Philippine Tsunami Warning and Mitigation System

ITIC Training Programme—Hawaii (ITP-HAWAII) on Tsunami Early Warning Systems and the PTWC Enhanced Products, Tsunami Evacuation Planning and UNESCO IOC Tsunami Ready Recognition Programme, Honolulu, 07-18 August 2023

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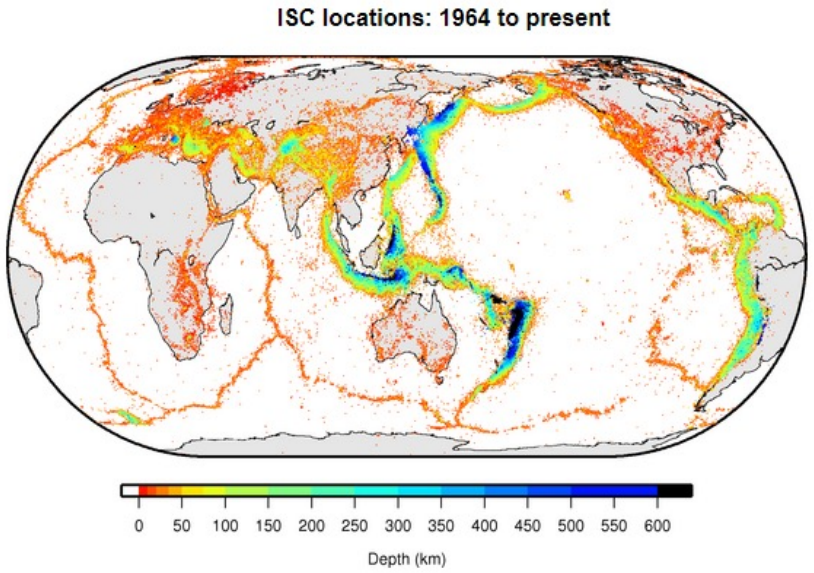
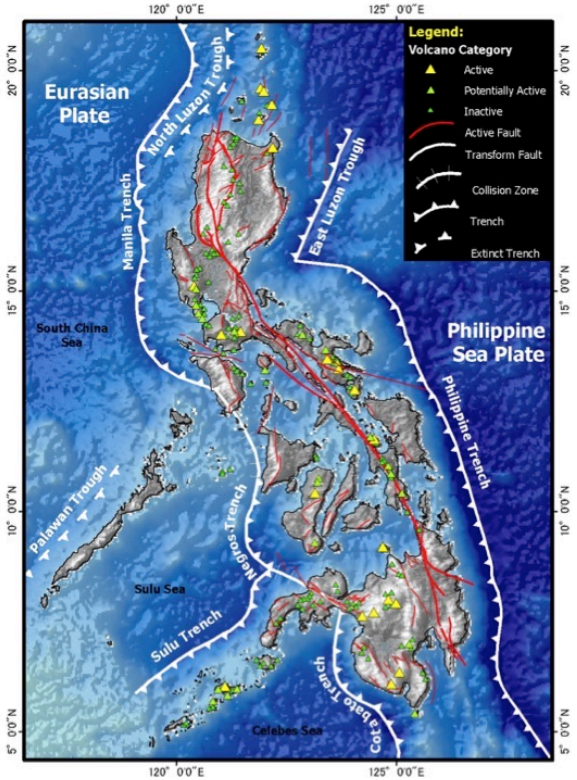
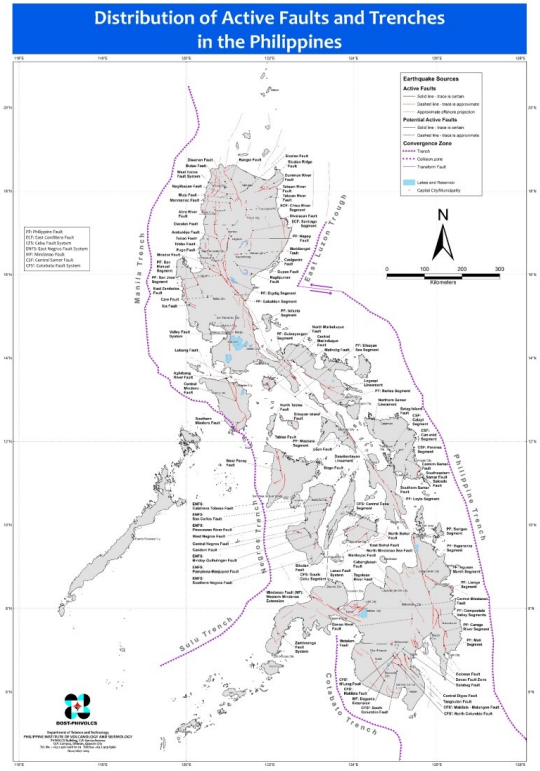
Department of Science and Technology – Philippine Institute of Volcanology and Seismology (DOST-PHIVOLCS)

Seismotectonic Setting of the Philippines







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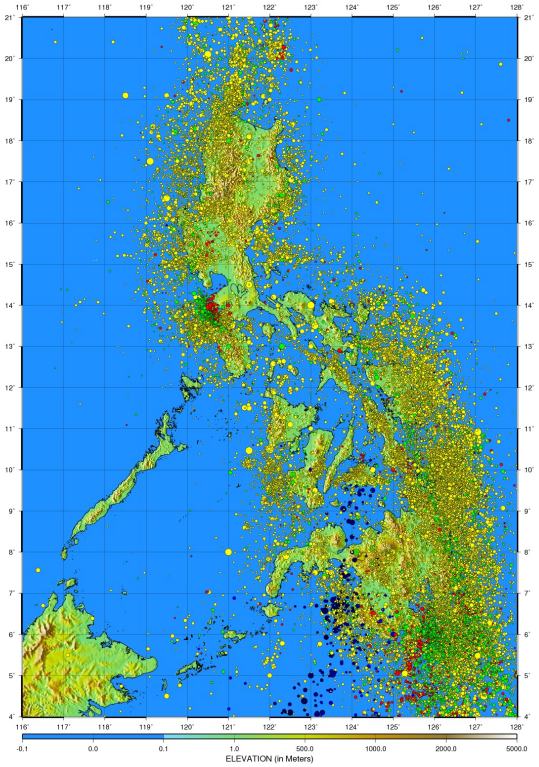
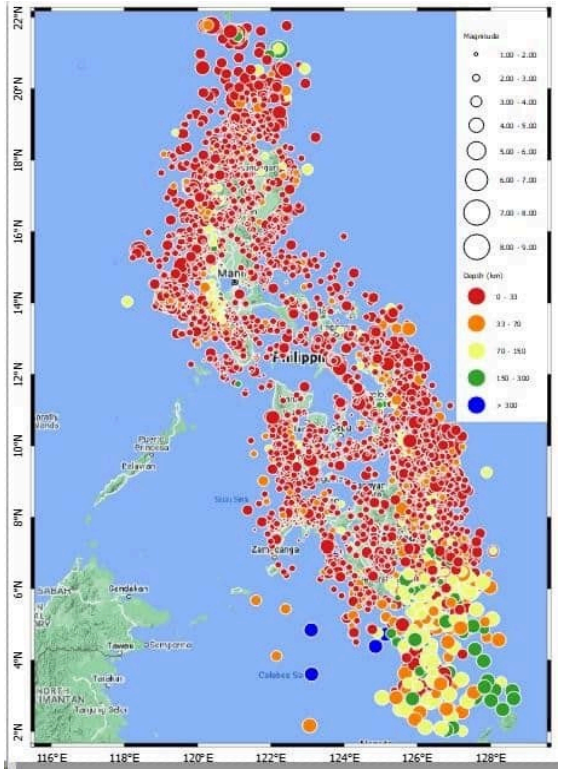
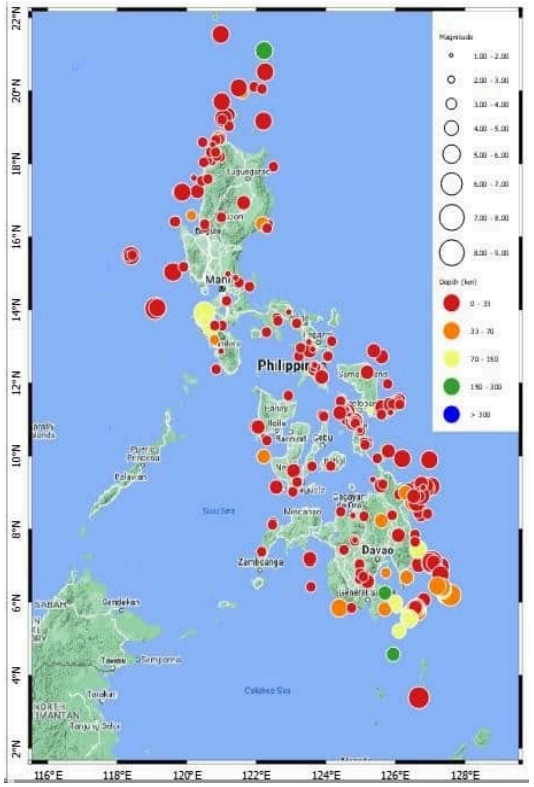
Seismotectonic Setting of the Philippines







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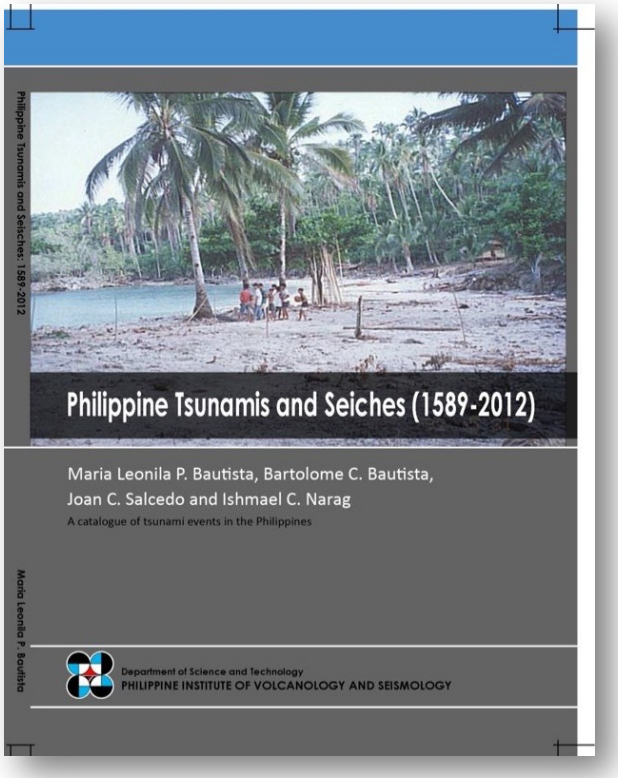
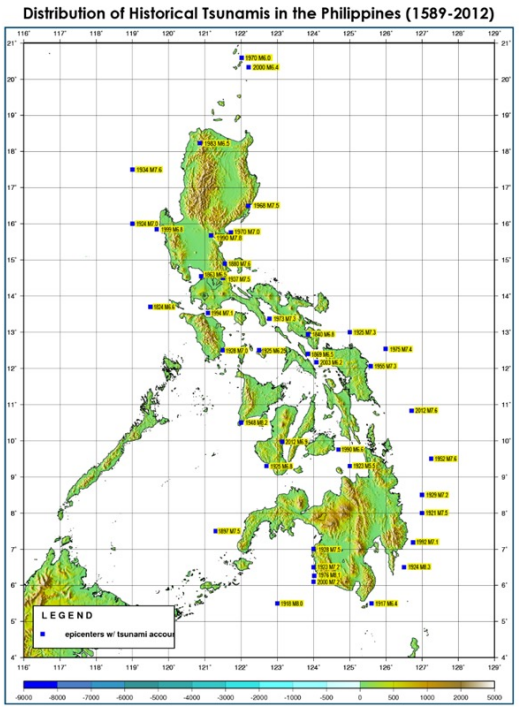
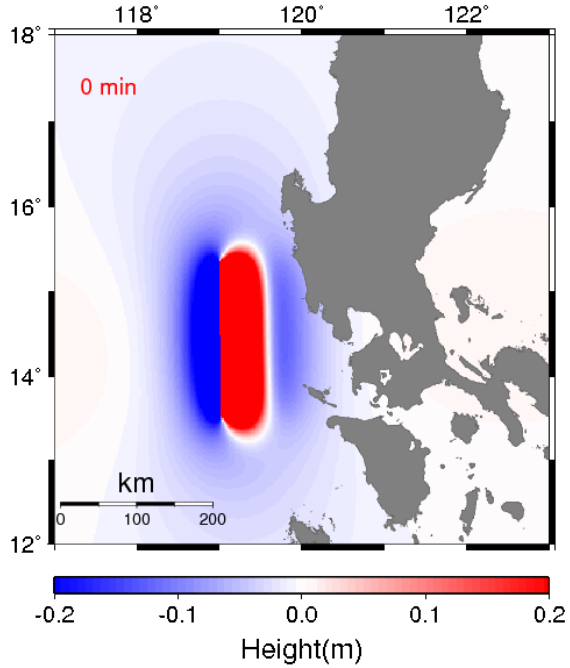
Philippine Tsunamis and Seiches (1589-2012)

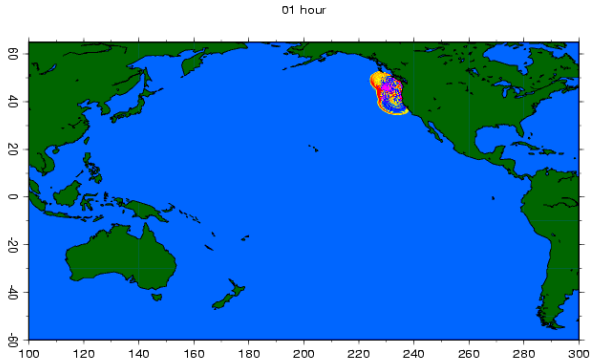




- 74 candidate events
- 41 confirmed tsunami
- Magnitude range 5.5 to 8.3
- Depth 15-60km
- Heights 1-9 meters
- Largest:
  - Celebes Sea
  - Sulu Sea

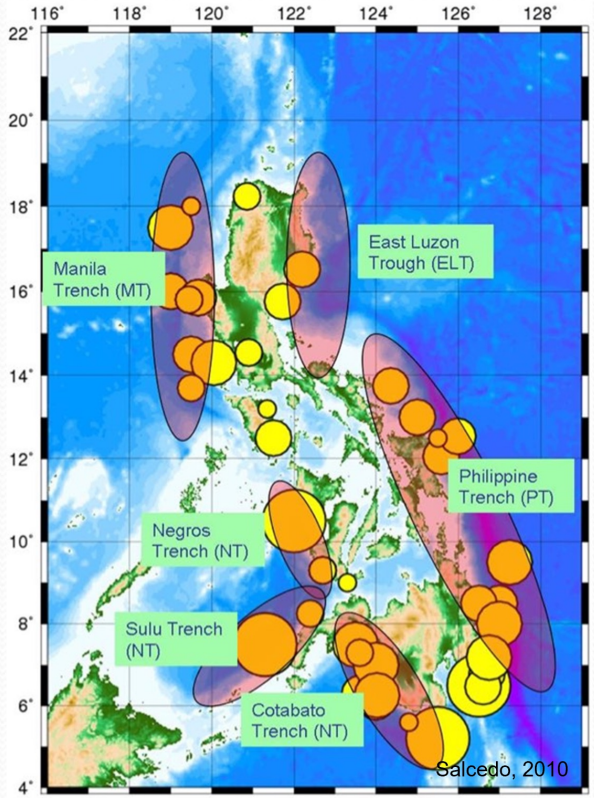
Local & Distant Tsunami





Tsunami simulation of
1700 Cascadia Earthquake

Areas with confirmed tsunami

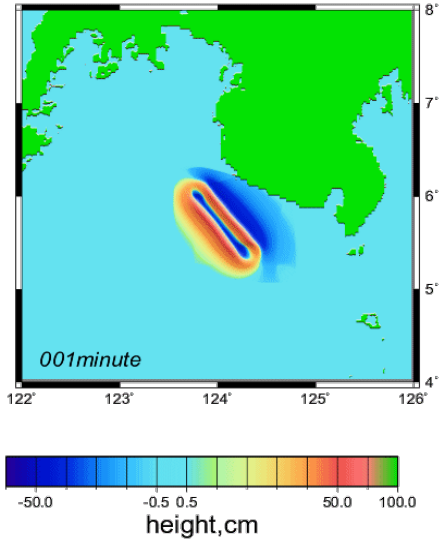


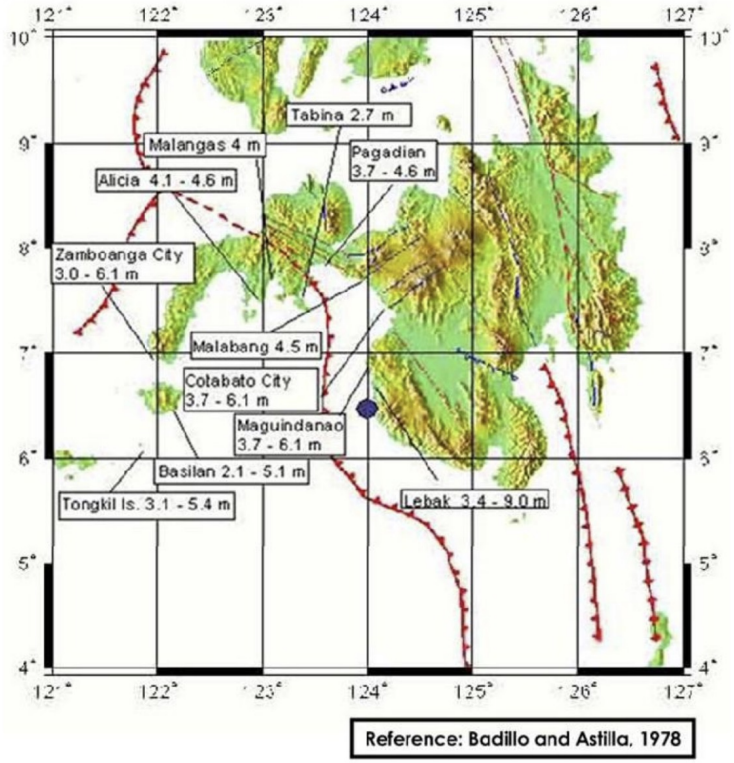
Location of epicenters of the earthquakes that caused tsunami in the Philippines and possible tsunami sources

