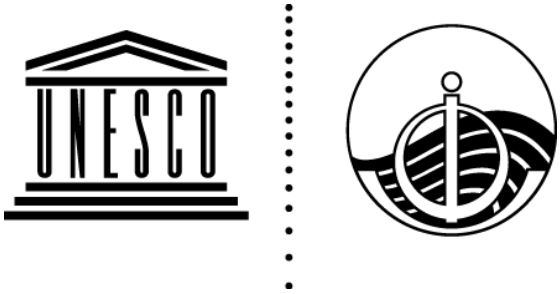
Intergovernmental Oceanographic Commission
Technical Series
149



User's Guide for the South China Sea Tsunami Advisory Center (SCSTAC) products for the South China Sea Tsunami Warning and Mitigation System

September 2019

UNESCO

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Report prepared by: South China Sea Tsunami Advisory Center (SCSTAC), ICG/PTWS Task Team on Establishment of SCSTAC

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(IOC/2019/TS/149)

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1. OVERVIEW

1.1 BACKGROUND

The South China Sea (SCS) and its adjoining basins Sulu Sea and Celebes Sea are identified as tsunami-prone areas due to high level of seismicity, and currently regional tsunami advisory services are provided by Northwest Pacific Tsunami Advisory Center (NWPTAC), the Japan Meteorological Agency (JMA) on an interim basis. The Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System (ICG/PTWS) took the establishment of the SCS Tsunami Warning and Mitigation System as a priority action in the PTWS Medium-Term Strategy 2014-2021 (IOC/2013/TS/108).

The ICG/PTWS at its 25th session (ICG/PTWS-XXV/3 rev.) held in Vladivostok, Russian Federation, from 9 to 11 September 2013, approved the proposal for a South China Sea Tsunami Warning and Mitigation System submitted by the SCS Regional Working Group (WG-SCS), and decides further to establish a Task Team on the Establishment of a South China Sea Tsunami Advisory Center (TT-SCSTAC). The First meeting of the ICG/PTWS Task Team on Establishment of the South China Sea Tsunami Advisory Center (TT-SCSTAC-I), and the Third meeting of the Regional Working Group on Tsunami Warning and Mitigation System for the South China Sea Region (ICG/PTWS-WG-SCS-III/3 Rev.) that immediately followed, were both hosted by Hong Kong Observatory from 7 to 9 April 2014. The WG-SCS adopted the recommendations of the TT-SCSTAC that the SCSTAC advisory products should comprise a suite of text and graphic products to keep pace with the PTWC New Enhanced Products, and the design of the SCSTAC advisory products should be accomplished and submitted for consideration to the WG-SCS at the 4th Regional Working Group meeting. During the Fourth meeting of the Regional Working Group on Tsunami Warning and Mitigation System for the South China Sea Region (ICG/PTWS-WG-SCS-IV/3) hosted by Meteorological, Climatological and Geophysical Agency (BMKG) in Jakarta, Indonesia, the WG-SCS instructed the TT-SCSTAC to continue its work on the draft of the SCS advisory products, and submit to the 5th ICG/PTWS-WG-SCS meeting for approval. The Fifth meeting Regional Working Group meeting. During the Fourth meeting of the Regional Working Group on Tsunami Warning and Mitigation System held in Manila, Philippines, the 2 and 3 March 2016, instructed the IOC Secretariat to circulate through Circular Letter the document “Tsunami Advisory Products for the South China Sea Regional Tsunami Warning and Mitigation System” to all WG-SCS Member States for final comments with a time limit of one month, and finalize the SCS tsunami advisory products accordingly. As approved by the ICG/PTWS Steering Committee at the meeting held from 29 June to 1 July 2016 in Honolulu, United States of America, the SCSTAC advisory products were tested during the Exercise Pacific Wave 2017 (IOC/2016/TS/131 Vol.1, Vol.2) among the SCS Member States, and the post-exercise survey was conducted and reported to the Sixth meeting of the ICG/PTWS-WG-SCS (1–3 March, 2017, Shanghai, China) and to the Twenty-seventh session of the ICG/PTWS (28 to 31 March 2017, Tahiti, French Polynesia).

The provision of the SCS tsunami advisory products aims at allowing the recipient countries to take appropriate actions against regional threats, in collaboration with the Pacific Ocean-wide service provided by Pacific Tsunami Warning Center (PTWC). The development of tsunami advisory products that account for regional features and particular requirements of the SCS Member States is crucial for an effective regional tsunami warning and mitigation system. In that regard, the in-depth involvement of all Member States in the development of the SCS regional products during the design period is very important.

The SCS tsunami advisory products incorporate the state-of-the-art forecasting skills such as tsunami scenario database, as well as real-time numerical modelling based on rapid CMT solution and GPU & OpenMP hybrid parallel computing technology. The benchmark of

numerical model and validation of forecasting results are essential. The SCS tsunami advisory products will serve as the basis for the operation of the SCSTAC in 2018.

1.2 AREA OF SERVICE

The SCS Tsunami advisory products are issued when SCSTAC detects a major earthquake with moment magnitude 6.0 or greater in its Area of Service (AoS) (see Figure 1, hereinafter referred to as “the SCS region”), which consists of the main body of the SCS, the Sulu Sea and the Celebes Sea. For major earthquakes that occur outside the SCS region but may pose threat to it, SCSTAC might issue tsunami advisory products by following the epicentre information identified by PTWC or NWPTAC.

Figure 1. SCSTAC Area of Service (AoS).

1.3 BULLETIN TYPES AND CRITERIA

For a long time, the Pacific Tsunami Warning Center (PTWC) had issued four basic categories of bulletins to PTWS Member States mainly based on earthquake magnitude and imminence/distance of expected tsunami threats on target areas. PTWC put each area into a warning or watch based primarily on an analysis of historical data.

At the Twenty-fifth session of the ICG/PTWS (ICG/PTWS-XXV/3 rev.) held from 11 to 13 September 2013, all Member States agreed on a changeover to the PTWC New enhanced Products suite since 1 October 2014. As each Member State is sovereign and thus responsible for taking actions to ensure the safety of its own population, the PTWC New Enhanced Products no longer use levels of alert (i.e., watch and warning) to define the tsunami bulletins, and instead provide levels of threat based on numerical modelling. The levels of threat now are provided as expected maximum tsunami wave amplitudes relative to the tide within four categories which are: (i) less than 0.3 metre, (ii) 0.3 to less than 1 metre, (iii) 1 m to 3 metres, and (iv) greater than 3 metres.

The SCS Tsunami Advisory Products stick to PTWC and NWPTAC's practice to provide quantitative tsunami threat to recipients, rather than warning levels that are more meaningful for domestic warnings. According to numerical studies in the SCS region, the basin-wide tsunami triggered by Manila Trench will strike the Philippines within hour and arrive at China, Viet Nam, Malaysia and Brunei in 1-4 hours, thus there are not much time left for emergency response. Basically, SCSTAC will send out the initial bulletin as soon as possible mainly based on the preliminary earthquake parameters like location, magnitude and focal depth. Whether a Member State will be put into 'threat area' depends on the relatively conservative output of tsunami scenario database.

PTWC now use W-phase Centroid Moment Tensor (WCMT) analysis, which is typically available about 10-20 minutes after the earthquake, to trigger the numerical model. It makes big stride that the WCMT can yield a more accurate initial condition which is critical to modelling result. While WCMT analysis is appropriate for Pacific Ocean-wide tsunamis, for regional and local tsunamis in the SCS region it might take too much time to provide the quantitative forecasts using this technique. Therefore, tsunami scenario database based on the preliminary earthquake parameters, in combination with rapid tsunami models, will be adopted to evaluate coastal threat levels quantitatively in the subsequent bulletin that comes up 3-5 minutes after the first one. After that, the supplementary bulletins may be issued if major earthquake magnitude revision occurs. SCSTAC will also run the high-resolution regional model when WCMT analysis is available, however the main purpose is to update and validate the preceding forecasting results.

Bulletin type		**Criteria**	**Content**	**Timeline**
Tsunami Information	Only one bulletin	Magnitude of 6.0-6.4; or on land; or depth≥100km	EQ parameters and statement of 'No tsunami threat'	5-10 min
	Only one bulletin unless minor waves observed and should be reported	Magnitude of 6.5-7.0	EQ parameters and statement of 'No tsunami threat'	5-10 min
Tsunami Threat Message	Bulletin with quantitative forecast	≥7.1 and shallow under water earthquake	EQ parameters and quantitative forecasts on threat level and Estimated Time of Arrival (ETA)	8-15 min
	Supplementary with observations		EQ parameters, quantitative forecast and tidal gauge observations	If revision on EQ & tsunami forecasts, or observation available
	Final bulletin		Statement of 'No tsunami confirmed or threat passed'	hazardous waves has passed or no significant tsunami observations

Table 1. Criteria adopted by SCSTAC

In Tsunami Information or Tsunami Threat Message, the tsunamigenic potential is provided based on preliminary earthquake parameters as follows:

Magnitude (Mw)	Tsunami Potential Description
$6.0 \leq M_w \leq 7.0$	There is no tsunami threat from this earthquake
$7.1 \leq M_w \leq 7.5$	Possibility of a destructive local tsunami confined to 100-300 km of the epicentre
$M_w \geq 7.6$	Possibility of a destructive basin-wide tsunami

Table 2. Tsunamigenic potential adopted by SCSTAC

1.4 IMPLEMENTATION TIMELINE

According to the "Proposal for the Tsunami Warning and Mitigation System of the South China Sea" approved by the ICG/PTWS at its 25th session, the SCSTAC should start its experimental operation at the end of 2016. Activities and timelines comprise:

- February 2015: Collecting revising comments on the SCSTAC products (Status: Finished and reported to 4th WG-SCS Meeting in Jakarta).

- March 2015-August 2015: Continuous research on experimental products and associated tsunami scenario database and models (Status: Finished).

- September 2015-October 2015: Experimental products submitted to TT-SCSTAC members for further comments (Status: Start in October 2015 and completed in January 2016).

- December 2015-March 2016: Submitted to the 5th WG-SCS Meeting for approval (Status: Submitted to 5th WG-SCS Meeting in Manila; WG-SCS instructed IOC Secretariat to circulate the SCSTAC products among the SCS Member States for final comments with a time limit of one month).

- April 2016-May 2016: Finalization of SCSTAC products (Status: UNESCO/IOC Circular Letter 2624 for final comments on SCSTAC products).

- June 2016-September 2016: WG-SCS reporting to Steering Committee (SC) Meeting for ICG/PTWS in Hawaii on 29 June - 2 July 2016. (Status: The SC agreed to take the opportunity to include testing of the SCSTAC Tsunami Advisory Products at PacWave17 to be conducted on 15 to 17 February 2017; Exercise details would be discussed in 2nd Task Team Meeting on SCSTAC).

- October 2016-February 2017: Testing the SCSTAC advisory products at PacWave17.

- January 2018: Experimental issuance of SCSTAC advisory products.

1.5 DISSEMINATION OF PRODUCTS

According to experience adopted by PTWS, text message should be available to National Tsunami Warning Centres (NTWCs) via WMO Global Telecommunication System, email, website and facsimile, while scientifically more complex graphical products should only be accessible to NTWCs and Tsunami Warning Focal Points (TWFPs) via excluded channels such as email or access-restricted website in order to minimize public confusion and

misunderstanding. A public and NTWC accessible website is developed to facilitate the spread of tsunami advisories. The website is www.scstac.org.

Approach	Services	Advantages & Disadvantages
GTS	Text Message	• Fast, reliable • Not accessible for all MSs
Website	Text Message for public and Graphical products for authorized users	• More information, flexible • Require stable Internet connection
Facsimile	Text Message for NTWCs and TWFPs	• Available to all MSs • Relatively slower • Require stable connection
Email	Text and Graphical products for NTWCs and TWFPs	• Fast, Easily accessible • Require stable Internet connection

Table 3. Dissemination approaches

2. TSUNAMI SCENARIO DATABASE, FORECAST MODEL AND DECISION SUPPORT SYSTEM

2.1 DESCRIPTION OF TSUNAMI SCENARIO DATABASE

The tsunami scenario database covering the North-West (NW) Pacific and the South China Sea (SCS) region was put into operation in the National Marine Environmental Forecasting Center (NMEFC) of the State Oceanic Administration (SOA) in 2015, with the objective to use preliminary earthquake parameters to retrieve pre-computed scenarios and provide real-time forecast of nearshore tsunami amplitude. Now, the Northwest Pacific Tsunami Advisory Center (NWPTAC) operated by the Japan Meteorological Agency (JMA) takes this tool as the primary approach to yield numerical guidance on tsunami advisory. The database is developed for different levels of depth (2, 20, 40, 60, 80 & 100 km) and magnitudes (6.5, 7.0, 7.5, 8.0, 8.5, 9.0) for 2010 pre-defined sources covering the main thrust faults in the NW Pacific and the SCS region. Each source is separated with a spatial interval of 0.5 degree. The database adopts the Okada Model as the source model to calculate seismic deformation. The strike, dip angles are determined by statistically analysing Harvard CMT catalogue and Slab 1.0 (Hayes et al., 2012), while the slip angles is set to 90 degree for conservation. The total scenarios sum up to 72,360 cases.

Each scenario covers 5 S to 52 N latitude and 99 E to 160 E longitude with a grid space of 4 minutes. The simulating length is 15 hours. The governing equation adopted is linear momentum equation that is not suitable for very shallow water. Hence the coastal forecast points are selected along the 50-800 metre isobath, and the coastal amplitudes along the 5, 10, 20 and 50 metre isobath are scaled by Green Law. Each coastal forecast point is spaced with an interval of 12 minutes (approximately 20 km) covering the SCS rim countries. The maximum wave amplitude and estimated time of arrival (ETA) at each coastal forecast point are stored in database for fast retrieval. Whenever an earthquake occurs, the closest scenarios to the event is extracted from the database and then interpolated to yield coastal amplitude forecast.

