

## **EXERCISE PACIFIC WAVE 16**

### **A Pacific-wide Tsunami Warning and Enhanced Products Exercise**

**1-5 February 2016**

#### **Exercise Manual**

**Volume 1**

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**UNESCO**

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## 1. BACKGROUND

The Intergovernmental Oceanographic Commission (IOC) of UNESCO established the International Coordination Group for the Tsunami Warning System in the Pacific (ICG/ITSU) in 1965 in response to the 1960 earthquake off the coast of Chile that generated a tsunami killing 2000 people locally, and hundreds in the far field in Hawaii, Japan, and the Philippines. The main focus of the Group is to facilitate the issuance of timely international alerts, and advocate for comprehensive national programmes in hazard assessment, warning guidance, and preparedness (ITSU Master Plan, 2004; PTWS Medium-Term Strategy 2014-2021, IOC TS 108; PTWS Implementation Plan 2013, vers 4). In 2005, ITSU was re-established as the Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System (ICG/PTWS).

The US Pacific Tsunami Warning Center (PTWC), established in 1965 with the start of the Tsunami Warning System in the Pacific, serves as the Tsunami Service Provider (TSP) for the Pacific. In response to Member State requests for additional regional information, Japan began operation of its Northwest Pacific Tsunami Advisory Center (NWPTAC) in March 2005, and in April 2006 expanded on an interim basis to the South China Sea. The NWPTAC, which serves as the TSP for the northwest Pacific, provides timely alerts for earthquakes occurring in the northwest Pacific. As of October 2015, the NWPTAC has issued the advisories for 190 events in total since it started the service in March 2005.

A Pacific-wide tsunami exercise is an effective tool for evaluating the readiness of PTWS countries and to identify changes that can improve its effectiveness. The international tsunami exercises were first conceived and conducted in 2006 by the ICG/PTWS under the leadership of the PTWS Exercises Task Teams with strong contributions from the ITIC, PTWC, and JMA. Altogether there have been five IOC-coordinated international exercises, Exercise Pacific Wave 2006, 2008, 2011, 2013, and 2015. The exercises, using a multitude of Pacific scenarios and accompanied by tsunami message products from the Pacific Tsunami Warning Center, Japan Northwest Pacific Tsunami Advisory Center, and the US National Tsunami Warning Center (formerly West Coast and Alaska Tsunami Warning Center), have been used to evaluate the effectiveness of the System and measure the readiness of countries to respond, as national tsunami warning centers and emergency response agencies and the public, to distant and local tsunamis. Exercise Pacific Wave 2011, 2013, and 2015 were additionally used to introduce and obtain feedback, test, and validate the PTWC new enhanced forecast products which became official on 1 October 2014.

At the 26th session the ICG/PTWS held in Honolulu, United States of America, from 22 to 24 April 2015 (ICG/PTWS-XXVI), it was agreed that the Northwest Pacific Tsunami Advisory Center (NWPTAC) should proceed with its development of enhanced products for the North West Pacific, targeting 2018 for its complete transition. At the session, it was also approved to conduct Exercise Pacific Wave 2016 (PacWave16) during the first quarter of 2016 as a regional exercise involving the sixteen countries that receive products of NWPTAC. The exercise intends to support the development of improved tsunami procedures and the NWPTAC Enhanced Products.

## 2. EXERCISE AIM

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

## 3. EXERCISE OBJECTIVE

The overall objectives for PacWave16 are to:

- Objective 1. Evaluate the format and content of experimental NWPTAC Enhanced Products.
- Objective 2. Determine whether countries are prepared to officially receive and utilize the NWPTAC Enhanced Products.

Each country may expand and/or customize its own objectives for the exercise.

#### 4. NEW ENHANCED PRODUCTS

The Area of Coverage map and recipient countries of NWPTA is shown in Figure 1. Regarding forecast points, updated ones which reflect the results of coordination among recipient countries up to October 2015 will be used. (ANNEX I)

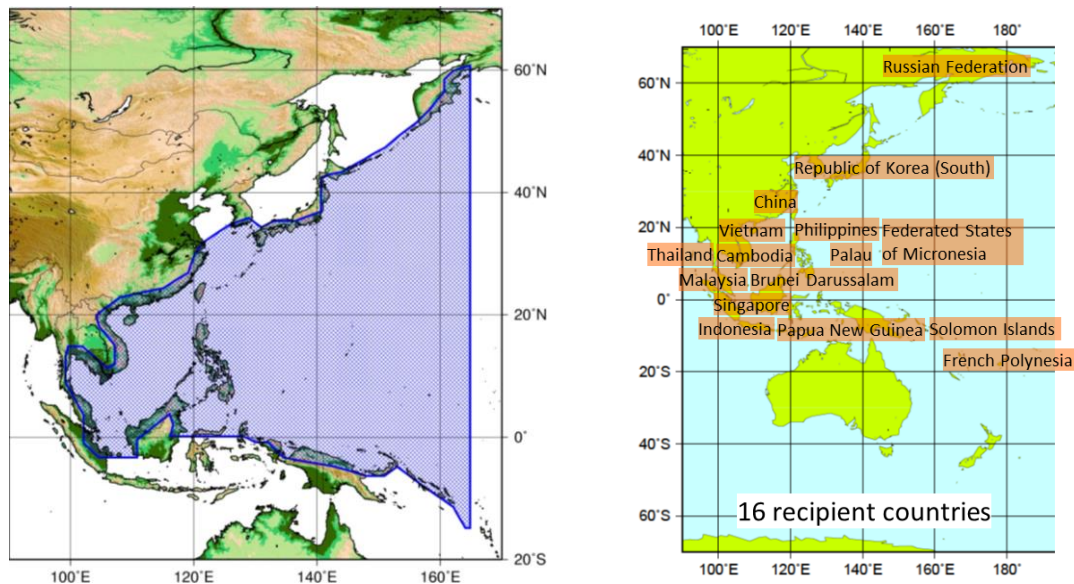


Figure 1. NWPTA will be issued to 16 recipient countries when the NWPTAC detects occurrence of an earthquake of magnitude 6.5 or greater in the blue-shaded area.

The NWPTAC new enhanced products consist of an initial text message prepared from a pre-established tsunami simulation database and followed by text messages and accompanied by graphical products based on real-time simulation techniques. The graphical products will be disseminated exclusively for national authorities of the recipient countries. There will be no change to the format of the text messages from the current format. Full changeover to the new enhanced products is planned for 2018, after approximately one year's parallel issuance of existing and enhanced products.

Details of the proposed enhancement of NWPTAC products are as follows:

##### a. Text products

- Forecast method
  - Tsunami forecast database (the first message, without graphics)
  - Real-time simulation (the second and subsequent messages, with graphical products)
- Contents (basically no change from the current format)
  - Hypocentral parameters (origin time, location, magnitude)
  - Tsunamigenic potential
  - Coastal blocks
  - Forecast amplitude and arrival time

- Observed amplitude and arrival time
- Dissemination of products
  - GTS, FAX and E-mail

b. Graphical Products (Maps)

- Forecast method
  - Real-time simulation
- Contents
  - Deep-Ocean tsunami amplitude forecast map
  - Tsunami travel time map
  - Coastal tsunami amplitude forecast map
- Dissemination of products
  - E-mail

## 5. EXERCISE DATES

PacWave16 will be held within the period of 1-5 February 2016. PacWave16 is recommended to be a Tabletop Exercise and will not be a live exercise. All products will be available beforehand on the PacWave16 web site (<http://www.pacwave.info>). Participating countries may choose to run their exercise at any time between 1 to 5 February 2016, allowing flexibility to avoid conflict with other important national events.