- Northern Luzon
- Western Luzon
- Eastern Luzon
- Metro Manila
- Mindoro Island
- Bicol Peninsula
- Visayan region
- Eastern Mindanao
- Western Mindanao
- Southern Mindanao

Bautista et al., 2012

The 1976 M8.1 Moro Gulf Earthquake & Tsunami



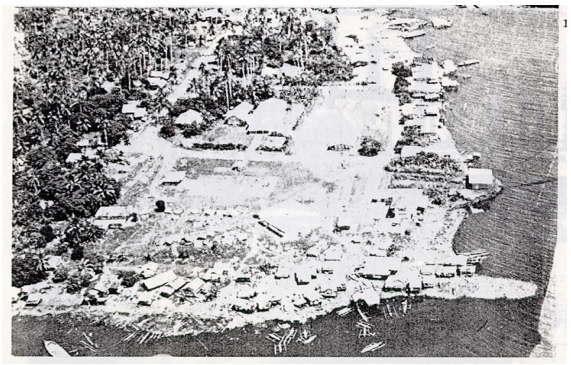


Tsunami heights observed

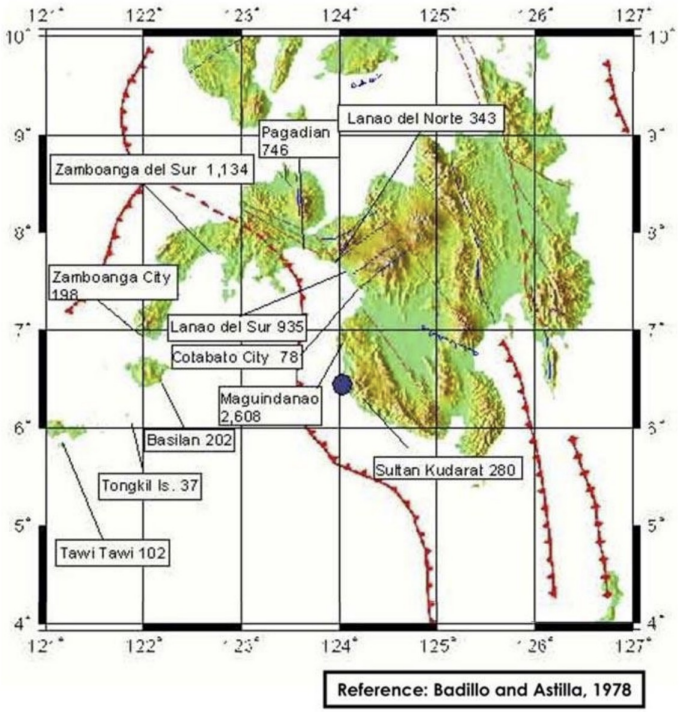
Characteristics

- ❑ Great Magnitude
- ❑ Shallow hypocenter
- ❑ Beneath a body of water
- ❑ Large rupture length
- ❑ Vertical displacement

The 1976 M8.1 Moro Gulf Earthquake & Tsunami



The Moro Gulf earthquake left in its wake **~4,000 deaths, ~2,000 missing, ~8,000 injured and ~ 12,000 families** (~90,000 people) were rendered homeless. Of the number of casualties, about 90% was due to the tsunami. Damage estimate (1976 Peso Value): 400 Million ++



Number of casualties

The 1976 Moro Gulf Earthquake & Tsunami

Tsunami Accounts:

Descriptions:

- *3 or 4 waves (one person said 9) == there was more than 1 wave*
- *1 to 5 minutes interval*
- *maximum inundation = 2 km*
- *maximum water recession (with sucking sound) = 2 km*

Descriptions: (height)

"as tall as coconut trees"

"2-storey house"

"twice a man's height"

The 1976 Moro Gulf Earthquake & Tsunami

Tsunami Accounts:

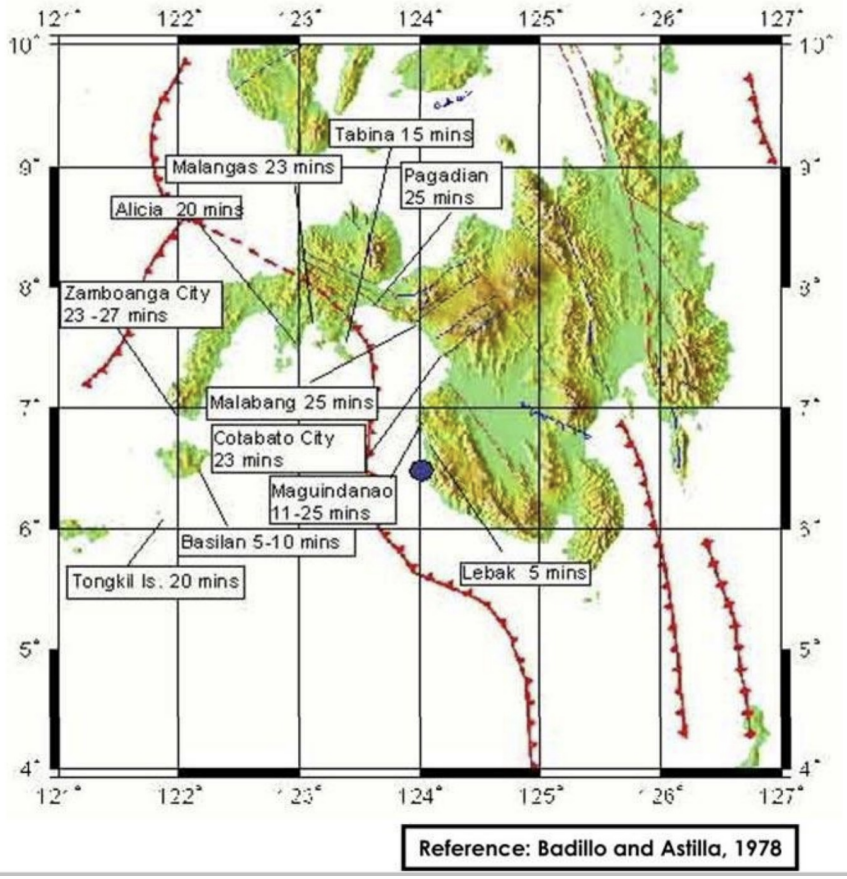
Descriptions: (sounds)

- *Loud roaring*
- *Like cascading rain*
- *unusual sound*
- *Loud (San Jose (1km inland from Pagadian), the sounds of the sea are not heard, but this roar was distinctly heard)*
- *Strange, strong, frightening*

Descriptions: (appearance)

- *Kept rising – like a tide*
- *Wall of water advancing*
- *tilted wall of water straightened up & crashed down*

The 1976 Moro Gulf Earthquake & Tsunami



Time first tsunami was observed

Tsunami Accounts:

Sequence of Events

- *A violent shock that awaken people and make standing & walking difficult*
- *unusually deep recession of the sea*
- *A strong prolonged approaching sound*
- *arrival of waves!!!*

DOST-PHIVOLCS

PHIVOLCS STRATEGY MAP

VISION

A leading global science and technology institution of empowered men and women helping develop communities safe from and resilient to volcanic eruptions, earthquakes, tsunamis and other related hazards.

MISSION

We provide timely, quality, and socially-inclusive information and services for warning, disaster preparedness and mitigation. This we do through the development and application of technologies for the monitoring and accurate prediction of and determination of areas prone to volcanic eruptions, earthquakes, tsunamis and other related hazards, and gender-responsive capacity enhancement for comprehensive disaster risk reduction.

Societal Outcome: Communities have achieved resilience to volcanic eruptions, earthquakes, tsunamis and other related hazards.

Enhanced safety through empowerment of men and women in communities.

1. Accurately predicted and simulated geological phenomena
2. Provided highly accurate and timely warning and information
3. Developed cost-effective monitoring and warning system
4. Empowered partners to lead in reducing risks from geologic hazards down to the barangay level
5. Enhanced collaboration with stakeholders

Highly responsive and competent organization

1. Highly competent, globally recognized experts
2. Motivated, rewarded and competent staff
3. Effective and efficient systems, procedures, structures
4. Inspiring, dynamic leadership

Excellence | Innovation | Integrity | Service | People

DOST-PHIVOLCS

PHIVOLCS Strategic Initiatives 2023-2028

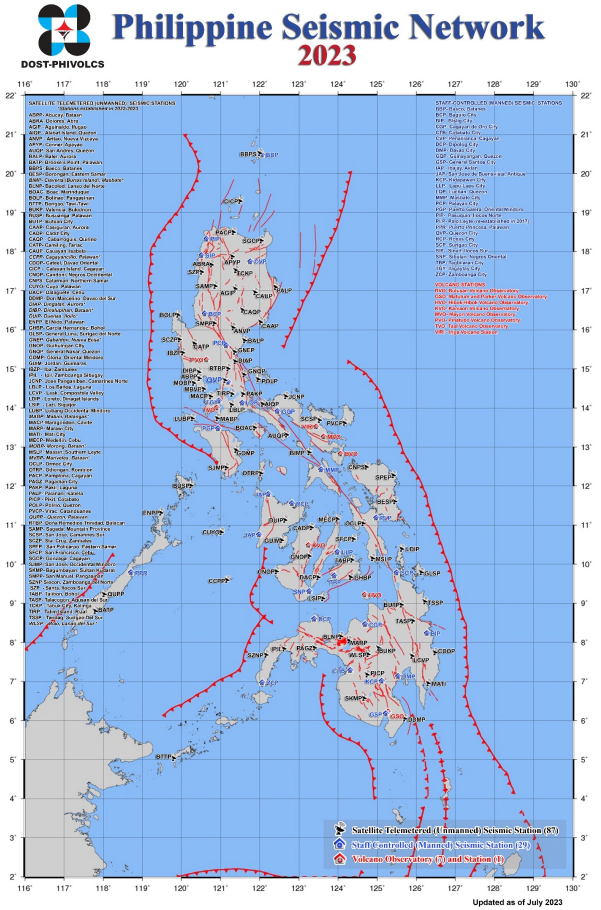
1. National Volcano Monitoring and Warning (NVMW)
2. National Earthquake Monitoring and Information (NEMI)
3. National Tsunami Monitoring and Early Warning (NTMEW)
4. Earthquake Hazards Assessment and Research and Development (EHARD)
5. Volcanic Hazards Assessment and Research and Development (VHARD)
6. PHIVOLCS Risk Information Management Assessment (PRIMA)
7. Landslide Monitoring, Early Warning and Risk Assessment (LMEWRA)
8. Volcano, Earthquake and Tsunami Disaster Preparedness and Risk Reduction
9. Leadership Enhancement and Development (LEAD)
10. Strategic Human Resource Management and Development (SHRMD)
11. Strategic Performance Assessment and Development for Excellence (SPADE)
12. Strategic ICT Management and Development (StrICT)
13. Financial Management and Administrative Support (FMAS)

PHIVOLCS Tsunami Monitoring System

- **National Earthquake Monitoring and Information**

  - **One hundred twenty-three (123)-station network**
    - 29 Staff-controlled seismic stations
    - 87 Satellite-telemetered seismic stations
    - 7 Volcano observatories

  - **Network Development Activities**
    - Commissioning of at least 4 new seismic stations each year
    - Acquisition of earthquake monitoring & communication equipment
    - Establishment of Visayas Cluster Center
    - Continued capacity enhancement of technical staff



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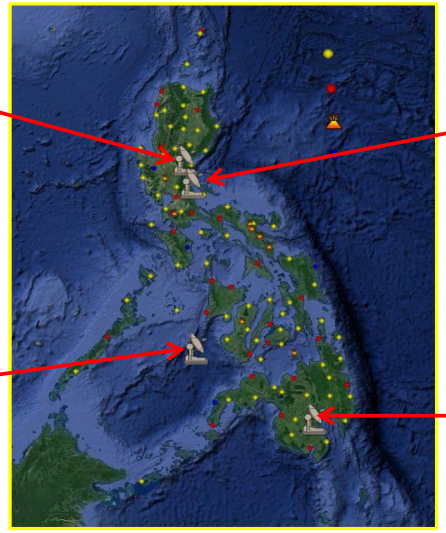
Satellite-Telemetered Seismic Stations

Gabaldon, Nueva Ecija (GNEP)

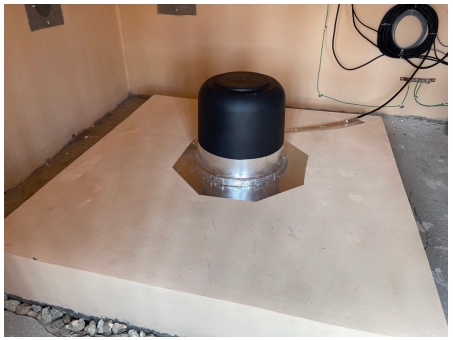
Cagayancillo, Palawan (CCPP)



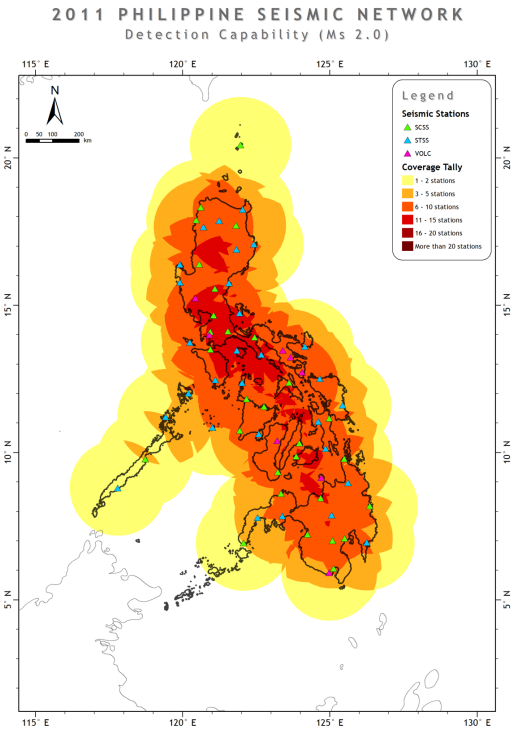
Dingalan, Aurora (DIAP)

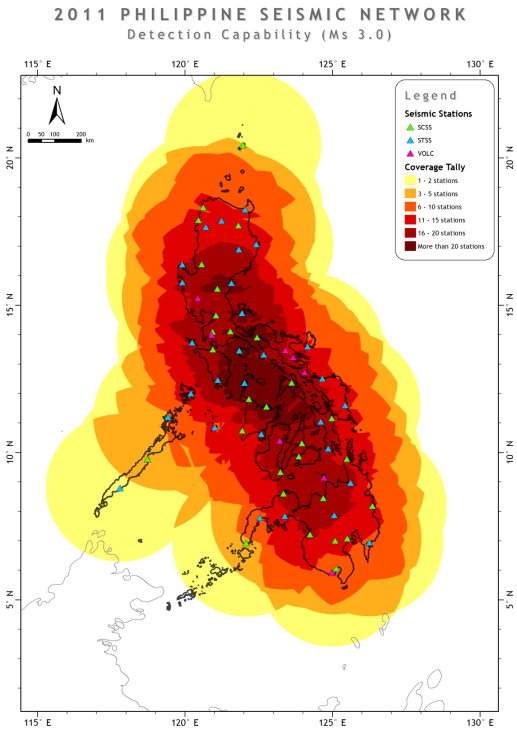
Wao, Lanao del Sur (WLSP)