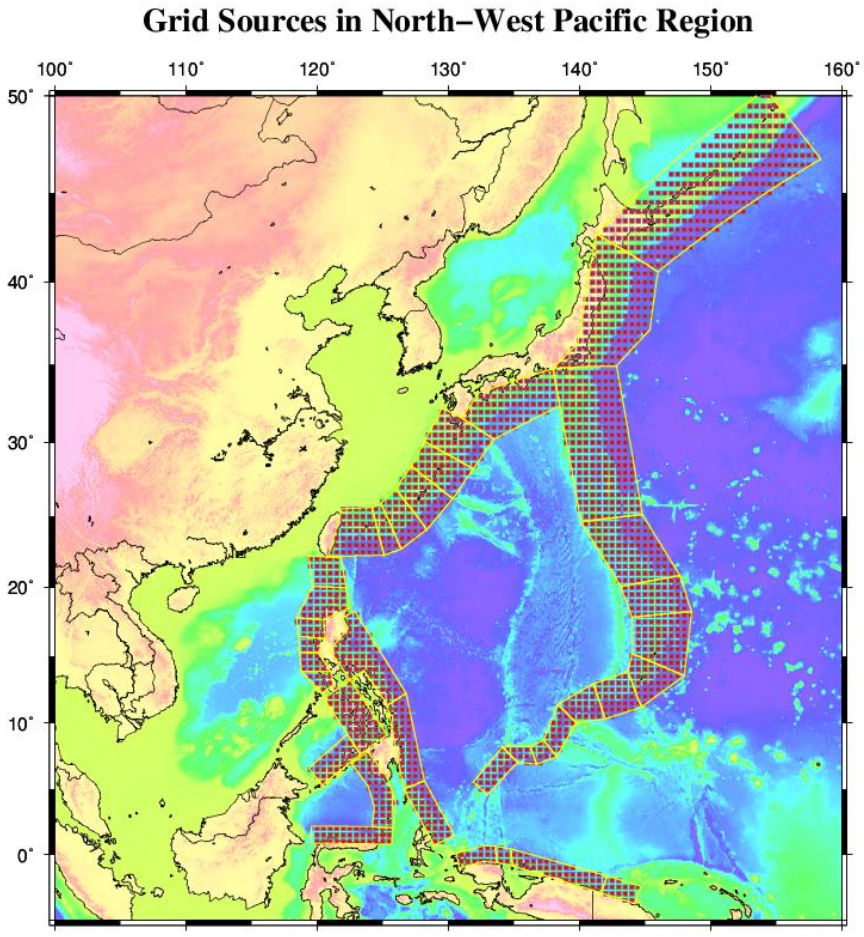


Figure 2. Tsunamigenic sources identified in the Tsunami Propagation Scenario Database.

2.2 DESCRIPTION OF REAL-TIME TSUNAMI FORECAST MODEL

Two sets of tsunami numerical forecasting model are in operation now in NMEFC/SOA. The first model is based on a GPU & OpenMP hybrid parallelized tsunami model based on COMCOT.

The computation domains for COMCOT include the SCS, NW Pacific and the whole Pacific with a resolution of 2, 4 and 5 arc-minute, respectively. The linear shallow water equation was adopted as the governing equation and the minimum water depth was 10 metres. For the focal mechanism input, the initial forecast could start when earthquake location and magnitude are available, while the strike, slip and dip angles are chosen based on the Harvard Global CMT catalogue in a conservative manner. As a W-phase CMT solution becomes available, the model can be run again to generate a more accurate forecast. A 15-hr forecast for the SCS region model domain at 2-arc-min can be produced within 10 seconds, a 15-hr forecast for the NW Pacific model domain at 4-arc-min can be obtained within 8 seconds, and a 30-hr forecast for the entire Pacific region can be achieved in less than 80 seconds.

2.3 INTERPRETATION OF DATABASE AND MODEL RESULTS

The uncertainties associated with the tsunami propagation scenario database and numerical models come from the CMT solution, the interpolation among neighbouring scenarios, numerical modelling of propagation, as well as Green's Law Scaling. Each uncertainty could result in large errors. For example, numerical forecast results can vary easily by a factor of two because of uncertainties in the earthquake magnitude, depth and assumed mechanism;

Green's Law is very sensitive to local topography and bathymetry, coastal amplitude could be over- or under-estimated by a factor of 2-3 depending on coastal features; wave dispersion effect is non-negligible for distant propagation of tsunami wave.

Hence, how to comprehend numerical forecasts is very important for national recipients to recognize the tsunami threats correctly. Basically, the main tsunami service providers like PTWC, NWPTAC interpret the numerical results by classifying them into several categories. In the PTWC New Enhanced Products, the coastal amplitude forecast at each forecast point is categorized into four threat levels of "<0.3 m; 0.3-1 m, 1-3 m and above 3 m", which are illustrated by different colours along the coastlines.

2.4 DECISION SUPPORT SYSTEM (DSS)

Decision support system (DSS) tailored for the SCSTAC has been put into operation since February 2016. The DSS is designed for watch stander to make decision in terms of Standard Operating Procedures (SOPs) and warning criteria. The SCSTAC text bulletins and graphical products can be finally generated through a series of functional modules including: Seismic module, tsunami observation module, tsunami scenario database and tsunami modelling modules, coastal impact assessment modules and bulletin production & dissemination modules.

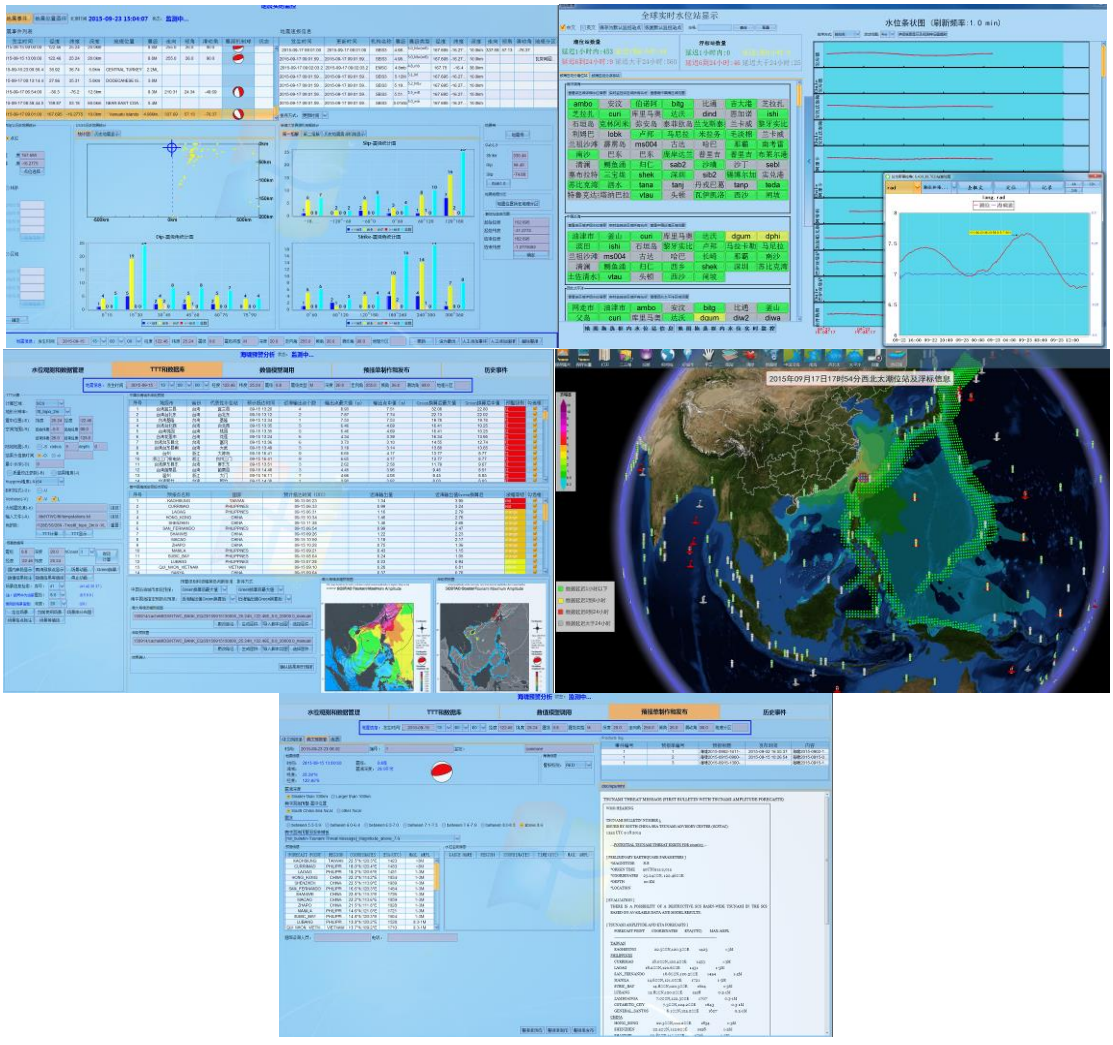


Figure 3. Decision support system for SCSTAC: a. Seismic module; b. Tsunami observation module; c-d. Tsunami Scenario database and TTT module; e. Bulletin production and dissemination module.

3. DESCRIPTION OF PRODUCTS

SCSTAC should be committed to ensuring all NTWCs and TWFPs can receive, understand and respond appropriately to tsunami advisory products. Overall, the SCS advisory products should be informative, intuitive and comprehensive, and more importantly, be compatible with PTWC's New Enhanced products so as to minimize confusion and facilitate usage.

3.1 DEFINITION OF GEOGRAPHIC AREAS

Employing Flinn-Engdahl regionalization to name the region of epicentre.

Southwestern Japan and Ryukyu Islands	**Borneo – Sulawesi**
231 SOUTH KOREA 232 WESTERN HONSHU, JAPAN 233 NEAR S. COAST OF WESTERN HONSHU 234 NORTHWEST OF RYUKYU ISLANDS 235 KYUSHU, JAPAN 236 SHIKOKU, JAPAN 237 SOUTHEAST OF SHIKOKU, JAPAN 238 RYUKYU ISLANDS, JAPAN 239 SOUTHEAST OF RYUKYU ISLANDS 240 WEST OF BONIN ISLANDS 241 PHILIPPINE SEA	261 BORNEO 262 CELEBES SEA 263 TALAUD ISLANDS, INDONESIA 264 NORTH OF HALMAHERA, INDONESIA 265 MINAHASSA PENINSULA, SULAWESI 266 NORTHERN MOLUCCA SEA 267 HALMAHERA, INDONESIA 268 SULAWESI, INDONESIA 269 SOUTHERN MOLUCCA SEA 270 CERAM SEA 271 BURU, INDONESIA 272 SERAM, INDONESIA
Taiwan Area	**Sunda Arc**
242 NEAR COAST OF SOUTHEASTERN CHINA 243 TAIWAN REGION 244 TAIWAN 245 NORTHEAST OF TAIWAN 246 SOUTHWESTERN RYUKYU ISL., JAPAN 247 SOUTHEAST OF TAIWAN	273 SOUTHWEST OF SUMATERA, INDONESIA 274 SOUTHERN SUMATERA, INDONESIA 275 JAVA SEA 276 SUNDA STRAIT, INDONESIA 277 JAVA, INDONESIA 278 BALI SEA 279 FLORES SEA 280 BANDA SEA 281 TANIMBAR ISLANDS REG., INDONESIA 282 SOUTH OF JAVA, INDONESIA 283 BALI REGION, INDONESIA 284 SOUTH OF BALI, INDONESIA 285 SUMBAWA REGION, INDONESIA 286 FLORES REGION, INDONESIA 287 SUMBA REGION, INDONESIA 288 SAVU SEA 289 TIMOR REGION 290 TIMOR SEA 291 SOUTH OF SUMBAWA, INDONESIA 292 SOUTH OF SUMBA, INDONESIA 293 SOUTH OF TIMOR, INDONESIA
Philippine Islands	**Myanmar and Southeast Asia**
248 PHILIPPINE ISLANDS REGION 249 LUZON, PHILIPPINES 250 MINDORO, PHILIPPINES 251 SAMAR, PHILIPPINES 252 PALAWAN, PHILIPPINES 253 SULU SEA	294 MYANMAR-INDIA BORDER REGION 295 MYANMAR-BANGLADESH BORDER REGION 296 MYANMAR 297 MYANMAR-CHINA BORDER REGION 298 NEAR SOUTH COAST OF MYANMAR

254 PANAY, PHILIPPINES	299 SOUTHEAST ASIA (NOT IN USE)
255 CEBU, PHILIPPINES	300 HAINAN ISLAND, CHINA
256 LEYTE, PHILIPPINES	301 SOUTH CHINA SEA
257 NEGROS, PHILIPPINES	733 THAILAND
258 SULU ARCHIPELAGO, PHILIPPINES	734 LAOS
259 MINDANAO, PHILIPPINES	735 CAMBODIA
260 EAST OF PHILIPPINE ISLANDS	736 VIETNAM
	737 GULF OF TONGKING

3.2 COASTAL FORECAST POINTS

Tsunami amplitude and arrival time are provided for each coastal forecast point in the SCS region. These coastal forecast points were agreed-upon points chosen by the SCS Member States during the 3rd, 4th and 5th meeting of the ICG/PTWS-WG-SCS in Hong Kong, Jakarta and Manila, respectively. They correspond to important coastal populated cities and sea-level gauges. In order to keep consistent, now majority of these coastal forecast points come from PTWC and NWPTAC's forecast points for ETA and amplitude (refer to Annex II). In the tsunami threat message, all forecast points with maximum amplitude greater than 0.3 metre are listed in groups that are entitled as Member States (Annex I). Tsunami amplitude estimates are extracted and interpolated from tsunami scenario database and grouped into four bins of "<0.3 m; 0.3 to less than 1 m; 1 to 3 m and above 3 m".

3.3 TEXT MESSAGE

Text message is available to the public and NTWCs. Typically, the SCSTAC text product contains earthquake parameters, tsunamigenic potential, tsunami amplitude and ETA forecasts for each Coastal Forecast Point, tsunami observations, and recommended actions. The earthquake parameters for major earthquakes need to be coordinated and consistent with those of the PTWC bulletin (refer to Annex I for bulletin templates).

3.4 TSUNAMI ENERGY MAP

The tsunami energy map gives the colour-filled distribution of maximum tsunami amplitude in the SCS region. Direction of tsunami energy beam and the threatened areas can be easily identified by different colour scale. The contour map of Tsunami Travel Time (TTT) is shown in light-grey lines and overlapped on tsunami energy map.

3.5 COASTAL FORECAST MAP

The coastal forecast Map gives a detailed view of tsunami threat on coasts in the SCS region. It divides the SCS coastlines into a number of Model Output Points (MOP). Each MOP is coloured according to the tsunami amplitude of the model grid points closest to the point. The tsunami energy map is also overlapped in grey-shading style with illuminated effect and further have TTT contour lines placed upon.

