Handbook of the Northwest Pacific Tsunami Advisory

Japan Meteorological Agency

Contents

Issued on 1 April 2006

1. Introduction

Since 1978, in-depth discussions have been made by the International Coordination Group for the Tsunami Warning System in the Pacific (ICG/ITSU) on the establishment of regional tsunami warning centers to issue tsunami advisories tailored for respective regions in the Pacific. With regard to the Northwest Pacific region, the Republic of Korea proposed at the 14th session of ICG/ITSU (Tokyo, 1993) that a center could be assumed by the Japan Meteorological Agency (JMA). This triggered a feasibility study in ICG/ITSU to set up the regional center for the Northwest Pacific.

At the 17th ICG/ITSU session (Seoul, 1999), JMA, based on the survey of the regional requirement as well as state-of-the-art technology of predicting tsunami wave amplitude, submitted a proposal to the session to establish a regional tsunami warning center for the Northwest Pacific at JMA and the session accepted the proposal. After concentrated efforts of research and development to fully meet the requirements of the center, JMA submitted a report at the 19th ICG/ITSU session (Wellington, 2003) to demonstrate its readiness for the operation of the center. In 2004, Executive Council of the Intergovernmental Oceanographic Commission (IOC), at its 37th session (Paris, 2004), adopted a resolution to start the services of the regional center at JMA by March 2005.

On such an international consensus, JMA initiated the operation of the regional center in the Tsunami Forecast Center in the Headquarters of the Agency to provide tsunami advisories to the countries in the Northwest Pacific in March 2005. At the 20th ICG/ITSU session (Vina del Mar, October 2005), JMA reported the inauguration of the Northwest Pacific Tsunami Advisory Center (NWPTAC) and the ICG/ISTU expressed its appreciation to Japan for undertaking the responsibilities of NWPTAC. The present handbook is prepared by JMA toward the proper use of the advisories of NWPTAC by the recipient countries.

2. Objectives of the Advisory

Provision of the Northwest Pacific Tsunami Advisory (NWPTA) from JMA aims at allowing recipient countries to take timely and appropriate actions against tsunami threats in conjunction with the Tsunami Bulletin from PTWC. To this end, NWPTA is expected to be user friendly and regionally tailored information on tsunamis including tsunami amplitude forecasts. It should be noted, however, that NWPTA is nothing more than an advisory to be considered by recipients in alerting the people and announcing evacuation notices on their own responsibility.

3. Geographical coverage of the Advisory

NWPTA covers the Northwest Pacific and a portion of the Southwest Pacific (see Annex I). Tsunami forecasts including tsunamigenic potential and estimated tsunami amplitude and arrival time are given to forecast points located on the coasts within the region (see Annexes I and II). The NWPTAC is currently exploring the feasibility of extending the coverage of NWPTA over the marginal seas of the Pacific.

4. Timing and criteria for issuance of the Advisory

(1) NWPTA is issued when NWPTAC detects occurrence of an earthquake of magnitude 6.5 or greater in the area indicated in the section 3 of the present document and evaluates that it could generate tsunamis. It provides estimation on the amplitude and arrival time of tsunamis at designated sites (forecast points) on the Northwest Pacific coasts.

(2) When reports of tsunami observations within the NWPTA coverage areas are received by NWPTAC, the tsunami observational data is presented in the subsequent NWPTA as necessary.

(3) When the location and magnitude of the earthquake are re-estimated using seismic data subsequently obtained and/or an unexpectedly significant tsunami is observed, NWPTA is further issued to revise the previous information.

5. Earthquake observation and hypocenter determination

For forecasting of tsunamis, information on the location and magnitude of earthquakes is essentially required. JMA collects those data from global seismological networks such as IRIS/USGS* and IRIS/IDA** through the Internet. The least square method is applied for determining hypocenters with observed arrival time of P and S waves and theoretical arrival time calculated from the IASPEI91 which is used as the travel timetable. Because a depth of an earthquake is one of the determining factors in tsunami generation, JMA utilizes arrival time of various reflected phases such as depth phases (pP, sS, PcP etc) for more reliable hypocenter determination.

Although the Internet is a useful mean for international communications, availability of data is not always secured because of various communication troubles including those uncontrollable. To avoid the serious consequences of unavailability of data via the Internet, JMA receives data also from the Matsushiro Seismic Array System of Matsushiro Seismological Observatory (Nagano, Japan) and from Large Aperture Array comprised of Japanese seismological observation networks.

*IRIS; Incorporated Research Institutions for Seismology, USGS; United States Geological Survey

**IDA; International Deployment of Accelerometers

6. Magnitude determination

(1) Determination methods

Generation of tsunamis heavily depends on the magnitude of earthquakes. Hence, it is essential for tsunami forecast to estimate the magnitude as quickly as possible with the highest accuracy. In this regard, the *moment magnitude (Mw)*, which is derived from the long-period components of the seismic signal, is used because it is more accurate for large earthquakes than the traditional Richter magnitude. In order to obtain Mw more rapidly, NWPTAC calculates Mwp, which is equivalent with Mw, from the signals of the first arriving seismic P-waves using two techniques proposed by Nishimae (2002) and Tsuboi (1995).

JMA operates about 180 seismic stations to determine the location and the magnitude of earthquakes near Japan. Magnitude determined using the JMA seismic network is described as Mjma [Katsumata (2004), Funasaki et al. (2004)] and NWPTAC uses Mjma in case of an earthquake near Japan.

(2) References

Nishimae, Y., K. Nakasoko, and M. Okada, Empirical formulas for quick estimation of the moment magnitude of tele-seismic earthquakes with STS2 seismometer, 2002, Technical Reports of the Matsushiro Seismological Observatory, 19, 57-79, in Japanese

Tsuboi, S., K. Abe, K. Takano, and Y. Yamanaka, Rapid Determination of Mw from Broadband P waveforms, 1995, Bull. Seism. Soc. Am., 85, 606-613

Katsumata, A. Revision of the JMA displacement magnitude, 2004, Quarterly Journal of Seismology, 67, 1-10, in Japanese

Funasaki, J. and Earthquake Prediction Information Division, Revision of the JMA velocity magnitude, 2004, Quarterly Journal of Seismology, 67, 1-10, in Japanese

7. Estimation of arrival time and amplitude of a tsunami

(1) Quantitative tsunami forecast technology

JMA has introduced the tsunami forecast system with a numerical simulation technique to issue quantitative tsunami warnings. Tsunami propagations originating from various types and locations of faults have been simulated to store the calculated tsunami amplitude and arrival time in the database along with magnitudes and hypocenter locations. Once an earthquake occurs and its hypocenter location and magnitude is determined, the best approximation of tsunami propagation is retrieved from the database according to the earthquake data.