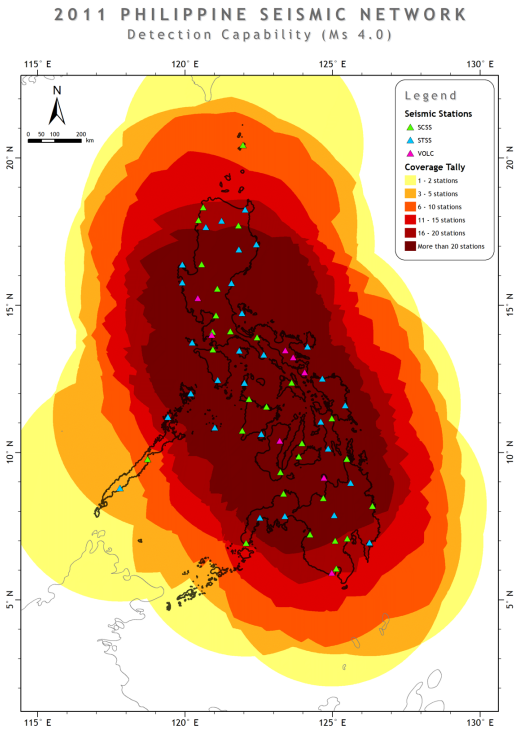
Satellite-Telemetered Seismic Stations



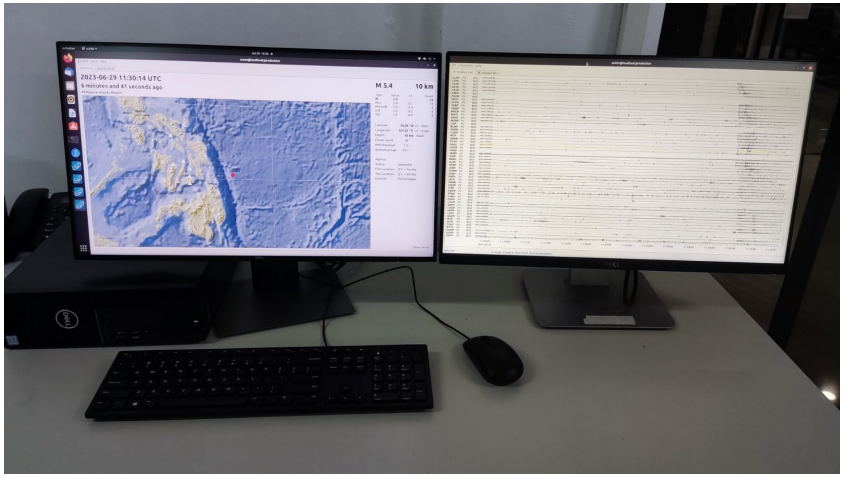
Event Detectability

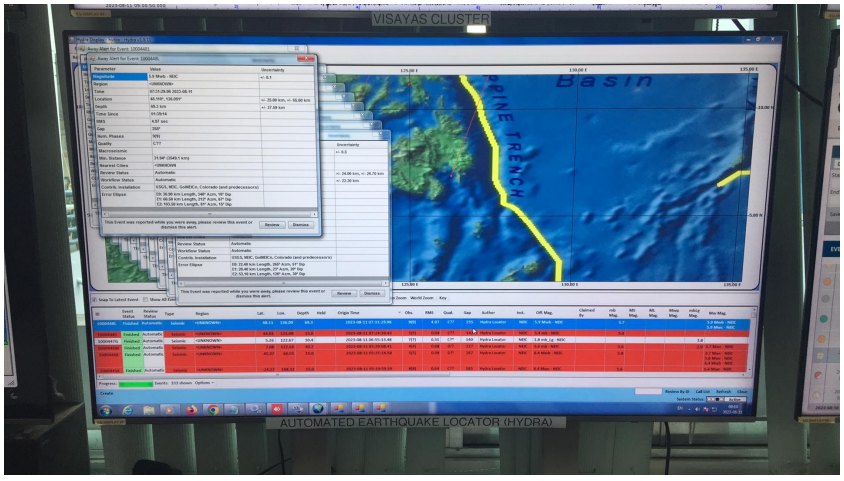


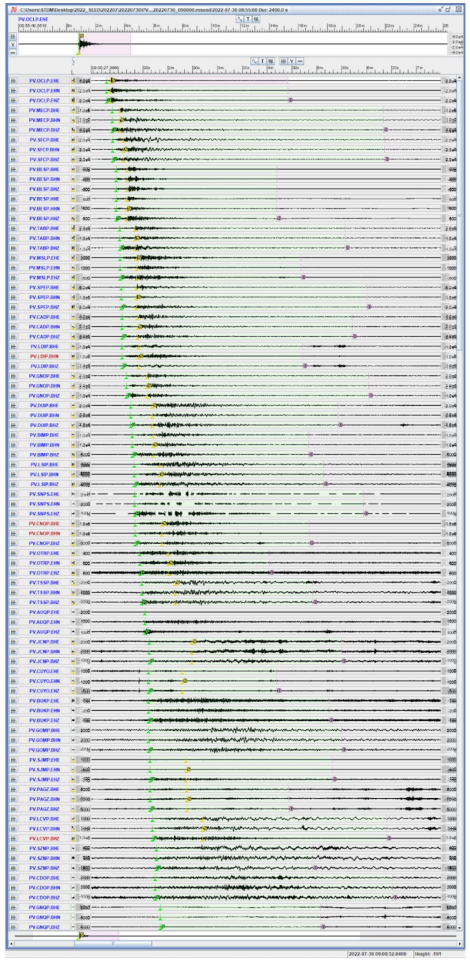




Data Acquisition and Processing

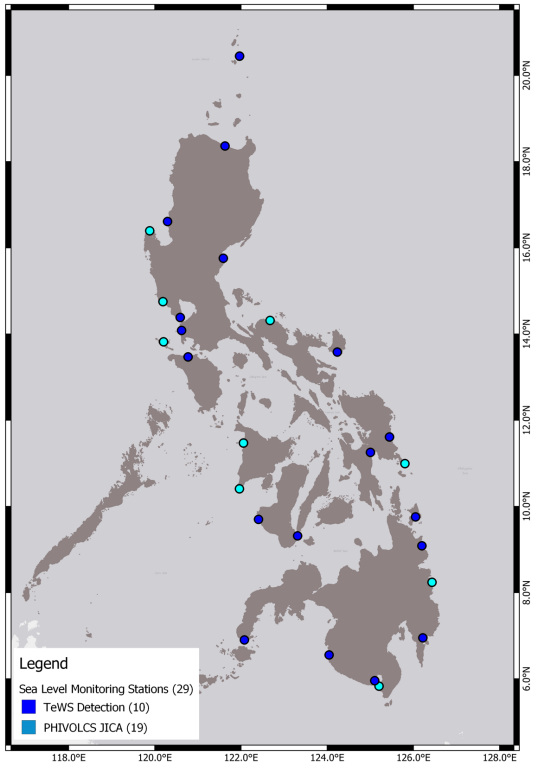


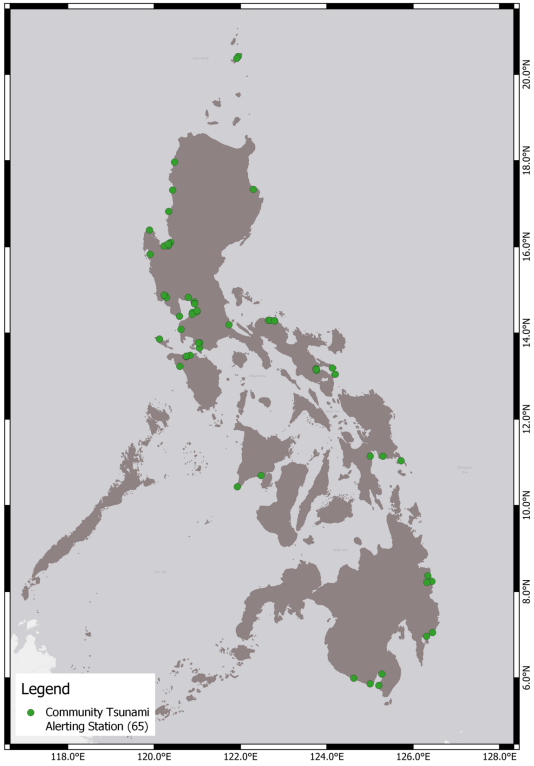




PHIVOLCS Tsunami Monitoring System

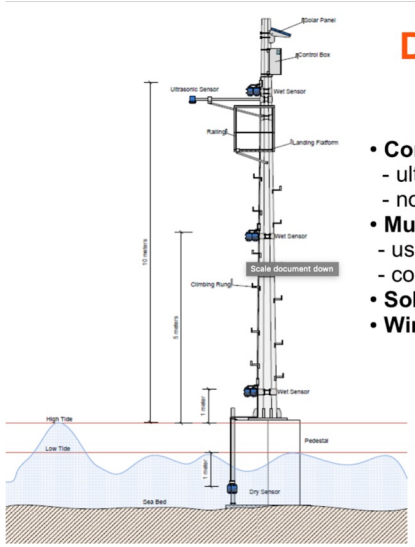
- **National Tsunami Monitoring and Early Warning**
  - **Twenty-nine (29) sea-level monitoring stations (SLMS) for tsunami detection**
  - **66 Community tsunami alerting siren (CTAS)**
  - **Ongoing Development Activities**
    - Commissioning of additional SLMS and CTAS
    - Community Evacuation Planning





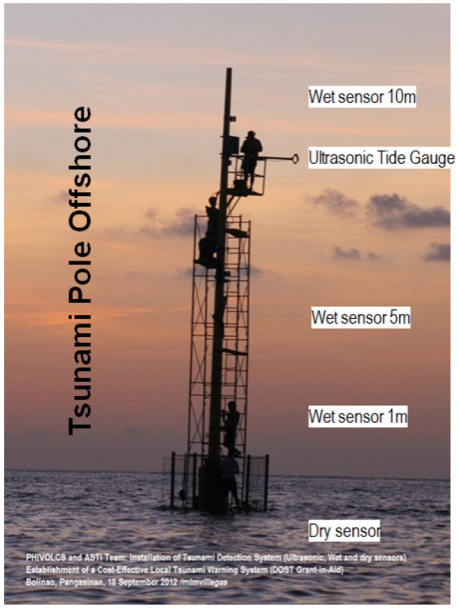
Sea-Level Monitoring Stations

Sea Level Monitoring Station

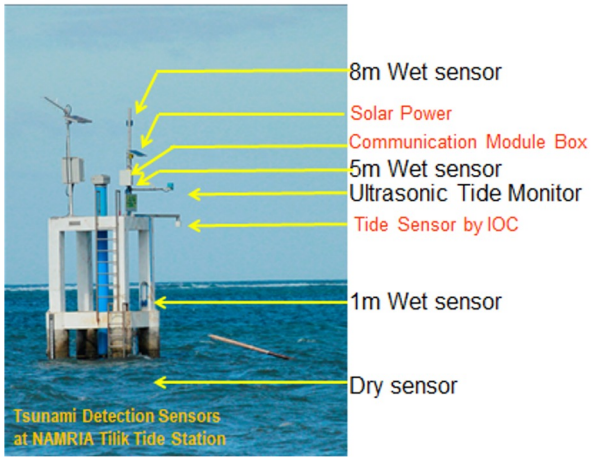


Detection Station

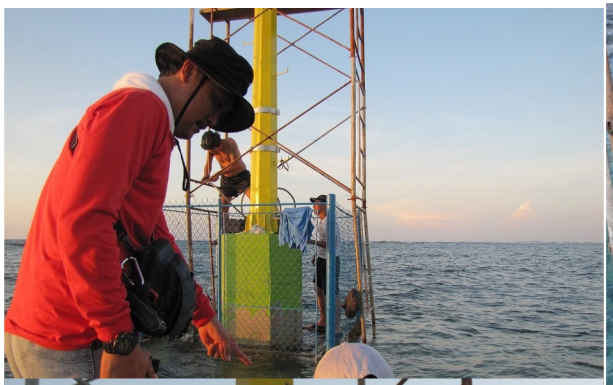
- **Continuous sea level monitoring**
  - ultrasonic base technology
  - non-contact
- **Multi-point level detection**
  - use of wet and dry sensor
  - contact
- **Solar-powered**
- **Wireless operation**



Lubang Tsunami Detection Sensors

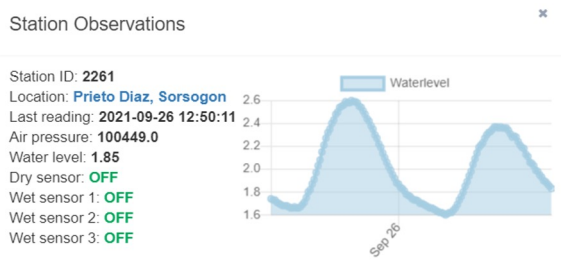


Installation



Repair and Maintenance

Installation of ultrasonic sensor and wet sensors (3m, 5m and 8m) at Prieto Diaz, Sorsogon Sea Level Station

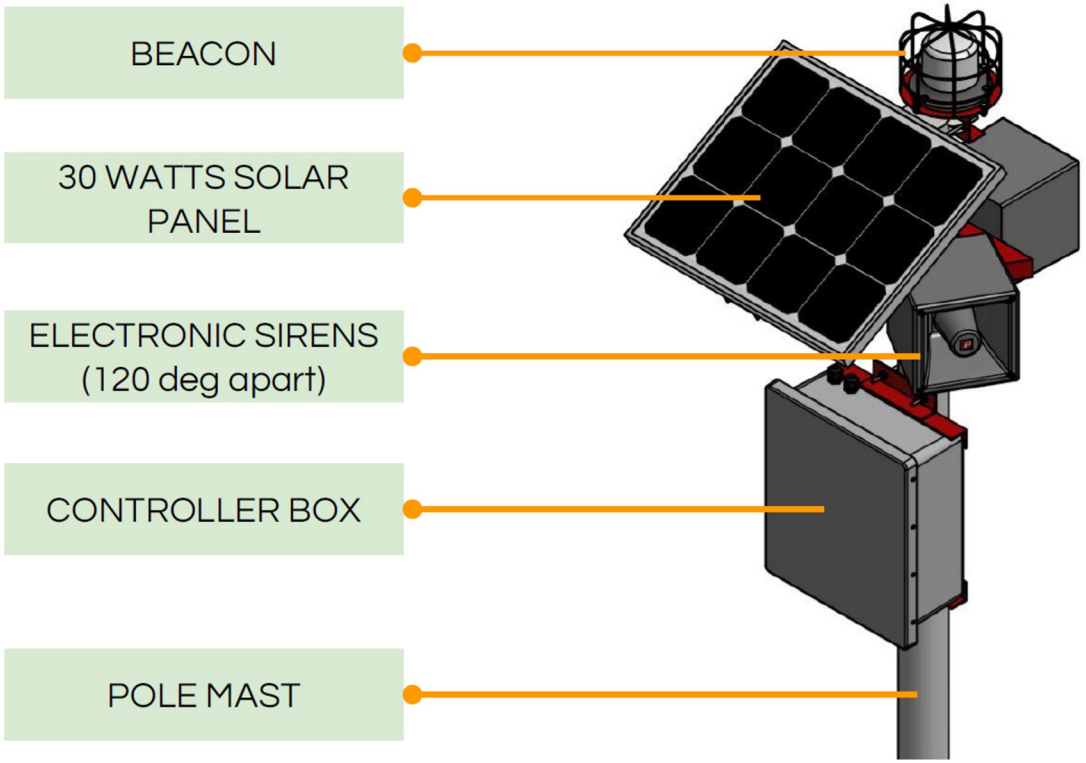


Repair of Jose Panganiban, Camarines Norte Sea Level Station

D.Camero, N. Anilao,J.Balboa

Department of Science and Technology
Philippine Institute of Volcanology and Seismology

Tsunami Alerting Station



1. ARQ (Data Logger)
2. Controller Box with customized holes
3. Lead-Acid Battery
4. Back plate with battery lock
5. Trigger Switch Board
6. ARQ Clip Holder
7. Beacon
8. Beacon Cage
9. Enclosure/Controller Box Bracket
10. Cable Assemblies
11. Solar Panel (30 Watts)
12. Solar Panel Holder and Bracket
13. GSM Antennae

Php 380,000.00

SOURCE: DOST-ASTI MASID

Inside the Controller Box (Data Logger)

arQ data logger

Trigger Switch Panel

Toggle Switch with safety cap

Rotary Switch

Lead acid battery

SOURCE: DOST-ASTI MASID

Installation of Tsunami Alerting Station

SOURCE: DOST-ASTI MASID

Maintenance of Tsunami Alerting Station

Check the following:
Solar panel (voltage, dust, etc)
Battery (voltage,
Corroded components
Wirings (deform, cut, etc)
Controller box (pests, water accumulation, etc)
Surroundings (vegetation, trees, etc)

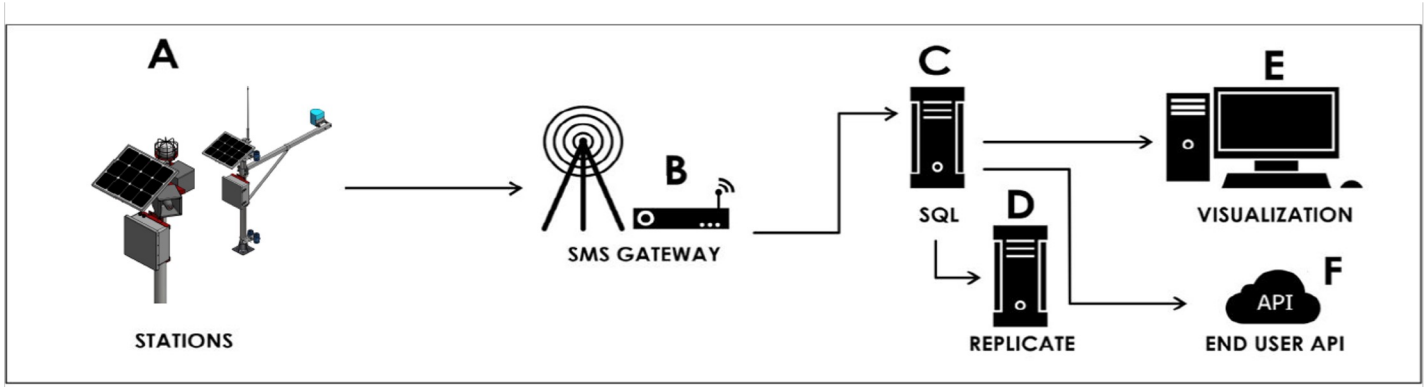
SOURCE: DOST-ASTI MASID

Systems Flow

Sampling rate:

TDS - 10mins (Shift to 1 min if wet/dry triggered)

TAS - 180mins

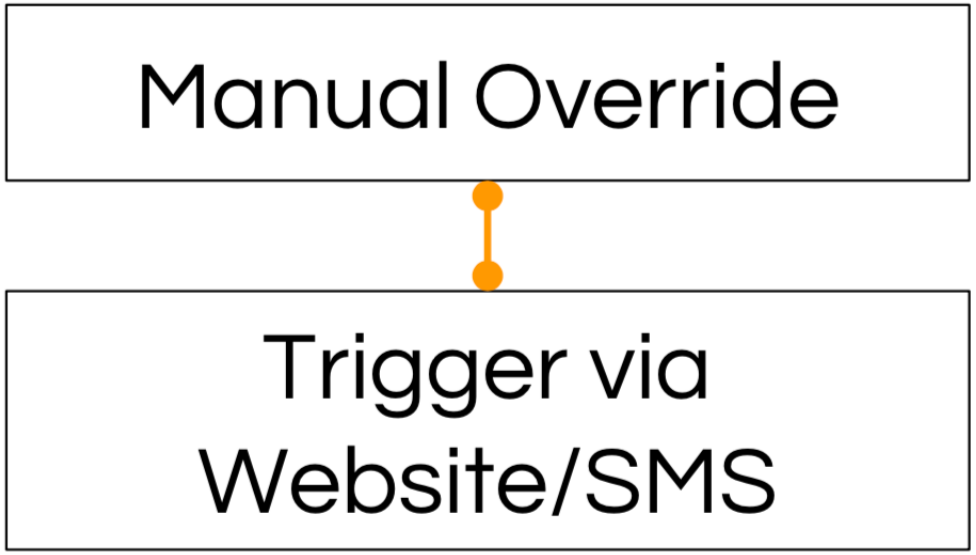


Get data from the stations at a specific time interval	Data collected are sent via SMS	The server receives and processes data	Data is shared and can be viewed online

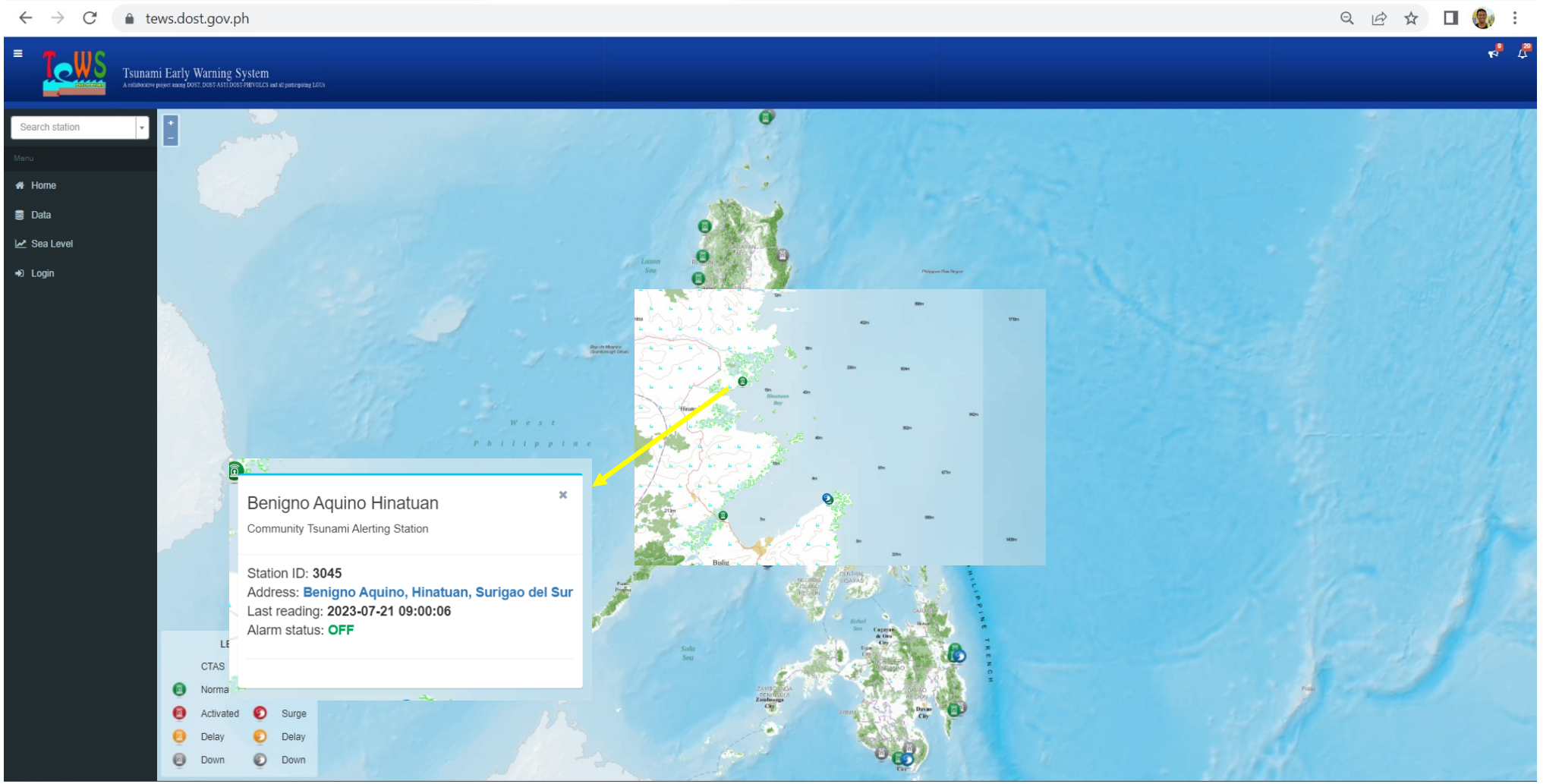
SOURCE: DOST-ASTI MASID

Triggering Options

Hierarchy for Alarm Triggering



Web Visualizations

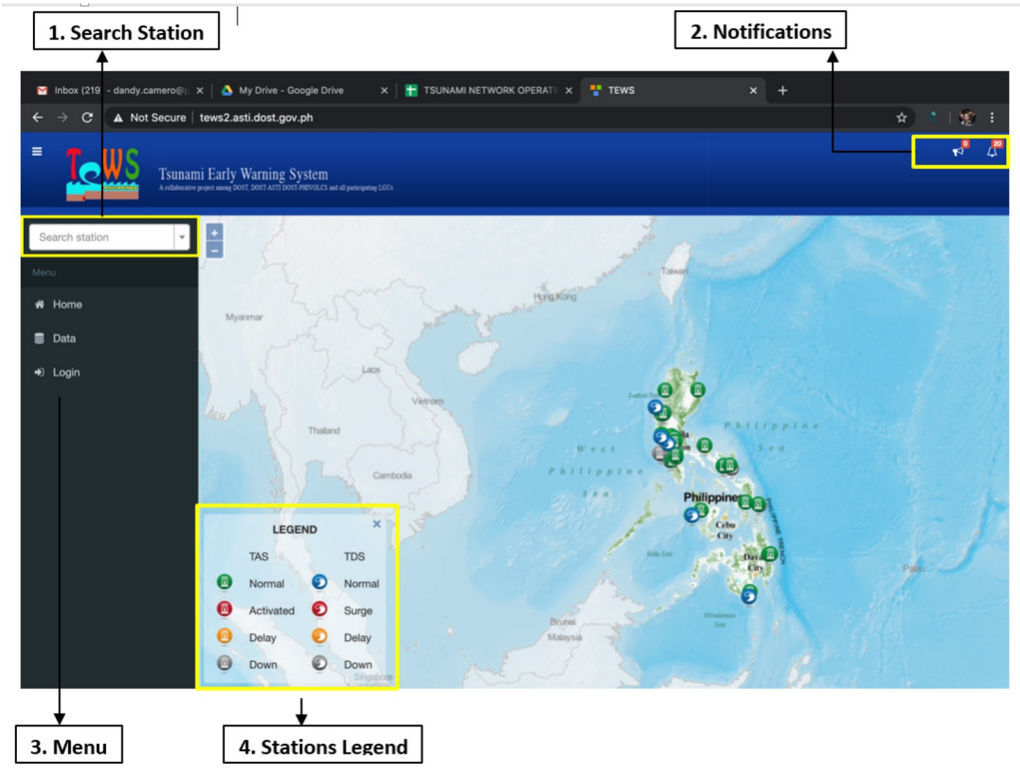


Web Visualizations

- It refers to the internet-based application use to trigger tsunami alerting station and also use to view and search sea level data recorded at tsunami detection station.

➔ Parts of the visualization tool

1. Search station – Its function is to quickly find the TAS and TDS in one specific location. Once a station is selected, it will zoom in to station domain.
2. Notification – It provide information to the user when the station is triggered or deactivated
3. Menu – It is a collection of links that allows the user to navigate from one content to another.
a. Home – It serves the starting point and default mode of the website.
b. Data – It allows the user to view and download TAS and TDS data.
c. Login – Allows the user to enter username and password for triggering purposes more advance configurations.
4. Station legend – Shows the station's current status.
5. **Map –** Shows the location of TEWS network around the Philippines.



Web Visualizations

➔ Station Current State / Map Legend

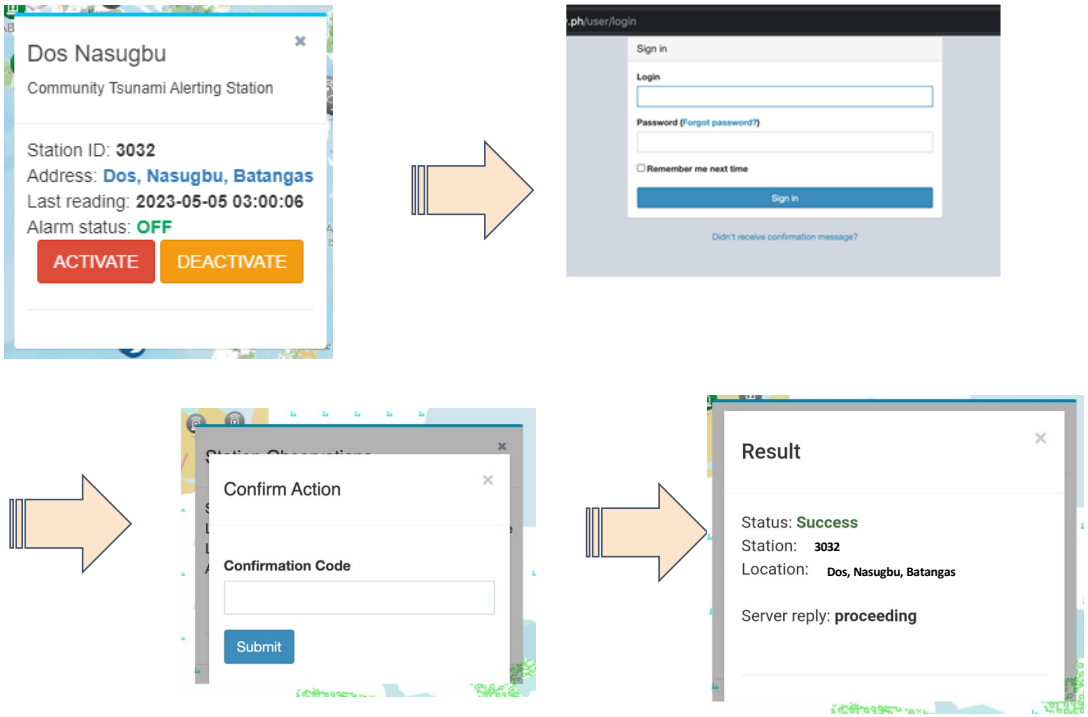
	The station is in normal status. This means that the communication between the station and the server is in near real-time with no data gaps.
	The station is in delayed status. This means that the TAS is unable to transmit data to the server within 3-hours.
	The station is triggered. This means that the TAS is currently in alarm mode.
	The station is in down status. This means that the TAS is unable to transmit data to the server within 24-hours.

	The station is in normal status. This means the communication between the station and the server is in near real-time with no data gaps.
	The station is in delayed status. This means that the Sea Level is unable to transmit data to the server within 9-hours.
	The station's wet sensor detected a water surge or the dry sensor got exposed or the water in the vicinity descend.
	The station is in down status. This means that the Sea Level is unable to transmit data to the server within 24-hours.

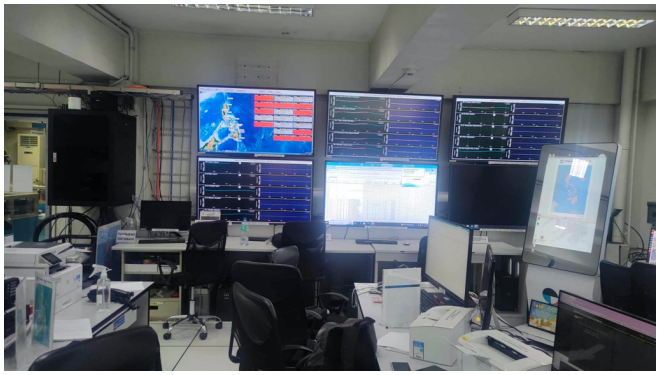
Web Visualizations

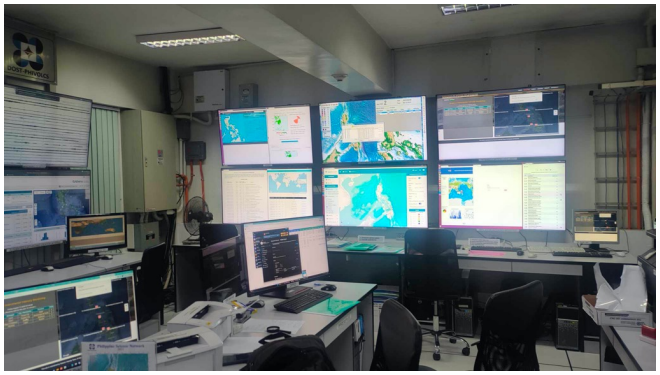
➔ Activate Tsunami Alerting Station

1. Click **Login** button in the menu section.
2. A pop-up window will show prompting the user to type **account name** and **password.**
3. Point the cursor to the target TAS marked with **bell icon**.
4. Click the icon.
5. A pop-up window should show the current status of the station.
6. Click **activate** button.
7. Again, a pop-up window will prompt to re-type the **password** for confirmation.



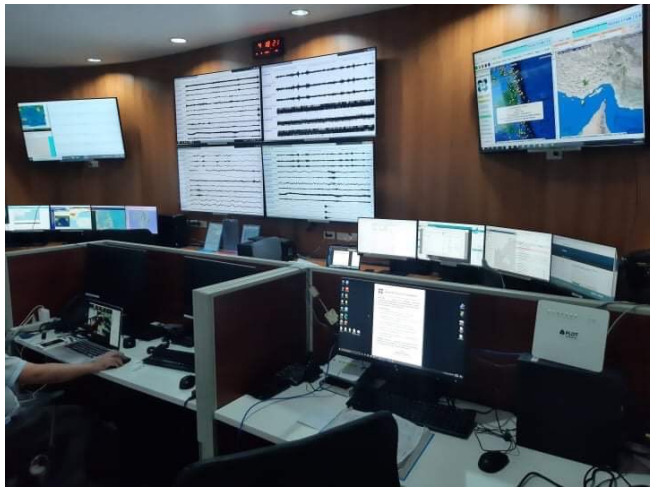
DOST-PHIVOLCS Data Receiving Center (DRC)



