



Technical Document

Tsunami Advisory Products for the South China Sea Regional Tsunami Warning and Mitigation System

October 2017

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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.

The ICG/PTWS-XXV Session in Vladivostok, Russia approved the proposal of the South China Sea Tsunami Warning and Mitigation System submitted by SCS Regional Working Group (WG-SCS), and decides further establish a Task Team on the Establishment of a South China Sea Tsunami Advisory Center (TT-SCSTAC). The 1st TT-SCSTAC Meeting, and the 3rd Meeting for ICG/PTWS WG-SCS that immediately followed, were both hosted by Hong Kong Observatory on 7-9 Apr. 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 in the 4th Regional Working Group Meeting. During the 4th WG-SCS Meeting hosted by BMKG in Jakarta, the WG-SCS instructed TT-SCSTAC to continue its work on the draft SCS advisory products, and submit to the 5th WG-SCS Meeting for approval. The WG-SCS at its 5th Meeting at Manila instructed IOC Secretariat to circulate the document on <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 PTWS Steering Committee in July 2016, the SCSTAC advisory products were tested during the PacWave 17 Tsunami Exercise among the SCS Member States, and the post-exercise survey was conducted and reported to the 6th WG-SCS meeting (March 1–3, 2017, Shanghai) and the ICG/PTWS 27th Session (March 31 to April 3, 2017, Tahiti).

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 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 modeling 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 Geographical Coverage

The SCS Tsunami advisory products are issued when a major earthquake with moment magnitude 6.0 or greater is detected in the Area of Service (AoS) of the SCSTAC (hereinafter referred to as “the SCS region” in Figure 1), 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, the tsunami advisory products might be issued in parallel with those of PTWC and NWPTAC, with epicenter information identified by them.

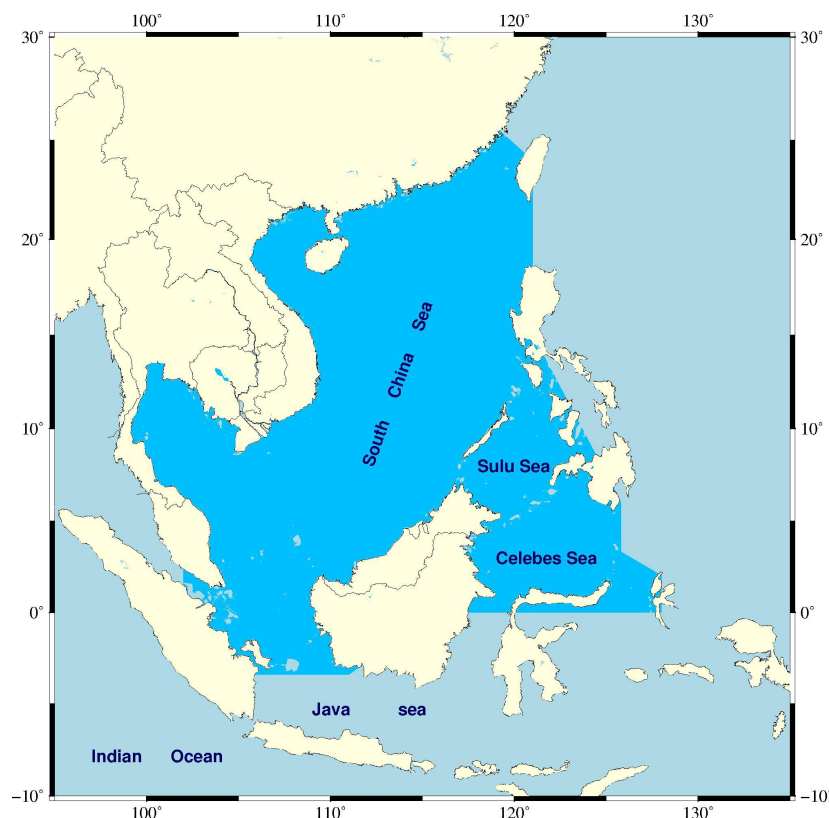


Figure 1 Geographic scope of the SCS and its adjoining basins

1.3 Bulletin Types and Criteria

For a long time, 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 ICG/PTWS 25th Session held 11-13 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 modeling. 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 m, ii) 0.3 to less than 1 m, iii) 1 m to 3 m, and iv) greater than 3 m.

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, Vietnam, Malaysia, Brunei in 1-4 hrs, 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 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 modeling 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.

Table 1 Criteria adopted by SCSTAC

Bulletin type		Criteria	Content	Timeline
Tsunami Information	Only one bulletin	Mag. of 6.0-6.4; or on land; or depth \geq 100km	EQ parameters and statement of 'No tsunami threat'	5-10 min
	Only one bulletin unless minor waves observed and should be reported	Mag. 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 above	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
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In Tsunami Information or Tsunami Threat Message, the tsunamigenic potential is provided based on preliminary earthquake parameters as follows:

Table 2 Tsunamigenic potential adopted by SCSTAC

Magnitude(M_w)	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 epicenter
$M_w \geq 7.6$	Possibility of a destructive basin-wide tsunami

1.4 Implementation Timeline

According to <Proposal for the Tsunami Warning and Mitigation System of the South China Sea> approved by ICG/PTWS 25th session, 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 4thWG-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 Oct. 2015 and completed in Jan. 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 Centers (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**.