Tsunami propagation is calculated using the long wave theory including of effects of Coriolis

force and sea floor friction [e.g. Satake (2002)]. In the long wave theory, the assumptions that "the wavelength of tsunami is much longer than the sea depth and the wave amplitude of tsunami is much smaller than the sea depth" are used. However, these assumptions are not realistic near a coast where the sea depth is shallow. Hence, application of the numerical simulation on the long wave theory is limited to the sea area from epicenter up to a point ("***calculation point***") of several to several ten kilometers offshore depending on the coastal topography. Tsunami amplitude at a coast is given by converting that at the calculation point to that at a designated point on the coast ("***forecast point***") based on the Green's law [e.g. Satake (2002)]. Meanwhile, tsunami arrival time at the forecast point is substituted with that at the calculation point.

(2) References

Satake, K., Tsunamis, 2002, in "International Handbook of Earthquake & Engineering Seismology", pp. 437-451, Academic Press

8. Contents of the Advisory

NWPTA contains:

(1) Earthquake information
(2) Tsunamigenic potential
(3) Estimated amplitude and arrival time of tsunami
(4) Observations of tsunami

Dates and time in NWPTA are given in Universal Time Coordinated (UTC). Examples of the NWPTA are presented in Annex III.

(1) Earthquake Information

a. Origin time (UTC)
b. Coordinates (latitude and longitude) of the epicenter
c. Location (name of geographical area)
d. Depth (only for the earthquake occurring at a depth of 100 km or more)
e. Magnitude ("(MJMA)" is attached in case the magnitude is Mjma.)

(2) Tsunamigenic potential

NWPTAC evaluates tsunamigenic potential of the earthquake occurring in the sea areas at a depth of less than 100 km, according to the following criteria adopted by PTWC:

a. M>7.8 Possibility of a destructive ocean-wide tsunami
b. 7.8≥M>7.5 Possibility of a destructive regional tsunami within 1000km of the epicenter
c. 7.5≥M>7.0 Possibility of a destructive local tsunami within 100km of the epicenter
d. 7.0≥M≥6.5 Very small possibility of a destructive local tsunami

(3) Estimated amplitude and arrival time of tsunami

Tsunami amplitude and arrival time are estimated for each of the forecast points and listed in groups of coast blocks. Each forecast point is identified by the name of a nearby major city and its latitude/longitude (in 0.1 degree) indicated along with the name. Forecast points used in NWPTA are chosen from PTWC's warning points designated at the ICG/PTWS. Also, a forecast point should be chosen near a calculation point. Definition of 'amplitude' is the largest difference between the crests of tsunami and the undisturbed sea level.

Estimated tsunami amplitude are indicated only for the forecast points at where tsunamis of 0.5 m or greater are expected to reach. Tsunami amplitude are classified in categories ranging from "less than 1m" to "greater than 10 m"; namely "0.5m"; "1m"; "2m"; "3m"; "4m"; "6m"; "8m"; and "≥10m". When tsunami amplitude of less than 0.5 m are forecasted at all the forecast points, "NO TSUNAMIS WITH AMPLITUDE OF 0.5 METER OR OVER ARE EXPECTED AT ANY OF THEM" is described in NWPTA.

(4) Observations of tsunami

When tsunami waves are actually recorded at tidal stations which are telemetrically linked to NWPTAC within the coverage of NWPTA (see Annex III), those observational data are provided as necessary, including the amplitude of the largest wave in 0.1 m unit (the amplitude of the largest wave is defined as the half of the vertical length from the trough to the crest of the wave).

9. Status of the Advisory

NWPTA, along with the bulletins from PTWC, should be regarded as an advisory for the recipient countries for their protective actions against the tsunami hazard. The accuracy of the estimation of amplitude and arrival time of tsunamis in NWPTA as well as the time required for the forecast operation depend on the availability of seismic data and the technologies of hypocenter determination and quantitative tsunami forecasting. It is highly advisable, therefore, that the recipient countries should make the best use of NWPTA with thorough understanding of the technological background of the Advisory as described below.

a. NWPTAC makes its utmost effort to disseminate NWPTA as quickly as possible. However, the people needs to be alerted in advance of the receipt of NWPTA in case of occurrence of a strong earthquake in the vicinity of their coasts, considering that tsunamis might be generated and reach the coasts in the shortest time.

b. NWPTAC determines the location and magnitude of earthquakes with the global seismic data received in real time from the Live Internet Seismic Server (LISS) operated by USGS. In case of malfunction of LISS or communication troubles with the Internet, NWPTAC will perform its operation using the data from the Matsushiro Seismic Array System of Matsushiro Seismological Observatory (Nagano, Japan) as well as the data from Large Aperture Array comprised of Japanese seismological observation networks. However, lack of information under these circumstances could lead to delayed issuance of NWPTA and affect the accuracy of estimation of tsunami amplitude and arrival time as well as the evaluation of tsunamigenic potential.

c. Estimated amplitude of tsunami are derived from the database of tsunami waves which have been calculated for each of the forecast points settled on the coastal regions, by using the quantitative tsunami forecast system of JMA. However, actual tsunami amplitude may change depending on the coastal topography. Further, we should note that the tsunami amplitude might also be critically varied by the sea bed topography which is hardly considered in the numerical simulation of tsunamis.

d. Tsunami arrival time are estimated taking into account the sea-bed topography and assuming that the epicenter is located in the midst of the segment concerned. Tsunamis do not necessarily travel outward evenly in all directions from their source. Further, travel time of tsunamis may be affected by the topographical features of the coasts and sea-bed which are not considered in the simulation. Therefore, even though the arrival time of a tsunami at each forecast point is given on a minute time scale, the time does not mean that they are estimated with the accuracy of such a time scale. Tsunamis may arrive at coasts earlier or later than the estimated arrival time in NWPTA.