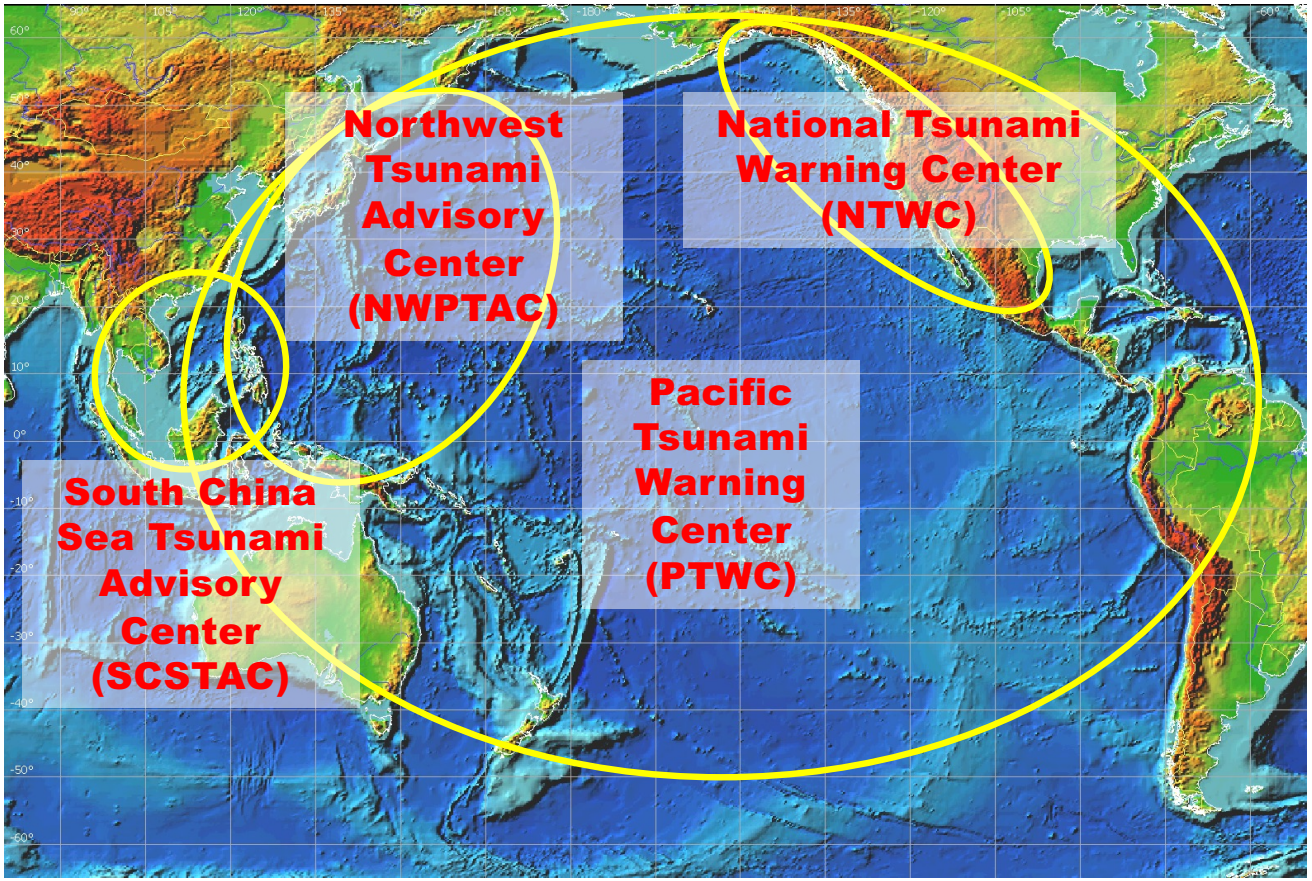


DOST-PHIVOLCS Tagaytay Mirror Station (TGY) & CTBTO AS080

DOST-PHIVOLCS Mindanao Cluster Center for Earthquake and Tsunami (PMCMCET)

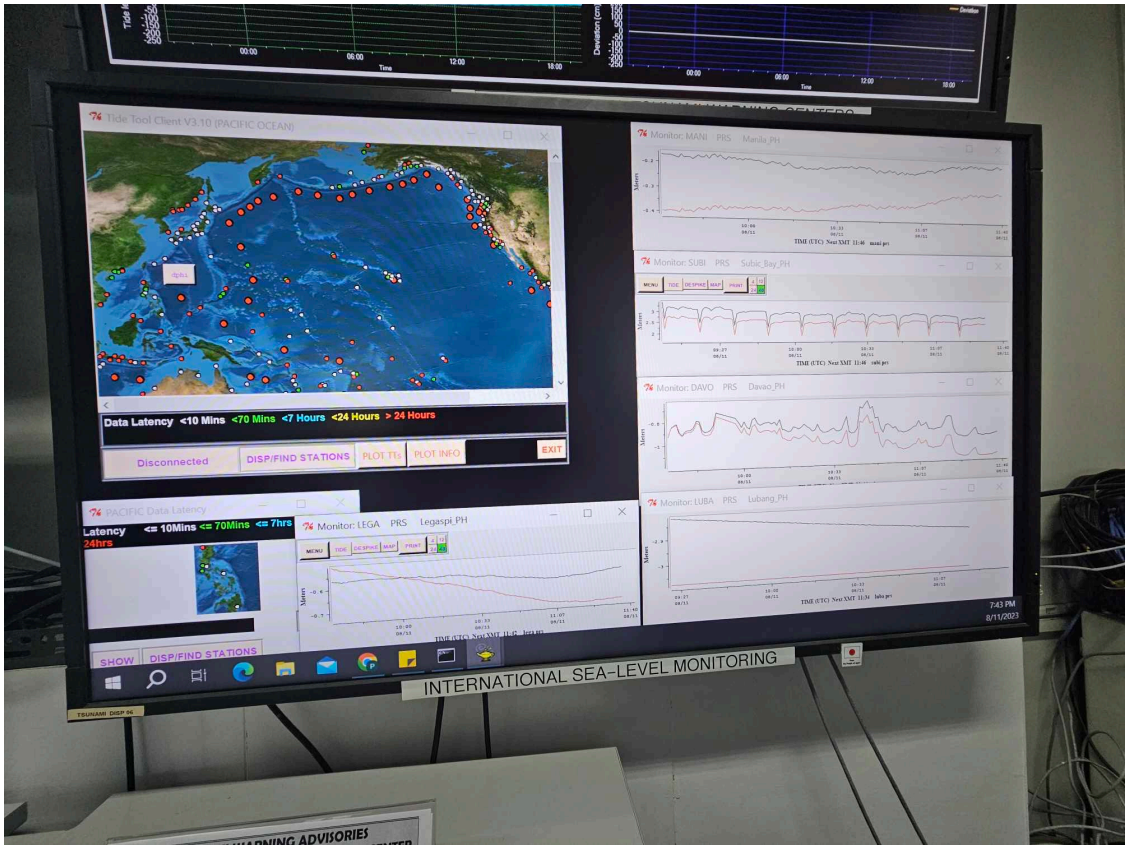


Tsunami Service Providers

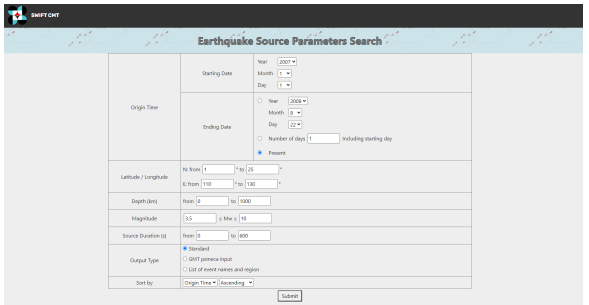


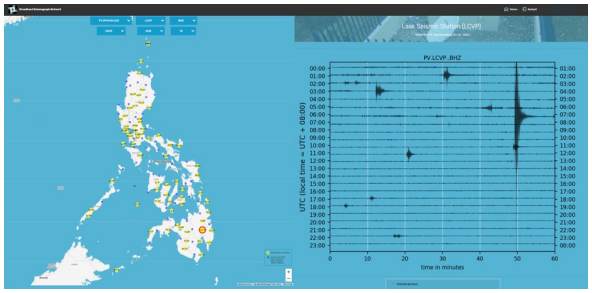
Department of Science and Technology
Philippine Institute of Volcanology and Seismology

Decision Support Tools – Tide Tool



Decision Support Tools - SWIFT





Date (UTC)	Longitude	Latitude	Depth (km)	Mw	Location	Analysis
2023-08-10 06:48	126.44°E	6.46°N	50	4.7	Offshore Davao Oriental, Philippines	Manual (Rapid solution)
2023-08-09 00:57	126.72°E	6.61°N	50	5.2	Davao Oriental, Philippines	Manual (Rapid solution)
2023-08-08 23:42	121.05°E	18.80°N	10	4.4	Offshore Cagayan, Philippines	Manual (Rapid solution)
2023-08-04 12:25	121.62°E	21.71°N	5	5.1	Offshore Batanes, Philippines	Manual (Rapid solution)
2023-08-04 12:22	121.38°E	21.68°N	5	5.1	Offshore Batanes, Philippines	Manual (Rapid solution)
2023-08-01 08:09	120.86°E	19.19°N	70	4.7	Offshore Cagayan, Philippines	Manual (Rapid solution)
2023-08-01 08:03	120.92°E	19.29°N	50	5.3	Offshore Cagayan, Philippines	Manual (Rapid solution)
2023-07-28 18:00	125.57°E	9.42°N	5	3.9	Surigao Del Norte, Philippines	Manual (Rapid solution)
2023-07-28 16:49	125.53°E	9.43°N	5	4.5	Surigao Del Norte, Philippines	Manual (Rapid solution)
2023-07-25 01:00	126.10°E	10.28°N	20	4.6	Offshore Surigao Del Norte, Philippines	Manual (Rapid solution)
2023-07-22 16:28	125.47°E	11.42°N	45	4.5	Eastern Samar, Philippines	Manual (Rapid solution)
2023-07-21 19:24	127.01°E	6.81°N	15	4.8	Offshore Davao Oriental, Philippines	Manual (Rapid solution)
2023-07-19 23:08	128.52°E	3.14°N	210	5.0	Offshore Davao Occidental, Philippines	Manual (Rapid solution)
2023-07-17 15:35	124.21°E	5.90°N	15	5.3	Offshore Sarangani, Philippines	Manual (Rapid solution)
2023-07-16 19:18	125.47°E	11.19°N	50	4.4	Eastern Samar, Philippines	Manual (Rapid solution)
2023-07-10 14:57	125.59°E	9.37°N	5	3.9	Agusan Del Norte, Philippines	Manual (Rapid solution)
2023-07-10 13:01	125.49°E	11.41°N	55	5.0	Eastern Samar, Philippines	Manual (Rapid solution)
2023-07-10 12:05	127.40°E	7.90°N	10	4.7	Offshore Davao Oriental, Philippines	Manual (Rapid solution)
2023-07-09 12:48	124.10°E	13.10°N	5	4.3	Albay, Philippines	Manual (Rapid solution)
2023-07-06 07:16	119.82°E	15.70°N	55	4.7	Offshore Zambales, Philippines	Manual (Rapid solution)
2023-07-05 11:14	125.77°E	6.82°N	40	4.2	Davao Del Norte, Philippines	Manual (Rapid solution)
2023-07-03 10:20	124.44°E	5.68°N	45	4.8	Offshore Sarangani, Philippines	Manual (Rapid solution)
2023-07-02 05:40	126.06°E	8.69°N	15	4.6	Surigao del Sur, Philippines	Manual (Rapid solution)
2023-07-01 04:42	126.88°E	10.08°N	5	4.4	Offshore Surigao del Norte, Philippines	Manual (Rapid solution)
2023-06-29 13:52	126.16°E	5.87°N	90	4.8	Offshore Davao Occidental, Philippines	Manual (Rapid solution)
2023-06-29 11:30	126.99°E	10.18°N	5	5.1	Offshore Surigao del Norte, Philippines	Manual (Rapid solution)
2023-06-29 05:15	126.70°E	8.30°N	55	4.6	Offshore Surigao del Sur, Philippines	Manual (Rapid solution)
2023-06-26 20:32	122.10°E	10.11°N	10	4.5	Antique, Philippines	Manual (Rapid solution)

https://doi.org/10.20965/jdr.2015.p0025
Development and Operation of a Regional Moment Tensor Analysis System in the Philippines

Paper:

Development and Operation of a Regional Moment Tensor Analysis System in the Philippines: Contributions to the Understanding of Recent Damaging Earthquakes

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A network of 10 satellite-telemetered broadband stations was established under a cooperative project between Japan and the Philippines, and a source analysis system based on waveform inversion of regional seismograms was adapted to operationalize a regional moment tensor analysis of Philippine earthquakes. This study presents the source information generated by the system for recent damaging earthquakes: the M_w6.7 Negros and M_w7.6 offshore Samar in 2012, and the M_w7.2 in Bohol in 2013. Results show that the Negros event was generated by shallow NE–SW thrust faulting with a small strike-slip component, and that the centroid was located slightly offshore. The Samar event occurred in relation to an outer-trench thrust fault within the Philippine Sea Plate, adjacent to a part of the Philippine Trench that has relatively low seismicity. Our centroid moment tensor (CMT) solutions show that the Samar event triggered distinct clusters of outer-rise normal and thrust aftershocks, which we explain as being consistent with a Coulomb stress change in the area. Finally, we infer that the previously unidentified fault zone that generated the Bohol earthquake has a length of ~100 km, is oriented ENE–WSW, transects parts of Bohol, and extends offshore towards Cebu. These examples show how recent improvements in Philippine earthquake monitoring could contribute to the characterization of earthquake sources and in the understanding of the seismotectonics of the area.

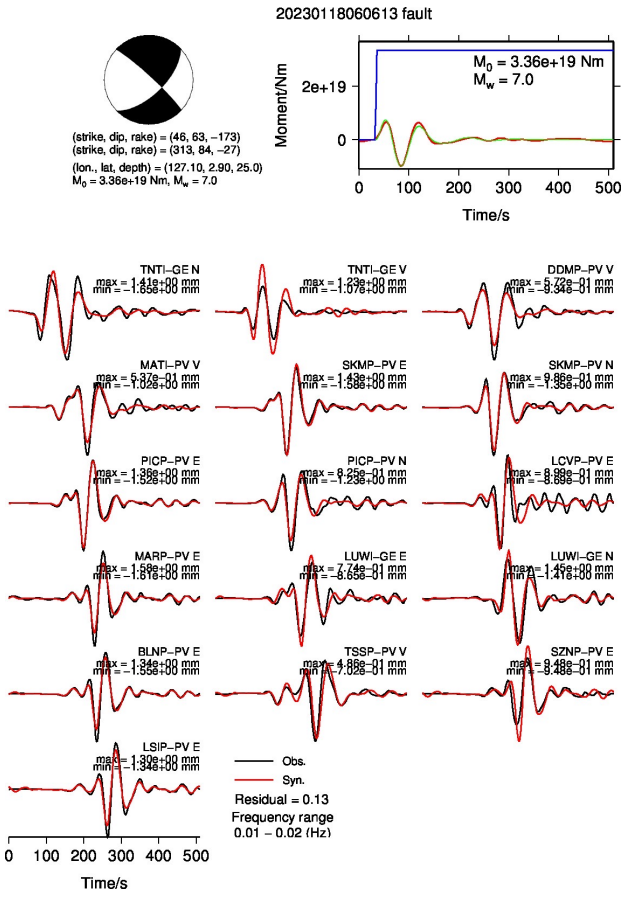
Keywords: earthquake monitoring, source parameters, waveform inversion, Negros, Bohol, Samar, Philippine Trench

1. Introduction

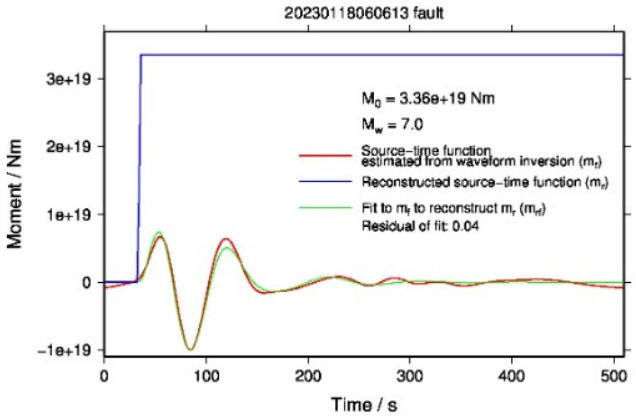
The Philippine region is known to be an area of complex seismotectonics, which accommodates deformations due to the opposing movements of the Philippine Sea Plate and the Sunda Plate (**Fig. 1**). The Philippine archipelago has 23 active volcanoes and numerous active faults and trenches [1]. The threat of tsunami is very high for most of the Philippine coastline, as both sides of the archipelago are bounded by active subduction zones associated with large earthquakes. Both the Philippine Trench and the North Luzon Trough lie to the east of the Philippines; the former has a history of large earthquake generation (e.g., 1925 M8.2, 1995 M7.5), and the latter is a bathymetric depression interpreted as either an incipient subduction or a remnant suture zone. The western coast of the archipelago is defined by the Manila Trench (1994 M7.2), the Mindoro-Negros collision zone (1948 M8.3), the Negros Trench, the Sulu Trench and the Cotabato Trench (1976 M7.6). Most of the major islands of the Philippines are transected by active faults, the most dominant of which is the ~1,250 km long, arc-parallel, left-lateral strike-slip Philippine Fault Zone (PFZ) (1645 M7.9; 1990 M_w7.7) [2, 3]. The PFZ traverses the major islands of the Philippines and manifests itself in several active splays, thereby dominating the seismic activities in the NW part of Luzon, Central Visayas, and Eastern Mindanao [4, 5]. To assist in improving the preparations for (and the mitigation of) earthquake and tsunami disasters in this country, it is considered important to gain an understanding of the seismic potential of all active faults and trenches.