Table 3 Dissemination approaches

Approach	Services	Advantages & Disadvantages
GTS	Text Message	<ul style="list-style-type: none"> ● Fast, reliable ● Not accessible for all MSs
Website	Text Message for public and Graphical products for authorized users	<ul style="list-style-type: none"> ● More information, flexible ● Require stable Internet connection
Facsimile	Text Message for NTWCs and TWFPs	<ul style="list-style-type: none"> ● Available to all MSs ● Relatively slower ● Require stable connection
Email	Text and Graphical products for NTWCs and TWFPs	<ul style="list-style-type: none"> ● Fast, Easily accessible ● Require stable Internet connection

2 Tsunami Scenario Database, Forecast Model and Decision Support System

2.1 Description of Tsunami Scenario Database

The tsunami scenario database covering the NW Pacific and the SCS region was put into operation in NMEFC/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 NWPTAC operated by 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 analyzing 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 72360 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 hrs. 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 meter isobath, and the coastal amplitudes along the 5, 10, 20 and 50 meter isobath are scaled by Green Law. Each coastal forecast point are spaced with an interval of 12 minutes (approximately 20 km) covering the SCS rim countries. The maximum wave amplitude, 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.

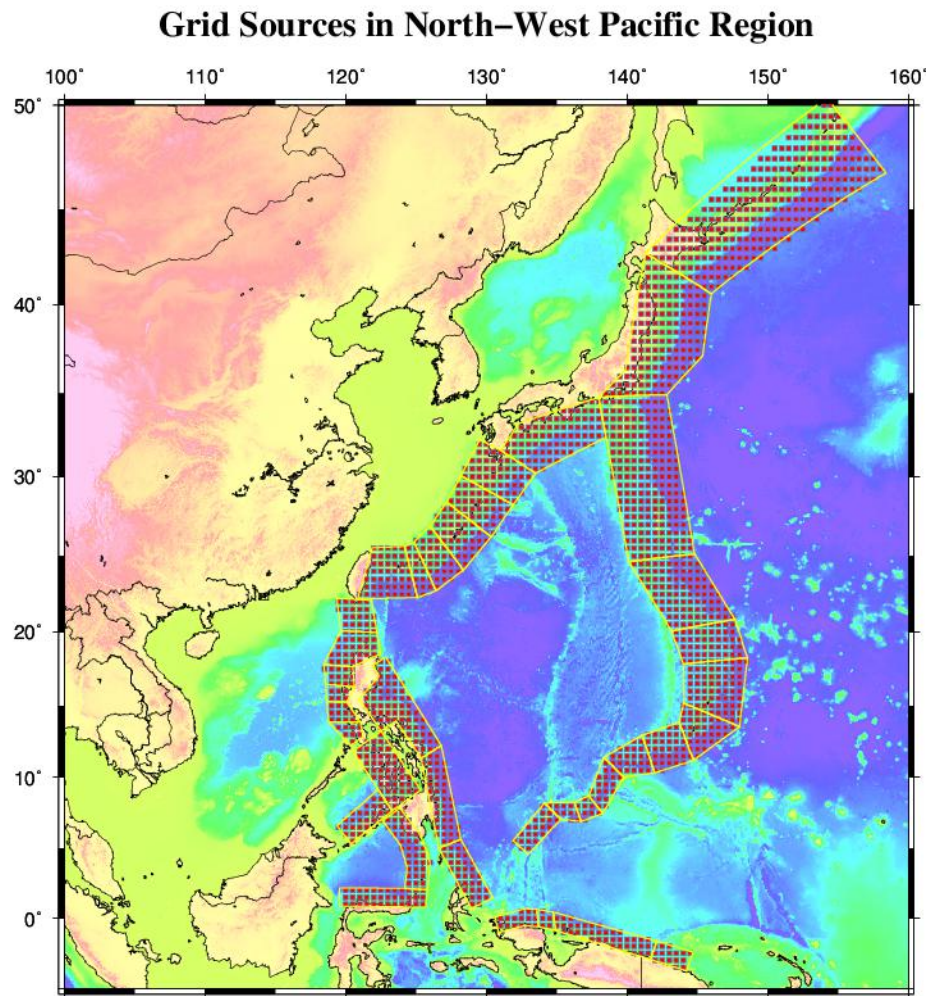


Figure 2 Tsunamigenic sources identified in the Tsunami Propagation Scenario Database

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 an 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 meters. 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 catalog 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 neighboring scenarios, numerical modeling 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. The NWPTAC categorizes tsunami amplitude into '0.5 m; 1 m; 2 m; 3 m; 4 m; 6 m; 8 m; and Over 10 m'. 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 colors along the coastlines.

2.4 Decision Support System

Decision support system (DSS) tailored for the SCSTAC has been put into operation since February 2016. The DSS is designed for watchstander to make decision in terms of Standard Operating Procedures 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 modeling modules, coastal impact assessment modules and bulletin production & dissemination modules.