e. NWPTA does not refer to the cancellation of its warnings in its subsequent issues. Because, NWPTAC is of the view that its warnings should be officially cancelled by the countries concerned on their own responsibility, on the ground that tsunamis varies depending on the coastal terrains.

f. In case of significant difference in the evaluation of severity of tsunami between the PTWC's bulletin and NWPTA, severer one should be adopted.

g. The operational system for NWPTA in JMA is duplicated in case of partial malfunction of

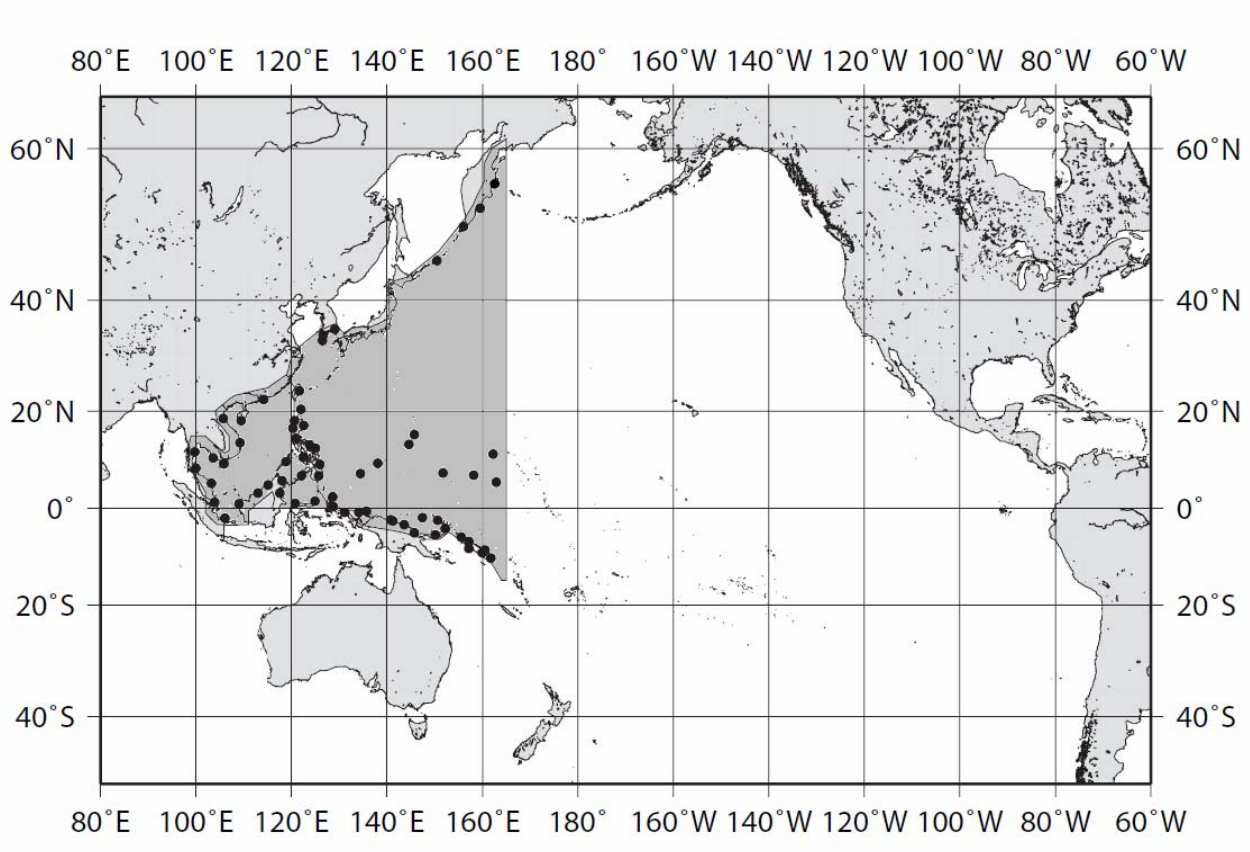
the system. However, possibility of a serious failure in the system cannot be totally excluded. In case NWPTA is not issued due to such an unforeseen emergency, the recipient countries/organizations of NWPTA should take appropriate actions according to the bulletins from PTWC.

10. Means of dissemination

Although NWPTA is to be provided basically via GTS, e-mail and facsimile are also considered depending on the circumstances of the recipient countries.

NWPTAC will conduct a communications test approximately on a quarterly basis to verify that communications links to the recipient organizations are functioning properly. An announcement will be made by NWPTAC in advance of the communications test. A sample message of the communications test is shown in Annex III (Example 7). After the test, please be sure to acknowledge the test message to:

Facsimile: +81-3-3215-2963 and/or **E-mail**: hokusei@eqvol.kishou.go.jp



Shaded area in the Pacific shows the coverage of NWPTA which is issued when an earthquake with magnitude 6.5 or more occurs (The NWPTA coverage will be extended to include marginal seas of the Pacific Ocean in the future). Dots indicate forecast points for the NWPTA.