4. TSUNAMI SCENARIOS AND PRODUCT SAMPLES

4.1 MANILA TRENCH

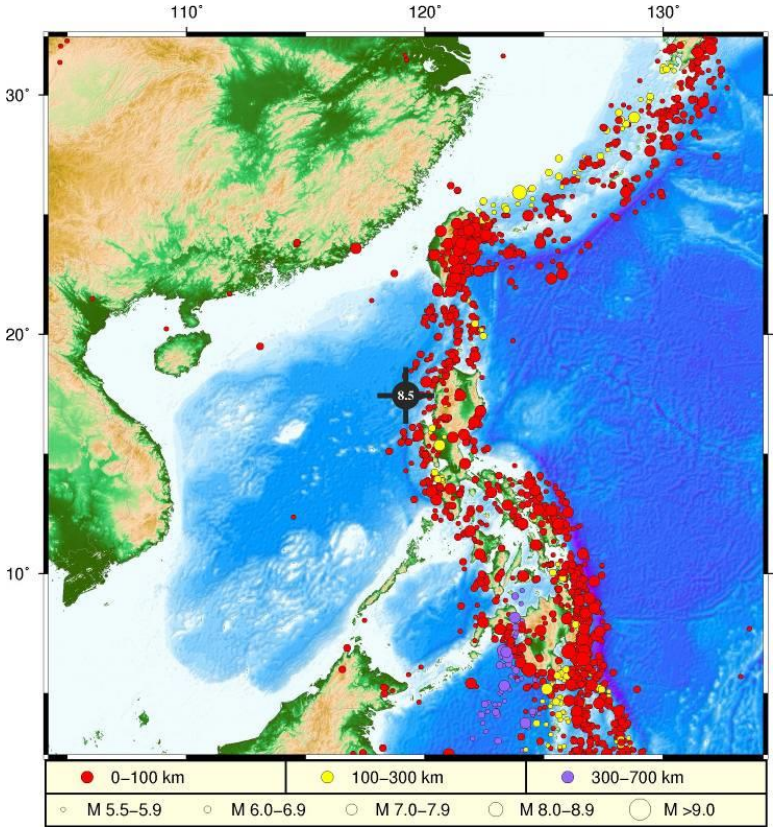


Figure 4. Earthquake scenario in Manila Trench

4.1.1 Text Product

----------BEGINNING OF BULLETIN ----------
WMO HEADING

TSUNAMI BULLETIN NUMBER 01
ISSUED BY SOUTH CHINA SEA TSUNAMI ADVISORY CENTER (SCSTAC)
ISSUED AT 2134 UTC JUL 14 2015

... POTENTIAL TSUNAMI THREAT EXISTS FOR BRUNEI, CHINA, INDONESIA, MALAYSIA, PHILIPPINES, VIETNAM...

****NOTICE****NOTICE****NOTICE****NOTICE****NOTICE*****NOTICE*****
THIS STATEMENT IS ISSUED FOR INFORMATION ONLY IN SUPPORT OF THEUNESCO/IOC SOUTH CHINA SEA SUB-REGIONAL TSUNAMI WARNING AND MITIGATION SYSTEM. NATIONAL AUTHORITIES WILL BE RESPONSIBLE FOR DETERMINATION OF THE APPROPRIATE LEVEL OF ALERT FOR EACH COUNTRY. THE PUBLIC SHOULD FOLLOW THE GUIDANCE OF NATIONAL AUTHORITIES.
**** NOTICE **** NOTICE ****NOTICE **** NOTICE **** NOTICE *****NOTICE*****

[PRELIMINARY EARTHQUAKE PARAMETERS (REVISION)]
*MAGNITUDE 8.5
*ORIGIN TIME 2126 UTC NOV15 2014
*COORDINATES 17.4N, 119.2E
*DEPTH 18 KM
*LOCATION PHILIPPINE ISLANDS REGION

[EVALUATION]

THERE IS A POSSIBILITY OF A DESTRUCTIVE BASIN-WIDE TSUNAMI BASED ON AVAILABLE INFORMATION.

[TSUNAMI AMPLITUDE AND ETA FORECASTS]

FORECAST POINTS	COORDINATES		ETA(UTC)	COAST_MAX_AMP(m)
BRUNEI				
MUARA	5.0N	115.1E	01:53	1-3
CHINA				
SANYA	18.2N	109.5E	00:08	1-3
SHANWEI	22.8N	115.3E	00:51	>3
HONG_KONG	22.3N	114.2E	01:47	>3
MACAO	22.2N	113.6E	02:12	>3
SHENZHEN	22.5N	113.9E	02:51	>3
ZHAPO	21.5N	111.8E	01:33	>3
QINGLAN	19.6N	110.9E	23:57	1-3
KAOHSIUNG, TAIWAN	22.5N	120.3E	22:28	>3
INDONESIA				
KEPULAUAN_RIAU	4.0N	108.5E	02:25	0.3-1
MALAYSIA				
K_TERENGGANU	5.3N	103.2E	07:25	0.3-1
BINTULU	3.2N	113.0E	03:03	0.3-1
SANDAKAN	5.9N	118.1E	02:34	0.3-1
PHILIPPINES				
SUBIC_BAY	14.8N	120.3E	22:55	>3
CURRIMAO	18.0N	120.4E	21:44	>3
LAOAG	18.2N	120.6E	21:51	>3
SAN_FERNANDO	16.6N	120.3E	21:50	>3
MANILA	14.6N	121.0E	00:12	>3
ILOILO	10.7N	122.5E	23:47	1-3
PUERTO_PRINCESA	9.8N	118.8E	00:17	0.3-1
MAIMBUNG	5.9N	121.0E	00:56	0.3-1
GENERAL_SANTOS	6.1N	125.2E	00:44	0.3-1
VIET NAM				
VINH	18.6N	105.7E	04:49	0.3-1
QUI_NHON	13.7N	109.2E	00:06	>3
BAC_LIEU	9.3N	105.8E	07:04	0.3-1
NHA_TRANG	12.3N	109.2E	00:38	>3
DA_NANG	16.0N	108.3E	00:48	1-3
VUNG_TAU	10.3N	107.1E	03:14	1-3

* THIS LIST IS GROUPED BY COUNTRIES, AND COUNTRY NAMES ARE ORDERED ACCORDING TO THREAT LEVELS.

* ETA - ESTIMATED TIME OF ARRIVAL FOR INITIAL WAVE. NOTING THAT IN SOME COASTAL AREA TSUNAMI WAVES MAY ARRIVE EARLIER THAN OUR ESTIMATE DUE TO COARSE BATHYMETRY USED BY MODEL.

* MAX. AMPL - MAXIMUM WAVE HEIGHT RELATIVE TO NORMAL SEA LEVEL, WHICH ARE EXTRACTED FROM MODEL RESULTS AND GROUPED INTO FOUR BINS OF '<0.3 M; 0.3 TO 1 M; 1 TO 3 M and ABOVE 3 M'. NOTING THAT THE INITIAL WAVE MAY NOT NECESSARILY THE LARGEST, AND WAVE ACTIVITIES MAY VARY SIGNIFICANT ALONG COASTS DUE TO LOCAL FEATURES.

[RECOMMENDED ACTIONS]

* LOCAL AUTHORITIES SHOULD PAY CLOSE ATTENTION ON THEIR NATIONAL TSUNAMI WARNING CENTER'S EVALUATION ON TSUNAMI HAZARD, AND TAKE APPROPRIATE ACTIONS IN RESPONSE TO THIS POTENTIAL HAZARD.
* PERSONS LOCATED IN THREATENED COASTAL AREAS SHOULD KEEP ALERT FOR WARNING INFORMATION AND FOLLOW INSTRUCTIONS FROM LOCAL AUTHORITIES.

[UPDATES]

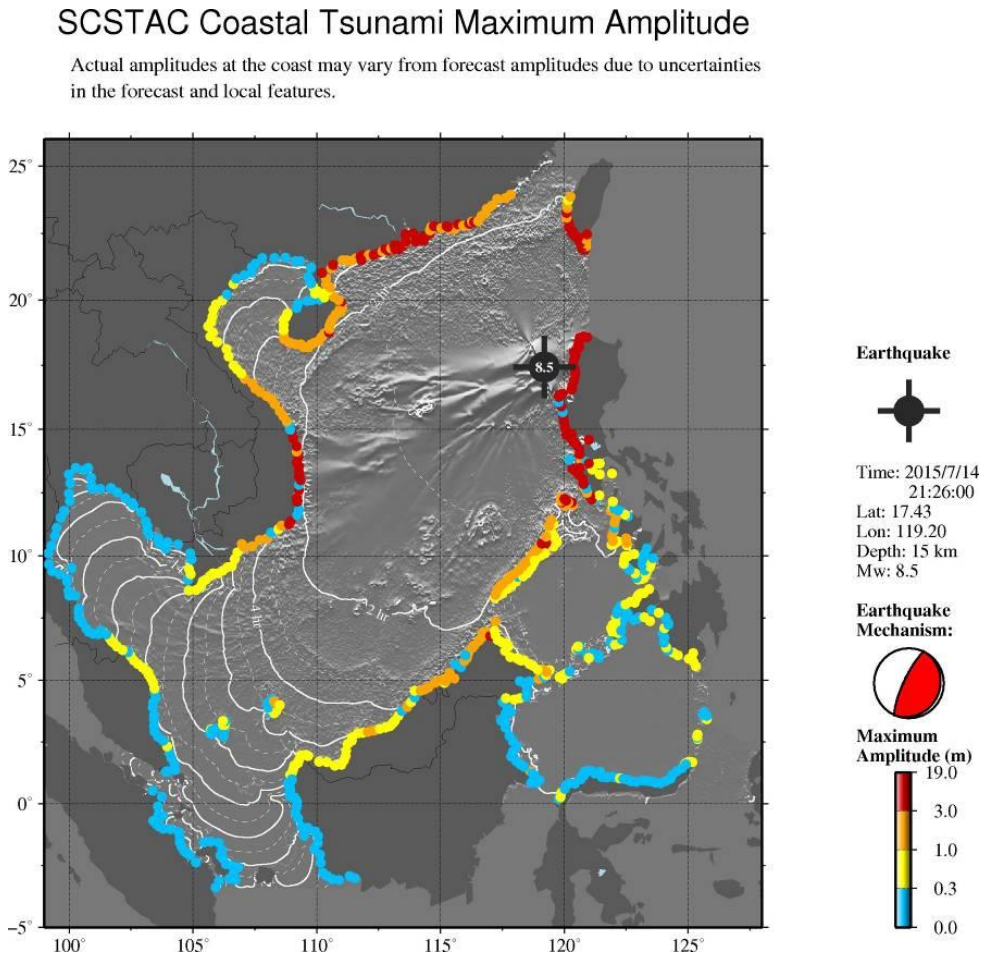
THE NEXT BULLETIN WILL BE ISSUED AS MORE INFORMATION BECOMES AVAILABLE.

[ADDITIONAL INFORMATION]

* MORE DETAILED INFORMATION CAN BE FOUND AT WEBSITE WWW.SCSTAC.ORG.
* TSUNAMI BULLETIN REGARDING THIS EVENT MAY BE ISSUED BY PACIFIC TSUNAMI WARNING CENTER AND NORTHWEST PACIFIC TSUNAMI ADVISORY CENTER. IN CASE OF CONFLICTING INFORMATION, MORE CONSERVATIVE INFORMATION SHOULD BE ADOPTED.
* TEL: +86-10-62104561
* EMAIL: TSU@NMEFC.CN

----------END OF BULLETIN ----------

4.1.2 **Graphic Products**



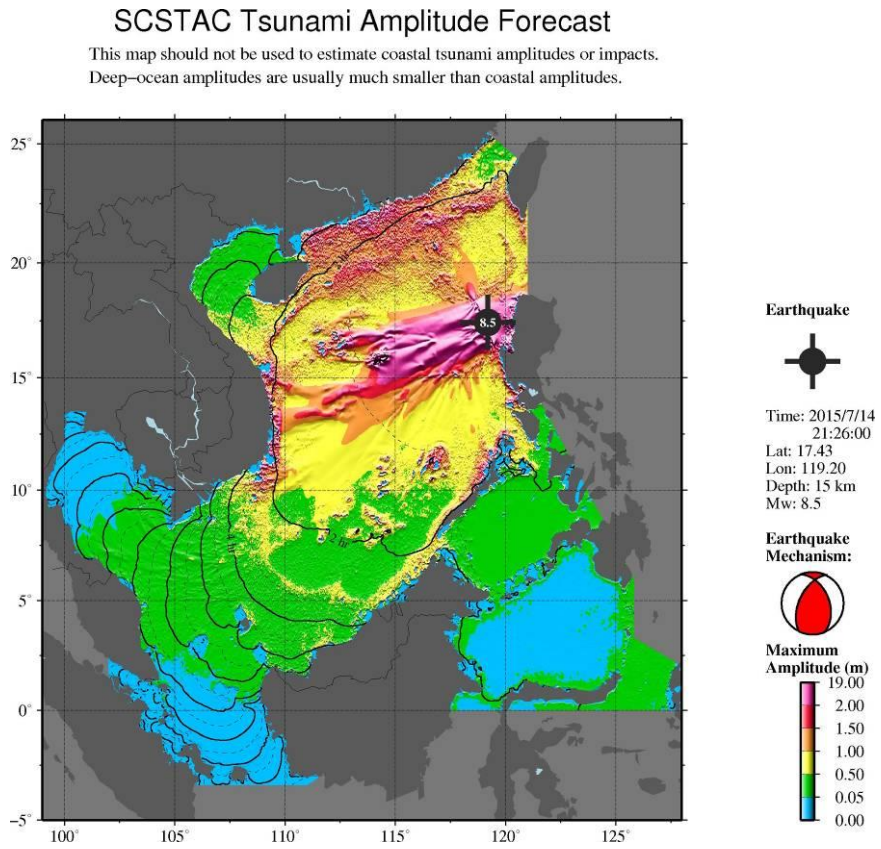


Figure 5. Tsunami scenario in Manila Trench: a. Coastal Amplitude Map; b. Tsunami Amplitude Forecast

4.2 SULU SEA

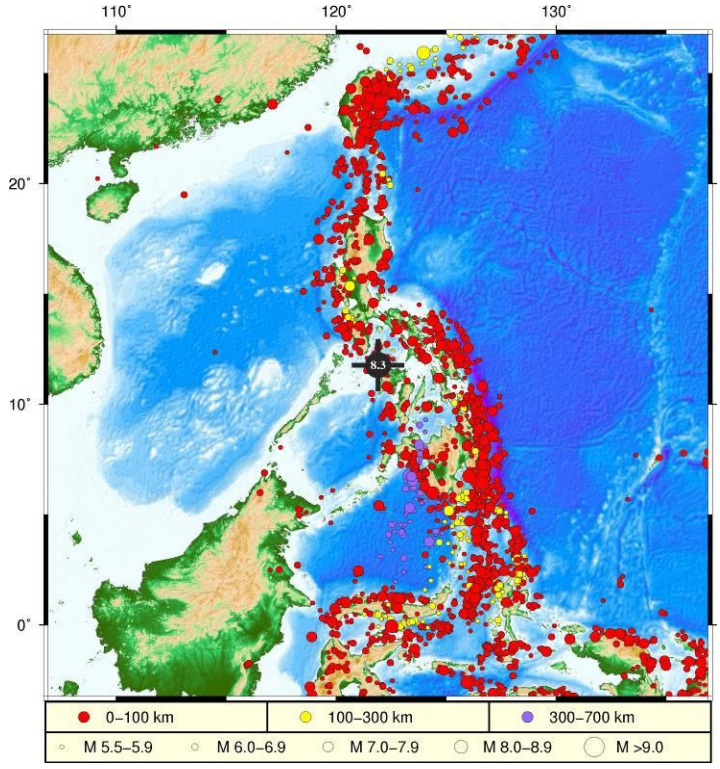


Figure 6. Earthquake scenario in Sulu Sea.