## 6. EXERCISE SCENARIO

Six scenarios are available to allow all participating countries to select and exercise a distant/regional/local source tsunami event. Countries are recommended to choose one scenario to exercise. The exercise scenarios include major tsunamis generated by great earthquakes in the following areas (see Annex I for scenario details):

- Kuril-Kamchatka Trench
- Japan Trench
- Nansei-Shoto Trench
- Manila Trench
- Philippine Trench
- New Britain-San Cristobal trench

The exercise will require Member State evaluation of experimental NWPTAC enhanced products, issuing of appropriate country specific alerts by National Tsunami Warning Centres, decision-making, including steps taken just prior to public notification. Member States may conduct the exercise through to the community level if they wish (however, this is not a requirement of the exercise).

If applicable, each country will be responsible for designing its own national, provincial and/or local level exercise(s) in line with the international Exercise Pacific Wave exercise framework.

## **7. TYPE OF EXERCISE**

It is recommended that PacWave16 be carried out in a tabletop format (also referred to as a 'discussion exercise', or 'DISCEX').

Participants are presented with a situation or problem that they are required to discuss and for which they have to formulate the appropriate response or solution. Normally, the exercise requires no simulation other than the scenario and/or prewritten exercise injects. An exercise controller or moderator introduces a simulated scenario to participants and, as the exercise advances (in time), exercise problems and activities (injects) are further introduced. This type of exercise is used to practice problem solving and coordination of services with or without time pressures. There is no deployment or actual use of equipment or resources.

An example of a Tabletop Exercise may involve only key stakeholders, such as the National Tsunami Warning Center and the National Disaster Management Office, discussing their response to a tsunami threat in a particular area, where the only injects are tsunami messages from the Pacific Tsunami Service Providers, such as the PTWC in Hawaii and the regional NWPTAC in Japan, which describe the nature of the threat.

## **8. FURTHER GUIDANCE – HOW TO PLAN, CONDUCT AND EVALUATE TSUNAMI EXERCISES GUIDELINE**

The IOC Manual and Guides 58, "How to Plan, Conduct and Evaluate IOC Tsunami Wave Exercises" (IOC/2011/MG/58, 2013, English, Spanish) has been developed to aid countries in planning, conducting, and evaluating a tsunami exercise at a national and/or provincial level. The guide is available at the PacWave16 website (<http://www.pacwave.info>).

## **9. ASSUMPTIONS**

Each country will be responsible for determining what assumptions should be considered as part of its national, provincial, and/or local tsunami exercise.

## **10. EXERCISE PARTICIPATION**

All Pacific countries that receive products of the NWPTAC are encouraged to participate in the exercise. However, it is up to each country to decide what level of governmental participation they will undertake. At a minimum, to meet the objectives of PacWave16, it is recommended that the National Tsunami Warning Center and the National Disaster Management Office, participate.

Each country's lead agency and its PacWave16 National Contact will be responsible for:

- **During the initial phase of exercise planning:**
  - Determining their country's level of participation.
  - Planning their exercise through the country's Exercise Planning Team.
- **During the exercise:**
  - Responding as necessary to fulfil their all-of-government and national, provincial and/or local arrangement obligations.
- **After the exercise:**
  - Encouraging the conduct of debriefs and evaluations by in-country agencies.
  - Completing the PacWave16 Exercise Evaluation Form based on in-country feedback.



## 11. EXERCISE DOCUMENTATION

PacWave16 planning, conduct, and evaluation should take into account the following documents:

- IOC Circular Letter No 2588: Pacific Tsunami Warning and Mitigation System (PTWS) Tsunami Exercise “PacWave16”, 1–5 February 2016, dated 11 August 2015
- Exercise Pacific Wave 16, A Pacific-wide Tsunami Warning and Enhanced Products Exercise, 1-5 February 2016. Exercise Manual, Volume 1, IOC Technical Series No 126. UNESCO/IOC 2015 (English)
- Draft Users Guide for the Northwest Pacific Tsunami Advisory Center Enhanced Products for the Pacific Tsunami Warning System. (English)
- Operational Users Guide for the Pacific Tsunami Warning and Mitigation System (PTWS), (IOC/2011/TS/87rev), revised in August 2011.
- How to Plan, Conduct, and Evaluate IOC Tsunami Wave Exercises, IOC Manuals and Guides No 58, 2013.
- Users Guide for the Pacific Tsunami Warning Center Enhanced Products for the Pacific Tsunami Warning System. IOC Technical Series No 105, Revised edition. UNESCO/IOC, 2014 (English; Spanish)

All information related to PacWave16 is available at the exercise website: <http://www.pacwave.info>

## 12. EXERCISE PRODUCTS

PacWave16 will NOT be played in real time, and thus will have no “dummy” kickoff exercise message. Participating countries should select a relevant scenario and its most convenient date and time to conduct the Tabletop Exercise within the 1-5 February 2016 time period. Participating countries may amend the exercise messages to suit their own timetable.

All NWPTAC products will be provided online at the PacWave16 website (<http://www.pacwave.info>) in advance to help countries plan and prepare. It is recommended to download from the PacWave16 website (<http://www.pacwave.info>), the NWPTAC products and messages for the appropriate scenario prior to the day of the exercise.

The earthquake origin time default date and time of the messages (e.g. 1 February 2016 @ 0100 hours) can be adjusted by participating countries to coincide with their selected Tabletop Exercise local date and time. Subsequent message issuance date and times, and earthquake and tsunami arrival times should then also be adjusted accordingly.

All documentation and correspondence relating to this exercise is to be clearly identified as **PacWave16** and **For Exercise Purposes Only**.

Each country is also welcome to modify estimated arrival times or estimated wave amplitudes to suit their preference; for example, to have the arrival of tsunami sooner and with a larger amplitude.

## 13. EXERCISE DELIVERY/FORMAT

Only the suite of experimental NWPTAC enhanced products are being reviewed in PacWave 16, and thus Pacific Tsunami Warning Center (PTWC) messages will be issued in the exercise for information purposes only. All messages are listed in the Master Scenario Events List (Annex II).

Distribution of the series of Tsunami Service Provider messages for each scenario within each country (available beforehand on the exercise website) will be the responsibility of each country.

Each PacWave16 National Contact and their Exercise Planning Team should decide whether the exercise scenario messages are made known to the other national, provincial and local agencies prior to the exercise.

During the exercise, the Exercise Control Team may choose to feed the bulletins into the exercise at times of their own choosing, or alternatively put them in envelopes with the time they must be opened written on each, with each key participating agency having their own set of envelopes.

Country Exercise Planning Teams may want to add their own national and/or local injects.

### 13.1 MASTER SCHEDULE OF EVENTS LIST (MSEL) – EXERCISE SCRIPT

The Master Schedule of Events List (MSEL) is a detailed sequence of events used by the Exercise Control Team to ensure that the exercise runs smoothly.

The Tsunami Service Provider Master Schedule of Events List (MSEL) giving the timeline for issuance of international products, and the product types are given in Annex II.

Each country's Exercise Control Team will be responsible for executing the Master Schedule of Events List.

## 14. POST-EXERCISE EVALUATION

All exercises should have a learning focus. Learning is maximised when there is a continuous process of review to draw out the lessons identified. Review is the process of evaluating and validating the exercise. The exercise should also test an agency's Standard Operating Procedures (SOPs).