Annex II

Forecast Points and Coast Blocks in the North Pacific Region

Coast Block	Name of Forecast Point	Latitude	Longitude
EAST COASTS OF KAMCHTKA PENINSULA	UST_KAMCHATSK	56.1N	162.6E
	PETROPAVLOVSK_K	53.2N	159.6E
KURIL ISLANDS	SEVERO_KURILSK	50.8N	156.1E
	URUP_IS.	46.1N	150.5E
SOUTH COASTS OF KOREAN PENINSULA	BUSAN	35.2N	129.1E
	NOHWA	34.2N	126.5E
	SEOGWIPO	33.2N	126.5E
EAST COASTS OF TAIWAN	HUALIEN	24.0N	121.6E
EAST COASTS OF PHILIPPINES	BASCO	20.4N	122.0E
	PALANAN	17.2N	122.6E
	LEGASPI	13.2N	123.8E
	LAOANG	12.6N	125.0E
	MADRID	09.2N	126.0E
	DAVAO	06.9N	125.7E
NORTH COASTS OF IRIAN JAYA	BEREBERE	02.5N	128.7E
	PATANI	00.4N	128.8E
	SORONG	00.8S	131.1E
	MANOKWARI	00.8S	134.2E
	WARSA	00.6S	135.8E
	JAYAPURA	02.4S	140.8E
NORTH COASTS OF PAPUA NEW GUINEA	VANIMO	02.6S	141.3E
	WEWAK	03.5S	143.7E
	MADANG	05.2S	145.8E
	MANUS_IS.	02.0S	147.5E
	RABAUL	04.2S	152.3E
	KAVIENG	02.5S	150.7E
	KIMBE	05.6S	150.2E
	KIETA	06.1S	155.6E
MARIANA ISLANDS	GUAM	13.4N	144.7E
	SAIPAN	15.3N	145.8E
PALAU	MALAKAL	07.3N	134.5E
MICRONESIA	YAP_IS.	09.5N	138.1E
	CHUUK_IS.	07.4N	151.8E
	POHNPEI_IS.	07.0N	158.2E
	KOSRAE_IS.	05.5N	163.0E
MARSHALL ISLANDS	ENIWETOK	11.4N	162.3E
NORTH COASTS OF SOLOMON ISLANDS	PANGGOE	06.9S	157.2E
	AUKI	08.8S	160.6E
	KIRAKIRA	10.4S	161.9E
SOLOMON SEA	MUNDA	08.4S	157.2E
	HONIARA	09.3S	160.0E

Forecast Points and Coast Blocks in the South China Sea, Sulu Sea and Celebes Sea

Coast Block	Name of Forecast Point	Latitude	Longitude
COASTS OF SOUTH CHINA SEA	HONG_KONG	22.3N	114.2E
	SANYA	18.2N	109.5E
COASTS OF GULF OF TONKIN	VINH	18.6N	105.7E
EAST COASTS OF INDO CHINA PENINSULA	QUI_NHON	13.7N	109.2E
	BAC_LIEU	09.3N	105.8E
GULF OF THAILAND	PRACHUAP_KHIRI KHAN	11.8N	099.8E
	SIHANOUKVILLE	10.6N	103.6E
	NAKHON_SI_THAMMARAT	08.4N	100.0E
NORTHWEST COASTS OF KALIMANTAN	MUARA	05.0N	115.1E
	BINTULU	03.2N	113.0E
WEST COASTS OF PHILIPPINES	LAOAG	18.2N	120.6E
	SAN_FERNANDO	16.6N	120.3E
	MANILA	14.6N	121.0E
SULU SEA	ILOILO	10.7N	122.5E
	PUERTO_PRINCESA	09.8N	118.8E
	SANDAKAN	05.9N	118.1E
EAST COASTS OF MALAY PENINSULA	KUARA_TERENGGANU	05.3N	103.2E
	SINGAPORE	01.3N	103.9E
CELEBES SEA	ZAMBOANGA	06.9N	122.1E
	TARAKAN	03.3N	117.6E
	MANADO	01.6N	124.9E
	TOLITOLI	01.1N	120.8E
NATUNA SEA	SINGKAWANG	01.0N	109.0E
	PANGKALPINANG	02.1S	106.1E

Example of NWPTA

Example (1) - When tsunami with amplitude (middle to crest) of 0.5m or over is expected

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WEPA40 RJTD 240904

TSUNAMI BULLETIN NUMBER 001
   ISSUED BY NWPTAC(JMA)
   ISSUED AT 0859Z 24 MAR 2005
PART 01 OF 01 PARTS

HYPOCENTRAL PARAMETERS
ORIGIN TIME:0858Z 24 MAR 2005
PRELIMINARY EPICENTER:LAT 3.0SOUTH LON148.0EAST
 EASTERN CAROLINE ISLANDS, MICRONESIA
 PACIFIC BASIN
MAG:8.2

EVALUATION
 THERE IS A POSSIBILITY OF A DESTRUCTIVE OCEAN-WIDE TSUNAMI

THIS BULLETIN IS FOR
EAST COASTS OF PHILIPPINES
NORTH COASTS OF IRIAN JAYA
NORTH COASTS OF PAPUA NEW GUINEA
CELEBES SEA

ESTIMATED TSUNAMI ARRIVAL TIME AND ESTIMATED TSUNAMI WAVE AMPLITUDE
EAST COASTS OF PHILIPPINES
 LOCATION              COORDINATES  ARRIVAL TIME  AMPL
 LEGASPI               13.2N 123.8E 1257Z 24 MAR  0.5M
 NORTH COASTS OF IRIAN JAYA
 LOCATION              COORDINATES  ARRIVAL TIME  AMPL
 MANOKWARI             00.8S 134.2E 1116Z 24 MAR  1M
 WARSA                 00.6S 135.8E 1046Z 24 MAR  1M
 JAYAPURA              02.4S 140.8E 1002Z 24 MAR  3M
NORTH COASTS OF PAPUA NEW GUINEA
 LOCATION              COORDINATES  ARRIVAL TIME  AMPL
 VANIMO                02.6S 141.3E 0953Z 24 MAR  2M
 WEWAK                 03.5S 143.7E 0931Z 24 MAR  4M
 MADANG                05.2S 145.8E 0935Z 24 MAR  8M
 MANUS_IS.             02.0S 147.5E 0858Z 24 MAR  4M
 RABAUL                04.2S 152.3E 1000Z 24 MAR  2M
CELEBES SEA
LOCATION              COORDINATES  ARRIVAL TIME   AMPL
 MANADO                01.6N 124.9E 1304Z 24 MAR  0.5M

AMPL - AMPLITUDE IN METERS FROM MIDDLE TO CREST

HOWEVER AT SOME COASTS, PARTICULARLY THOSE NEAR THE EPICENTER, HIGHER
TSUNAMIS MAY ARRIVE EARLIER THAN OUR ESTIMATION AT THE NEARBY
FORECAST POINTS
AUTHORITIES SHOULD BE AWARE OF THIS POSSIBILITY

FURTHERMORE THE EVALUATION OF TSUNAMIGENIC POTENTIAL AND ESTIMATED
ARRIVAL TIME OF TSUNAMIS MAY BE DIFFERENT FROM THOSE OF PTWC
DUE TO DIFFERENCES IN THE ESTIMATED EARTHQUAKE PARAMETERS
AUTHORITIES SHOULD USE THE EARLIEST ARRIVAL TIMES FOR
GREATEST SAFETY