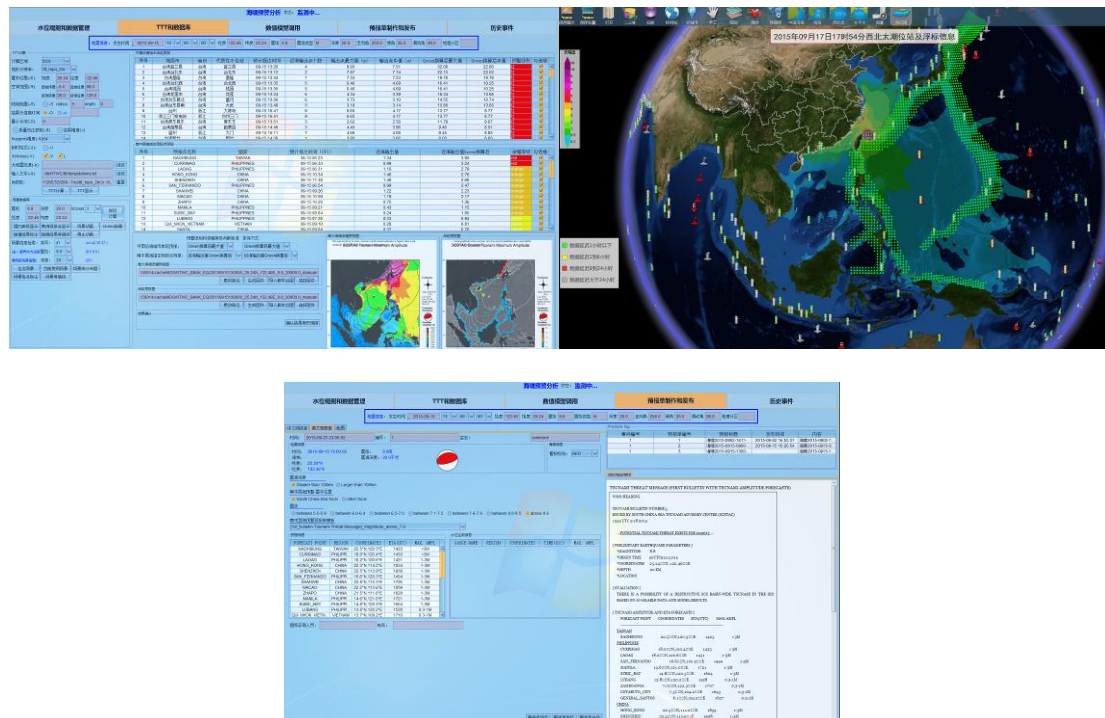


Figure 3 Decision support system for SCSTAC (a. Seismic module; b. Tsunami observation module; c-d. Tsunami Scenario database and TTT module; e. Bulletin production and dissemination module)

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 epicenter.

Southwestern Japan and Ryukyu Islands	Borneo – Sulawesi
231 SOUTH KOREA	261 BORNEO
232 WESTERN HONSHU, JAPAN	262 CELEBES SEA
233 NEAR S. COAST OF WESTERN HONSHU	263 TALAUD ISLANDS, INDONESIA
234 NORTHWEST OF RYUKYU ISLANDS	264 NORTH OF HALMAHERA, INDONESIA
235 KYUSHU, JAPAN	265 MINAHASSA PENINSULA, SULAWESI
236 SHIKOKU, JAPAN	266 NORTHERN MOLUCCA SEA
237 SOUTHEAST OF SHIKOKU, JAPAN	267 HALMAHERA, INDONESIA
238 RYUKYU ISLANDS, JAPAN	268 SULAWESI, INDONESIA
239 SOUTHEAST OF RYUKYU ISLANDS	269 SOUTHERN MOLUCCA SEA
240 WEST OF BONIN ISLANDS	270 CERAM SEA
241 PHILIPPINE SEA	271 BURU, INDONESIA
	272 SERAM, INDONESIA
Taiwan Area	Sunda Arc
242 NEAR COAST OF SOUTHEASTERN CHINA	273 SOUTHWEST OF SUMATERA, INDONESIA
243 TAIWAN REGION	274 SOUTHERN SUMATERA, INDONESIA
244 TAIWAN	275 JAVA SEA
245 NORTHEAST OF TAIWAN	276 SUNDA STRAIT, INDONESIA
246 SOUTHWESTERN RYUKYU ISL., JAPAN	277 JAVA, INDONESIA
247 SOUTHEAST OF TAIWAN	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	294 MYANMAR-INDIA BORDER REGION
249 LUZON, PHILIPPINES	295 MYANMAR-BANGLADESH BORDER REGION
250 MINDORO, PHILIPPINES	296 MYANMAR

251	SAMAR, PHILIPPINES	297	MYANMAR-CHINA BORDER REGION
252	PALAWAN, PHILIPPINES	298	NEAR SOUTH COAST OF MYANMAR
253	SULU SEA	299	SOUTHEAST ASIA (NOT IN USE)
254	PANAY, PHILIPPINES	300	HAINAN ISLAND, CHINA
255	CEBU, PHILIPPINES	301	SOUTH CHINA SEA
256	LEYTE, PHILIPPINES	733	THAILAND
257	NEGROS, PHILIPPINES	734	LAOS
258	SULU ARCHIPELAGO, PHILIPPINES	735	CAMBODIA
259	MINDANAO, PHILIPPINES	736	VIETNAM
260	EAST OF PHILIPPINE ISLANDS	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 WG-SCS Meeting 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 Appendix II). In the tsunami threat message, all forecast points with maximum amplitude greater than 0.3 meter are listed in groups that are entitled as Member States (Appendix 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 NTCs. 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 Appendix I for bulletin templates).