A review (including a hot and cold debrief) should evaluate the effectiveness of arrangements and procedures in place and identify if there are any corrective actions and gaps to fill. The hot and cold debriefs are then used to complete the PacWave16 post-exercise evaluation form.

**All participating countries are asked to provide feedback through the PacWave16 Evaluation Form (Annex III) by 26 February 2016.** Forms should be submitted online by visiting [https://www.surveymonkey.com/s/pacwave16\\_eval](https://www.surveymonkey.com/s/pacwave16_eval), noting only **one form per country** is permitted. This feedback will greatly assist in the evaluation of PacWave16.

### 14.1 DEBRIEFING

A post-exercise debrief is a critical review of the entire exercise. It identifies those areas that were handled well, those areas where issues were experienced, and recommendations for improvement.

The aim of organisational debriefing is for staff to communicate their experiences of the exercise so that lessons can be identified. Arrangements (plans, procedures, training etc.) can then be modified to reflect lessons identified along with best practice, and therefore improve the agency's ability to respond in future exercises/real events.

Each agency that participates in PacWave16 is expected to conduct its own debrief after the exercise. This may take the form of a hot debrief (or hotwash) on the day of the exercise, with each participating agency conducting its own cold (formal) debrief within the week(s) following the exercise.

A formal exercise debrief inclusive of all participants in the respective countries will be required to facilitate a collective and official evaluation. The method (in person meeting, survey,

teleconference, or other means) used to collect the data required is to be decided upon by the individual participating countries.

The feedback received from this structured debrief is then used to complete standard evaluation forms which are to be based on the overall exercise objectives, plus any additional evaluation forms or tools developed by each country.

A useful guide to debriefing is one used by New Zealand Ministry of Civil Defence & Emergency Management (ISBN 0-478-25467-9). It can be found at:  
<http://www.civildefence.govt.nz/assets/Uploads/publications/is-06-05-organisational-debriefing.pdf>

## 14.2 EXERCISE VALIDATION

The final stage of the exercise process is to determine whether or not the exercise has met its objectives. At the country level, a national exercise should compare the performance of the involved agencies during the exercise against the performance expected. After validation, countries and agencies may need to change or develop new plans, procedures, and training programmes. Exercise outcomes may be retested in future tsunami exercises, or new exercises written to meet newly identified needs.

## 14.3 EVALUATION CRITERIA

There will be two types of evaluation criteria. The first type will be international criteria based on the overall exercise objectives (see Section 3 above). These are provided in Annex III. The second type will be criteria to be determined by each individual country to measure its own objectives.

In compiling the Exercise Pacific Wave Summary Report, the Exercise Task Team requests **one** international evaluation from each participating country.

## 14.4 EVALUATORS

Countries may appoint Exercise Evaluators to observe and evaluate selected objectives during their exercise. Evaluators should be subject matter experts in the field they are evaluating, such as in warning centre operations, emergency response, communications, or in specific agency areas of responsibility.

Appointing and assigning evaluators is the responsibility of each participating country.

## 14.5 OBSERVERS

PacWave16 may generate interest within the wider sector or local community. Visitors from other agencies (whether local or international) may be invited to observe various exercise activities. Media may also be invited to observe as a way of helping to increase tsunami awareness. Some media may also participate or be simulated, if they are part of the official warning and evacuation dissemination chain.

The invitation of internal or external agency personnel to view the exercise is the responsibility of each participating country.

## 14.6 EVALUATION TOOLS

The goal of exercise evaluation is to validate strengths and identify opportunities for improvement within the participating organisations. This is to be accomplished by collating supporting data; analysing the data to compare effectiveness against requirements; and determining what changes need to be made by participating organisations. At the international level, this would involve the

ICG/PTWS as the intergovernmental coordinating group supporting effective tsunami warning and decision making.

Evaluation of an exercise should focus on the adequacy of plans, policies, procedures, assessment of capabilities, communication, resources and inter-agency/inter-jurisdictional relationships that support effective tsunami warning and decision-making at all levels of government. Participants that choose to include additional objectives, for example by exercising public warning and/or response plans, can expand the evaluation form accordingly. The evaluation of such additional objectives will be for the use of the particular participating agency only, and is not required for the PTWS PacWave16 Summary Report.

The evaluation tool aims to inform and facilitate individual participating country evaluations as well as the PacWave16 Summary Report.

All participating countries are asked to complete the official PacWave16 Exercise Evaluation Form (one per country) **(Annex III) by 26 February 2016**. Forms should be submitted online by visiting [https://www.surveymonkey.com/s/pacwave16\\_eval](https://www.surveymonkey.com/s/pacwave16_eval).

#### 14.7 EXERCISE PACIFIC WAVE 2016 SUMMARY REPORT

The Exercise Task Team will compile the Exercise Pacific Wave 2016 Summary Report based on the official Exercise Evaluation Forms received. The report will include the following:

- Exercise description
- Post-exercise evaluation summary and findings
- Recommendations based on a review of the Pacwave16 responses

#### 15. REAL EVENTS DURING EXERCISE PLAY

In the case of a real event occurring during the exercise, PTWC and JMA / NWPTAC will issue their normal message products for the event, which will be given full priority.

Nationally, each country may suspend or terminate the exercise for their own reasons.

#### 16. RESOURCING

Although participating countries will have advance notice of the exercise and may elect to stand up a special dedicated shift to allow normal core business to continue uninterrupted, it is requested that realistic resource levels be deployed in order to reflect some of the issues that are likely to be faced in a real event.

#### 17. MEDIA ARRANGEMENTS

The UNESCO Bureau of Public Information will issue an international Media Advisory before the PacWave16 providing details of the exercise.

ICG/PTWS Member States should consider issuing at least one press release to their respective country's media. Member States' press releases will give adequate alert to their country's population and give their local media time to conduct interviews and documentaries with participating exercise organisations in advance of the exercise.

Annex IV contains a sample press release that can be customised by Member States. The sample press release is provided in English. Samples in other languages can be found at the PacWave16 website (<http://www.pacwave.info>).

# **ANNEX I. FORECAST POINTS USED FOR EXERCISE PACIFIC WAVE 2016**

Table 1. Forecast points and coastal blocks of NWPTAC Enhanced Products for PacWave16.