THIS WILL BE THE FINAL INFORMATION UNLESS THERE ARE CHANGES ABOUT THE
POTENTIAL OF TSUNAMI GENERATION BY RE-EVALUATION OF THE EARTHQUAKE OR
THERE ARE REPORTS ON TSUNAMI OBSERVATIONS
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Example (2) - When tsunami with amplitude (middle to crest) of 0.5m or over is expected

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WEPA40 RJTD 01020

TSUNAMI BULLETIN NUMBER 001
   ISSUED BY NWPTAC(JMA)
   ISSUED AT 0020Z 01 MAR 2006
PART 01 OF 01 PARTS

HYPOCENTRAL PARAMETERS
ORIGIN TIME:0000Z 01 MAR 2006
PRELIMINARY EPICENTER:LAT 15.0NORTH LON120.0EAST
 PHILIPPINE ISLANDS REGION
 SOUTH CHINA SEA
MAG:8.5

EVALUATION
 THERE IS A POSSIBILITY OF A DESTRUCTIVE OCEAN-WIDE TSUNAMI

THIS BULLETIN IS FOR
EAST COASTS OF TAIWAN
COASTS OF SOUTH CHINA SEA
EAST COASTS OF PHILIPPINES
WEST COASTS OF PHILIPPINES
NORTHWEST COASTS OF KALIMANTAN

ESTIMATED TSUNAMI ARRIVAL TIME AND ESTIMATED TSUNAMI WAVE AMPL
EAST COASTS OF TAIWAN
 LOCATION             COORDINATES  ARRIVAL TIME  AMPL
 HUALIEN              24.0N 121.6E 0140Z 01 MAR  1M
COASTS OF SOUTH CHINA SEA
LOCATION              COORDINATES  ARRIVAL TIME  AMPL
 HONG_KONG            22.3N 114.2E 0250Z 01 MAR  2M
EAST COASTS OF PHILIPPINES
 LOCATION             COORDINATES  ARRIVAL TIME  AMPL
 BASCO                20.4N 122.0E 0108Z 01 MAR  1M
WEST COASTS OF PHILIPPINES
 LOCATION             COORDINATES  ARRIVAL TIME  AMPL
 LAOAG                18.2N 120.6E 0042Z 01 MAR  4M
 SAN_FERNANDO         16.6N 120.3E 0030Z 01 MAR  4M
 MANILA               14.6N 121.0E 0012Z 01 MAR  OVER 10M
NORTHWEST COASTS OF KALIMANTAN
 LOCATION             COORDINATES  ARRIVAL TIME  AMPL
 MUARA                05.0N 115.1E 0204Z 01 MAR  3M
 BINTULU              03.2N 113.0E 0406Z 01 MAR  1M

AMPL -  AMPLITUDE IN METERS FROM MIDDLE TO CREST

HOWEVER AT SOME COASTS, PARTICULARLY THOSE NEAR THE EPICENTER, HIGHER
TSUNAMIS MAY ARRIVE EARLIER THAN OUR ESTIMATION AT THE NEARBY
FORECAST POINTS
AUTHORITIES SHOULD BE AWARE OF THIS POSSIBILITY

FURTHERMORE THE EVALUATION OF TSUNAMIGENIC POTENTIAL AND ESTIMATED
ARRIVAL TIME OF TSUNAMIS MAY BE DIFFERENT FROM THOSE OF PTWC
DUE TO DIFFERENCES IN THE ESTIMATED EARTHQUAKE PARAMETERS
AUTHORITIES SHOULD USE THE EARLIEST ARRIVAL TIMES FOR
GREATEST SAFETY

THIS WILL BE THE FINAL INFORMATION UNLESS THERE ARE CHANGES ABOUT THE
POTENTIAL OF TSUNAMI GENERATION BY RE-EVALUATION OF THE EARTHQUAKE OR
THERE ARE REPORTS ON TSUNAMI OBSERVATIONS
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Example (3) - When no tsunami with a height of 0.5 meter or over is expected at any forecast points

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WEPA40 RJTD 100743

TSUNAMI BULLETIN NUMBER 001
   ISSUED BY NWPTAC(JMA)
   ISSUED AT 0739Z 10 JAN 2005
PART 01 OF 01 PARTS

HYPOCENTRAL PARAMETERS
ORIGIN TIME: 0724Z 10 JAN 2005
PRELIMINARY EPICENTER: LAT7.0NORTH LON138.0EAST
 WESTERN CAROLINE ISLANDS,MICRONESIA
 CAROLINE ISLANDS TO GUAM
MAG:6.6

EVALUATION
 THERE IS A VERY SMALL POSSIBILITY OF A DESTRUCTIVE LOCAL TSUNAMI

 ESTIMATION AT THE FORECAST POINTS - NO TSUNAMIS WITH AMPLITUDE
 OF 0.5 METER OR OVER ARE EXPECTED AT ANY OF THEM

HOWEVER AT SOME COASTS, PARTICULARLY THOSE NEAR THE EPICENTER, HIGHER
TSUNAMIS MAY ARRIVE THAN OUR ESTIMATION
AUTHORITIES SHOULD BE AWARE OF THIS POSSIBILITY

 THIS WILL BE THE FINAL INFORMATION UNLESS THERE ARE CHANGES ABOUT THE
 POTENTIAL OF TSUNAMI GENERATION BY RE-EVALUATION OF THE EARTHQUAKE OR
 THERE ARE REPORTS ON TSUNAMI OBSERVATIONS
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Example (4) - When the earthquake occurs in inland areas

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WEPA40 RJTD 100743

TSUNAMI BULLETIN NUMBER 001
   ISSUED BY NWPTAC(JMA)
   ISSUED AT 0739Z 10 JAN 2005
PART 01 OF 01 PARTS

HYPOCENTRAL PARAMETERS
ORIGIN TIME: 0724Z 10 JAN 2005
PRELIMINARY EPICENTER: LAT7.0NORTH LON138.0EAST
 WESTERN CAROLINE ISLANDS,MICRONESIA
 CAROLINE ISLANDS TO GUAM
MAG:6.6