4.2.1 Text Products

----------BEGINNING OF BULLETIN ----------
WMO HEADING

TSUNAMI BULLETIN NUMBER 01
ISSUED BY SOUTH CHINA SEA TSUNAMI ADVISORY CENTER (SCSTAC)
ISSUED AT 2208 UTC JUL 14 2015

... POTENTIAL TSUNAMI THREAT EXISTS FOR MALAYSIA,PHILIPPINES...

****NOTICE****NOTICE****NOTICE****NOTICE****NOTICE*****NOTICE*****
THIS STATEMENT IS ISSUED FOR INFORMATION ONLY IN SUPPORT OF THEUNESCO/IOC SOUTH CHINA SEA SUB-REGIONAL TSUNAMI WARNING AND MITIGATION SYSTEM. NATIONAL AUTHORITIES WILL BE RESPONSIBLE FOR DETERMINATION OF THE APPROPRIATE LEVEL OF ALERT FOR EACH COUNTRY. THE PUBLIC SHOULD FOLLOW THE GUIDANCE OF NATIONAL AUTHORITIES.
**** NOTICE **** NOTICE ****NOTICE **** NOTICE **** NOTICE *****NOTICE*****

[PRELIMINARY EARTHQUAKE PARAMETERS]
*MAGNITUDE 8.3
*ORIGIN TIME 2157 UTC JUL 14 2015
*COORDINATES 11.8N, 121.9E
*DEPTH 18 KM
*LOCATION SULU SEA

[EVALUATION]
THERE IS A POSSIBILITY OF A DESTRUCTIVE BASIN-WIDE TSUNAMI BASED ON AVAILABLE INFORMATION.

[TSUNAMI AMPLITUDE AND ETA FORECASTS]

FORECAST POINTS	COORDINATES		ETA(UTC)	COAST_MAX_AMP(m)
MALAYSIA				
SANDAKAN	5.9N	118.1E	01:39	0.3-1
PHILIPPINES				
SUBIC_BAY	14.8N	120.3E	00:04	0.3-1
ILOILO	10.7N	122.5E	22:52	1-3
PUERTO_PRINCESA	9.8N	118.8E	23:22	0.3-1
MAIMBUNG	5.9N	121.0E	00:01	0.3-1

* THIS LIST IS GROUPED BY COUNTRIES, AND COUNTRY NAMES ARE ORDERED ACCORDING TO THREAT LEVELS.
* ETA - ESTIMATED TIME OF ARRIVAL FOR INITIAL WAVE. NOTING THAT IN SOME COASTAL AREA TSUNAMI WAVES MAY ARRIVE EARLIER THAN OUR ESTIMATE DUE TO COARSE BATHYMETRY USED BY MODEL.
* MAX. AMPL - MAXIMUM WAVE HEIGHT RELATIVE TO NORMAL SEA LEVEL, WHICH ARE EXTRACTED FROM MODEL RESULTS AND GROUPED INTO FOUR BINS OF '<0.3 M; 0.3 TO 1 M; 1 TO 3 M and ABOVE 3 M'. NOTING THAT THE INITIAL WAVE MAY NOT NECESSARILY THE LARGEST, AND WAVE ACTIVITIES MAY VARY SIGNIFICANT ALONG COASTS DUE TO LOCAL FEATURES.

[RECOMMENDED ACTIONS]
* LOCAL AUTHORITIES SHOULD PAY CLOSE ATTENTION ON THEIR NATIONAL TSUNAMI WARNING CENTER'S EVALUATION ON TSUNAMI HAZARD, AND TAKE APPROPRIATE ACTIONS IN RESPONSE TO THIS POTENTIAL HAZARD.
* PERSONS LOCATED IN THREATENED COASTAL AREAS SHOULD KEEP ALERT FOR WARNING INFORMATION AND FOLLOW INSTRUCTIONS FROM LOCAL AUTHORITIES.

[UPDATES]

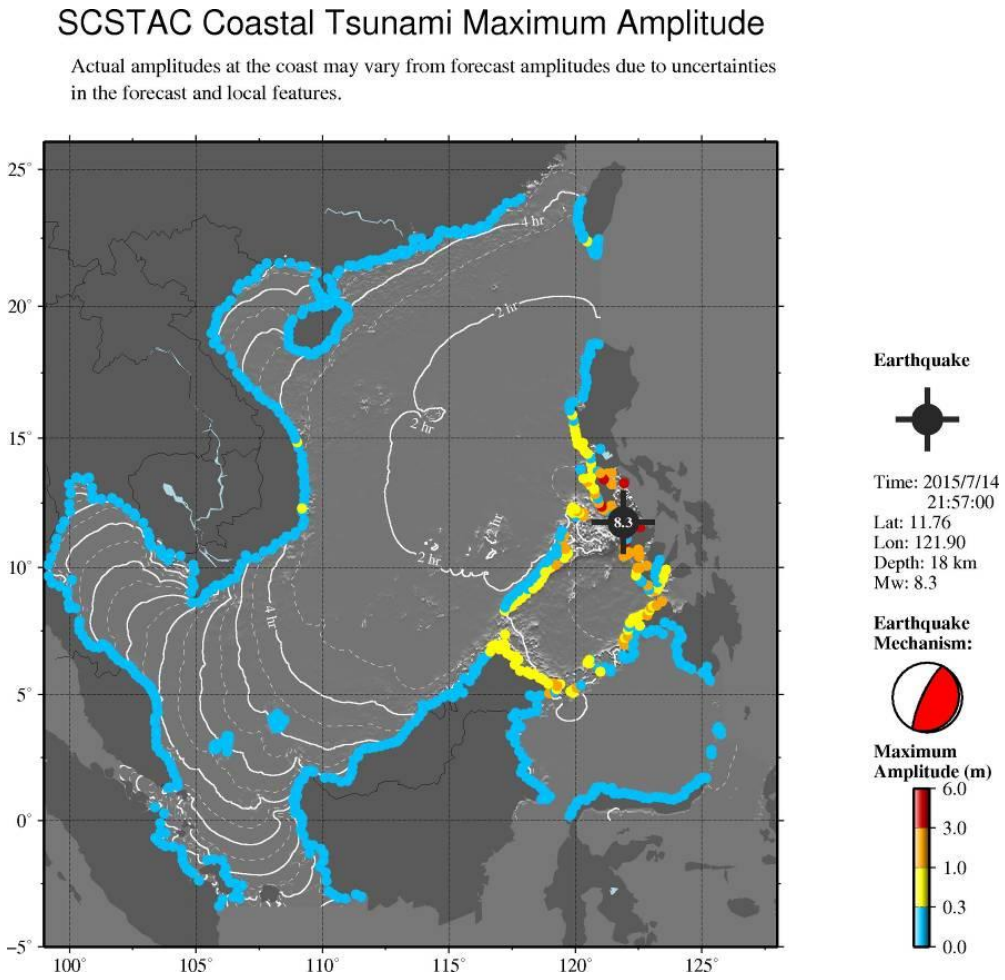
THE NEXT BULLETIN WILL BE ISSUED AS MORE INFORMATION BECOMES AVAILABLE.

[ADDITIONAL INFORMATION]

* MORE DETAILED INFORMATION CAN BE FOUND AT WEBSITE WWW.SCSTAC.ORG.
* TSUNAMI BULLETIN REGARDING THIS EVENT MAY BE ISSUED BY PACIFIC TSUNAMI WARNING CENTER AND NORTHWEST PACIFIC TSUNAMI ADVISORY CENTER. IN CASE OF CONFLICTING INFORMATION, MORE CONSERVATIVE INFORMATION SHOULD BE ADOPTED.
* TEL: +86-10-62104561
* EMAIL: TSU@NMEFC.CN

----------END OF BULLETIN ----------

4.2.2 **Graphic Products**



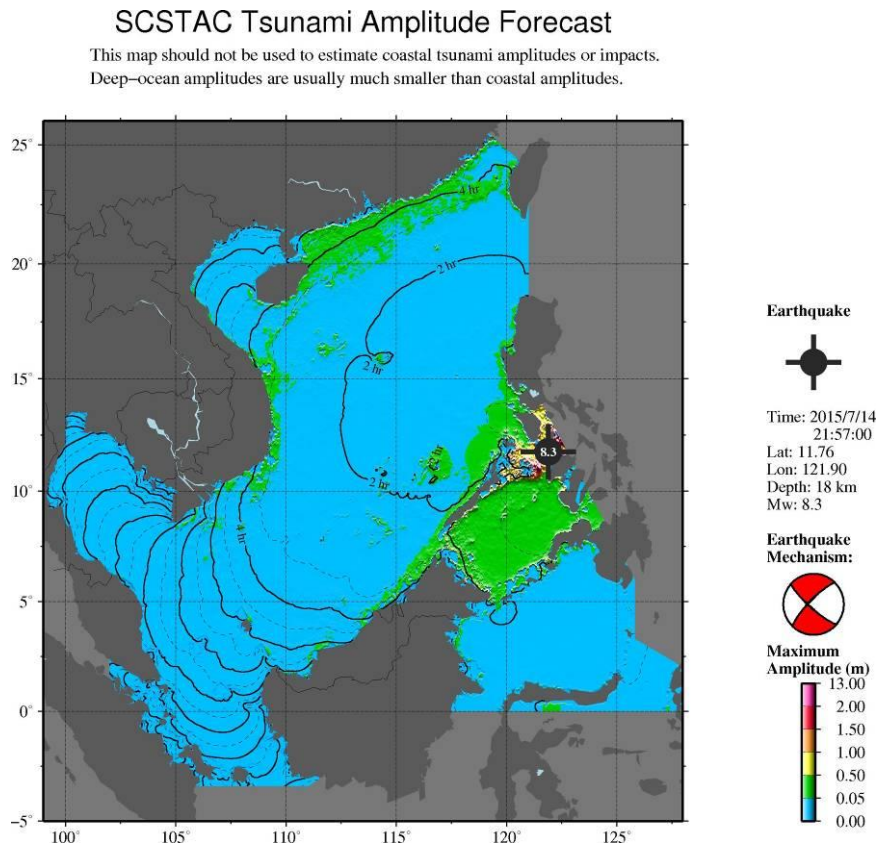


Figure 7**.** Tsunami scenario in Sulu Sea: a. Coastal Amplitude Map;
b. Tsunami Energy Map

ANNEX I

PRODUCT TEMPLATES

A. TSUNAMI INFORMATION (NO TSUNAMI THREAT:

(1) Earthquake magnitude 6.0-6.5; (2) Earthquake occurs inland; (3) Earthquake occurs at a depth of 100 km or more; (4) Minor tsunami expected for entire area with earthquake magnitude 6.6-7.0)

A.1 TSUNAMI INFORMATION (EARTHQUAKE MAGNITUDE 6.0-6.4)

WMO HEADING

TSUNAMI BULLETIN NUMBER 01
ISSUED BY SOUTH CHINA SEA TSUNAMI ADVISORY CENTER (SCSTAC)
ISSUED AT 1028 UTC MAY 15 2014

... TSUNAMI INFORMATION ...

****NOTICE****NOTICE****NOTICE****NOTICE****NOTICE*****NOTICE*****
THIS STATEMENT IS ISSUED FOR INFORMATION ONLY IN SUPPORT OF THEUNESCO/IOC SOUTH CHINA SEA SUB-REGIONAL TSUNAMI WARNING AND MITIGATION SYSTEM. NATIONAL AUTHORITIES WILL BE RESPONSIBLE FOR DETERMINATION OF THE APPROPRIATE LEVEL OF ALERT FOR EACH COUNTRY. THE PUBLIC SHOULD FOLLOW THE GUIDANCE OF NATIONAL AUTHORITIES.
**** NOTICE **** NOTICE ****NOTICE **** NOTICE **** NOTICE *****NOTICE*****

[PRELIMINARY EARTHQUAKE PARAMETERS]

*MAGNITUDE	6.3
*ORIGIN TIME	1016 UTC MAY15 2014
*COORDINATES	9.4N, 122.1E
*DEPTH	15 KM
*LOCATION	SULU SEA

[EVALUATION]
THERE IS NO TSUNAMI THREAT FROM THIS EARTHQUAKE BASED ON PRELIMINARY EARTHQUAKE PARAMETERS.

[RECOMMENDED ACTIONS]
NO ACTIONS IS REQUIRED.

[UPDATES]
THIS WILL BE THE ONLY BULLETIN REGARDING THIS EVENT UNLESS MAJOR REVISION ON EARTHQUAKE PARAMETERS BECOME AVAILABLE OR TSUNAMI WAVES ARE CONFIRMED.

[ADDITIONAL INFORMATION]
* MORE DETAILED INFORMATION CAN BE FOUND AT WEBSITE WWW.SCSTAC.ORG
* TEL: +86-10-62104561
* EMAIL: TSU@NMEFC.CN
----------END OF BULLETIN ----------

A.2 TSUNAMI INFORMATION (EARTHQUAKE OCCURS INLAND)

WMO HEADING

TSUNAMI BULLETIN NUMBER 01
ISSUED BY SOUTH CHINA SEA TSUNAMI ADVISORY CENTER (SCSTAC)
ISSUED AT 0912 UTC JUL 10 2014

... TSUNAMI INFORMATION ...

****NOTICE****NOTICE****NOTICE****NOTICE****NOTICE*****NOTICE*****
THIS STATEMENT IS ISSUED FOR INFORMATION ONLY IN SUPPORT OF THEUNESCO/IOC SOUTH CHINA SEA SUB-REGIONAL TSUNAMI WARNING AND MITIGATION SYSTEM. NATIONAL AUTHORITIES WILL BE RESPONSIBLE FOR DETERMINATION OF THE APPROPRIATE LEVEL OFA LERT FOR EACH COUNTRY. THE PUBLIC SHOULD FOLLOW THE GUIDANCE OF NATIONAL AUTHORITIES.
**** NOTICE **** NOTICE ****NOTICE **** NOTICE **** NOTICE *****NOTICE*****

[PRELIMINARY EARTHQUAKE PARAMETERS]
*MAGNITUDE 6.9
*ORIGIN TIME 0900 UTC JUL 10 2014
*COORDINATES 17.5N, 121.2E
*DEPTH 30 KM
*LOCATION LUZON, PHILIPPINES

[EVALUATION]
THERE IS NO TSUNAMI THREAT FROM THIS EARTHQUAKE BASED ON PRELIMINARY EARTHQUAKE PARAMETERS.

[RECOMMENDED ACTIONS]
NO ACTIONS IS REQUIRED.

[UPDATES]
THIS WILL BE THE ONLY BULLETIN REGARDING THIS EVENT UNLESS MAJOR REVISION ON EARTHQUAKE PARAMETERS BECOME AVAILABLE OR TSUNAMI WAVES ARE CONFIRMED.