Coastal Block	Forecast Point	Latitude	Longitude	Number in Fig. 1
EAST COASTS OF KAMCHATKA PENINSULA	OSTROV_KARAGINSKIY	58.8N	164.5E	1
	UST_KAMCHATSK	56.1N	162.6E	2
	PETROPAVLOVSK_K	53.2N	159.6E	3
KURIL ISLANDS	SEVERO_KURILSK	50.8N	156.1E	4
	URUP_IS.	46.1N	150.5E	5
SOUTH COASTS OF KOREAN PENINSULA	BUSAN	35.1N	129.1E	6
	TONGYEONG	34.7N	128.4E	7
	NOHWA	34.2N	126.6E	8
	HEUKSANDO	34.6N	125.4E	9
	CHEJU_ISLAND	33.5N	127.0E	10
	SEOGWIPO	33.2N	126.5E	11
TAIWAN	CHILUNG	25.2N	121.8E	12
	HUALIEN	24.0N	121.6E	13
	TAITUNG	22.7N	121.2E	14
	KAHHSIUNG	22.5N	120.3E	15
	HOMEL	24.2N	120.4E	16
EAST COASTS OF PHILIPPINES	BASCO	20.4N	122.0E	17
	PALANAN	17.2N	122.6E	18
	LEGASPI	13.2N	123.8E	19
	LAOANG	12.6N	125.0E	20
	MADRID	09.2N	126.0E	21
	DAVAO	06.9N	125.7E	22
NORTH COASTS OF IRIAN JAYA	GEME	04.6N	126.8E	23
	BEREBERE	02.5N	128.7E	24
	PATANI	00.4N	128.8E	25
	SORONG	00.8S	131.1E	26
	MANOKWARI	00.8S	134.2E	27
	WARSA	00.6S	135.8E	28
	JAYAPURA	02.4S	140.8E	29
NORTH COASTS OF PAPUA NEW GUINEA	VANIMO	02.6S	141.3E	30
	WEWAK	03.5S	143.7E	31
	MADANG	05.2S	145.8E	32
	MANUS_IS.	02.0S	147.5E	33
	KAVIENG	02.5S	150.7E	34
	RABAUL	04.2S	152.3E	35
	ULAMONA	05.0S	151.3E	36
	KIMBE	05.6S	150.2E	37
	KIETA	06.1S	155.6E	38
MARIANA ISLANDS	SAIPAN	15.3N	145.8E	39
	GUAM	13.4N	144.7E	40
PALAU	MALAKAL	07.3N	134.5E	41

Table 1 --- continued

Coastal Block	Forecast Point	Latitude	Longitude	Number in Fig. 1
MICRONESIA	YAP_IS.	09.5N	138.1E	42
	CHUUK_IS.	07.4N	151.8E	43
	POHNPEI_IS.	07.0N	158.2E	44
	KOSRAE_IS.	05.5N	163.0E	45
MARSHALL ISLANDS	ENIWETOK	11.4N	162.3E	46
NORTH COASTS OF SOLOMON ISLANDS	PANGGOE	06.9S	157.2E	47
	GHATERE	07.8S	159.2E	48
	AUKI	08.8S	160.6E	49
	KIRAKIRA	10.4S	161.9E	50
SOLOMON SEA	AMUN	06.0S	154.7E	51
	FALAMAE	07.4S	155.6E	52
	MUNDA	08.4S	157.2E	53
	HONIARA	09.3S	160.0E	54
COASTS OF EAST CHINA SEA	SHANGHAI	31.2N	122.3E	55
	ZHOUSHAN	29.9N	122.5E	56
	WENZHOU	27.8N	121.2E	57
COASTS OF SOUTH CHINA SEA	QUANZHOU	24.8N	118.8E	58
	HONG_KONG	22.3N	114.2E	59
	HAINAN_ISLAND	18.8N	110.5E	60
	SANYA	18.2N	109.5E	61
COASTS OF GULF OF TONKIN	VINH	18.6N	105.7E	62
EAST COASTS OF INDO CHINA PENINSULA	QUI_NHON	13.7N	109.2E	63
	BAC_LIEU	09.3N	105.8E	64
GULF OF THAILAND	SIHANOUKVILLE	10.6N	103.6E	65
	PATTAYA	12.8N	100.9E	66
	PRACHUAP_KHIRI KHAN	11.8N	099.8E	67
	NAKHON_SI_THAMMARAT	08.4N	100.0E	68
NORTHWEST COASTS OF KALIMANTAN	KOTA_KINABALU	6.0N	116.0E	69
	MUARA	05.0N	115.1E	70
	BINTULU	03.2N	113.0E	71
WEST COASTS OF PHILIPPINES	LAOAG	18.2N	120.6E	72
	SAN_FERNANDO	16.6N	120.3E	73
	MANILA	14.6N	121.0E	74
SULU SEA	ILOILO	10.7N	122.5E	75
	PUERTO_PRINCESA	09.8N	118.8E	76
	SANDAKAN	05.9N	118.1E	77
	LAHAD_DATU	04.9N	118.4E	78
EAST COASTS OF MALAY PENINSULA	KUALA_TERENGGANU	05.3N	103.2E	79
	SINGAPORE	01.3N	103.9E	80

Table 1 --- continued

Coastal Block	Forecast Point	Latitude	Longitude	Number in Fig. 1
CELEBES SEA	COTABUTO_CITY	07.3N	124.2E	81
	ZAMBOANGA	06.9N	122.1E	82
	MAIMBUNG	05.9N	121.0E	83
	TARAKAN	03.3N	117.6E	84
	TABUKAN_TENGAH	03.6N	125.6E	85
	MANADO	01.6N	124.9E	86
	TOLITOLI	01.1N	120.8E	87
NATUNA SEA	KEPULAUAN_RIAU	04.0N	108.5E	88
	SINGKAWANG	01.0N	109.0E	89
	KUALA_INDRAGIRI	00.5S	103.8E	90
	PANGKALPINANG	02.1S	106.1E	91

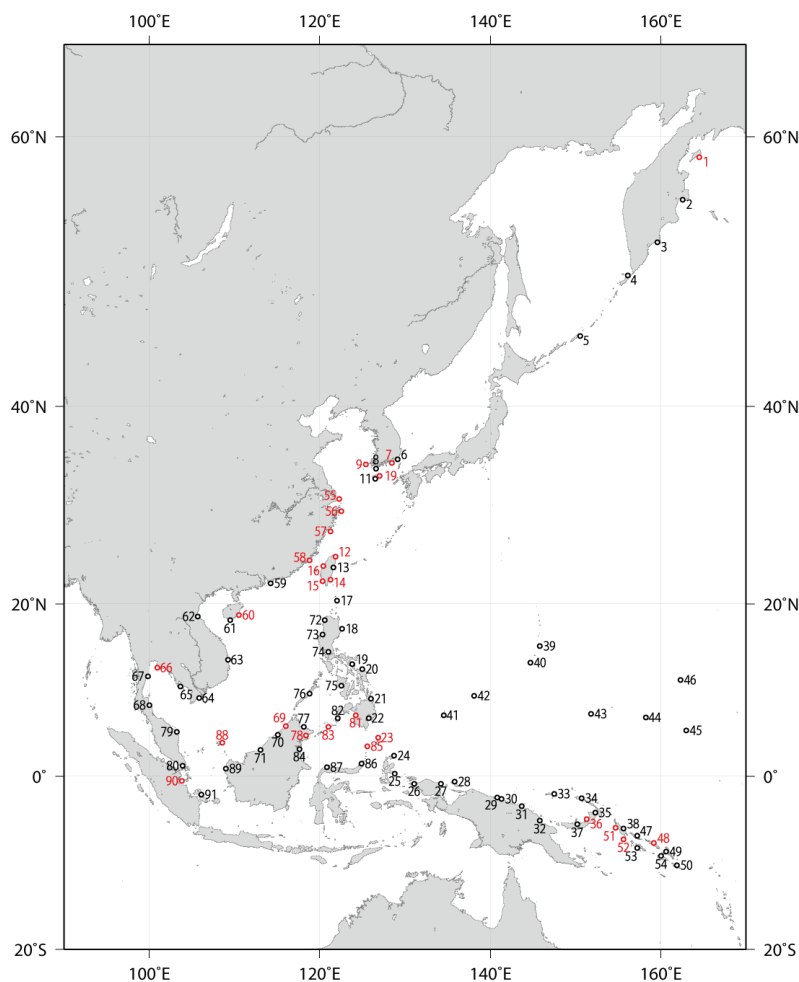


Figure 1. Forecast points of NWPTAC Enhanced Products for PacWave16. Changed points from current ones are indicated as red symbols.