EVALUATION
 THERE IS NO POSSIBILITY OF A TSUNAMI

 THIS WILL BE THE FINAL INFORMATION UNLESS THERE ARE CHANGES ABOUT THE
 POTENTIAL OF TSUNAMI GENERATION BY RE-EVALUATION OF THE EARTHQUAKE OR
 THERE ARE REPORTS ON TSUNAMI OBSERVATIONS
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Example (5) - When depth of the earthquake exceeds 100km

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WEPA40 RJTD 100743

TSUNAMI BULLETIN NUMBER 001
   ISSUED BY NWPTAC(JMA)
   ISSUED AT 0739Z 10 JAN 2005
PART 01 OF 01 PARTS

HYPOCENTRAL PARAMETERS
ORIGIN TIME: 0724Z 10 JAN 2005
PRELIMINARY EPICENTER: LAT7.0NORTH LON138.0EAST
 WESTERN CAROLINE ISLANDS,MICRONESIA
 CAROLINE ISLANDS TO GUAM
FOCAL DEPTH:120KM MAG:6.6

EVALUATION
 THERE IS NO POSSIBILITY OF A TSUNAMI

 THIS WILL BE THE FINAL INFORMATION UNLESS THERE ARE CHANGES ABOUT THE
 POTENTIAL OF TSUNAMI GENERATION BY RE-EVALUATION OF THE EARTHQUAKE OR
 THERE ARE REPORTS ON TSUNAMI OBSERVATIONS
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Example (6) - Amendment of the Advisory

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WEPA40 RJTD 240934

TSUNAMI BULLETIN NUMBER 002
   ISSUED BY NWPTAC(JMA)
   ISSUED AT 0929Z 24 MAR 2005
PART 01 OF 01 PARTS

HYPOCENTRAL PARAMETERS(REVISION)
ORIGIN TIME:0858Z 24 MAR 2005
PRELIMINARY EPICENTER:LAT 3.5SOUTH LON148.2EAST
 EASTERN CAROLINE ISLANDS, MICRONESIA
 PACIFIC BASIN
MAG:8.3

EVALUATION
 THERE IS A POSSIBILITY OF A DESTRUCTIVE OCEAN-WIDE TSUNAMI

THIS BULLETIN IS FOR
EAST COASTS OF PHILIPPINES(REVISION)
NORTH COASTS OF IRIAN JAYA(REVISION)
NORTH COASTS OF PAPUA NEW GUINEA(REVISION)
CELEBES SEA

ESTIMATED TSUNAMI ARRIVAL TIME AND ESTIMATED TSUNAMI WAVE AMPL
EAST COASTS OF PHILIPPINES
 LOCATION              COORDINATES  ARRIVAL TIME  AMPL
 LEGASPI               13.2N 123.8E (ALREADY ARRIVED)
 DAVAO                 06.9N 125.7E 1237Z 24 MAR  1M(ADDITION)
 NORTH COASTS OF IRIAN JAYA
 LOCATION              COORDINATES  ARRIVAL TIME  AMPL
 MANOKWARI             00.8S 134.2E 1116Z 24 MAR  0.5M(REVISION)
 WARSA                 00.6S 135.8E 1046Z 24 MAR  1M
 JAYAPURA              02.4S 140.8E 1002Z 24 MAR  3M
NORTH COASTS OF PAPUA NEW GUINEA
 LOCATION              COORDINATES  ARRIVAL TIME  AMPL
 VANIMO                02.6S 141.3E 0953Z 24 MAR  2M
 WEWAK                 03.5S 143.7E 0931Z 24 MAR  4M
 MADANG                05.2S 145.8E 0935Z 24 MAR  8M
 MANUS_IS.             02.0S 147.5E 0858Z 24 MAR  4M
 RABAUL                04.2S 152.3E (CANCELLATION)
CELEBES SEA
LOCATION              COORDINATES  ARRIVAL TIME  AMPL
 MANADO                01.6N 124.9E 1304Z 24 MAR  0.5M

AMPL - AMPLITUDE IN METERS FROM MIDDLE TO CREST

HOWEVER AT SOME COASTS, PARTICULARLY THOSE NEAR THE EPICENTER, HIGHER
TSUNAMIS MAY ARRIVE EARLIER THAN OUR ESTIMATION AT THE NEARBY
FORECAST POINTS
AUTHORITIES SHOULD BE AWARE OF THIS POSSIBILITY

FURTHERMORE THE EVALUATION OF TSUNAMIGENIC POTENTIAL AND ESTIMATED
ARRIVAL TIME OF TSUNAMIS MAY BE DIFFERENT FROM THOSE OF PTWC
DUE TO DIFFERENCES IN THE ESTIMATED EARTHQUAKE PARAMETERS
AUTHORITIES SHOULD USE THE EARLIEST ARRIVAL TIMES FOR
GREATEST SAFETY

MEASUREMENTS OR REPORTS ON TSUNAMI
 LOCATION                      COORDINATES  ARRIVAL TIME  AMPL
 LEGASPI                       13.2N 123.8E
                        MAXIMAM TSUNAMI WAVE 0810Z 10 JAN   0.5M
```

MAXIMUN TSUNAMI WAVE -- HALF OF AMPLITUDE FROM THE THROUGH
TO THE CREST

THIS WILL BE THE FINAL INFORMATION UNLESS THERE ARE CHANGES ABOUT THE
POTENTIAL OF TSUNAMI GENERATION BY RE-EVALUATION OF THE EARTHQUAKE OR
THERE ARE REPORTS ON TSUNAMI OBSERVATIONS

Example (7) - Communications test message