The integration of routine regional moment tensor analysis in the Philippine earthquake monitoring system is

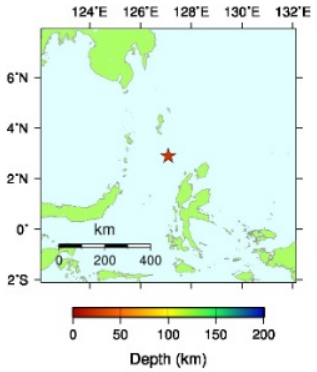
Decision Support Tools - SWIFT



- Source-time function



- Summary



SWIFT Centroid Moment Tensor Solution:

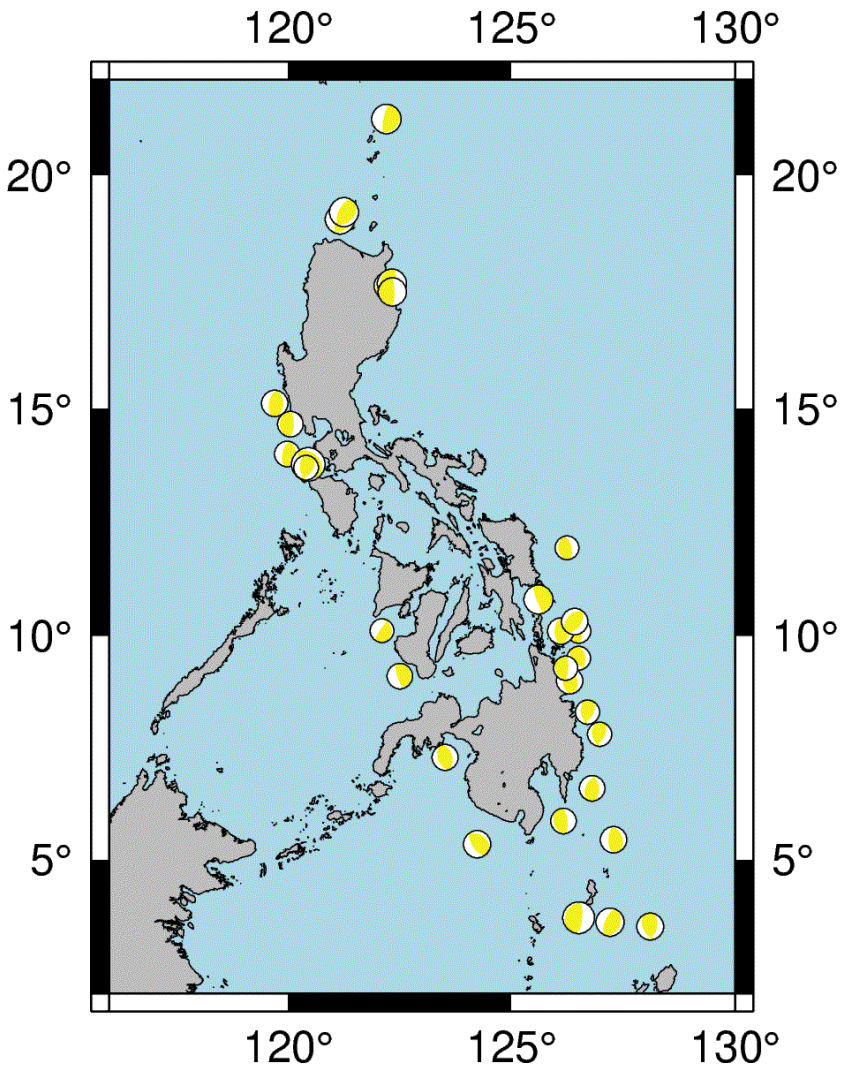
Moment magnitude (M_w) = 7.0

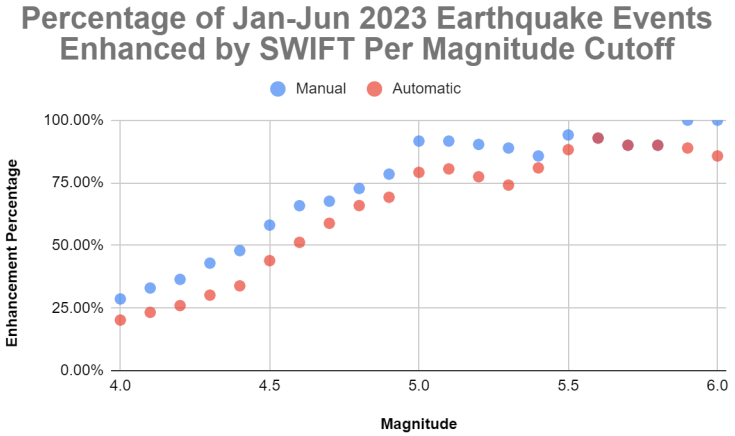
Seismic moment (M_0) = 3.36×10^{19} Nm

(Lon, Lat, Depth) = (127.10°E, 2.90°N, 25 km)

(Strike 1, Dip 1, Rake 1) = (46°, 63°, −173°)

(Strike 2, Dip 2, Rake 2) = (313°, 84°, −27°)

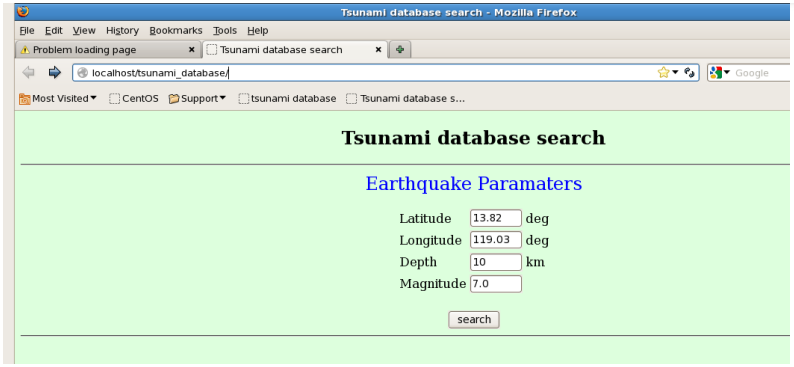


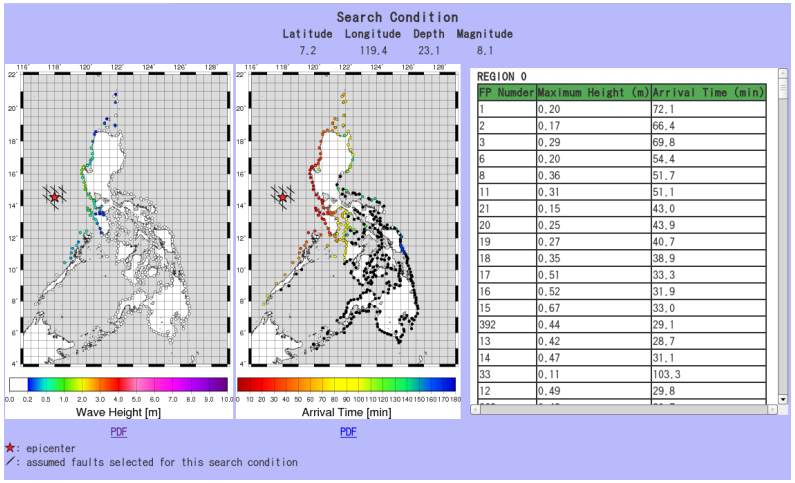


- **86/148 (58.11%)** M4.5+ EQ events with manual SWIFT CMT Solution in 2023
  - **56** manually revised and accepted out of the **67** available automatic solutions (triggered by DRC SeisComP3)
- **9** EQ events with Mw 4.0 – 4.4 result
- Total: **95** M4.0+ EQ events with manual SWIFT CMT Solution:
  - **33** Reverse
  - **15** Reverse – Strike-slip
  - **9** Strike-slip – Reverse
  - **14** Strike-slip
  - **11** Strike-slip – Normal
  - **8** Normal – Strike-slip
  - **5** Normal

Decision Support Tools – Tsunami Scenario Database

- Computed arrival time of (+) tsunami wave and maximum wave height at 405 forecast points along the Philippine coast
- Over 30,000 scenarios





https://doi.org/10.20965/jdr.2015.p0051

Building a Tsunami Simulation Database for the Tsunami Warning System in the Philippines

Survey Report:

Building a Tsunami Simulation Database for the Tsunami Warning System in the Philippines

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To enhance the tsunami warning operation system in the Philippines caused by earthquakes in and around the country, staff members of the Japan Meteorological Agency (JMA) joined the SATREPS program in 2012 to help building a tsunami simulation database in the Philippine Institute of Volcanology and Seismology (PHIVOLCS), which stores multiple results of tsunami simulations such as estimated tsunami arrival times and heights at coasts for multiple hypothetical earthquakes of various hypocenter locations and magnitudes. The procedure to construct a database consists of several steps starting from setting assumed fault parameters and others, proceeding to tsunami simulations and data creation to be stored in the database, and as the last step, creating a searching system which picks results from the database according to the location and magnitude of an earthquake. As of July 2014, the PHIVOLCS has stored the results of tsunami simulations conducted for more than 30,000 assumed faults for local tsunamis. The searching system is also prepared which enables to get a quick grasp of expected tsunami features quantitatively. With this database and the searching system, the PHIVOLCS is in near future to issue initial tsunami warnings based on the information of estimated tsunami arrival times and heights immediately after the hypocenter location and magnitude of an earthquake are determined. When the necessary coordination with related organizations as well as the public education for the system and warning messages are ready, the PHIVOLCS will start the enhanced local tsunami warning operation.

Keywords: tsunami warning system, tsunami simulation database, tsunami disaster preparedness, the Philippines

1. Introduction

Many countries have suffered serious damage due to tsunamis on a number of occasions: recent examples are the tsunami due to the 2011 Great East Japan Earthquake, the 2010 Chilean tsunami, the 2004 Indian Ocean tsunami and so on. These experiences raised the awareness for the necessity of tsunami mitigation system both in the world and in each country, and these days, not a few countries are working on establishing/enhancing their national tsunami warning system.

The Philippines is one of those countries. Similar to Japan's situation, the Philippines is surrounded by the plate boundaries and offshore active faults; large earthquakes occur in and around this country and sometimes they generate tsunamis which strike coasts in a short time (**Fig. 1**). For example, an earthquake with a moment magnitude of 8.1 occurred in Mindanao in 1976, which generated tsunamis whose initial waves hit coasts in a few minutes after the occurrence of the earthquake and several thousands were killed [1]. This region suffered another tsunami in 1918 [1]. A large earthquake also occurred at the western edge of Mindanao Island and caused tsunamis along the coasts as well as in the Sulu Sea in 1897 [1]. Therefore, immediate issuance of tsunami warnings is a necessity.

Under circumstances like this, the PHIVOLCS decided to build a tsunami simulation database for their warning operations for local tsunamis. In this project, the JMA first provided information on the social requirements and tsunami warning system in Japan and discussed in order to get these matters in the Philippines into perspective, then, proceeded to each step. The JMA and the PHIVOLCS staff members engaged in this project occasionally visited each office to work together, including a field trip to sea level monitoring facilities in both countries as well as to coastal areas along Manila Bay to see the living environment and disaster mitigation system, to promote our understanding.

Procedures for Issuance of Earthquake and Tsunami Information

1. Objectives

This procedure states the steps for the issuance and updating of Earthquake Information, using earthquake data from recording seismic stations.

2. Scope

This procedure applies to earthquake data gathered from the Philippine Seismic Network (PSN), automatic interface and software, PHIVOLCS Instrumental Intensity Network and intensities accumulated from the public.

3. Definition of Terms

Contact Information Directory is a list of contact persons from different Local Government Units (LGUs) and partner agencies and their contact details for intensity survey.

Data Receiving Center (DRC) is the base operation of PHIVOLCS in Quezon City where earthquake and tsunami data and information are transmitted, received, processed, analyzed and disseminated.

DRC Watchstander refers to the identified SOEPD personnel who perform earthquake and tsunami monitoring at the DRC.

Earthquake is the sudden stress changes in the earth or sudden slip on a fault resulting in ground movement and shaking due to radiated seismic waves from the source.

Earthquake Information refers to the information summary sheet of basic parameters of an earthquake information subsequently updated every time additional data are timely received.

Earthquake Parameters are basic parameters of an earthquake which consist of its date and time of occurrence, location and depth of origin, magnitude and available intensities.

Earthquake Phase Data are data extracted from earthquake records and generally consist of arrival times and characteristics of major earthquake waves, its maximum duration & amplitude, and its dominant frequency.

Earthquake-Related Information is additional information about an earthquake derived from reported and instrumental intensities, impact & damage reports and source mechanisms.

1. Objectives

This procedure describes the steps in the issuance and updating of the Tsunami Information using earthquake and tsunami data from recording seismic stations and sea-level monitoring stations.

2. Scope

This procedure on issuance of tsunami information applies to earthquake-induced tsunami and uses data and information generated from earthquake and sea-level monitoring networks, such as the Philippine Seismic Network (PSN) and Sea-Level Monitoring Network operated and maintained by the Philippine Institute of Volcanology and Seismology (PHIVOLCS), as well as tsunami-related information provided by the international tsunami warning centers.

3. Definition of Terms

Centroid Moment Tensor (CMT) Solution is a set of parameters that define the general sense of movement and magnitude of an earthquake by processing broadband records of the event.

Data Receiving Center (DRC) is the base operation of PHIVOLCS in Quezon City where earthquake and tsunami data and information are transmitted, received, processed, analyzed and disseminated.

Distant Tsunami is a series of sea waves caused by a large-magnitude-offshore earthquake that occurred outside the Philippines.

DRC Watchstander refers to the identified PHIVOLCS personnel of the Seismological Observation and Earthquake Prediction Division (SOEPD) who perform earthquake and tsunami monitoring at the DRC.

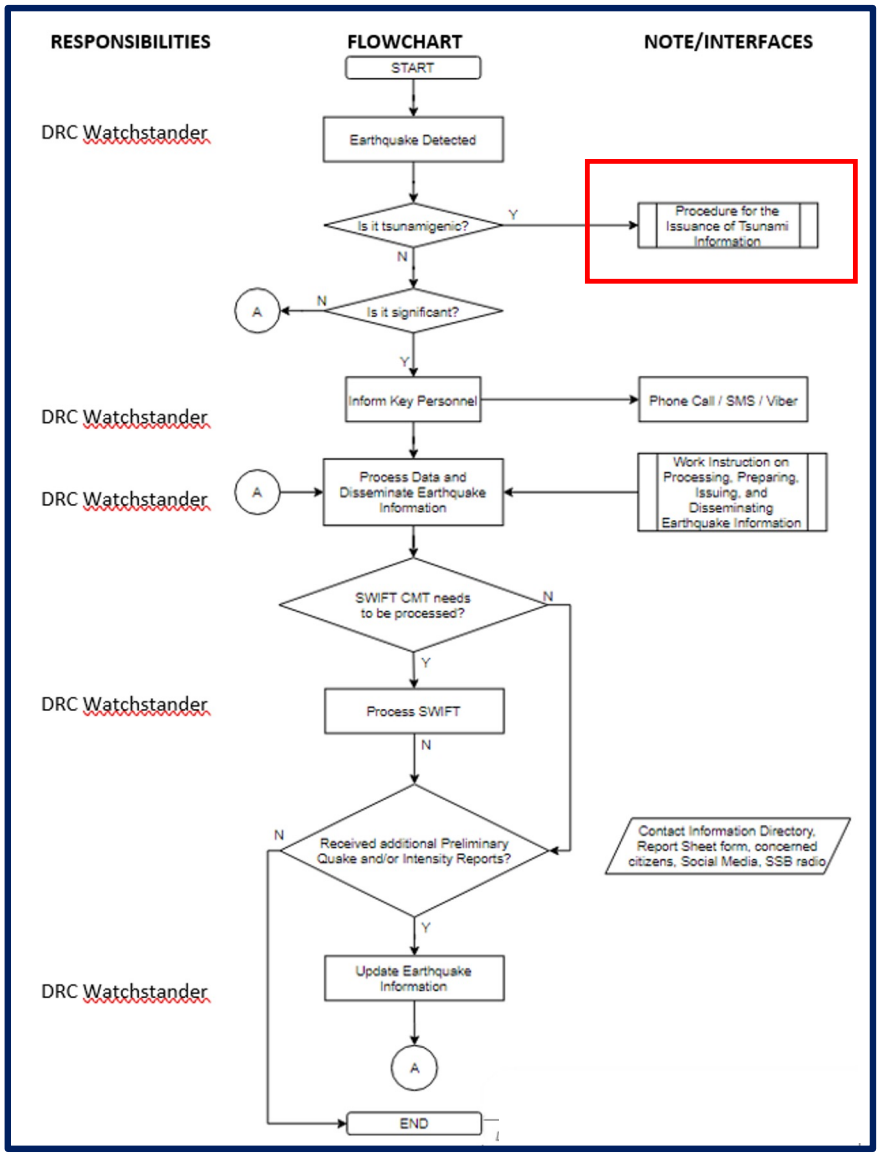
Earthquake is the sudden stress changes in the earth or sudden slip on a fault resulting to ground movement and shaking due to radiated seismic waves from the source.

Earthquake and Tsunami Alerting Module (ETAM) a tsunami decision tool for near real-time seismic monitoring and assessment of tsunami potential.