## ANNEX II. EXERCISE PACIFIC WAVE 2016 - SCENARIOS

Location	Latitude	Longitude	Depth	Magnitude	Past Exercise
Kuril-Kamchatka Trench (Kamchatka)	52.5 North	159.5 East	20km	9.0	PacWave11
Japan Trench (Off Northern Japan)	38.1 North	142.9 East	20km	9.0	PacWave13, 15
Nansei-Shoto Trench (Ryukyu Islands)	28.0 North	129.0 East	20km	9.0	PacWave11, 15
Manila Trench (Philippines - South China Sea)	17.0 North	119.0 East	20km	9.0	PacWave13, 15
Philippine Trench (Philippines - Pacific Ocean)	9.5 North	126.6 East	20km	9.0	PacWave11
New Britain-San Cristobal Trench (Solomon Islands)	7.3 South	156.0 East	20km	9.0	-



### ANNEX III. INTERNATIONAL MASTER SCHEDULE OF EVENTS LIST (MSEL)

Date(UTC)	2/1				2/2				2/3				2/4				2/5				2/5			
Scenario →	Kuril-Kamchatka Trench				Japan Trench				Nansei-Shoto Trench				Manila Trench				Philippine Trench				New Britain-San Cristobal trench			
Center →	PTWC	NWPTAC	PTWC	NWPTAC	PTWC	NWPTAC	PTWC	NWPTAC	PTWC	NWPTAC	PTWC	NWPTAC	PTWC	NWPTAC	PTWC	NWPTAC	PTWC	NWPTAC	PTWC	NWPTAC	PTWC	NWPTAC	PTWC	NWPTAC
Time (UTC)	#	TYP	#	TYP	#	TYP	#	TYP	#	TYP	#	TYP	#	TYP	#	TYP	#	TYP	#	TYP	#	TYP	#	TYP
0100	Quake				Quake				Quake				Quake				Quake				Quake			
0107	1	TI			1	TI			1	TI			1	TI			1	TI			1	TI		
0120			1	TI			1	TI			1	TI			1	TI			1	TI			1	TI
0135	2	TFR			2	TFR			2	TFR			2	TFR			2	TFR			2	TFR		
0140			2	TFR			2	TFR			2	TFR			2	TFR			2	TFR			2	TFR
0200	3	TFP			3	TFP			3	TFP			3	TFP			3	TFP			3	TFP		
0230	4	TFH			4	TFH			4	TFH			4	TFH			4	TFH			4	TFH		
0310			3	TS			3	TS			3	TS			3	TS			3	TS			3	TS
0400	5	TS			5	TS			5	TS			5	TS			5	TS			5	TS		
0440			4	TS			4	TS			4	TS			4	TS			4	TS			4	TS
0530	6	TS			6	TS			6	TS			6	TS			6	TS			6	TS		
0610			5	TS			5	TS			5	TS			5	TS			5	TS			5	TS
0700	7	TS			7	TS			7	TS			7	TS			7	TS			7	TS		
0740			6	TS			6	TS			6	TS			6	TS			6	TS			6	TS
0830	8	TS			8	TS			8	TS			8	TS			8	TS			8	TS		
0910			7	TS			7	TS			7	TS			7	TS			7	TS			7	TS
1000	9	TS			9	TS			9	TS			9	TS			9	TS			9	TS		
1040			8	TS			8	TS			8	TS			8	TS			8	TS			8	TS
1130	10	TS			10	TS			10	TS			10	TS			10	TS			10	TS		
1210			9	TS			9	TS			9	TS			9	TS			9	TS			9	TS
1300	11	TS			11	TS			11	TS			11	TS			11	TS			11	TS		
1340			10	TS			10	TS			10	TS			10	TS			10	TS			10	TS
1430	12	TS			12	TS			12	TS			12	TS			12	TS			12	TS		
1510			11	TS			11	TS			11	TS			11	TS			11	TS			11	TS
1600	13	TS			13	TS			13	TS			13	TS			13	TS			13	TS		
1640			12	TS			12	TS			12	TS			12	TS			12	TS			12	TS
1730	14	TS			14	TS			14	TS			14	TS			14	TS			14	TS		
1810							13	TS							13	TS								
1900	15	TS			15	TS			15	TS			15	TS			15	TS			15	TS		
1940							14	TS							14	TS								
2030	16	TS			16	TS			16	TS			16	TS			16	TS			16	TS		
2110							15	TS							15	TS								
2200	17	TS			17	TS			17	TS			17	TS			17	TS			17	TS		
2240							16	TS							16	TS								
2330	18	TS			18	TS			18	TS			18	TS			18	TS			18	TS		
(next day) 0040							16	TS							16	TS								
0130	19	TL			19	TL			19	TL			19	TL			19	TL			19	TL		

**Message Types:** TI = PTWC/NWPTAC Initial Text Message  
 TFR = PTWC/NWPTAC text Message with a Forecast for the Regional near the Earthquake  
 TFP = PTWC Products with a Pacific-wide Forecast  
 TFH = PTWC Products with a Forecast for Shallow Marginal Seas (High-Resolution Forecast Model Run)  
 TS = PTWC/NWPTAC Text Message with Tsunami Observations  
 TL = PTWC Last Message for this Event

#### **ANNEX IV. POST-EXERCISE EVALUATION**

Exercise evaluation forms are to be completed by each participating agency and forwarded to the country PacWave16 National Contact, or the country Tsunami National Contact. **The PacWave16 National Contact will compile the country Evaluation Form and complete and submit this online no later than 26 February 2016.**

Note: Only **one** on-line evaluation form is to be completed **per country**.

The PacWave16 Evaluation Form can be found at  
[https://www.surveymonkey.com/s/pacwave16\\_eval](https://www.surveymonkey.com/s/pacwave16_eval).

Alternatively, the country evaluation forms can be submitted by email or fax to the Exercise PacWave 16 Task Team Chairs:

- Laura Kong (email: [laura.kong@noaa.gov](mailto:laura.kong@noaa.gov), fax: +1 808 725-6055), or
- Jo Guard (email: [jo.guard@dpmc.govt.nz](mailto:jo.guard@dpmc.govt.nz)), or
- Tomoaki Ozaki (email: [hokusei@eqvol2.kishou.go.jp](mailto:hokusei@eqvol2.kishou.go.jp)).