```
WEPA40 RJTD 240934

COMMUNICATION TEST
      ISSUED BY NWPTAC(JMA)
      ISSUED AT 0929Z 24 MAR 2005

       THIS IS A TEST INFORMATION

       TEST MESSAGE IS FORWAREDED TO EACH RECIPIENT ORGANIZATION
       IN ORDER TO EXAMINE THE COMMUNICATION
```

Acknowledge form for reception of the NWPTA test message

Acknowledge Form for reception of the NWPTA test message

1. Name of country

2. Recipient organization

3. Responsible office

4. Officer in charge

   Name:

5. Reception status of the NWPTA test message

(1) GTS
- ・Received ( ) time of receipt (UTC): h m
- ・Failed to receive ( )
- ・Not registered ( )

(2) E-mail
- ・Received ( ) time of receipt (UTC): h m
- ・Failed to receive ( )
- ・Not registered ( )

(3) Facsimile
- ・Received ( ) time of receipt (UTC): h m
- ・Failed to receive ( )
- ・Not registered ( )

Annex Ⅳ

Excerpts from the summary reports of the relevant sessions of ICG/ITSU

Summary Report of the ICG/ITSU-XIV Session (1993)

90 The Representative of Korea proposed the establishment of the Far East Tsunami Warning Center. One of the possible locations for the Center could be at the Japan Meteorological Agency. The Representative of Japan informed the Group that much discussion and consensus among the Member States concerned would be necessary to establish the Center and obtain additional tide and seismic data from and improve communications with the concerned countries in the are of Japan, Yellow and East China Seas for the tsunami warning service.

91 After a discussion in which many Member States participated, **the Group agreed** that it would be desirable for the Member States bordering on these Seas to discuss the possibility of establishing a Far East Tsunami Warning Center. Japan was requested to advise the Secretary of the results of any discussions, so that if appropriate, the issue can be included as Agenda Item at ITSU-XV.

Summary Report of the ICG/ITSU-XV Session (1995)

96 **The Group received** the comments of the Delegate of Japan relative to the proposal made by the Delegate of the Republic of Korea at ITSU-XIV, regarding the establishment of a Far East Tsunami Warning Centre and its possible location at the Japan Meteorological Agency. There were a number of concerns open for discussion: the area of responsibility of the Centre, communications for warnings and the need for additional seismic and tidal data which would be required to support the operations of the Centre.

Summary Report of the ICG/ITSU-XVI Session (1997)

77 The Delegate of Japan reported on the progress made in relation to the establishment of the Far East Tsunami Centre in JMA. In the case of a regional centre he expressed concern on communication problems, especially on transmission of seismic signals to determine the hypocenters. Trying to solve this problem, JMA is considering to arrange a questionnaire survey within the countries of the region in order to identify problems, needs and requirements for a regional centre. The Delegate of USA expressed appreciation for the Japanese initiative due to the fact that PTWC cannot be operationally effective for this region.

78 The Delegate of the Republic of Korea thanked Japan for the initiative underway, and expressed his willingness to participate and co-operate in it.

79 **The Group recognized** the effort made by Japan, expressed its appreciation for it and encouraged it to continue the progress of this activity.

Summary Report of the ICG/ITSU-XVII Session (1999)

110 The Delegate of Japan recalled the discussions held at ITSU-XVI regarding the establishment of the Far East Centre. In response to ITSU-XVI recommendations, Japan Meteorological Agency conducted a survey of 6 Member States of the Western Pacific on the interest and possibility to provide seismic and tidal observational data to JMA for facilitating early tsunami warning.

111 The survey showed the interest of the Member States and their readiness to collaborate with Japan on this important initiative. The Member States requested Japan to include in tsunami forecasts information on the location and the magnitude of the earthquake, the estimated times of the first tsunami arrival and the forecast of estimated tsunami heights.

112 JMA began to operate its new tsunami forecasting system in April 1999. This system has the capability to make forecasts of tsunamis caused by the earthquakes for surrounding coastal areas. In 2000, it will be able to issue a tsunami forecast and after minor modifications of the system transmit it automatically to the Member States concerned.

113 **The Group expressed deep appreciation** to Japan for its efforts in providing for the surrounding coastal areas, the estimated tsunami height and times of the first wave arrival caused by the earthquake in the sea between the Asian continent, Korean peninsula and Japan. The tsunami forecast would be transmitted through Global Telecommunications System (GTS) to the Member States concerned, in accordance with the ITSU Communication Plan. **The Group advised** that the possibility of using the Internet should also be considered.

114 **The Group recommended** that information on tsunamis provided by Japan should be transmitted to responsible national authorities directly.

115 **The Group endorsed** Japan's proposal and **adopted,** in principle, the procedure to issue the tsunami forecast as given in Annex IX. **The Group urged** the Member States concerned to ensure that a transmitted tsunami forecast be relayed to Member States securely and rapidly, in accordance with the ITSU Communication Plan. **The Group requested** the IOC Executive Secretary to inform the Governments of China and the Democratic People's Republic of Korea of the developments and invite them to join the system.

116 **The Group further urged** Japan to continue considering the possibility of expanding the centre's functions to the coastal areas in and around the Yellow Sea, the East China Sea and the Western North Pacific. **The Group supported** the need for a regional workshop with the participation of all countries concerned to discuss actions to be taken for the smooth running of the system.

Summary Report of the ICG/ITSU-XVIII Session (2001)

120 The Delegate of Japan reported that on 15 January 2001, the Japan Meteorological Agency (JMA) partially began operations of the Regional Tsunami Warning Centre (Doc. IOC/ITSU-XVIII/7 Japan) to provide the tsunami forecasts in the sea between the Asian continent, Korean Peninsula and Japan to overseas authorities concerned. The JMA prepared and distributed a '*Handbook for Tsunami Forecast in the Japan Sea*' with the explanation of the procedure for the effective utilization of forecasts.

121 The next stage will be the expansion of the target area to the Northwestern Pacific. Its boundaries will be determined later. The Delegate of Japan explained that real-time seismic waveform data in the target area are indispensable for determining the hypocenters accurately and quickly (Doc. IOC/ITSU-XVIII/21). The JMA is proceeding with a study on optimal distribution of seismographic stations, considering the tsunami travel time to each coast.

122 The Delegate of Japan explained that JMA was planning to include tsunami heights and arrival times in the content of the forecast like those for the sea between the Asian continent, Korean Peninsula and Japan. By executing numerical simulation for various cases, the characteristics of tsunamis on each coast will be obtained and used to set up the forecast areas. For that purpose, the JMA is going to carry out many simulations and analyse the results.