[ADDITIONAL INFORMATION]
* MORE DETAILED INFORMATION CAN BE FOUND AT WEBSITE WWW.SCSTAC.ORG
* TSUNAMI BULLETIN REGARDING THIS EVENT MAY BE ISSUED BY PACIFIC TSUNAMI WARNING CENTER AND NORTHWEST PACIFIC TSUNAMI ADVISORY CENTER. IN CASE OF CONFLICTING INFORMATION, MORE CONSERVATIVE INFORMATION SHOULD BE ADOPTED.
* TEL: +86-10-62104561
* EMAIL: TSU@NMEFC.CN
----------END OF BULLETIN ----------

A.3 TSUNAMI INFORMATION (EARTHQUAKE OCCURS AT A DEPTH OF 100 KM OR MORE)

WMO HEADING

TSUNAMI BULLETIN NUMBER 01
ISSUED BY SOUTH CHINA SEA TSUNAMI ADVISORY CENTER (SCSTAC)
ISSUED AT 0525 UTC DEC 02 2014

... TSUNAMI INFORMATION ...

****NOTICE****NOTICE****NOTICE****NOTICE****NOTICE*****NOTICE*****

THIS STATEMENT IS ISSUED FOR INFORMATION ONLY IN SUPPORT OF THEUNESCO/IOC SOUTH CHINA SEA SUB-REGIONAL TSUNAMI WARNING AND MITIGATION SYSTEM. NATIONAL AUTHORITIES WILL BE RESPONSIBLE FOR DETERMINATION OF THE APPROPRIATE LEVEL OF ALERT FOR EACH COUNTRY. THE PUBLIC SHOULD FOLLOW THE GUIDANCE OF NATIONAL AUTHORITIES.
**** NOTICE **** NOTICE ****NOTICE **** NOTICE **** NOTICE *****NOTICE*****

[PRELIMINARY EARTHQUAKE PARAMETERS]
*MAGNITUDE 6.6
*ORIGIN TIME 0511 UTC DEC02 2014
*COORDINATES 6.2N, 123.1E
*DEPTH 614 KM
*LOCATION MORO GULF, PHILIPPINES

[EVALUATION]
THERE IS NO TSUNAMI THREAT FROM THIS EARTHQUAKE BASED ON PRELIMINARY EARTHQUAKE PARAMETERS.

[RECOMMENDED ACTIONS]
NO ACTIONS IS REQUIRED.

[UPDATES]
THIS WILL BE THE ONLY BULLETIN REGARDING THIS EVENT UNLESS MAJOR REVISION ON EARTHQUAKE PARAMETERS BECOME AVAILABLE OR TSUNAMI WAVES ARE CONFIRMED.

[ADDITIONAL INFORMATION]
* MORE DETAILED INFORMATION CAN BE FOUND AT WEBSITE WWW.SCSTAC.ORG
* TSUNAMI BULLETIN REGARDING THIS EVENT MAY BE ISSUED BY PACIFIC TSUNAMI WARNING CENTER AND NORTHWEST PACIFIC TSUNAMI ADVISORY CENTER. IN CASE OF CONFLICTING INFORMATION, MORE CONSERVATIVE INFORMATION SHOULD BE ADOPTED.
* TEL: +86-10-62104561
* EMAIL: TSU@NMEFC.CN

----------END OF BULLETIN ----------

A.4 TSUNAMI INFORMATION (MINOR TSUNAMI EXPECTED WITH EARTHQUAKE MAGNITUDE 6.5-7.0)

WMO HEADING

TSUNAMI BULLETIN NUMBER 01
ISSUED BY SOUTH CHINA SEA TSUNAMI ADVISORY CENTER (SCSTAC)
ISSUED AT 1024 UTC NOV 21 2014

... TSUNAMI INFORMATION ...

****NOTICE****NOTICE****NOTICE****NOTICE****NOTICE*****NOTICE*****
THIS STATEMENT IS ISSUED FOR INFORMATION ONLY IN SUPPORT OF THEUNESCO/IOC SOUTH CHINA SEA SUB-REGIONAL TSUNAMI WARNING AND MITIGATION SYSTEM. NATIONAL AUTHORITIES WILL BE RESPONSIBLE FOR DETERMINATION OF THE APPROPRIATE LEVEL OF ALERT FOR EACH COUNTRY. THE PUBLIC SHOULD FOLLOW THE GUIDANCE OF NATIONAL AUTHORITIES.
**** NOTICE **** NOTICE ****NOTICE **** NOTICE **** NOTICE *****NOTICE*****

[PRELIMINARY EARTHQUAKE PARAMETERS]
*MAGNITUDE 6.9
*ORIGIN TIME 1010 UTC NOV21 2014
*COORDINATES 2.1N, 127.0E
*DEPTH 10 KM
*LOCATION HALMAHERA INDONESIA

[EVALUATION]
THERE IS NO TSUNAMI THREAT FROM THIS EARTHQUAKE BASED ON HISTORICAL EARTHQUAKE AND TSUNAMI DATA. HOWEVER, NON-DESTRUCTIVE SEA LEVEL FLUCTUATIONS MAY BE GENERATED ALONG COASTS NEAR THE EPICENTER.

[RECOMMENDED ACTIONS]
PERSONS ALONG COASTAL AREAS NEAR THE EPICENTER SHOULD BE AWARE OF POSSIBILITY OF MINOR TSUNAMI WAVES AND UNUSUAL CURRENT. NO OTHER ACTION IS REQUIRED.

[UPDATES]
THIS WILL BE THE ONLY BULLETIN REGARDING THIS EVENT UNLESS MAJOR REVISION ON EARTHQUAKE PARAMETERS BECOME AVAILABLE OR TSUNAMI WAVES ARE CONFIRMED.

[ADDITIONAL INFORMATION]
* MORE DETAILED INFORMATION CAN BE FOUND AT WEBSITE WWW.SCSTAC.ORG
* TSUNAMI BULLETIN REGARDING THIS EVENT MAY BE ISSUED BY PACIFIC TSUNAMI WARNING CENTER AND NORTHWEST PACIFIC TSUNAMI ADVISORY CENTER. IN CASE OF CONFLICTING INFORMATION, MORE CONSERVATIVE INFORMATION SHOULD BE ADOPTED.
* TEL: +86-10-62104561
* EMAIL: TSU@NMEFC.CN

----------END OF BULLETIN ----------

A.5 TSUNAMI INFORMATION (SUPPLEMENTAL BULLETIN WITH MINOR TSUNAMI OBSERVATION)

WMO HEADING

TSUNAMI BULLETIN NUMBER 02
ISSUED BY SOUTH CHINA SEA TSUNAMI ADVISORY CENTER (SCSTAC)
ISSUED AT 1024 UTC NOV 21 2014

... TSUNAMI INFORMATION SUPPLEMENT ...

****NOTICE****NOTICE****NOTICE****NOTICE****NOTICE*****NOTICE*****
THIS STATEMENT IS ISSUED FOR INFORMATION ONLY IN SUPPORT OF THEUNESCO/IOC SOUTH CHINA SEA SUB-REGIONAL TSUNAMI WARNING AND MITIGATION SYSTEM. NATIONAL AUTHORITIES WILL BE RESPONSIBLE FOR DETERMINATION OF THE APPROPRIATE LEVEL OF ALERT FOR EACH COUNTRY. THE PUBLIC SHOULD FOLLOW THE GUIDANCE OF NATIONAL AUTHORITIES.
**** NOTICE **** NOTICE ****NOTICE **** NOTICE **** NOTICE *****NOTICE*****

[PRELIMINARY EARTHQUAKE PARAMETERS]
*MAGNITUDE 6.9
*ORIGIN TIME 1010 UTC NOV21 2014
*COORDINATES 2.1N, 127.0E
*DEPTH 10 KM
*LOCATION HALMAHERA INDONESIA

[TSUNAMI OBSERVATIONS]

GAUGE NAME	REGION	COORDINATES	TIME (UTC)	MAX. AMPL
BITUNG	INDONESIA	1.4N, 125.2E	1100	0.13 M
DAVAO	PHILIPPINES	7.1N, 125.6E	1310	0.08 M

* MAX. AMPL - TSUNAMI AMPLITUDE MEASURED RELATIVE TO NORMAL SEA LEVEL.

[EVALUATION]
ACCORDING TO AVAILABLE SEA LEVEL READINGS, THERE IS NO TSUNAMI THREAT FROM THIS EARTHQUAKE.
* TSUNAMI OBSERVATIONS INDICATE MINOR TSUNAMI WAVES WERE ACTUALLY GENERATED BY EARTHQUAKE. TSUNAMI AMPLITUDES MAY VARY ALONG COASTS DUE TO LOCAL FEATURES.

[RECOMMENDED ACTIONS]
PERSONS ALONG COASTAL AREAS NEAR THE EPICENTER SHOULD BE AWARE OF POSSIBILITY OF MINOR TSUNAMI WAVES AND UNUSUAL CURRENT. NO OTHER ACTION IS REQUIRED.

[UPDATES]
THIS WILL BE THE FINAL BULLETIN REGARDING THIS EVENT UNLESS FURTHER INFORMATION BECOMES AVAILABLE.

[ADDITIONAL INFORMATION]
* MORE DETAILED INFORMATION CAN BE FOUND AT WEBSITE WWW.SCSTAC.ORG.
* TSUNAMI BULLETIN REGARDING THIS EVENT MAY BE ISSUED BY PACIFIC TSUNAMI WARNING CENTER AND NORTHWEST PACIFIC TSUNAMI ADVISORY CENTER. IN CASE OF CONFLICTING INFORMATION, MORE CONSERVATIVE INFORMATION SHOULD BE ADOPTED.
* TEL: +86-10-62104561
* EMAIL: TSU@NMEFC.CN
----------END OF BULLETIN ----------

B. TSUNAMI THREAT MESSAGE (POSSIBILITY OF TSUNAMI THREAT

(1) With tsunami amplitude forecast; (2) Supplemental bulletin with revision on earthquake information or tsunami observations)

B.1 TSUNAMI THREAT MESSAGE (SUPPLEMENT WITH MAJOR REVISION)

WMO HEADING

TSUNAMI BULLETIN NUMBER 01
ISSUED BY SOUTH CHINA SEA TSUNAMI ADVISORY CENTER (SCSTAC)
ISSUED AT 0242 UTC NOV 15 2014

... POTENTIAL TSUNAMI THREAT EXISTS FOR PHILIPPINES ...

****NOTICE****NOTICE****NOTICE****NOTICE****NOTICE*****NOTICE*****
THIS STATEMENT IS ISSUED FOR INFORMATION ONLY IN SUPPORT OF THEUNESCO/IOC SOUTH CHINA SEA SUB-REGIONAL TSUNAMI WARNING AND MITIGATION SYSTEM. NATIONAL AUTHORITIES WILL BE RESPONSIBLE FOR DETERMINATION OF THE APPROPRIATE LEVEL OF ALERT FOR EACH COUNTRY. THE PUBLIC SHOULD FOLLOW THE GUIDANCE OF NATIONAL AUTHORITIES.
**** NOTICE **** NOTICE ****NOTICE **** NOTICE **** NOTICE *****NOTICE*****

[PRELIMINARY EARTHQUAKE PARAMETERS]
*MAGNITUDE 7.4
*ORIGIN TIME 0232 UTC NOV15 2014
*COORDINATES 18.4N, 119.3E
*DEPTH 25 KM
*LOCATION LUZON, PHILIPPINES

[EVALUATION]
THERE IS A POSSIBILITY OF A DESTRUCTIVE LOCAL TSUNAMI CONFINED TO 100-300 KM OF THE EPICENTER BASED ON AVAILABEL INFORMATION.

[TSUNAMI AMPLITUDE AND ETA FORECASTS]
FORECAST POINT COORDINATES ETA (UTC) MAX. AMPL

PHILIPPINES

CURRIMAO	18.0N, 120.5E	0330	0.3-1 M

---

* THIS LIST IS GROUPED BY COUNTRIES, AND COUNTRY NAMES ARE ORDERED ACCORDING TO THREAT LEVELS.
* ETA - ESTIMATED TIME OF ARRIVAL FOR INITIAL WAVE. NOTING THAT IN SOME COASTAL AREA TSUNAMI WAVES MAY ARRIVE EARLIER THAN OUR ESTIMATE DUE TO COARSE BATHYMETRY USED BY MODEL.
* MAX. AMPL - MAXIMUM WAVE HEIGHT RELATIVE TO NORMAL SEA LEVEL, WHICH ARE EXTRACTED FROM MODEL RESULTS AND GROUPED INTO FOUR BINS OF '<0.3 M; 0.3 TO 1 M; 1 TO 3 M and ABOVE 3 M'. NOTING THAT THE INITIAL WAVE MAY NOT NECESSARILY THE LARGEST, AND WAVE ACTIVITIES MAY VARY SIGNIFICANT ALONG COASTS DUE TO LOCAL FEATURES.

[RECOMMENDED ACTIONS]
* LOCAL AUTHORITIES SHOULD PAY CLOSE ATTENTION ON THEIR NATIONAL TSUNAMI WARNING CENTER'S EVALUATION ON TSUNAMI HAZARD, AND TAKE APPROPRIATE ACTIONS IN RESPONSE TO THIS POTENTIAL HAZARD.
* PERSONS LOCATED IN THREATENED COASTAL AREAS SHOULD KEEP ALERT FOR WARNING INFORMATION AND FOLLOW INSTRUCTIONS FROM LOCAL AUTHORITIES.

[UPDATES]
THE NEXT BULLETIN WILL BE ISSUED AS MORE INFORMATION BECOMES AVAILABLE.

[ADDITIONAL INFORMATION]
* MORE DETAILED INFORMATION CAN BE FOUND AT WEBSITE WWW.SCSTAC.ORG.
* TSUNAMI BULLETIN REGARDING THIS EVENT MAY BE ISSUED BY PACIFIC TSUNAMI WARNING CENTER AND NORTHWEST PACIFIC TSUNAMI ADVISORY CENTER. IN CASE OF CONFLICTING INFORMATION, MORE CONSERVATIVE INFORMATION SHOULD BE ADOPTED.
* TEL: +86-10-62104561
* EMAIL: TSU@NMEFC.CN

----------END OF BULLETIN ----------

B.2 TSUNAMI THREAT MESSAGE (SUPPLEMENTAL BULLETIN WITH MAJOR REVISION ON EARTHQUAKE MAGNITUDE AND TSUNAMI FORECASTS)

B.2.1 Text Product

WMO HEADING

TSUNAMI BULLETIN NUMBER 02
ISSUED BY SOUTH CHINA SEA TSUNAMI ADVISORY CENTER (SCSTAC)
ISSUED AT 0248 UTC NOV 15 2014

... POTENTIAL TSUNAMI THREAT EXISTS FOR PHILIPPINES, CHINA, VIETNAM, MALAYSIA, BRUNEI...