<b>Exercise Pacific Wave 16</b> <b>Instructions on how to complete this Evaluation Form</b>		
<b>Step</b>	<b>Who completes this step?</b>	<b>Description</b>
<b>1</b>	Each participating Agency/Country	Decide if your agency/country will include additional evaluation questions for each objective. Country/agency evaluation questions can be added at the <b>end</b> of each section. However, do NOT change the reference numbers to the questions.
<b>2</b>	Each participating Agency/Country	Print this form and mark your evaluation answers on it.
<b>3</b>	Each participating Agency/Country	<ul style="list-style-type: none"> <li>• Answer each statement with either Y (Yes), N (No).</li> <li>• Comments should be used to explain/expand upon your Yes or No answer..</li> <li>• Write your comments on the page following the evaluation questions. Note the question number in the left column and write your comments alongside.</li> </ul>
<b>4</b>	Each participating Agency/Country	Send completed agency evaluation form to country PacWave16 National Contact so he/she can compile to complete Country PacWave16 Evaluation Form (this URL).
<b>5</b>	PacWave16 National Contact	PacWave16 National Contact should complete and submit the PacWave16 Evaluation Form by <b>26 February 2016</b> ( <a href="https://www.surveymonkey.com/s/pacwave16_eval">https://www.surveymonkey.com/s/pacwave16_eval</a> ). If there are problems or questions, please contact the PacWave16 Task Team co-Chairs (Laura Kong, <a href="mailto:laura.kong@noaa.gov">laura.kong@noaa.gov</a> ; Jo Guard, <a href="mailto:jo.guard@dpmc.govt.nz">jo.guard@dpmc.govt.nz</a> ; Tomoaki Ozaki, <a href="mailto:hokusei@eqvol2.kishou.go.jp">hokusei@eqvol2.kishou.go.jp</a> )

<b>EXERCISE PACIFIC WAVE 2016 EVALUATION FORM</b>
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**CONTACT DETAILS**

- Country: \_\_\_\_\_
- Agency: \_\_\_\_\_
- Contact Name: \_\_\_\_\_
- Contact Position: \_\_\_\_\_
- Contact Phone: \_\_\_\_\_
- Contact Mobile: \_\_\_\_\_
- Contact E-mail: \_\_\_\_\_

**COUNTRY EXERCISE SCENARIO**

Select Scenario Used:

- \_\_\_ Kuril-Kamchatka Trench (Kamchatka)
- \_\_\_ Japan Trench (Off Northern Japan)
- \_\_\_ Nansei-Shoto Trench (Ryukyu Islands)
- \_\_\_ Manila Trench (Philippines - South China Sea)
- \_\_\_ Philippine Trench (Philippines - Pacific Ocean)
- \_\_\_ New Britain-San Cristobal trench (Solomon Islands)

**OBJECTIVE 1**

Evaluate the format and content of experimental NWPTAC Enhanced Products for each scenario exercised.

1.1 Are the following products useful in helping you assess your national tsunami threat? Indicate Yes or No, and provide comments as needed. Please explain why it is/is not useful.

☐ Y ☐ N Text Message

☐ Y ☐ N Deep Ocean Tsunami Amplitude Forecast Map

☐ Y ☐ N Tsunami Travel Time Map

☐ Y ☐ N Coastal Tsunami Amplitude Forecast Map

Comments:

1.2 Please rank the usefulness of each product, where .1=most useful and 4=least useful.

☐ Text Message

☐ Deep Ocean Tsunami Amplitude Forecast Map

☐ Tsunami Travel Time Map

☐ Coastal Tsunami Amplitude Forecast Map

Comments:

1.3 Format and Content: Is your country satisfied with the format and content of experimental NWPTAC Enhanced Products?

Indicate Yes or No, and provide comments as needed. If your answer is No, please provide comments on what improvements are needed.

☐ Y ☐ N Text Message

☐ Y ☐ N Deep Ocean Tsunami Amplitude Forecast Map

☐ Y ☐ N Tsunami Travel Time Map

☐ Y ☐ N Coastal Tsunami Amplitude Forecast Map

Comments:

1.4 Do any features, other than listed above, need to be changed or added?

If Yes, please comment.

☐ Y ☐ N

Comments:

1.5 Are any parts of the NWPTAC text message or graphical products, other than the actual values of the wave forecasts, confusing or in conflict with the PTWC Enhanced Products?

If Yes, please comment

☐ Y ☐ N

Comments:

**OBJECTIVE 2**

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

2.1 Does your National Tsunami Warning Centre (NTWC) understand the contents of the NWPTAC Enhanced Products, how to use the Products, and the limitations of the Products? Indicate Yes or No.

\_\_\_ Y \_\_\_ N

Comments:

2.2 Does your National Disaster Management Office (NDMO) understand the contents of the NWPTAC Enhanced Products, how to use the Products, and the limitations of the Products? Indicate Yes or No.

\_\_\_ Y \_\_\_ N

Comments:

2.3 Will your country's NTWC (and NDMO) be prepared to utilize the NWPTAC Enhanced Products in 2018? Your NTWC should be prepared to issue appropriate national alerts (e.g., Warning/Watch/Cancellations) based on the current PTWC Enhanced Products and/or NWPTAC Enhanced Products. Indicate Yes or No, and provide comments as needed on country status.

\_\_\_ Y \_\_\_ N Currently ready.

\_\_\_ Y \_\_\_ N Will be ready in 2018.

\_\_\_ Y \_\_\_ N Need to develop new or revise existing SOPs.

\_\_\_ Y \_\_\_ N Need to inform and prepare other key stakeholders

\_\_\_ Y \_\_\_ N Need NTWC or NDMO to conduct training for their national and local stakeholders

\_\_\_ Y \_\_\_ N Need international experts to conduct more training for national stakeholders

Comments:

<b>GENERAL EXERCISE OBSERVATIONS</b>
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**OVERALL ASSESSMENT.** Please provide comments as needed.

\_\_\_ Y \_\_\_ N Country stakeholder agencies have a better understanding of the goals, responsibilities and roles in tsunami emergencies.

\_\_\_ Y \_\_\_ N Gaps in capability and capacity have been identified. If Y, please provide details.

Comments:

**EXERCISE PLANNING.** Please provide comments as needed.

\_\_\_ Y \_\_\_ N Overall, the exercise planning, conduct, format and style were satisfactory.

\_\_\_ Y \_\_\_ N Exercise planning went well.

\_\_\_ Y \_\_\_ N The PacWave16 exercise website pages were useful.

\_\_\_ Y \_\_\_ N This evaluation form was easy to use.

\_\_\_ Y \_\_\_ N PacWave16 Exercise Manual provided an appropriate level of detail.

\_\_\_ Y \_\_\_ N IOC Manual & Guides 58: How to Plan, Conduct, and Evaluate IOC Tsunami Wave Exercises was useful.

Comments:

## **EXERCISE PACIFIC WAVE 16 EXPERIENCE**

Please provide general statements on your Exercise Pacific Wave 16 experience.

- **EXERCISE PLANNING**

Please provide a general statement about what went well.

*Insert comments*

Please provide a general statement about what did not go well.

*Insert comments*

Please provide a general statement about what could be improved.

*Insert comments*

- **EXERCISE CONDUCT**

Please provide a general statement about what went well.

*Insert comments*

Please provide a general statement about what did not go well.

*Insert comments*

Please provide a general statement about what could be improved.

*Insert comments*

- **EXERCISE DEBRIEF OR EVALUATION**

Please provide a general statement about what went well.

*Insert comments*

Please provide a general statement about what did not go well.

*Insert comments*

Please provide a general statement about what could be improved.

*Insert comments*



## ANNEX V. SAMPLE PRESS RELEASE

### TEMPLATE FOR NEWS RELEASE

#### USE AGENCY MASTHEAD

Contact: (insert name)  
(insert phone number)  
(insert email address)

**FOR IMMEDIATE RELEASE**  
(insert date)

### FIFTH PACIFIC-WIDE TSUNAMI DRILL SET FOR FEBRUARY 2016

(Insert country name) will join over 15 other countries around the northwest Pacific region as a participant in a mock tsunami scenario during 1-5 February 2016. The purpose of this Pacific-wide exercise is to exercise country tsunami decision-making procedures using the experimental enhanced forecast products of the Northwest Pacific Tsunami Advisory Center (NWPTAC) in Japan. The enhanced products include tsunami wave forecasts that enable each country to better assess its own tsunami threat.