3.4 Tsunami Energy Map

The tsunami energy map gives the color-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 color scale. The contour map of Tsunami Travel Time (TTT) is shown in light-gray 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 colored according to the tsunami amplitude of the model grid points closest to the point. The tsunami energy map is also overlapped in gray-shading style with illuminated effect and further have TTT contour lines placed upon.

4. Tsunami Scenarios and Product Samples

4.1 Manila Trench

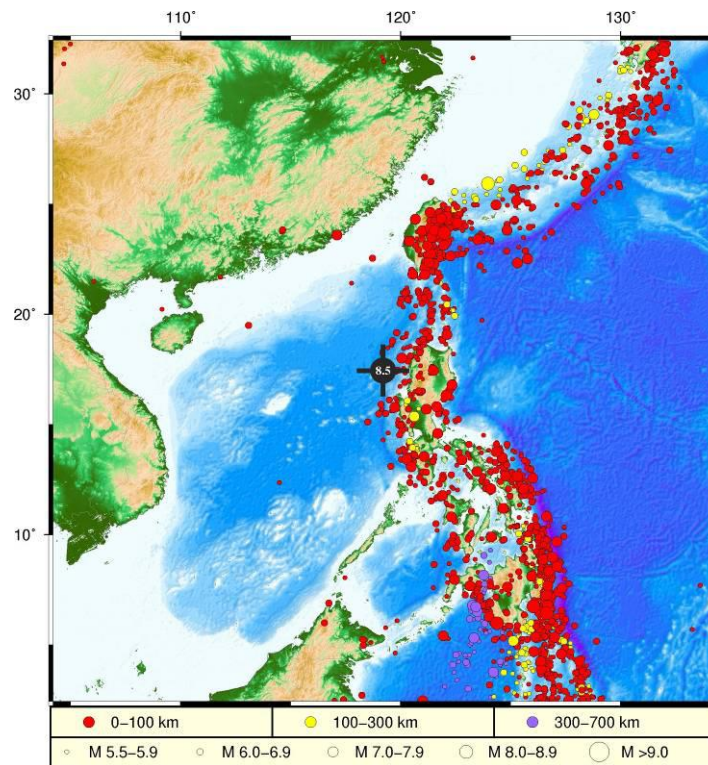


Figure 4 Earthquake scenario in Manila Trench

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 THE UNESCO/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 8.3
 *ORIGIN TIME 2126 UTC NOV15 2014
 *COORDINATES 17.4N, 119.2E
 *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)
<u>BRUNEI</u>				
MUARA	5.0N	115.1E	01:53	1-3
<u>CHINA</u>				
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
KAHHSIUNG, TAIWAN	22.5N	120.3E	22:28	>3
<u>INDONESIA</u>				
KEPULAUAN_RIAU	4.0N	108.5E	02:25	0.3-1
<u>MALAYSIA</u>				
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
<u>PHILIPPINES</u>				
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
<u>VIETNAM</u>				
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 IS 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

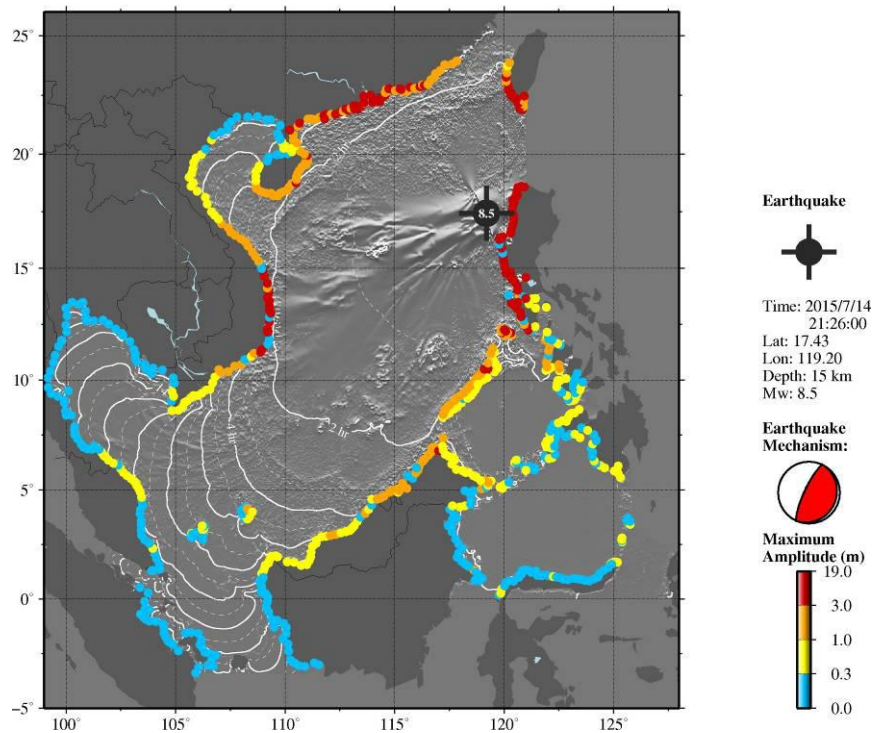
* EMAIL: TSU@NMEFC.GOV.CN

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

2. Graphic Products

SCSTAC Coastal Tsunami Maximum Amplitude

Actual amplitudes at the coast may vary from forecast amplitudes due to uncertainties in the forecast and local features.