****NOTICE****NOTICE****NOTICE****NOTICE****NOTICE*****NOTICE*****
THIS STATEMENT IS ISSUED FOR INFORMATION ONLY IN SUPPORT OF THEUNESCO/IOC SOUTH CHINA SEA SUB-REGIONAL TSUNAMI WARNING AND MITIGATION SYSTEM. NATIONAL AUTHORITIES WILL BE RESPONSIBLE FOR DETERMINATION OF THE APPROPRIATE LEVEL OF ALERT FOR EACH COUNTRY. THE PUBLIC SHOULD FOLLOW THE GUIDANCE OF NATIONAL AUTHORITIES.
**** NOTICE **** NOTICE ****NOTICE **** NOTICE **** NOTICE *****NOTICE*****

[PRELIMINARY EARTHQUAKE PARAMETERS (REVISION)]
*MAGNITUDE 8.8
*ORIGIN TIME 0232 UTC NOV15 2014
*COORDINATES 18.4N, 119.3E

*DEPTH 25 KM
*LOCATION LUZON, PHILIPPINES

[EVALUATION]
THERE IS A POSSIBILITY OF A DESTRUCTIVE BASIN-WIDE TSUNAMI BASED ON AVAILABLE INFORMATION.

[TSUNAMI AMPLITUDE AND ETA FORECASTS (REVISION)]

FORECAST POINT	COORDINATES	ETA (UTC)	MAX. AMPL
PHILIPPINES			
CURRIMAO	18.0N, 120.5E	0310	>3 M
SUBIC_BAY	14.8N, 120.3E	0330	>3 M
LUBANG	13.8N, 120.2E	0350	1-3 M
CHINA			
QINGLAN	19.6N, 110.8E	0435	>3 M
SHENZHEN	22.5N, 113.9E	0540	>3 M
HONG KONG, CHINA			
QUARRY_BAY	22.3N, 114.3E	0510	>3 M
VIETNAM			
QUI_NHON	13.8N, 109.3E	0440	1-3 M
VUNG_TAU	10.3N, 107.1E	0520	0.3-1 M
MALAYSIA			
PAPAR	5.7N, 115.9E	0510	0.3-1 M
BRUNEI			
JERUDONG	5.0N, 114.8E	0522	0.3-1 M

* THIS LIST IS GROUPED BY COUNTRIES, AND COUNTRY NAMES ARE ORDERED ACCORDING TO THREAT LEVELS.
* ETA - ESTIMATED TIME OF ARRIVAL FOR INITIAL WAVE. NOTING THAT IN SOME COASTAL AREA TSUNAMI WAVES MAY ARRIVE EARLIER THAN OUR ESTIMATE DUE TO COARSE BATHYMETRY USED BY MODEL.
* MAX. AMPL - MAXIMUM WAVE HEIGHT RELATIVE TO NORMAL SEA LEVEL, WHICH ARE EXTRACTED FROM MODEL RESULTS AND GROUPED INTO FOUR BINS OF '<0.3 M; 0.3 TO 1 M; 1 TO 3 M and ABOVE 3 M'. NOTING THAT THE INITIAL WAVE MAY NOT NECESSARILY THE LARGEST, AND WAVE ACTIVITIES MAY VARY SIGNIFICANT ALONG COASTS DUE TO LOCAL FEATURES.

[RECOMMENDED ACTIONS]
* LOCAL AUTHORITIES SHOULD PAY CLOSE ATTENTION ON THEIR NATIONAL TSUNAMI WARNING CENTER'S EVALUATION ON TSUNAMI HAZARD, AND TAKE APPROPRIATE ACTIONS IN RESPONSE TO THIS POTENTIAL HAZARD.
* PERSONS LOCATED IN THREATENED COASTAL AREAS SHOULD KEEP ALERT FOR WARNING INFORMATION AND FOLLOW INSTRUCTIONS FROM LOCAL AUTHORITIES.

[UPDATES]
THE NEXT BULLETIN WILL BE ISSUED AS MORE INFORMATION BECOMES AVAILABLE.

[ADDITIONAL INFORMATION]
* MORE DETAILED INFORMATION CAN BE FOUND AT WEBSITE WWW.SCSTAC.ORG.
* TSUNAMI BULLETIN REGARDING THIS EVENT MAY BE ISSUED BY PACIFIC TSUNAMI WARNING CENTER AND NORTHWEST PACIFIC TSUNAMI ADVISORY CENTER. IN CASE OF CONFLICTING INFORMATION, MORE CONSERVATIVE INFORMATION SHOULD BE ADOPTED.
* TEL: +86-10-62104561
* EMAIL: TSU@NMEFC.CN

B.2.2 Tsunami Energy Map

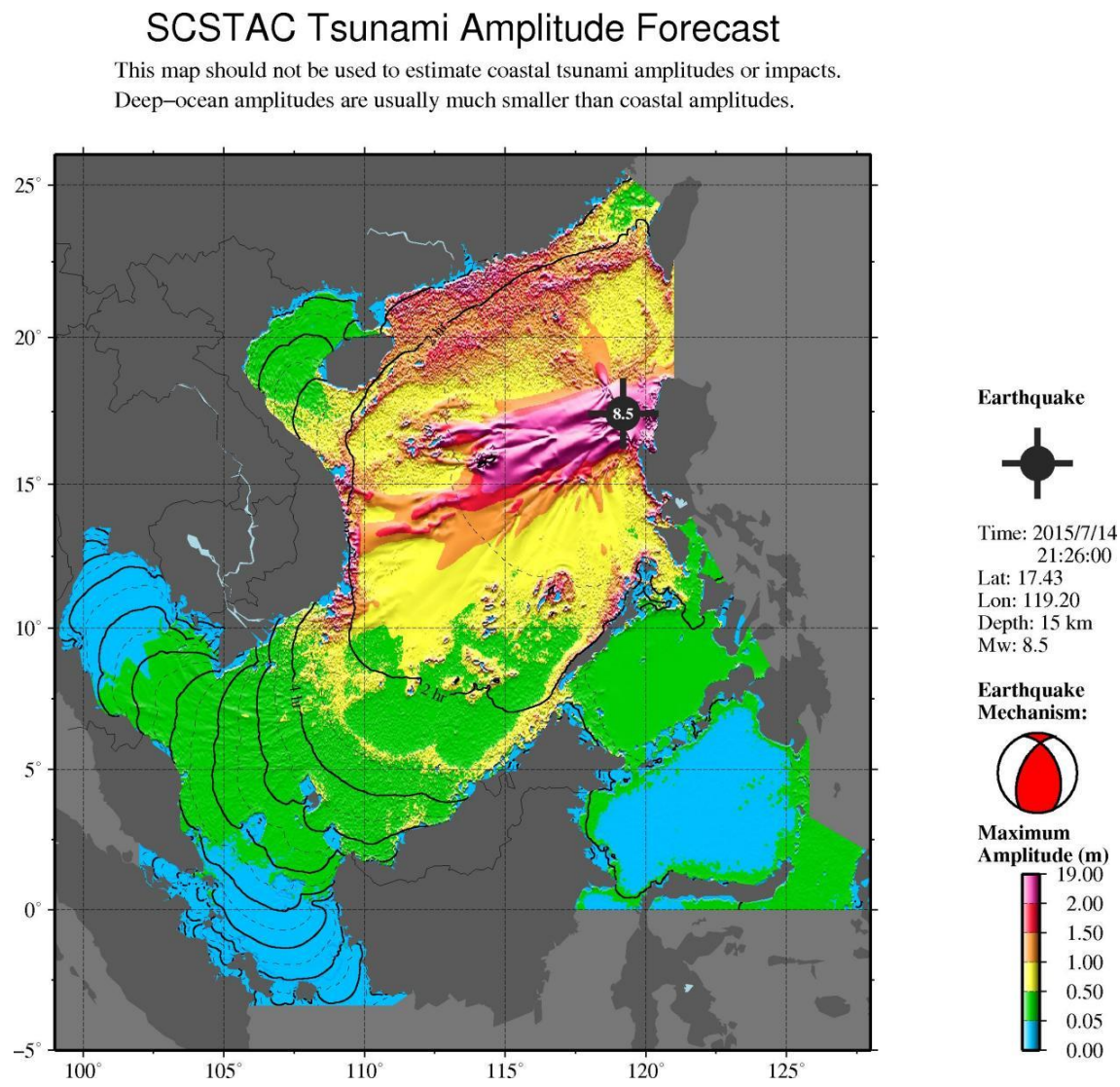


Figure I-1. Tsunami Amplitude Forescats Map

B.2.3 Coastal Tsunami Amplitude Map

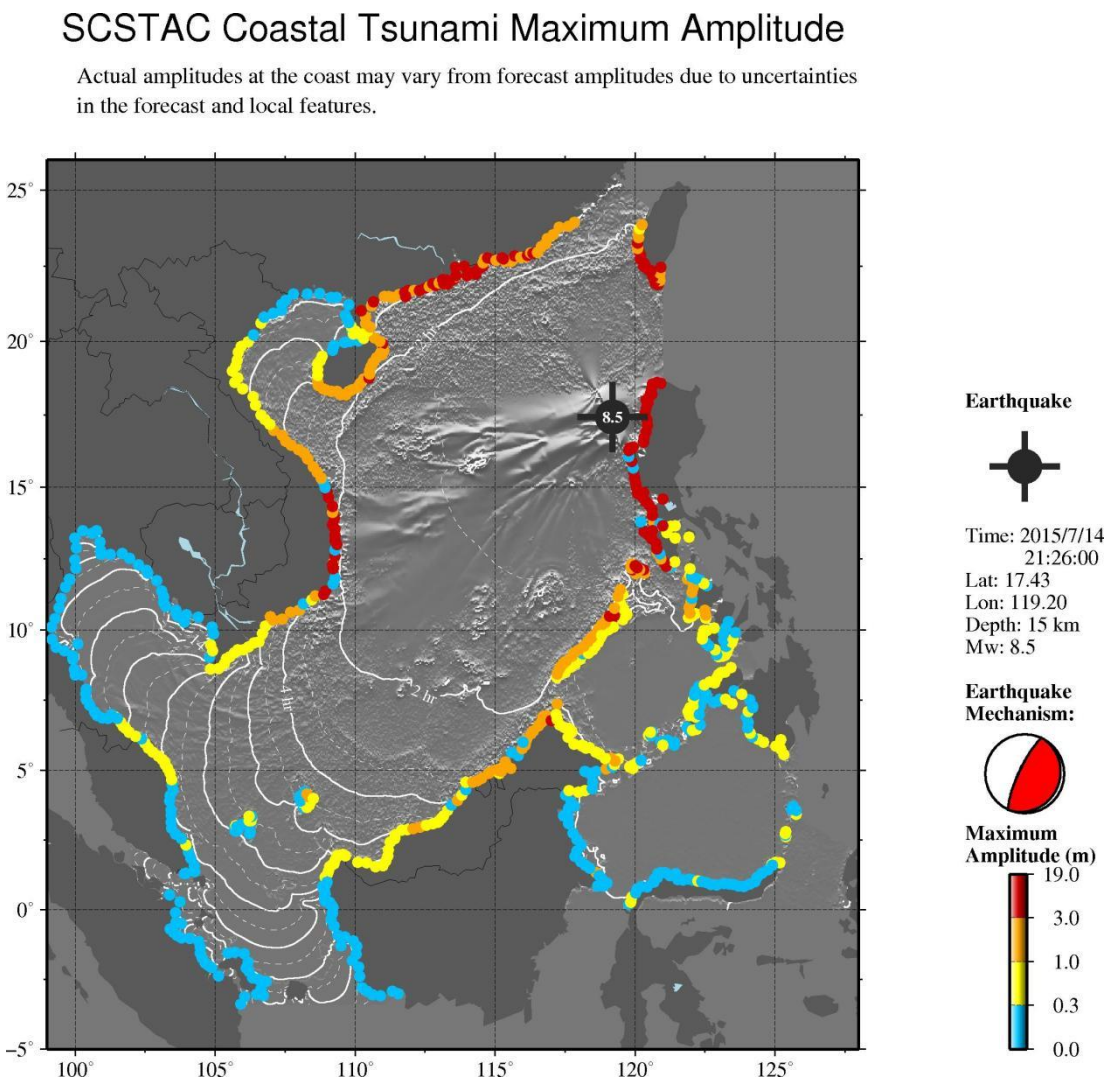


Figure I-2. Coastal Tsunami Amplitude Map.

B.3 TSUNAMI THREAT MESSAGE (SUPPLEMENTAL BULLETIN WITH TSUNAMI OBSERVATIONS REPORTED)

WMO HEADING

TSUNAMI BULLETIN NUMBER 03
ISSUED BY SOUTH CHINA SEA TSUNAMI ADVISORY CENTER (SCSTAC)
ISSUED AT 0450 UTC NOV 15 2014

...POTENTIAL TSUNAMI THREAT EXISTS FOR BRUNEI, CHINA, MALAYSIA, PHILIPPINES,VIETNAM...

****NOTICE****NOTICE****NOTICE****NOTICE****NOTICE*****NOTICE*****
THIS STATEMENT IS ISSUED FOR INFORMATION ONLY IN SUPPORT OF THEUNESCO/IOC SOUTH CHINA SEA SUB-REGIONAL TSUNAMI WARNING AND MITIGATION SYSTEM. NATIONAL AUTHORITIES WILL BE RESPONSIBLE FOR DETERMINATION OF THE APPROPRIATE LEVEL OF ALERT FOR EACH COUNTRY. THE PUBLIC SHOULD FOLLOW THE GUIDANCE OF NATIONAL AUTHORITIES.
**** NOTICE **** NOTICE ****NOTICE **** NOTICE **** NOTICE *****NOTICE*****

[PRELIMINARY EARTHQUAKE PARAMETERS]

*MAGNITUDE	8.8
*ORIGIN TIME	0232 UTC NOV15 2014
*COORDINATES	18.4N, 119.3E
*DEPTH	25 KM
*LOCATION	LUZON, PHILIPPINES

[TSUNAMI OBSERVATIONS]

GAUGE NAME	REGION	COORDINATES	TIME (UTC)	MAX. AMPL
CURRIMAO	PHILIPPINES	18.0N, 120.5E	0313	6.9 M
SUBIC_BAY	PHILIPPINES	14.8N, 120.3E	0330	4.2 M
QINGLAN	CHINA	19.6N, 110.8E	0445	3.2 M
QUI_NHON	VIETNAM	13.8N, 109.3E	0435	2.0 M

* MAX. AMPL - TSUNAMI AMPLITUDE MEASURED RELATIVE TO NORMAL SEA LEVEL.

[EVALUATION]

THERE IS A POSSIBILITY OF A DESTRUCTIVE BASIN-WIDE TSUNAMI IN THE SCS BASED ON AVAILABLE DATA AND MODEL RESULTS.

