- Modification based on PacWave16 and 17 results.

- Coordination with PTWC on operation.

- Technical issues (resolution, revision of database, offshore grid points for green's law, operation procedure, ...)

Future schedule (draft)

Apr. 2015 ICG/PTWS XXVI in Honolulu, Hawaii, USA
- Approval of NWPTAC's Enhanced Products proposal.

Feb. 2016 PacWave16
- Experimental issuance of NWPTAC Enhanced Products.

<Evaluation>

Feb. 15-17 2017 PacWave17 (IOC CL 2636, Aug 16, 2016)
- Experimental issuance of NWPTAC Enhanced Products.

<Evaluation>

Mar. 2017 ICG/PTWS-XXVII
- PacWave17 results and recommendations
- Approval of NWPTAC's Enhanced Products taking into consideration of PacWave17

xxx 2017 (TBD) Parallel issuance of existing and enhanced products.

xxx 2018 (TBD) Final changeover to NWPTAC Enhanced Products.