SCSTAC Tsunami Amplitude Forecast

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

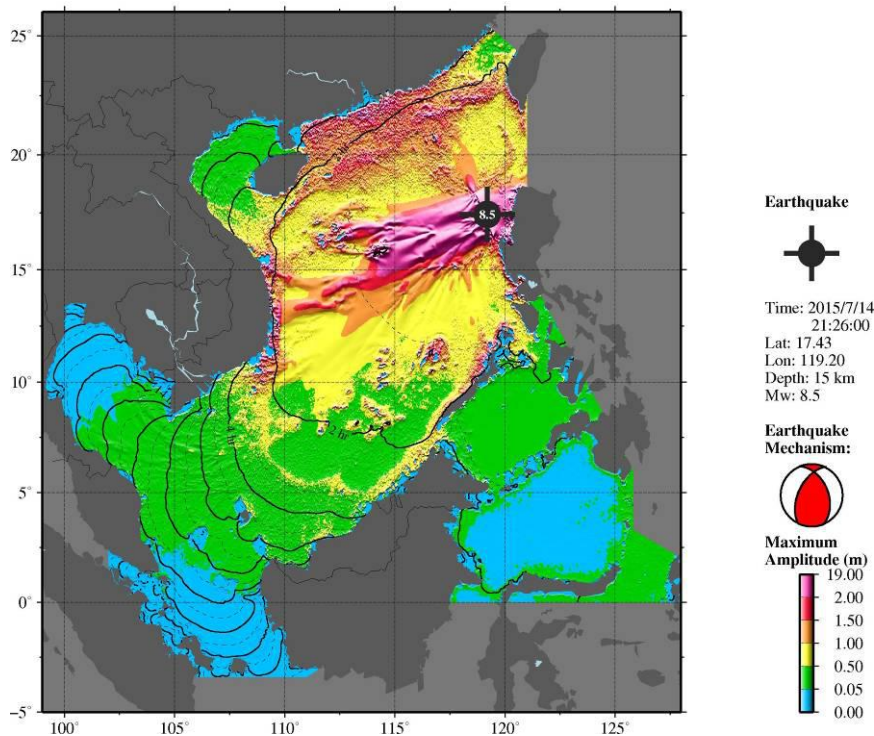


Figure 5 Tsunami scenario in Manila Trench: a. Coastal Amplitude Map; b. Tsunami Energy Map.

4.2 Sulu Sea

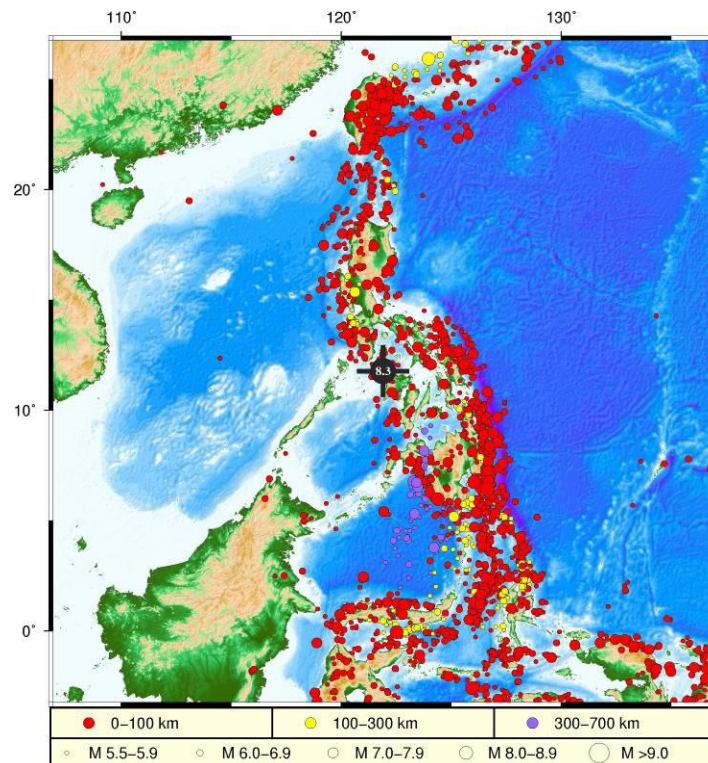


Figure 6 Earthquake scenario in Sulu Sea

1. Text Product

-----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 THE UNESCO/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)
<u>MALAYSIA</u>				
SANDAKAN	5.9N	118.1E	01:39	0.3-1
<u>PHILIPPINES</u>				
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 IS 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