"The recent events of the 2009 Samoa Islands, 2010 Chile, 2011 Japan, 2013 Solomon Islands, 2014 Chile, and the September 2015 Chile tsunamis have increased our need to be more prepared for such events," said (insert name of appropriate official). "This important exercise will validate NWPTAC's enhanced products for future official use by countries of the Pacific Tsunami Warning and Mitigation System.

The exercise, titled Exercise Pacific Wave 2016 (PacWave16), will simulate Pacific countries being put into a Tsunami Warning situation requiring government decision-making. It is the sixth such exercise with the first having been carried out in May 2006, the second in October 2008, the third in November 2011, the fourth in May 2013 and the fifth in February 2015. Participating countries will select from six different northwest Pacific scenarios and conduct a Tabletop Exercise within the first week of February. Destructive Pacific-wide tsunamis will be simulated through tsunami information messages from Japan's NWPTAC and reviewed by focal points designated by each country that are responsible for their country's tsunami response.

*Insert paragraph tailored for specific country. Could identify participating agencies and specific plans. Could describe current early warning program, past evacuation drills (if any), ongoing mitigation and public education programs, etc. Could describe tsunami threat, history of tsunami hazards, if any.*

The exercise is sponsored by UNESCO's Intergovernmental Oceanographic Commission through its Intergovernmental Coordination Group of the Pacific Tsunami Warning and Mitigation System (ICG/PTWS)

###

#### On the Web:

Exercise Pacific Wave 16 information site: <http://www.pacwave.info>

#### Media Resources:

[http://itic.ioc-unesco.org/index.php?option=com\\_content&view=category&layout=blog&id=1150&Itemid=1150&lang=en](http://itic.ioc-unesco.org/index.php?option=com_content&view=category&layout=blog&id=1150&Itemid=1150&lang=en)

Northwest Pacific Tsunami Advisory Center:

[http://www.jma.go.jp/en/distant\\_tsunami/WEPA40/index.html](http://www.jma.go.jp/en/distant_tsunami/WEPA40/index.html)

Pacific Tsunami Warning and Mitigation System:

[http://www.ioc-tsunami.org/index.php?option=com\\_content&view=article&id=11&Itemid=12&lang=en](http://www.ioc-tsunami.org/index.php?option=com_content&view=article&id=11&Itemid=12&lang=en)

Pacific Tsunami Warning Center: <http://ptwc.weather.gov>

US National Tsunami Warning Center: <http://wcatwc.arh.noaa.gov/>

[Insert country URLs]

## **ANNEX VI. LIST OF ACRONYMS**

<b>DISCEX</b>	Discussion Exercise' or Tabletop Exercise
<b>ICG/PTWS</b>	Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System (formerly ITSU)
<b>IOC</b>	Intergovernmental Oceanographic Commission (of UNESCO)
<b>ITIC</b>	International Tsunami Information Center (UNESCO/IOC–NOAA)
<b>JMA</b>	Japan Meteorological Agency
<b>MSEL</b>	Master Schedule of Events List
<b>NDMO</b>	National Disaster Management Office
<b>NOAA</b>	National Oceanic & Atmospheric Administration (USA)
<b>NTWC</b>	National Tsunami Warning Centre
<b>NWPTA</b>	Northwest Pacific Tsunami Advisory
<b>NWPTAC</b>	Northwest Pacific Tsunami Advisory Center (Japan)
<b>PTWC</b>	Pacific Tsunami Warning Center (USA)
<b>SOP</b>	Standard Operating Procedures
<b>TT</b>	Task Team
<b>TNC</b>	Tsunami National Contact
<b>TWFP</b>	Tsunami Warning Focal Point
<b>UNESCO</b>	United Nations Educational, Scientific & Cultural Organization
<b>USNTWC</b>	US National Tsunami Warning Center (formerly West Coast/Alaska Tsunami Warning Center) (USA)
<b>WG</b>	Working Group

# IOC Technical Series

No.	Title	Languages
1	Manual on International Oceanographic Data Exchange. 1965	(out of stock)
2	Intergovernmental Oceanographic Commission (Five years of work). 1966	(out of stock)
3	Radio Communication Requirements of Oceanography. 1967	(out of stock)
4	Manual on International Oceanographic Data Exchange - Second revised edition. 1967	(out of stock)
5	Legal Problems Associated with Ocean Data Acquisition Systems (ODAS). 1969	(out of stock)
6	Perspectives in Oceanography, 1968	(out of stock)
7	Comprehensive Outline of the Scope of the Long-term and Expanded Programme of Oceanic Exploration and Research. 1970	(out of stock)
8	IGOSS (Integrated Global Ocean Station System) - General Plan Implementation Programme for Phase I. 1971	(out of stock)
9	Manual on International Oceanographic Data Exchange - Third Revised Edition. 1973	(out of stock)
10	Bruun Memorial Lectures, 1971	E, F, S, R
11	Bruun Memorial Lectures, 1973	(out of stock)
12	Oceanographic Products and Methods of Analysis and Prediction. 1977	E only
13	International Decade of Ocean Exploration (IDOE), 1971-1980. 1974	(out of stock)
14	A Comprehensive Plan for the Global Investigation of Pollution in the Marine Environment and Baseline Study Guidelines. 1976	E, F, S, R
15	Bruun Memorial Lectures, 1975 - Co-operative Study of the Kuroshio and Adjacent Regions. 1976	(out of stock)
16	Integrated Ocean Global Station System (IGOSS) General Plan and Implementation Programme 1977-1982. 1977	E, F, S, R
17	Oceanographic Components of the Global Atmospheric Research Programme (GARP) . 1977	(out of stock)
18	Global Ocean Pollution: An Overview. 1977	(out of stock)
19	Bruun Memorial Lectures - The Importance and Application of Satellite and Remotely Sensed Data to Oceanography. 1977	(out of stock)
20	A Focus for Ocean Research: The Intergovernmental Oceanographic Commission - History, Functions, Achievements. 1979	(out of stock)
21	Bruun Memorial Lectures, 1979: Marine Environment and Ocean Resources. 1986	E, F, S, R
22	Scientific Report of the Interecalibration Exercise of the IOC-WMO-UNEP Pilot Project on Monitoring Background Levels of Selected Pollutants in Open Ocean Waters. 1982	(out of stock)
23	Operational Sea-Level Stations. 1983	E, F, S, R
24	Time-Series of Ocean Measurements. Vol.1. 1983	E, F, S, R
25	A Framework for the Implementation of the Comprehensive Plan for the Global Investigation of Pollution in the Marine Environment. 1984	(out of stock)
26	The Determination of Polychlorinated Biphenyls in Open-ocean Waters. 1984	E only
27	Ocean Observing System Development Programme. 1984	E, F, S, R
28	Bruun Memorial Lectures, 1982: Ocean Science for the Year 2000. 1984	E, F, S, R
29	Catalogue of Tide Gauges in the Pacific. 1985	E only
30	Time-Series of Ocean Measurements. Vol. 2. 1984	E only
31	Time-Series of Ocean Measurements. Vol. 3. 1986	E only
32	Summary of Radiometric Ages from the Pacific. 1987	E only
33	Time-Series of Ocean Measurements. Vol. 4. 1988	E only
34	Bruun Memorial Lectures, 1987: Recent Advances in Selected Areas of Ocean Sciences in the Regions of the Caribbean, Indian Ocean and the Western Pacific. 1988	Composite E, F, S
35	Global Sea-Level Observing System (GLOSS) Implementation Plan. 1990	E only