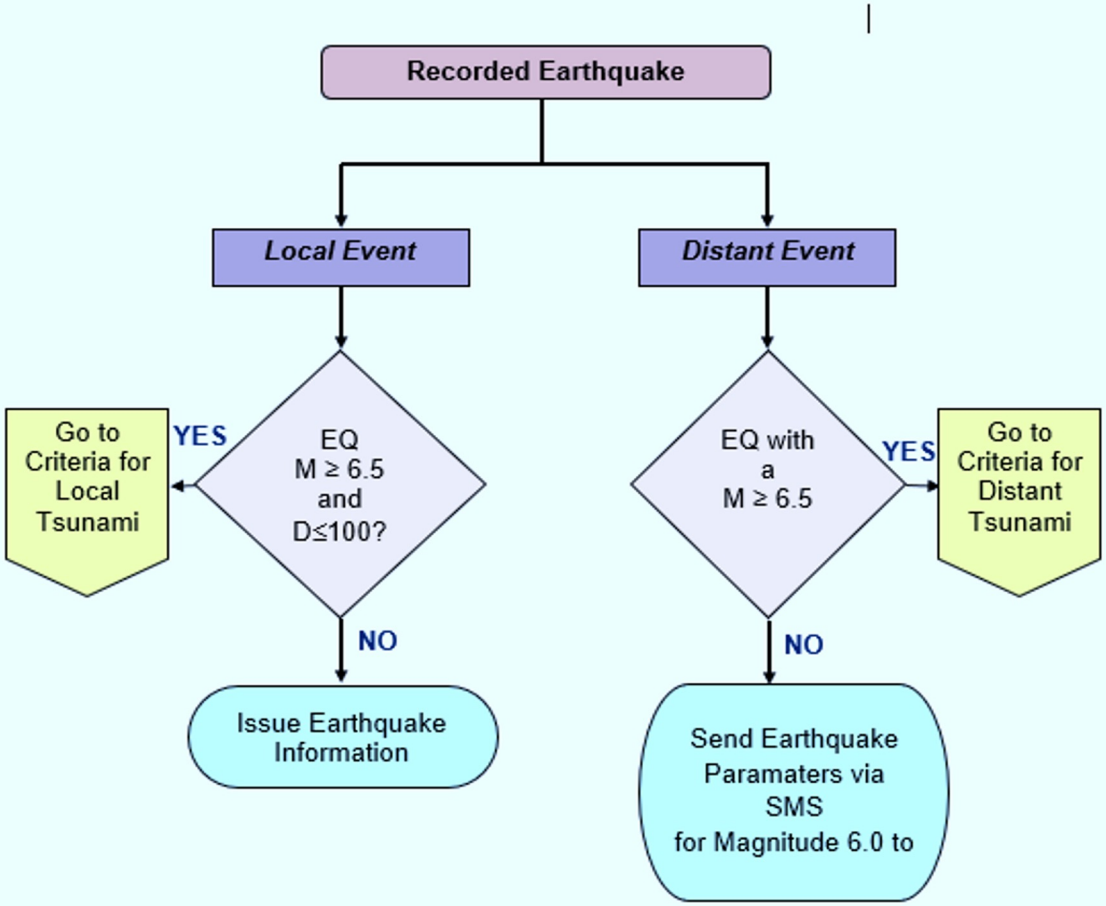
Procedure for the Issuance of **Earthquake Information**

DRC: Data Receiving Center

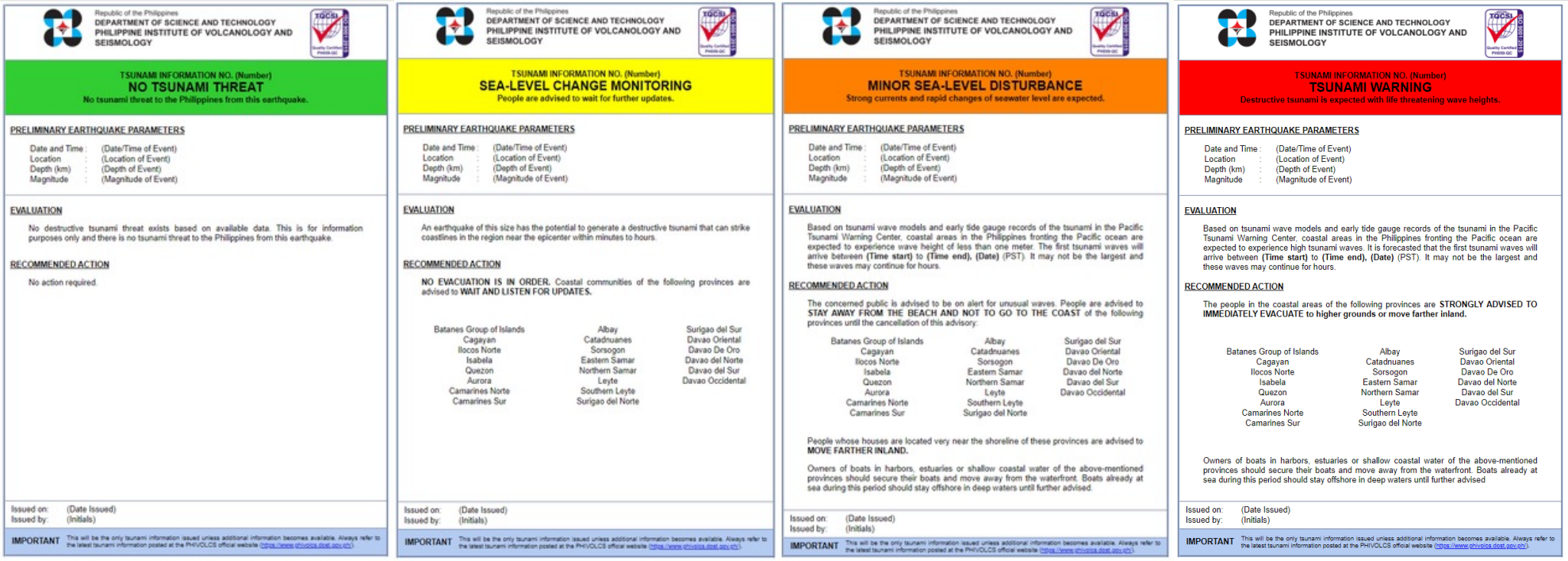
Earthquake Bulletin must be issued within 13 minutes as per PHIVOLCS Citizen's Charter



TSUNAMI ISSUANCE FLOWCHART



Tsunami Information Products



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TSUNAMI INFORMATION NO. (Number)

NO TSUNAMI THREAT

No tsunami threat to the Philippines from this earthquake.

PRELIMINARY EARTHQUAKE PARAMETERS

Date and Time : (Date/Time of Event)
Location : (Location of Event)
Depth (km) : (Depth of Event)
Magnitude : (Magnitude of Event)

EVALUATION

No destructive tsunami threat exists based on available data. This is for information purposes only and there is no tsunami threat to the Philippines from this earthquake.

RECOMMENDED ACTION

No action required.

Issued on: (Date Issued)
Issued by: (Initials)

IMPORTANT This will be the only tsunami information issued unless additional information becomes available. Always refer to the latest tsunami information posted at the PHIVOLCS official website (https://www.phivolcs.dost.gov.ph/).

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TSUNAMI INFORMATION NO. (Number)

SEA-LEVEL CHANGE MONITORING

People are advised to wait for further updates.

PRELIMINARY EARTHQUAKE PARAMETERS

Date and Time : (Date/Time of Event)
Location : (Location of Event)
Depth (km) : (Depth of Event)
Magnitude : (Magnitude of Event)

EVALUATION

An earthquake of this size has the potential to generate a destructive tsunami that can strike coastlines in the region near the epicenter within minutes to hours.

RECOMMENDED ACTION

NO EVACUATION IS IN ORDER. Coastal communities of the following provinces are advised to **WAIT AND LISTEN FOR UPDATES.**

Batanes Group of Islands
Cagayan
Ilocos Norte
Isabela
Quezon
Aurora
Camarines Norte
Camarines Sur
Albay
Catadnuanes
Sorsogon
Eastern Samar
Northern Samar
Leyte
Southern Leyte
Surigao del Norte
Surigao del Sur
Davao Oriental
Davao De Oro
Davao del Norte
Davao del Sur
Davao Occidental

Issued on: (Date Issued)
Issued by: (Initials)

IMPORTANT This will be the only tsunami information issued unless additional information becomes available. Always refer to the latest tsunami information posted at the PHIVOLCS official website (https://www.phivolcs.dost.gov.ph/).

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TSUNAMI INFORMATION NO. (Number)

MINOR SEA-LEVEL DISTURBANCE

Strong currents and rapid changes of seawater level are expected.

PRELIMINARY EARTHQUAKE PARAMETERS

Date and Time : (Date/Time of Event)
Location : (Location of Event)
Depth (km) : (Depth of Event)
Magnitude : (Magnitude of Event)

EVALUATION

Based on tsunami wave models and early tide gauge records of the tsunami in the Pacific Tsunami Warning Center, coastal areas in the Philippines fronting the Pacific ocean are expected to experience wave height of less than one meter. The first tsunami waves will arrive between **(Time start)** to **(Time end), (Date)** (PST). It may not be the largest and these waves may continue for hours.

RECOMMENDED ACTION

The concerned public is advised to be on alert for unusual waves. People are advised to **STAY AWAY FROM THE BEACH AND NOT TO GO TO THE COAST** of the following provinces until the cancellation of this advisory:

Batanes Group of Islands
Cagayan
Ilocos Norte
Isabela
Quezon
Aurora
Camarines Norte
Camarines Sur
Albay
Catadnuanes
Sorsogon
Eastern Samar
Northern Samar
Leyte
Southern Leyte
Surigao del Norte
Surigao del Sur
Davao Oriental
Davao De Oro
Davao del Norte
Davao del Sur
Davao Occidental

People whose houses are located very near the shoreline of these provinces are advised to **MOVE FARTHER INLAND.**

Owners of boats in harbors, estuaries or shallow coastal water of the above-mentioned provinces should secure their boats and move away from the waterfront. Boats already at sea during this period should stay offshore in deep waters until further advised.

Issued on: (Date Issued)
Issued by: (Initials)

IMPORTANT This will be the only tsunami information issued unless additional information becomes available. Always refer to the latest tsunami information posted at the PHIVOLCS official website (https://www.phivolcs.dost.gov.ph/).

Republic of the Philippines
DEPARTMENT OF SCIENCE AND TECHNOLOGY
PHILIPPINE INSTITUTE OF VOLCANOLOGY AND SEISMOLOGY

TSUNAMI INFORMATION NO. (Number)

TSUNAMI WARNING

Destructive tsunami is expected with life threatening wave heights.

PRELIMINARY EARTHQUAKE PARAMETERS

Date and Time : (Date/Time of Event)
Location : (Location of Event)
Depth (km) : (Depth of Event)
Magnitude : (Magnitude of Event)

EVALUATION

Based on tsunami wave models and early tide gauge records of the tsunami in the Pacific Tsunami Warning Center, coastal areas in the Philippines fronting the Pacific ocean are expected to experience high tsunami waves. It is forecasted that the first tsunami waves will arrive between **(Time start)** to **(Time end), (Date)** (PST). It may not be the largest and these waves may continue for hours.

RECOMMENDED ACTION

The people in the coastal areas of the following provinces are **STRONGLY ADVISED TO IMMEDIATELY EVACUATE to higher grounds or move farther inland.**

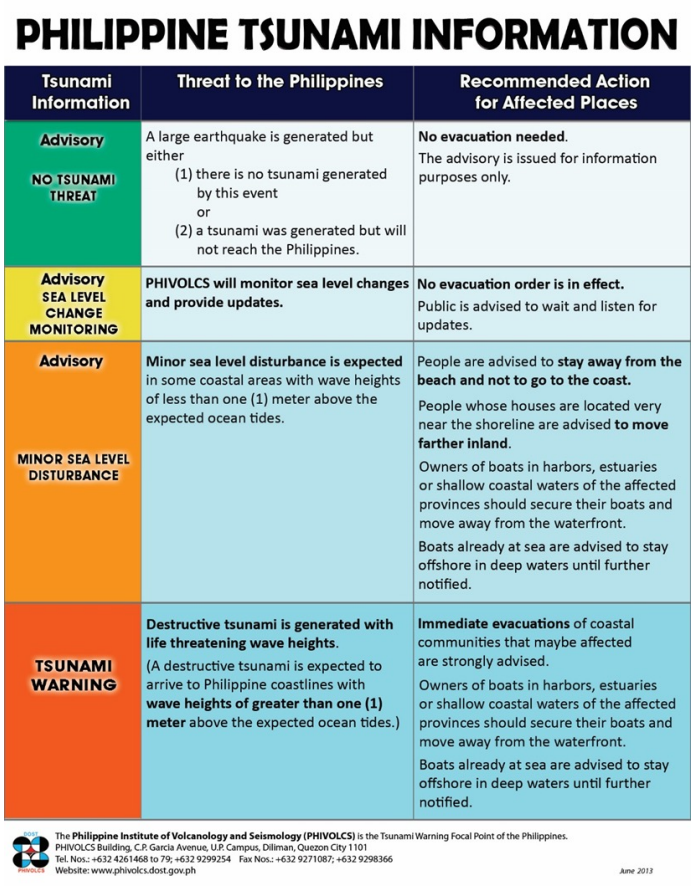
Batanes Group of Islands
Cagayan
Ilocos Norte
Isabela
Quezon
Aurora
Camarines Norte
Camarines Sur
Albay
Catadnuanes
Sorsogon
Eastern Samar
Northern Samar
Leyte
Southern Leyte
Surigao del Norte
Surigao del Sur
Davao Oriental
Davao De Oro
Davao del Norte
Davao del Sur
Davao Occidental

Owners of boats in harbors, estuaries or shallow coastal water of the above-mentioned provinces should secure their boats and move away from the waterfront. Boats already at sea during this period should stay offshore in deep waters until further advised

Issued on: (Date Issued)
Issued by: (Initials)

IMPORTANT This will be the only tsunami information issued unless additional information becomes available. Always refer to the latest tsunami information posted at the PHIVOLCS official website (https://www.phivolcs.dost.gov.ph/).

Tsunami Information Products

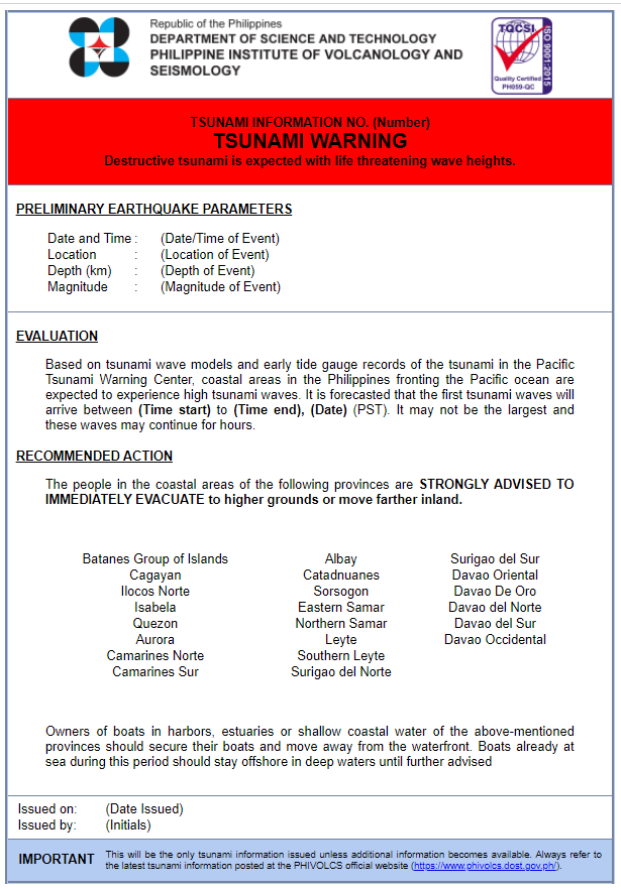


PHILIPPINE TSUNAMI INFORMATION

Tsunami Information	Threat to the Philippines	Recommended Action for Affected Places
Advisory **NO TSUNAMI THREAT**	A large earthquake is generated but either (1) there is no tsunami generated by this event or (2) a tsunami was generated but will not reach the Philippines.	**No evacuation needed.** The advisory is issued for information purposes only.
Advisory **SEA LEVEL CHANGE MONITORING**	**PHIVOLCS will monitor sea level changes and provide updates.**	**No evacuation order is in effect.** Public is advised to wait and listen for updates.
Advisory **MINOR SEA LEVEL DISTURBANCE**	**Minor sea level disturbance is expected** in some coastal areas with wave heights of less than one (1) meter above the expected ocean tides.	People are advised to **stay away from the beach and not to go to the coast.** People whose houses are located very near the shoreline are advised **to move farther inland.** Owners of boats in harbors, estuaries or shallow coastal waters of the affected provinces should secure their boats and move away from the waterfront. Boats already at sea are advised to stay offshore in deep waters until further notified.
TSUNAMI WARNING	**Destructive tsunami is generated with life threatening wave heights.** (A destructive tsunami is expected to arrive to Philippine coastlines with **wave heights of greater than one (1) meter** above the expected ocean tides.)	**Immediate evacuations** of coastal communities that maybe affected are strongly advised. Owners of boats in harbors, estuaries or shallow coastal waters of the affected provinces should secure their boats and move away from the waterfront. Boats already at sea are advised to stay offshore in deep waters until further notified.

The **Philippine Institute of Volcanology and Seismology (PHIVOLCS)** is the Tsunami Warning Focal Point of the Philippines.
PHIVOLCS Building, C.P. Garcia Avenue, U.P. Campus, Diliman, Quezon City 1101
Tel. Nos.: +632 4261468 to 79; +632 9299254 Fax Nos.: +632 9271087; +632 9298366
Website: www.phivolcs.dost.gov.ph

June 2013



Republic of the Philippines
DEPARTMENT OF SCIENCE AND TECHNOLOGY
PHILIPPINE INSTITUTE OF VOLCANOLOGY AND SEISMOLOGY

TSUNAMI INFORMATION NO. (Number)

TSUNAMI WARNING

Destructive tsunami is expected with life threatening wave heights.

PRELIMINARY EARTHQUAKE PARAMETERS

Date and Time : (Date/Time of Event)
Location : (Location of Event)
Depth (km) : (Depth of Event)
Magnitude : (Magnitude of Event)

EVALUATION

Based on tsunami wave models and early tide gauge records of the tsunami in the Pacific Tsunami Warning Center, coastal areas in the Philippines fronting the Pacific ocean are expected to experience high tsunami waves. It is forecasted that the first tsunami waves will arrive between **(Time start)** to **(Time end), (Date)** (PST). It may not be the largest and these waves may continue for hours.