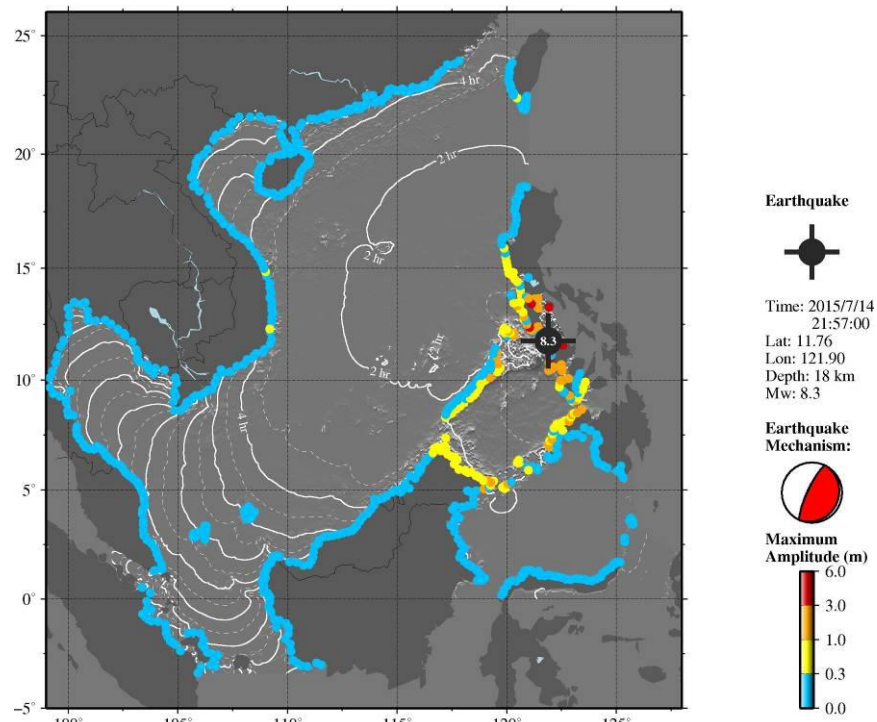
* EMAIL: TSU@NMEFC.GOV.CN

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

2. Graphic Products

SCSTAC Coastal Tsunami Maximum Amplitude

Actual amplitudes at the coast may vary from forecast amplitudes due to uncertainties in the forecast and local features.



SCSTAC Tsunami Amplitude Forecast

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

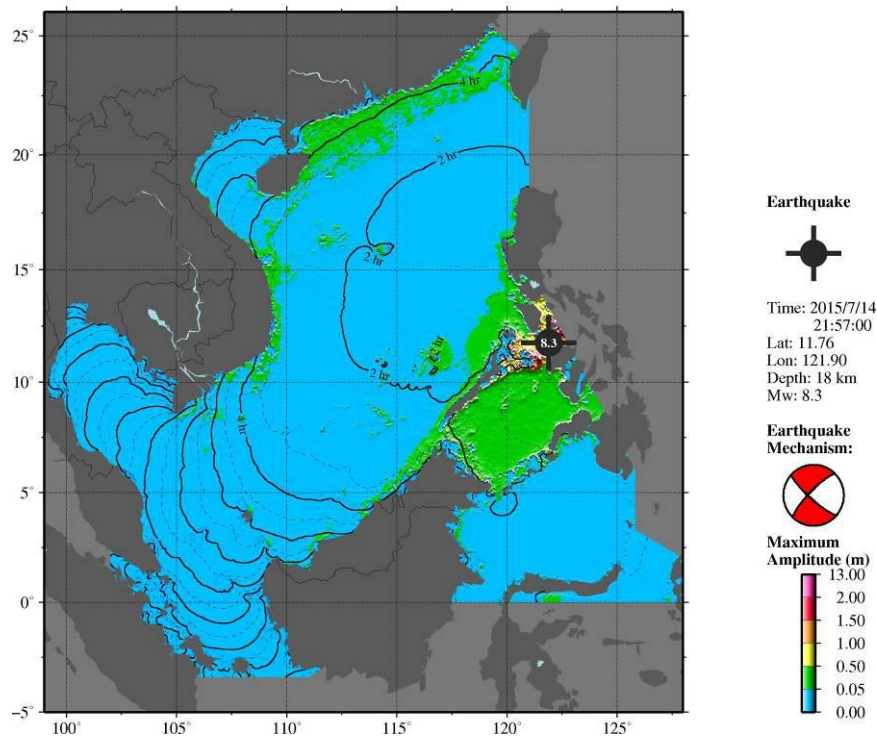


Figure 7 Tsunami scenario in Sulu Sea: a. Coastal Amplitude Map; b. Tsunami Energy Map.

Annex I Products 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 THE UNESCO/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.GOV.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 THE UNESCO/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 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.GOV.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 THE UNESCO/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.GOV.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 THE UNESCO/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.GOV.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 THE UNESCO/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.GOV.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 THE UNESCO/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 AVAILABLE INFORMATION.

[TSUNAMI AMPLITUDE AND ETA FORECASTS]

FORECAST POINT	COORDINATES	ETA (UTC)	MAX. AMPL

<u>PHILIPPINES</u>			
CURRIMAO	18.0N, 120.5E	0330	0.3-1 M

* THIS LIST IS GROUPED BY COUNTRIES, AND COUNTRY NAMES IS 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 BE 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.GOV.CN

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

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

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 THE UNESCO/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

<u>PHILIPPINES</u>			
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
<u>CHINA</u>			

QINGLAN	19.6N, 110.8E	0435	>3 M
SHENZHEN	22.5N, 113.9E	0540	>3 M
<u>HONG KONG, CHINA</u>			
QUARRY_BAY	22.3N, 114.3E	0510	>3 M
<u>VIETNAM</u>			
QUI_NHON	13.8N, 109.3E	0440	1-3 M
VUNG_TAU	10.3N, 107.1E	0520	0.3-1 M
<u>MALAYSIA</u>			
PAPAR	5.7N, 115.9E	0510	0.3-1 M
<u>BRUNEI</u>			
JERUDONG	5.0N, 114.8E	0522	0.3-1 M