(continued)

36	Bruun Memorial Lectures 1989: Impact of New Technology on Marine Scientific Research. 1991	Composite E, F, S
37	Tsunami Glossary - A Glossary of Terms and Acronyms Used in the Tsunami Literature. 1991	E only
38	The Oceans and Climate: A Guide to Present Needs. 1991	E only
39	Bruun Memorial Lectures, 1991: Modelling and Prediction in Marine Science. 1992	E only
40	Oceanic Interdecadal Climate Variability. 1992	E only
41	Marine Debris: Solid Waste Management Action for the Wider Caribbean. 1994	E only
42	Calculation of New Depth Equations for Expendable Bathymetographs Using a Temperature-Error-Free Method (Application to Sippican/TSK T-7, T-6 and T-4 XBTS. 1994	E only
43	IGOSS Plan and Implementation Programme 1996-2003. 1996	E, F, S, R
44	Design and Implementation of some Harmful Algal Monitoring Systems. 1996	E only
45	Use of Standards and Reference Materials in the Measurement of Chlorinated Hydrocarbon Residues. 1996	E only
46	Equatorial Segment of the Mid-Atlantic Ridge. 1996	E only
47	Peace in the Oceans: Ocean Governance and the Agenda for Peace; the Proceedings of <i>Pacem in Maribus</i> XXIII, Costa Rica, 1995. 1997	E only
48	Neotectonics and fluid flow through seafloor sediments in the Eastern Mediterranean and Black Seas - Parts I and II. 1997	E only
49	Global Temperature Salinity Profile Programme: Overview and Future. 1998	E only
50	Global Sea-Level Observing System (GLOSS) Implementation Plan-1997. 1997	E only
51	L'état actuel de l'exploitation des pêcheries maritimes au Cameroun et leur gestion intégrée dans la sous-région du Golfe de Guinée ( <i>cancelled</i> )	F only
52	Cold water carbonate mounds and sediment transport on the Northeast Atlantic Margin. 1998	E only
53	The Baltic Floating University: Training Through Research in the Baltic, Barents and White Seas - 1997. 1998	E only
54	Geological Processes on the Northeast Atlantic Margin (8 <sup>th</sup> training-through-research cruise, June-August 1998). 1999	E only
55	Bruun Memorial Lectures, 1999: Ocean Predictability. 2000	E only
56	Multidisciplinary Study of Geological Processes on the North East Atlantic and Western Mediterranean Margins (9 <sup>th</sup> training-through-research cruise, June-July 1999). 2000	E only
57	Ad hoc Benthic Indicator Group - Results of Initial Planning Meeting, Paris, France, 6-9 December 1999. 2000	E only
58	Bruun Memorial Lectures, 2001: Operational Oceanography – a perspective from the private sector. 2001	E only
59	Monitoring and Management Strategies for Harmful Algal Blooms in Coastal Waters. 2001	E only
60	Interdisciplinary Approaches to Geoscience on the North East Atlantic Margin and Mid-Atlantic Ridge (10 <sup>th</sup> training-through-research cruise, July-August 2000). 2001	E only
61	Forecasting Ocean Science? Pros and Cons, Potsdam Lecture, 1999. 2002	E only
62	Geological Processes in the Mediterranean and Black Seas and North East Atlantic (11 <sup>th</sup> training-through-research cruise, July- September 2001). 2002	E only
63	Improved Global Bathymetry – Final Report of SCOR Working Group 107. 2002	E only
64	R. Revelle Memorial Lecture, 2006: Global Sea Levels, Past, Present and Future. 2007	E only
65	Bruun Memorial Lectures, 2003: Gas Hydrates – a potential source of energy from the oceans. 2003	E only
66	Bruun Memorial Lectures, 2003: Energy from the Sea: the potential and realities of Ocean Thermal Energy Conversion (OTEC). 2003	E only

67	Interdisciplinary Geoscience Research on the North East Atlantic Margin, Mediterranean Sea and Mid-Atlantic Ridge (12 <sup>th</sup> training-through-research cruise, June-August 2002). 2003	E only
68	Interdisciplinary Studies of North Atlantic and Labrador Sea Margin Architecture and Sedimentary Processes (13 <sup>th</sup> training-through-research cruise, July-September 2003). 2004	E only
69	Biodiversity and Distribution of the Megafauna / Biodiversité et distribution de la mégafaune. 2006 Vol.1 The polymetallic nodule ecosystem of the Eastern Equatorial Pacific Ocean / Ecosystème de nodules polymétalliques de l'océan Pacifique Est équatorial Vol.2 Annotated photographic Atlas of the echinoderms of the Clarion-Clipperton fracture zone / Atlas photographique annoté des échinodermes de la zone de fractures de Clarion et de Clipperton Vol.3 Options for the management and conservation of the biodiversity — The nodule ecosystem in the Clarion Clipperton fracture zone: scientific, legal and institutional aspects	E F
70	Interdisciplinary geoscience studies of the Gulf of Cadiz and Western Mediterranean Basin (14 <sup>th</sup> training-through-research cruise, July-September 2004). 2006	E only
71	Indian Ocean Tsunami Warning and Mitigation System, IOTWS. Implementation Plan, 7–9 April 2009 (2 <sup>nd</sup> Revision). 2009	E only
72	Deep-water Cold Seeps, Sedimentary Environments and Ecosystems of the Black and Tyrrhenian Seas and the Gulf of Cadiz (15 <sup>th</sup> training-through-research cruise, June–August 2005). 2007	E only
73	Implementation Plan for the Tsunami Early Warning and Mitigation System in the North-Eastern Atlantic, the Mediterranean and Connected Seas (NEAMTWS), 2007–2011. 2007 ( <i>electronic only</i> )	E only
74	Bruun Memorial Lectures, 2005: The Ecology and Oceanography of Harmful Algal Blooms – Multidisciplinary approaches to research and management. 2007	E only
75	National Ocean Policy. The Basic Texts from: Australia, Brazil, Canada, China, Colombia, Japan, Norway, Portugal, Russian Federation, United States of America. (Also Law of Sea Dossier 1). 2008	E only
76	Deep-water Depositional Systems and Cold Seeps of the Western Mediterranean, Gulf of Cadiz and Norwegian Continental margins (16 <sup>th</sup> training-through-research cruise, May–July 2006). 2008	E only
77	Indian Ocean Tsunami Warning and Mitigation System (IOTWS) – 12 September 2007 Indian Ocean Tsunami Event. Post-Event Assessment of IOTWS Performance. 2008	E only
78	Tsunami and Other Coastal Hazards Warning System for the Caribbean and Adjacent Regions (CARIBE EWS) – Implementation Plan 2013–2017 (Version 2.0). 2013	E only
79	Filling Gaps in Large Marine Ecosystem Nitrogen Loadings Forecast for 64 LMEs – GEF/LME global project Promoting Ecosystem-based Approaches to Fisheries Conservation and Large Marine Ecosystems. 2008	E only
80	Models of the World's Large Marine Ecosystems. GEF/LME Global Project Promoting Ecosystem-based Approaches to Fisheries Conservation and Large Marine Ecosystems. 2008	E only
81	Indian Ocean Tsunami Warning and Mitigation System (IOTWS) – Implementation Plan for Regional Tsunami Watch Providers (RTWP). 2008	E only
82	Exercise Pacific Wave 08 – A Pacific-wide Tsunami Warning and Communication Exercise, 28–30 October 2008. 2008	E only
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