[TSUNAMI AMPLITUDE AND ETA FORECASTS (REVISION)]

FORECAST POINT	COORDINATES	ETA (UTC)	MAX. AMPL
CHINA			
SHENZHEN	22.5N, 113.9E	0540	1-3 M
HONG KONG, CHINA			
QUARRY_BAY	22.3N, 114.3E	0510	>3 M
VIETNAM			
VUNG_TAU	10.3N, 107.1E	0520	0.3-1 M
MALAYSIA			
PAPAR	5.7N, 115.9E	0510	0.3-1 M
BRUNEI			
JERUDONG	5.0N, 114.8E	0522	0.3-1 M

* THIS LIST IS GROUPED BY COUNTRIES, AND COUNTRY NAMES ARE ORDERED ACCORDING TO THREAT LEVELS.
* ETA - ESTIMATED TIME OF ARRIVAL FOR INITIAL WAVE. NOTING THAT IN SOME COASTAL AREA TSUNAMI WAVES MAY ARRIVE EARLIER THAN OUR ESTIMATE DUE TO COARSE BATHYMETRY USED BY MODEL.
* MAX. AMPL - MAXIMUM WAVE HEIGHT RELATIVE TO NORMAL SEA LEVEL, WHICH ARE EXTRACTED FROM MODEL RESULTS AND GROUPED INTO FOUR BINS OF '<0.3 M; 0.3 TO 1 M; 1 TO 3 M and ABOVE 3 M'. NOTING THAT THE INITIAL WAVE MAY NOT NECESSARILY THE LARGEST, AND WAVE ACTIVITIES MAY VARY SIGNIFICANT ALONG COASTS DUE TO LOCAL FEATURES.

[RECOMMENDED ACTIONS]

* LOCAL AUTHORITIES SHOULD PAY CLOSE ATTENTION ON THEIR NATIONAL TSUNAMI WARNING CENTER'S EVALUATION ON TSUNAMI HAZARD, AND TAKE APPROPRIATE ACTIONS IN RESPONSE TO THIS POTENTIAL HAZARD.
* PERSONS LOCATED IN THREATENED COASTAL AREAS SHOULD KEEP ALERT FOR WARNING INFORMATION AND FOLLOW INSTRUCTIONS FROM LOCAL AUTHORITIES.

[UPDATES]

THE NEXT BULLETIN WILL BE ISSUED AS MORE INFORMATION BECOMES AVAILABLE.

[ADDITIONAL INFORMATION]

* MORE DETAILED INFORMATION CAN BE FOUND AT WEBSITE WWW.SCSTAC.ORG.
* TSUNAMI BULLETIN REGARDING THIS EVENT MAY BE ISSUED BY PACIFIC TSUNAMI WARNING CENTER AND NORTHWEST PACIFIC TSUNAMI ADVISORY CENTER. IN CASE OF CONFLICTING INFORMATION, MORE CONSERVATIVE INFORMATION SHOULD BE ADOPTED.

* TEL: +86-10-62104561
* EMAIL: TSU@NMEFC.CN

----------END OF BULLETIN ----------

C. FINAL BULLETIN (Tsunami not confirmed by observations; Tsunami threat has passed)

C.1 FINAL BULLETIN (TSUNAMI NOT CONFIRMED BY OBSERVATIONS)

WMO HEADING

TSUNAMI BULLETIN NUMBER 02
ISSUED BY SOUTH CHINA SEA TSUNAMI ADVISORY CENTER (SCSTAC)
ISSUED AT 0350 UTC NOV 15 2014

... TSUNAMI THREAT NOT CONFIRMED...

****NOTICE****NOTICE****NOTICE****NOTICE****NOTICE*****NOTICE*****
THIS STATEMENT IS ISSUED FOR INFORMATION ONLY IN SUPPORT OF THEUNESCO/IOC SOUTH CHINA SEA SUB-REGIONAL TSUNAMI WARNING AND MITIGATION SYSTEM. NATIONAL AUTHORITIES WILL BE RESPONSIBLE FOR DETERMINATION OF THE APPROPRIATE LEVEL OF ALERT FOR EACH COUNTRY. THE PUBLIC SHOULD FOLLOW THE GUIDANCE OF NATIONAL AUTHORITIES.
**** NOTICE **** NOTICE ****NOTICE **** NOTICE **** NOTICE *****NOTICE*****

[PRELIMINARY EARTHQUAKE PARAMETERS]
*MAGNITUDE 7.4
*ORIGIN TIME 0232 UTC NOV15 2014
*COORDINATES 18.4N, 119.3E
*DEPTH 25 KM
*LOCATION LUZON, PHILIPPINES

[EVALUATION]
NO EVIDENCE SHOWED A DESTRUCTIVE TSUNAMI ACTUALLY OCCURED BASED ON ALL AVAILABLE INFORMATION. HOWEVER, NATIONAL TSUNAMI WARNING CENTERS SHOULD CONTINUOUSLY MONITOR THEIR OWN SEA LEVEL STATIONS DUE TO RELATIVELY SPARSE OBSERVING NETWORKS IN THIS REGION.

[RECOMMENDED ACTIONS]
* LOCAL AUTHORITIES MAY ASSUME NO TSUNAMI THREAT EXISTS WHEN NO OBVIOUS SEA LEVEL FLUCTUATION OBSERVED FOR TWO HOURS AFTER THE ESTIMATED TIME OF ARRIVAL.
* PERSONS LOCATED IN THREATENED COASTAL AREAS SHOULD KEEP ALERT FOR WARNING INFORMATION AND FOLLOW INSTRUCTIONS FROM LOCAL AUTHORITIES.

[UPDATES]
THIS WILL BE THE FINAL BULLETIN REGARDING THIS EVENT UNLESS ADDITIONAL INFORMATION BECOMES AVAILABLE..

[ADDITIONAL INFORMATION]
* MORE DETAILED INFORMATION CAN BE FOUND AT WEBSITE WWW.SCSTAC.ORG.
* TSUNAMI BULLETIN REGARDING THIS EVENT MAY BE ISSUED BY PACIFIC TSUNAMI WARNING CENTER AND NORTHWEST PACIFIC TSUNAMI ADVISORY CENTER. IN CASE OF CONFLICTING INFORMATION, MORE CONSERVATIVE INFORMATION SHOULD BE ADOPTED.
* TEL: +86-10-62104561
* EMAIL: TSU@NMEFC.CN

----------END OF BULLETIN ----------

C.2 FINAL BULLETIN (TSUNAMI THREAT HAS PASSED)

WMO HEADING

TSUNAMI BULLETIN NUMBER 04
ISSUED BY SOUTH CHINA SEA TSUNAMI ADVISORY CENTER (SCSTAC)
ISSUED AT 1250 UTC NOV 15 2014

... TSUNAMI THREAT HAS PASSED...

****NOTICE****NOTICE****NOTICE****NOTICE****NOTICE*****NOTICE*****
THIS STATEMENT IS ISSUED FOR INFORMATION ONLY IN SUPPORT OF THEUNESCO/IOC SOUTH CHINA SEA SUB-REGIONAL TSUNAMI WARNING AND MITIGATION SYSTEM. NATIONAL AUTHORITIES WILL BE RESPONSIBLE FOR DETERMINATION OF THE APPROPRIATE LEVEL OF ALERT FOR EACH COUNTRY. THE PUBLIC SHOULD FOLLOW THE GUIDANCE OF NATIONAL AUTHORITIES.
**** NOTICE **** NOTICE ****NOTICE **** NOTICE **** NOTICE *****NOTICE*****

[PRELIMINARY EARTHQUAKE PARAMETERS]

*MAGNITUDE	8.8
*ORIGIN TIME	0232 UTC NOV15 2014
*COORDINATES	18.4N, 119.3E
*DEPTH	25 KM
*LOCATION	LUZON, PHILIPPINES

[EVALUATION]
BASED ON ALL AVAILABLE DATA, TSUNAMI THREAT NO LONGER EXISTS. HOWEVER, DUE TO LOCAL FEATURES MINOR SEA LEVEL FLUCTUATIONS MAY CONTINUE FOR HOURS.

[RECOMMENDED ACTIONS]
* LOCAL AUTHORITIES MAY ASSUME NO TSUNAMI THREAT EXISTS WHEN NO OBVIOUS SEA LEVEL FLUCTUATION OBSERVED FOR TWO HOURS AFTER THE ESTIMATED TIME OF ARRIVAL OR HAZARDOUS WAVES HAVE NOT OCCURED FOR AT LEAST TWO HOURS.
* PERSONS LOCATED IN THREATENED COASTAL AREAS SHOULD KEEP ALERT FOR WARNING INFORMATION AND FOLLOW INSTRUCTIONS FROM LOCAL AUTHORITIES.

[UPDATES]
THIS WILL BE THE FINAL BULLETIN REGARDING THIS EVENT UNLESS ADDITIONAL INFORMATION BECOMES AVAILABLE..

[ADDITIONAL INFORMATION]
* MORE DETAILED INFORMATION CAN BE FOUND AT WEBSITE WWW.SCSTAC.ORG.
* TSUNAMI BULLETIN REGARDING THIS EVENT MAY BE ISSUED BY PACIFIC TSUNAMI WARNING CENTER AND NORTHWEST PACIFIC TSUNAMI ADVISORY CENTER. IN CASE OF CONFLICTING INFORMATION, MORE CONSERVATIVE INFORMATION SHOULD BE ADOPTED.
* TEL: +86-10-62104561
* EMAIL: TSU@NMEFC.CN

----------END OF BULLETIN ----------

ANNEX II

LIST OF COASTAL FORECASTING POINTS FOR ETA AND AMPLITUDE

	COUNTRY/PLACE	LOCATION	LATITUDE	LONGITUDE
1	BRUNEI	MUARA	5.0°N	115.1°E
2	CAMBODIA	SIHANOUKVILLE	10.6°N	103.6°E
3	CHINA	SANYA	18.2°N	109.5°E
4	CHINA	SHANWEI	22.75°N	115.3°E
5	CHINA	HONG_KONG	22.3°N	114.2°E
6	CHINA	MACAO	22.2°N	113.6°E
7	CHINA	SHENZHEN	22.5°N	113.9°E
8	CHINA	ZHAPO	21.5°N	111.8°E
9	CHINA	QINGLAN	19.6°N	110.9°E
10	CHINA	KAOHSIUNG, TAIWAN	22.5°N	120.3°E
11	INDONESIA	TABUKAN_TENGAH	3.6°N	125.6°E
12	INDONESIA	PANGKALPINANG	2.1°S	106.1°E
13	INDONESIA	KEPULAUAN_RIAU	4.0°N	108.5°E
14	INDONESIA	KUALA_INDRAGIRI	0.5°S	103.8°E
15	INDONESIA	SINGKAWANG	1.0°N	109.0°E
16	INDONESIA	TARAKAN	3.3°N	117.6°E
17	INDONESIA	MELONGUANE	4.1°N	126.6°E
18	INDONESIA	TOLI-TOLI	1.1°N	120.7°E
19	INDONESIA	GORONTALO	0.5°N	123.0°E
20	INDONESIA	MANADO	1.6°N	124.9°E
21	INDONESIA	JAILOLO	1.1°N	127.5°E
22	MALAYSIA	K_TERENGGANU	5.3°N	103.2°E
23	MALAYSIA	BINTULU	3.2°N	113.0°E
24	MALAYSIA	KOTA_KINABALU	6.0°N	116.0°E
25	MALAYSIA	LAHAD_DATU	4.9°N	118.4°E
26	MALAYSIA	SANDAKAN	5.9°N	118.1°E
27	MALAYSIA	KUDAT	6.9°N	116.9°E
28	PHILIPPINES	LUBANG	13.8°N	120.2°E
29	PHILIPPINES	SUBIC_BAY	14.82°N	120.3°E
30	PHILIPPINES	CURRIMAO	18.0°N	120.4°E
31	PHILIPPINES	LAOAG	18.2°N	120.6°E
32	PHILIPPINES	SAN_FERNANDO	16.6°N	120.3°E
33	PHILIPPINES	MANILA	14.6°N	121.0°E
34	PHILIPPINES	ILOILO	10.7°N	122.5°E
35	PHILIPPINES	PUERTO_PRINCESA	9.8°N	118.8°E
36	PHILIPPINES	ZAMBOANGA	7.0°N	122.3°E
37	PHILIPPINES	MAIMBUNG	5.9°N	121.0°E

	COUNTRY/PLACE	LOCATION	LATITUDE	LONGITUDE
38	PHILIPPINES	COTABATO_CITY	7.3°N	124.2°E
39	PHILIPPINES	GENERAL_SANTOS	6.1°N	125.2°E
40	SINGAPORE	SINGAPORE	1.3°N	103.9°E
41	THAILAND	PRACHUAP_KRK	11.8°N	99.8°E
42	THAILAND	PATTAYA	12.8°N	100.9°E
43	THAILAND	NAKHON_SI_TMR	8.4°N	100.0°E
44	THAILAND	NARATHIWAT	6.5°N	101.8°E
45	THAILAND	SONGKHLA	7.2°N	100.6°E
46	THAILAND	SAMUI_ISLAND	9.5°N	100.1°E
47	THAILAND	BANGKOK	13.4°N	100.6°E
48	THAILAND	TRAT	12.0°N	102.6°E
49	VIET NAM	VINH	18.6°N	105.7°E
50	VIET NAM	QUI_NHON	13.7°N	109.2°E
51	VIET NAM	QUANG_NGAI	15.1°N	108.9°E
52	VIET NAM	NHA_TRANG	12.3°N	109.2°E
53	VIET NAM	DA_NANG	16°N	108.3°E
54	VIET NAM	VUNG_TAU	10.34°N	107.071°E
55	VIET NAM	HAI_PHONG	20.7°N	106.9°E

Table II-1. List of Coastal Forecasting Points

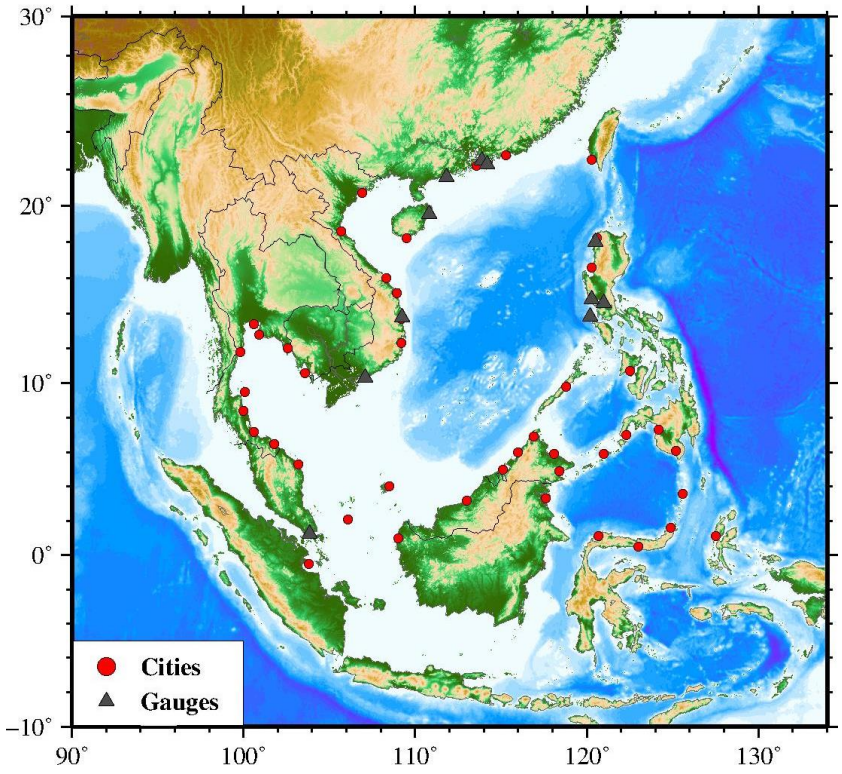


Figure II-1**.** Coastal Forecasting Points for the SCS tsunami advisory products.