123 **The Group expressed** deep appreciation to Japan and **invited** the country to continue its efforts. Member States were encouraged to co-operate with Japan in the acquisition of real-time seismic

waveform data in the target areas.

124 The Delegate of Japan explained that at this stage there is no need for a regional workshop to discuss actions to be taken for the smooth running of the system. The Group decided to come back to this issue when the target area of the Far East TWC is expanded and experience gained.

Summary Report of the ICG/ITSU-XIX Session (2003)

185 This Agenda Item was introduced by Mr. Noritake Nishide (Japan). He recalled the Earthquake that occurred on 25 September 2003 in Hokkaido, Japan. He then proceeded to provide information on the tsunami warning centre based at JMA and its activities. In Document IOC/ITSU-XIX/13, Japan explained the present status of technical improvement of determining earthquake location using LISS (Live Internet Seismic Server) data. Japan also presented the quick determination method for Mw using P wave according to the same document.

186 Mr. Nishide explained Japan's quantitative tsunami forecast method for local and distant tsunami as described in the National Report of Japan, and provided information on Japan's tide gauge network for tsunami observation in detail as information for Sea Level Enhancement discussed under Agenda item 3.6.

187 Responding to a question from Australia, Japan explained about the reliability of LISS for the operational tsunami warning system as follows: there are almost no problems because data of about 20 stations can usually be used for hypocenter determination of large earthquakes even if some stations may drop, but, it is not appropriate for the operational tsunami warning system to rely only on LISS because LISS uses the Internet.

Summary Report of the IOC/EC-XXXVII Session (2004)

Resolution EC-XXXVII.4

THE INTERNATIONAL CO-ORDINATION GROUP FOR THE TSUNAMI WARNING SYSTEM IN THE PACIFIC

The Executive Council,

Recalling that the IOC Tsunami Programme is a high priority programme of the Commission,

Appreciating:

(i) the support of Chile, France, New Zealand, Republic of Korea and USA to the IOC Tsunami Programme in 2002–2003 through Trust Fund and in-kind contributions,

(ii) the support of the USA in hosting and co-funding the operation of the International Tsunami Information Centre (ITIC) in Hawaii, and of Chile for the post of ITIC Associate Director,

(iii) the establishment of the North-western Pacific Tsunami Information Centre by Japan in 2004*,

Considering the Summary Report, Resolution and Recommendations of the 19th Session of the International Co-ordination Group for the Tsunami Warning System in the Pacific (ITSU-XIX), held in Wellington, New Zealand, from 29 September to 2 October 2003, and the progress achieved by the ICG in the implementation of the ITSU Programme at the national and international levels,

Welcoming the studies in support of the development of sub-regional tsunami warning systems for the Central American Pacific Coast and for the South-west Pacific and Indian Ocean, and the possible development of a comprehensive tsunami hazard-reduction programme,

Endorses the Summary Report and Resolution **and adopts** the Recommendations of ITSU-XIX;

*) *Japanese fiscal year (April 2004 ～ March 2005)*

Summary Report of the ICG/ITSU-XIX Session (2005)

254 The Delegate of Japan introduced this Agenda item. Japan established the North West Pacific Tsunami Advisory Centre (NWPTAC) in March 2005. The Delegate noted that the etablishment of a regional tsunami warning centre has been discussed by the ITSU since 1978. Regarding the Northwest Pacific region, the Republic of Korea proposed at the Fourteenth Session of the ICG/ITSU that Japan should take the responsibility of operating a regional centre for the area. In response to this request, JMA started to provide tsunami information to relevant countries in 2001, when a tsunami was expected due to the earthquake that occurred off the west coast of Hokkaido and Honshu, Japan. The JMA had made efforts for expansion of the area, so since March 2005, the NWPTAC started to provide tsunami information to countries around the Northwest Pacific Ocean Region. The NWPTAC collects seismic data from Japanese and globalnetworks, determines hypocenter and magnitude, and exchanges information with PTWC. The NWPTAC estimates arrival times and expected tsunami heights from a pre-simulated tsunami database based on the location and magnitude of the earthquake and transmitted the advisory to the relevant countries around the Northwest Pacific region. When an earthquake greater than magnitude 6.5 occurs in this region, the NWPTAC provides tsunami information to relevant countries in 20 to 30 minutes by means of GTS, e-mail and facsimile. The advisory contains source parameters, evaluation of tsunamigenic potential and estimated tsunami arrival times and estimated tsunami heights for a set of forecast points. If a tsunami would actually be observed at tidal stations in this region, the NWPTAC would provide tsunami observations as subsequent information. The first information on 20 March 2005 is the information to the Republic of Korea and other relevant countries of the earthquake off the west of the Fukuoka prefecture.

255 Several Member States requested Japan to expand coverage of the NWPTAC to the South China Sea and the Sea of Okhotsk. Japan explained that the coverage area of the NWPTAC will be expanded on a step-by-step basis. The expansion to the South China Sea is in preparation and will be able to be included in the coverage area of the NWPTAC by March 2006. However, it was pointed out that there are currently insufficient sea-level gauges in that area to provide quality tsunami advisory information.

256 **The Group expressed** its high appreciation to Japan for the establishment of the North West Pacific Tsunami Advisory Centre as an important contribution to the Pacific Tsunami Warning System.

257 **The Group expressed** its concern about the insufficient network density of sea-level

stations in the South China Sea, in the Sea of Okhotsk and off the Pacific coast of Russia and decided to study this matter in more detail for discussion at the next Session of the ICG/ITSU. In this regard, **the Group requested** the GE-GLOSS to provide information on the status of sealevel stations in this region.

258 The ITIC Director further recommended that the ITSU Chair and IOC Technical Secretary welcome,through a letter to the ASEAN Secretariat, the close cooperation between ITSU and the Southeast Asian countries represented in ASEAN. Dr Kong noted the valuable beneficial contributions made by Malaysia, Philippines, Singapore, and Thailand during ITSU and is looking forward to working with them and the other nations in the region to build an effective tsunami warning and mitigation system. Cooperation and collaboration with ASEAN will facilitate the improvements and enhancements.

259 **The Group requested** both the PTWC and the JMA to provide an interim tsunami advisory service for the South China Sea. **The Group further requested** the PTWC and the JMA to develop a communication plan for the South China Sea that describes messages, criteria, etc. for distribution to the concerned countries.

260 The United States of America informed the Group that the PTWC would make the interim tsunami information bulletins available to the countries in the South China Sea, beginning 1 December 2005, continuing through March 2006, and requested Member States, desiring to receive such interim support, to provide both the JMA and the PTWC national contact information by 1 November 2005.