* THIS LIST IS GROUPED BY COUNTRIES, AND COUNTRY NAMES IS 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.GOV.CN

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

2. TSUNAMI ENERGY MAP

SCSTAC Tsunami Amplitude Forecast

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

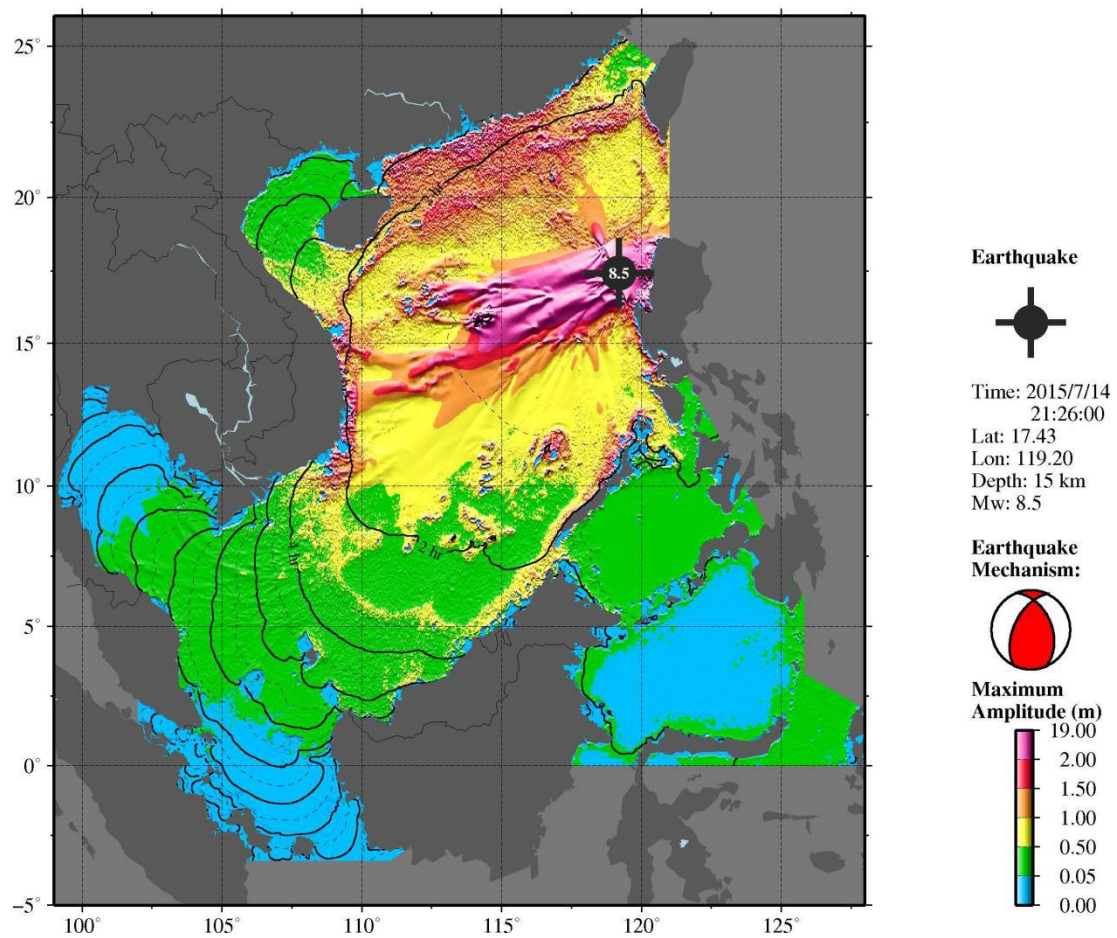


Figure A.1 Tsunami Energy Map

3. COASTAL TSUNAMI AMPLITUDE MAP

SCSTAC Coastal Tsunami Maximum Amplitude

Actual amplitudes at the coast may vary from forecast amplitudes due to uncertainties in the forecast and local features.