ANNEX III

LIST OF ACRONYMS

AoS	Area of Service
BMKG	Meteorological, Climatological and Geophysical Agency
DSS	Decision support system
ETA	Estimated time of arrival
ICG/PTWS	Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System
IOC	Intergovernmental Oceanographic Commission (UNESCO)
NMEFC	National Marine Environmental Forecasting Center, China
NTWC	National Tsunami Warning Centre
NW	North-West
NWPTAC	Northwest Pacific Tsunami Advisory Center
PTWC	Pacific Tsunami Warning Center
PTWS	Pacific Tsunami Warning and Mitigation System
SCS	South China Sea
SCSTAC	South China Sea Tsunami Advisory Center
SOA	State Oceanic Administration, China
SOP	Standard Operating Procedures
TT-SCSTAC	Task Team on the Establishment of a South China Sea Tsunami Advisory Center
TTT	Tsunami Travel Time
TWFP	Tsunami Warning Focal Point
WCMT	W-phase Centroid Moment Tensor

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 Interealibration 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 Bathymerographs 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 *Pacem in Maribus* 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 1'exploitation des pêcheries maritimes au Cameroun et leur gestion intégrée dans la sous-région du Golfe de Guinée *(cancelled)*	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 (8th 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 (9th 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 (10th 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 (11th 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 (12th training-through-research cruise, June-August 2002). 2003	E only
68	Interdisciplinary Studies of North Atlantic and Labrador Sea Margin Architecture and Sedimentary Processes (13th 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 (14th 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 (2nd Revision). 2009	E only
72	Deep-water Cold Seeps, Sedimentary Environments and Ecosystems of the Black and Tyrrhenian Seas and the Gulf of Cadiz (15th 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 *(electronic only)*	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 (16th 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
83.	*Cancelled*	
84.	Global Open Oceans and Deep Seabed (GOODS) Bio-geographic Classification. 2009	E only
85.	Tsunami Glossary	E, F, S
86	Pacific Tsunami Warning System (PTWS) Implementation Plan	*Electronic publication*

(continued)

87.	Operational Users Guide for the Pacific Tsunami Warning and Mitigation System (PTWS) – Second Edition. 2011	E only
88.	Exercise Indian Ocean Wave 2009 (IOWave09) – An Indian Ocean-wide Tsunami Warning and Communication Exercise – 14 October 2009. 2009	E only
89.	Ship-based Repeat Hydrography: A Strategy for a Sustained Global Programme. 2009	E only
90.	12 January 2010 Haiti Earthquake and Tsunami Event Post-Event Assessment of CARIBE EWS Performance. 2010	E only
91.	Compendium of Definitions and Terminology on Hazards, Disasters, Vulnerability and Risks in a coastal context	*Under preparation*
92.	27 February 2010 Chile Earthquake and Tsunami Event – Post-Event Assessment of PTWS Performance (Pacific Tsunami Warning System). 2010	E only
93.	Exercise CARIBE WAVE 11 / LANTEX 11—A Caribbean Tsunami Warning Exercise, 23 March 2011	
	Vol. 1 Participant Handbook / Exercise CARIBE WAVE 11 —Exercice d'alerte au tsunami dans les Caraïbes, 23 mars 2011. Manuel du participant / Ejercicio Caribe Wave 11. Un ejercicio de alerta de tsunami en el Caribe, 23 de marzo de 2011. Manual del participante. 2010	E/F/S
	Vol. 2 Report. 2011	E only
	Vol. 3 Supplement: Media Reports. 2011	E/F/S
94.	Cold seeps, coral mounds and deep-water depositional systems of the Alboran Sea, Gulf of Cadiz and Norwegian continental margin (17th training-through-research cruise, June–July 2008)	E only
95.	International Post-Tsunami Survey for the 25 October 2010 Mentawai, Indonesia Tsunami	E only
96.	Pacific Tsunami Warning System (PTWS) 11 March 2011 Off Pacific coast of Tohoku, Japan, Earthquake and Tsunami Event. Post-Event Assessment of PTWS Performance	E only
97.	Exercise PACIFIC WAVE 11: A Pacific-wide Tsunami Warning and Communication Exercise, 9–10 November 2011	
	Vol. 1 Exercise Manual. 2011	E only
	Vol. 2 Report. 2013	E only
98.	Tsunami Early Warning and Mitigation System in the North-Eastern Atlantic, the Mediterranean and connected seas. First Enlarged Communication Test Exercise (ECTE1). Exercise Manual and Evaluation Report. 2011	E only
99.	Exercise INDIAN OCEAN WAVE 2011 – An Indian Ocean-wide Tsunami Warning and Communication Exercise, 12 October 2011	E only
	Vol. 1 Exercise Manual. 2011 Supplement: Bulletins from the Regional Tsunami Service Providers	
	Vol. 2 Exercise Report. 2013	
100.	Global Sea Level Observing System (GLOSS) Implementation Plan – 2012. 2012	E only
101.	Exercise Caribe Wave/Lantex 13. A Caribbean Tsunami Warning Exercise, 20 March 2013. Volume 1: Participant Handbook. 2012	E only
102.	Tsunami Early Warning and Mitigation System in the North-Eastern Atlantic, the Mediterranean and Connected Seas — Second Enlarged Communication Test Exercise (CTE2), 22 May 2012.	E only
	Vol. 1 Exercise Manual. 2012	
	Vol. 2 Evaluation Report. 2014	
103.	Exercise NEAMWAVE 12. A Tsunami Warning and Communication Exercise for the North-eastern Atlantic, the Mediterranean, and Connected Seas Region, 27–28 November 2012.	E only
	Vol. 1: Exercise Manual. 2012	
	Vol. 2: Evaluation Report. 2013	
104.	Seísmo y tsunami del 27 de agosto de 2012 en la costa del Pacífico frente a El Salvador, y seísmo del 5 de septiembre de 2012 en la costa del Pacífico frente a Costa Rica. Evaluación subsiguiente sobre el funcionamiento del Sistema de Alerta contra los Tsunamis y Atenuación de sus Efectos en el Pacífico. 2012	Español solamente (resumen en inglés y francés)
105.	Users Guide for the Pacific Tsunami Warning Center Enhanced Products for the Pacific Tsunami Warning System, August 2014. Revised Edition. 2014	E, S

106.	Exercise Pacific Wave 13. A Pacific-wide Tsunami Warning and Enhanced Products Exercise, 1–14 May 2013. Vol. 1 Exercise Manual. 2013 Vol. 2 Summary Report. 2013	E only
107.	Tsunami Public Awareness and Educations Strategy for the Caribbean and Adjacent Regions. 2013	E only
108.	Pacific Tsunami Warning and Mitigation System (PTWS) Medium-Term Strategy, 2014−2021. 2013	E only
109.	Exercise Caribe Wave/Lantex 14. A Caribbean and Northwestern Atlantic Tsunami Warning Exercise, 26 March 2014. Vol. 1 Participant Handbook. 2014	E/S
110.	Directory of atmospheric, hydrographic and biological datasets for the Canary Current Large Marine Ecosystem, 3rd edition: revised and expanded. 2017	E only
111.	Integrated Regional Assessments in support of ICZM in the Mediterranean and Black Sea Basins. 2014	E only
112.	11 April 2012 West of North Sumatra Earthquake and Tsunami Event - Post-event Assessment of IOTWS Performance	E only
113.	Exercise Indian Ocean Wave 2014: An Indian Ocean-wide Tsunami Warning and Communication Exercise. Vol.1 Manual Vol. 2 Exercise Report. 2015	E only
114.	Exercise NEAMWAVE 14. A Tsunami Warning and Communication Exercise for the North-Eastern Atlantic, the Mediterranean, and Connected Seas Region, 28–30 October 2014 Vol. 1 Manual Vol. 2 Evaluation Report – Supplement: Evaluation by Message Providers and Civil Protection Authorities	E only
115.	Oceanographic and Biological Features in the Canary Current Large Marine Ecosystem. 2015 *(revised in 2016)*	E only
116.	Tsunami Early Warning and Mitigation System in the North-Eastern Atlantic, the Mediterranean and Connected Seas. Third Enlarged Communication Test Exercise (CTE3), 1st October 2013. Vol. 1 Exercise Manual Vol. 2 Evaluation Report	E only
117.	Exercise Pacific Wave 15. A Pacific-wide Tsunami Warning and Enhanced Products Exercise, 2–6 February 2015 Vol. 1: Exercise Manual; Vol. 2: Summary Report	E only
118.	Exercise Caribe Wave/Lantex 15. A Caribbean and Northwestern Atlantic Tsunami Warning Exercise, 25 March 2015 (SW Caribbean Scenario) Vol. 1: Participant Handbook	E only
119.	Transboundary Waters Assessment Programme (TWAP) Assessment of Governance Arrangements for the Ocean Vol 1: Transboundary Large Marine Ecosystems; Supplement: Individual Governance Architecture Assessment for Fifty Transboundary Large Marine Ecosystems Vol 2: Areas Beyond National Jurisdiction	E only
120.	Transboundary Waters Assessment Programme (TWAP) – Status and Trends in Primary Productivity and Chlorophyll from 1996 to 2014 in Large Marine Ecosystems and the Western Pacific Warm Pool, Based on Data from Satellite Ocean Colour Sensors. 2017	E only
121.	Exercise Indian Ocean Wave 14, an Indian Ocean wide Tsunami Warning and Communications Exercise, 9–10 September 2014	*In preparation*
122.	Tsunami Early Warning and Mitigation System in the North-Eastern Atlantic, the Mediterranean and Connected Seas. Sixth Communication Test Exercise (CTE6), 29 July 2015. Vol. 1: Exercise Manual Vol. 2: Evaluation Report	E only
123	Preparing for the next tsunami in the North-Eastern Atlantic, the Mediterranean and Connected Seas – Ten years of the Tsunami Warning System (NEAMTWS). 2017 —*Cancelled*—	*(IOC/INF-1340)*

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124	Indicadores Marino Costeros del Pacífico Sudeste / Coastal and Marine Indicators of the Southeast Pacific (SPINCAM)	E/S
125	Exercise CARIBE WAVE 2016: A Caribbean and Adjacent Regions Tsunami Warning Exercise, 17 March 2016 (Venezuela and Northern Hispaniola Scenarios) Volume 1: Participant Handbook	E only
126	Exercise Pacific Wave 16. A Pacific-wide Tsunami Warning and Enhanced Products Exercise, 1-5 February 2016. Volume 1: Exercise Manual. Volume 2: Summary Report	E only
127	How to reduce coastal hazard risk in your community – A step by step approach	E only
128.	Exercise Indian Ocean Wave 2016: An Indian Ocean-wide Tsunami Warning and Communications Exercise, 7–8 September 2016 Vol 1: Participant Manual Vol. 2: Exercise Report	E only
129	What are Marine Ecological Time Series telling us about the Ocean – A status report	E only
130	Tsunami Watch Operations – Global Service Definition Document	E only
131	Exercise Pacific Wave 2017. A Pacific-wide Tsunami Warning and Enhanced Products Exercise, 15-17 February 2017. Volume 1: Exercise Manual Volume 2: Exercise Report	E only
132.	2nd March 2016 Southwest of Sumatra Earthquake and Tsunami Event Post-Event Assessment of the Performance of the Indian Ocean Tsunami Warning and Mitigation System; Supplement: Tsunami Service Provider Bulletins and Maps	E only
133.	Exercise CARIBE WAVE 17. A Caribbean and Adjacent Regions Tsunami Warning Exercise, 21 March 2017 (Costa Rica, Cuba and Northeastern Antilles Scenarios). Volume 1: Participant Handbook Volume 2: Final Report	E only
134.	Tsunami Exercise NEAMWave17 – A Tsunami Warning and Communication Exercise for the North-eastern Atlantic, the Mediterranean, and Connected Seas Region, 31 October – 3 November 2017 Volume 1: Exercise Instructions. 2017 Volume 2: Evaluation Report. 2018 Supplement: Evaluation by Message Providers and Civil Protection Authorities	E only
135.	User's Guide for the Pacific Tsunami Warning Center Enhanced Products for the Tsunami and other Coastal Hazards Warning System for the Caribbean and Adjacent Regions (CARIBE-EWS), October 2017	E only
136.	Exercise CARIBE WAVE 18. Tsunami Warning Exercise, 15 March 2018 (Barbados, Colombia and Puerto Rico Scenarios). Volume 1: Participant Handbook. 2017 Volume 2: Final Report	E only
137.	The Ocean is losing its breath: declining oxygen in the world's ocean and coastal waters	(under preparation)
138.	Exercise Indian Ocean Wave 2018: An Indian Ocean-wide Tsunami Warning and Communication Exercise, 4–5 September 2018 Volume 1: Exercise Manual & Supplements Volume 2: Exercise Report. 2019	E only
139.	Exercise Pacific Wave 2018. A Pacific-wide Tsunami Warning and Enhanced Products Exercise, September to November 2018. Volume 1: Exercise Manual. Volume 2: Summary Report	E only
140	Analysis of transboundary Water Ecosystems and Green and Blue Infrastructures: Intercontinental Biosphere Reserve of the Mediterranean: Andalusia (Spain) – Morocco	E F S
141	Exercise Caribe Wave 2019. A Caribbean and Adjacent Region Tsunami Warning Exercise, 14 March 2019. Volume 1: Participant handbook. Volume 2: Summary Report	E only

142	Users' Guide for the Northwest Pacific Tsunami Advisory Center (NWPTAC) – Enhanced Products for the Pacific Tsunami Warning System. 2019	E only
143	Status of the Indian Ocean Tsunami Warning and Mitigation System 2019	(under preparation)
144	IOTWMS Medium Term Strategy: 2019–2024	(under preparation)
145	IOTWMS Users Guide for National Tsunami Warning Centres	(under preparation)
146	Definition of Services provided by the Tsunami Service Providers of the IOTWMS	(under preparation)
147	The Global Ocean Observing System 2030 Strategy	(under preparation)
148	Ejercicio TSUNAMI-CA 19. Un simulacro de tsunami para Centroamérica, 19 de agosto de 2019. Volumen 1, Manual para participantes.	S only
149	User's Guide for the South China Sea Tsunami Advisory Center (SCSTAC) products for the South China Sea Tsunami Warning and Mitigation System	E only
150	Limitations and Challenges of Early Warning Systems:A Case Study from the 2018 Palu-Donggala Tsunami	E only

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