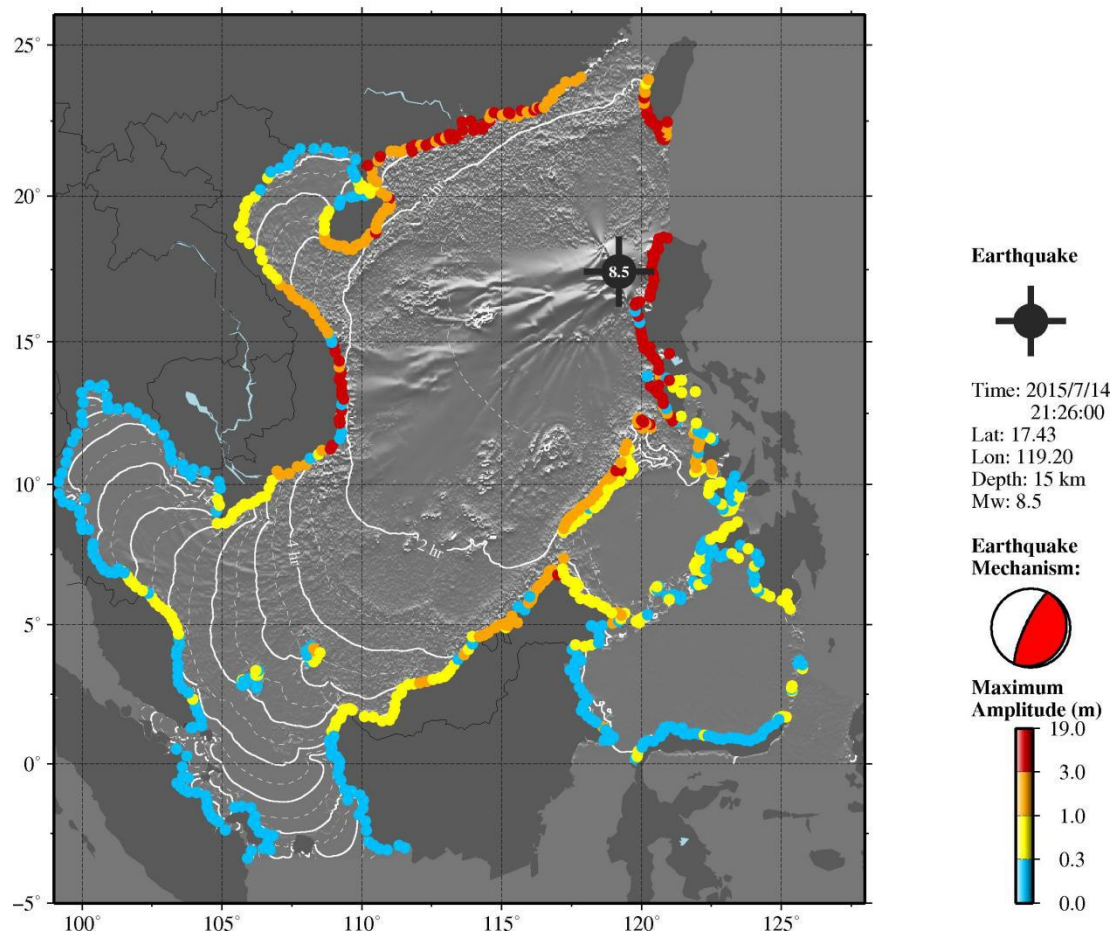


Figure A.2 Coastal Tsunami Amplitude Map

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 THE UNESCO/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
<u>CHINA</u>			
SHENZHEN	22.5N, 113.9E	0540	1-3 M
<u>HONG KONG, CHINA</u>			
QUARRY_BAY	22.3N, 114.3E	0510	>3 M

VIETNAM

VUNG_TAU	10.3N, 107.1E	0520	0.3-1 M
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MALAYSIA

PAPAR	5.7N, 115.9E	0510	0.3-1 M
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BRUNEI

JERUDONG	5.0N, 114.8E	0522	0.3-1 M
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* THIS LIST IS GROUPED BY COUNTRIES, AND COUNTRY NAMES IS 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 GROUPE 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.GOV.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 THE UNESCO/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.GOV.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 THE UNESCO/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.GOV.CN

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

Annex II List of Coastal Forecasting Points for ETA and Amplitude

Table II.1 List of Coastal Forecasting Points

	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
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	VIETNAM	VINH	18.6°N	105.7°E
50	VIETNAM	QUI_NHON	13.7°N	109.2°E
51	VIETNAM	QUANG_NGAI	15.1°N	108.9°E
52	VIETNAM	NHA_TRANG	12.3°N	109.2°E
53	VIETNAM	DA_NANG	16°N	108.3°E
54	VIETNAM	VUNG_TAU	10.34°N	107.071°E
55	VIETNAM	HAI_PHONG	20.7°N	106.9°E

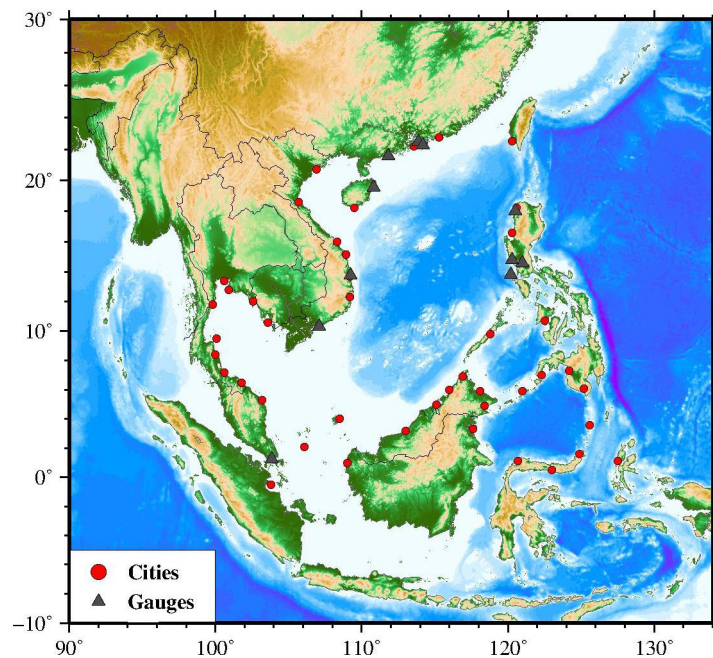


Figure A.3 Coastal Forecasting Points for the SCS tsunami advisory products