RECOMMENDED ACTION

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Batanes Group of Islands	Albay	Surigao del Sur
Cagayan	Catadnuanes	Davao Oriental
Ilocos Norte	Sorsogon	Davao De Oro
Isabela	Eastern Samar	Davao del Norte
Quezon	Northern Samar	Davao del Sur
Aurora	Leyte	Davao Occidental
Camarines Norte	Southern Leyte	
Camarines Sur	Surigao del Norte	

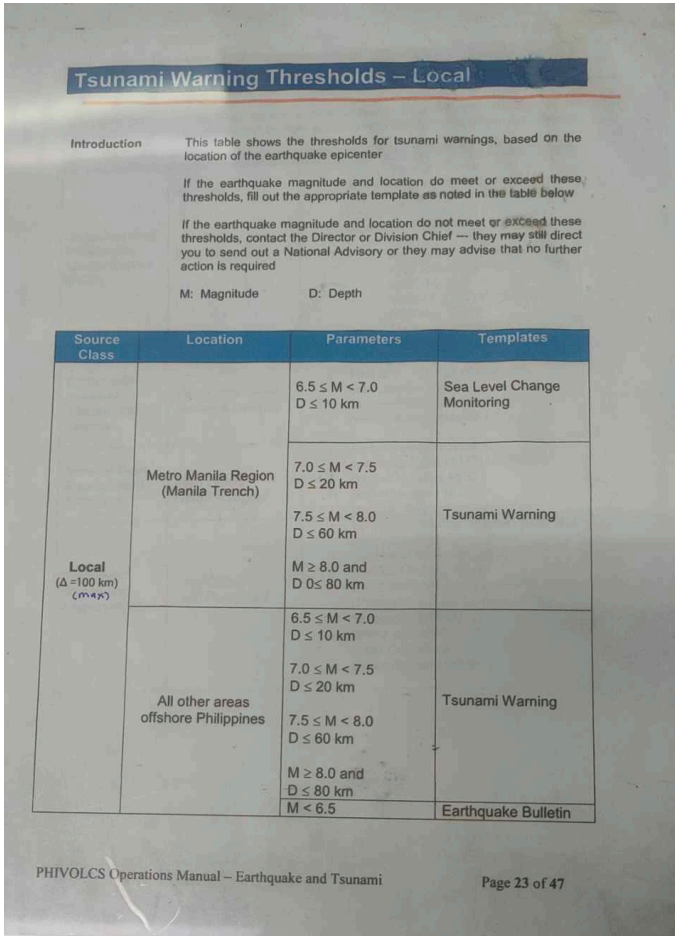
Owners of boats in harbors, estuaries or shallow coastal water of the above-mentioned provinces should secure their boats and move away from the waterfront. Boats already at sea during this period should stay offshore in deep waters until further advised

Issued on: (Date Issued)
Issued by: (Initials)

IMPORTANT This will be the only tsunami information issued unless additional information becomes available. Always refer to the latest tsunami information posted at the PHIVOLCS official website (https://www.phivolcs.dost.gov.ph).

- Bulletin number
- Date and time
- Type of Tsunami Information
- Preliminary EQ parameters
- Evaluation
- Recommended Action
- Areas covered by warning

Tsunami Information Products



Tsunami Warning Thresholds – Local

Introduction

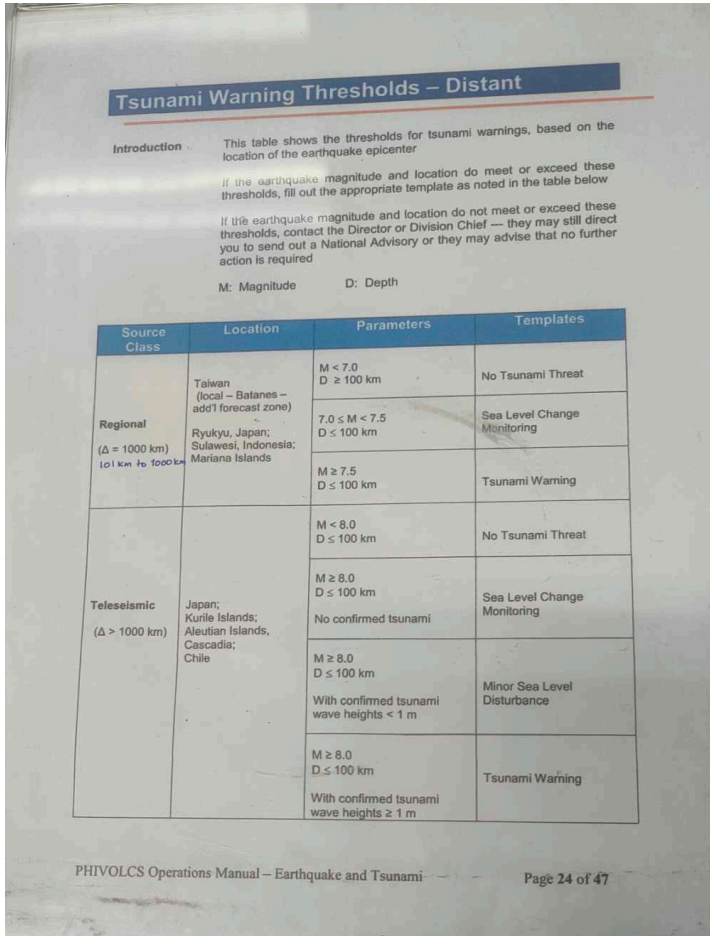
This table shows the thresholds for tsunami warnings, based on the location of the earthquake epicenter

If the earthquake magnitude and location do meet or exceed these thresholds, fill out the appropriate template as noted in the table below

If the earthquake magnitude and location do not meet or exceed these thresholds, contact the Director or Division Chief — they may still direct you to send out a National Advisory or they may advise that no further action is required

M: Magnitude D: Depth

Source Class	Location	Parameters	Templates
Local (Δ =100 km) (max)	Metro Manila Region (Manila Trench)	6.5 ≤ M < 7.0 D ≤ 10 km	Sea Level Change Monitoring
		7.0 ≤ M < 7.5 D ≤ 20 km 7.5 ≤ M < 8.0 D ≤ 60 km M ≥ 8.0 and D 0≤ 80 km	Tsunami Warning
	All other areas offshore Philippines	6.5 ≤ M < 7.0 D ≤ 10 km 7.0 ≤ M < 7.5 D ≤ 20 km 7.5 ≤ M < 8.0 D ≤ 60 km M ≥ 8.0 and D ≤ 80 km	Tsunami Warning
		M < 6.5	Earthquake Bulletin



Tsunami Warning Thresholds – Distant

Introduction

This table shows the thresholds for tsunami warnings, based on the location of the earthquake epicenter

If the earthquake magnitude and location do meet or exceed these thresholds, fill out the appropriate template as noted in the table below

If the earthquake magnitude and location do not meet or exceed these thresholds, contact the Director or Division Chief — they may still direct you to send out a National Advisory or they may advise that no further action is required

M: Magnitude D: Depth

Source Class	Location	Parameters	Templates
Regional (Δ = 1000 km) 101 km to 1000 km	Taiwan (local – Batanes – add'l forecast zone) Ryukyu, Japan; Sulawesi, Indonesia; Mariana Islands	M < 7.0 D ≥ 100 km	No Tsunami Threat
		7.0 ≤ M < 7.5 D ≤ 100 km	Sea Level Change Monitoring
		M ≥ 7.5 D ≤ 100 km	Tsunami Warning
Teleseismic (Δ > 1000 km)	Japan; Kurile Islands; Aleutian Islands, Cascadia; Chile	M < 8.0 D ≤ 100 km	No Tsunami Threat
		M ≥ 8.0 D ≤ 100 km No confirmed tsunami	Sea Level Change Monitoring
		M ≥ 8.0 D ≤ 100 km With confirmed tsunami wave heights < 1 m	Minor Sea Level Disturbance
		M ≥ 8.0 D ≤ 100 km With confirmed tsunami wave heights ≥ 1 m	Tsunami Warning

Released Tsunami Information

PHIVOLCS TSUNAMI INFORMATION

https://tsunami.phivolcs.dost.gov.ph

Department of Science and Technology
Philippine Institute of Volcanology and Seismology

Date and Time(PST)	Latitude	Longitude	Depth	Magnitude	Location	Advisory
26 Jul 2023 - 08:45 PM	14.90°S	167.80°E	010	6.8	Vanuatu	Tsunami Information # 1
16 Jul 2023 - 02:48 PM	54.50°N	160.80°W	021	7.3	Alaska Peninsula	Tsunami Information # 1
02 Jul 2023 - 06:27 PM	17.90°S	174.70°W	246	6.7	Near The Tonga Islands	Tsunami Information # 1
17 Jun 2023 - 03:11 AM	23.80°S	175.20°W	010	6.5	In The Tonga Islands Region	Tsunami Information # 1
16 Jun 2023 - 02:06 AM	22.90°S	176.60°W	206	7.0	South Of The Fiji Islands	Tsunami Information # 1
20 May 2023 - 09:51 AM	23.10°S	170.40°E	045	7.4	Southeast Of Loyalty Islands	Tsunami Information # 1
19 May 2023 - 10:57 AM	23.2°S	170.7°E	010	7.7	Southeast of Loyalty Islands	Tsunami Information # 1
11 May 2023 - 12:02 AM	15.60°S	174.40°W	213	7.4	Tonga	Tsunami Information # 1
24 Apr 2023 - 08:41 AM	30.40°S	176.70°W	010	7.3	Kermadec Islands Region	Tsunami Information # 1
05 Apr 2023 - 06:18 AM	7.60°N	82.30°W	010	6.6	South Of Panama	Tsunami Information # 1
04 Apr 2023 - 08:54 PM	13.76°N	125.51°E	09	6.6	Offshore Gigmoto (Catanduanes)	Tsunami Information # 2 Tsunami Information # 1
03 Apr 2023 - 11:06 AM	52.80°N	158.60°E	100	6.7	Near the east coast of Kamchatka Russia	Tsunami Information # 1
03 Apr 2023 - 02:04 AM	4.30°S	143.20°E	074	7.3	New Guinea Papua New Guinea	Tsunami Information # 1
19 Mar 2023 - 01:12 AM	2.80°S	79.60°W	075	6.9	Near The Coast Of Ecuador	Tsunami Information # 1
16 Mar 2023 - 08:55 AM	30.20°S	175.90°W	010	7.1	Kermadec Islands Region	Tsunami Information # 1
03 Mar 2023 - 02:05 AM	15.50°S	166.30°E	033	6.8	Vanuatu	Tsunami Information # 1
01 Mar 2023 - 01:36 PM	4.80°S	149.60°E	583	6.5	Bismarck Sea	Tsunami Information # 1
26 Feb 2023 - 05:25 AM	6.60°S	149.90°E	065	6.5	New Britain Region Papua New Guinea	Tsunami Information # 1
24 Feb 2023 - 04:02 AM	3.32°N	128.10°E	114	6.6	Sarangani Island (Municipality Of Sarangani) (Davao Occidental)	Tsunami Information # 1
18 Jan 2023 - 02:06 PM	02.69°N	127.05°E	064	7.3	Sarangani (Davao Occidental)	Tsunami Information # 1
08 Jan 2023 - 08:32 PM	15.10°S	166.70°E	010	7.2	Vanuatu	Tsunami Information # 1

Released Tsunami Information

---------- Forwarded message ---------
From: <ptwc@ptwc.ncsa.gov>
Date: Wed, Jul 26, 2023 at 8:54 PM
Subject: PTWC TSUNAMI INFORMATION STATEMENT
To: <tsunami@phivolcs.dost.gov.ph>

TSUNAMI INFORMATION STATEMENT NUMBER 1
NWS PACIFIC TSUNAMI WARNING CENTER HONOLULU HI
1251 UTC WED JUL 26 2023

...PTWC TSUNAMI INFORMATION STATEMENT...

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

THIS STATEMENT IS ISSUED FOR INFORMATION ONLY IN SUPPORT OF THE UNESCO/IOC PACIFIC TSUNAMI WARNING AND MITIGATION SYSTEM AND IS MEANT FOR NATIONAL AUTHORITIES IN EACH COUNTRY OF THAT SYSTEM.

NATIONAL AUTHORITIES WILL DETERMINE THE APPROPRIATE LEVEL OF ALERT FOR EACH COUNTRY AND MAY ISSUE ADDITIONAL OR MORE REFINED INFORMATION.

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

PRELIMINARY EARTHQUAKE PARAMETERS
---

* MAGNITUDE 6.8
* ORIGIN TIME 1245 UTC JUL 26 2023
* COORDINATES 14.9 SOUTH 167.8 EAST
* DEPTH 10 KM / 6 MILES
* LOCATION VANUATU

EVALUATION
---

* AN EARTHQUAKE WITH A PRELIMINARY MAGNITUDE OF 6.8 OCCURRED IN THE VANUATU ISLANDS AT 1245 UTC ON WEDNESDAY JULY 26 2023.

* BASED ON ALL AVAILABLE DATA... THERE IS NO TSUNAMI THREAT FROM THIS EARTHQUAKE.

RECOMMENDED ACTIONS
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* NO ACTION IS REQUIRED.

NEXT UPDATE AND ADDITIONAL INFORMATION
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* THIS WILL BE THE ONLY STATEMENT ISSUED FOR THIS EVENT UNLESS ADDITIONAL DATA ARE RECEIVED OR THE SITUATION CHANGES.

* AUTHORITATIVE INFORMATION ABOUT THE EARTHQUAKE FROM THE U.S. GEOLOGICAL SURVEY CAN BE FOUND ON THE INTERNET AT EARTHQUAKE.USGS.GOV.

* FURTHER INFORMATION ABOUT THIS EVENT MAY BE FOUND AT WWW.TSUNAMI.GOV.

* COASTAL REGIONS OF HAWAII... AMERICAN SAMOA... GUAM... AND CNMI SHOULD REFER TO PACIFIC TSUNAMI WARNING CENTER MESSAGES SPECIFICALLY FOR THOSE PLACES THAT CAN BE FOUND AT WWW.TSUNAMI.GOV.

* COASTAL REGIONS OF CALIFORNIA... OREGON... WASHINGTON... BRITISH COLUMBIA AND ALASKA SHOULD ONLY REFER TO U.S. NATIONAL TSUNAMI WARNING CENTER MESSAGES THAT CAN BE FOUND AT WWW.TSUNAMI.GOV.

$$

Republic of the Philippines
DEPARTMENT OF SCIENCE AND TECHNOLOGY
PHILIPPINE INSTITUTE OF VOLCANOLOGY AND SEISMOLOGY

TSUNAMI INFORMATION NO. 1
NO TSUNAMI THREAT
No tsunami threat to the Philippines from this earthquake.

PRELIMINARY EARTHQUAKE PARAMETERS

Date and Time	:	26 Jul 2023 - 08:45:00 PM
Location	:	14.9°S, 167.8°E - Vanuatu
Depth (km)	:	010
Magnitude	:	6.8

EVALUATION

No destructive tsunami threat exists based on available data. This is for information purposes only and there is no tsunami threat to the Philippines from this earthquake.

RECOMMENDED ACTION

No action required.

Issued on: 26 Jul 2023 - 08:57:52 PM
Issued by: KMG/KRV/PAADR

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12 Aug 2021 M7.3 Offshore Mati

Date:

12 Aug 2020

Time :

01:46 AM PST

Coordinates:

04.98°N, 124.01°E

Depth:

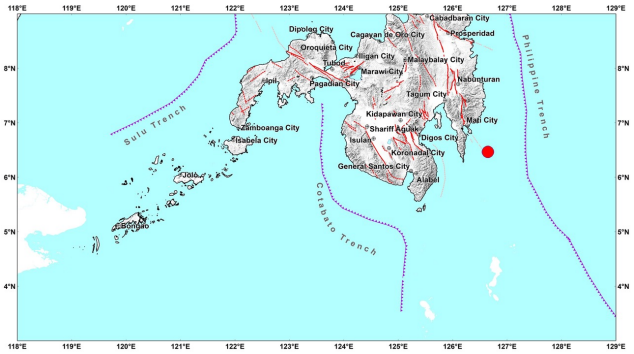
013 km

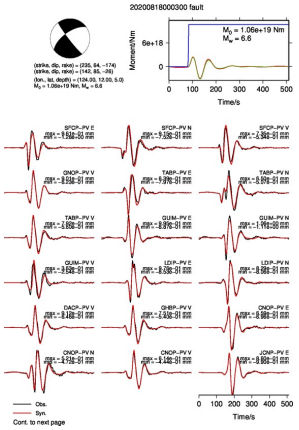
Magnitude:

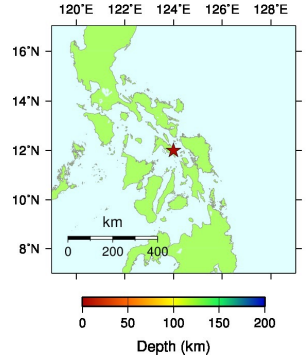
M 7.1

Location:

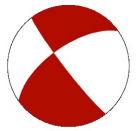
022 km S 20° E of General Generoso (Davao Oriental)







SWIFT Centroid Moment Tensor Solution:



Moment magnitude (M_w) = 6.6

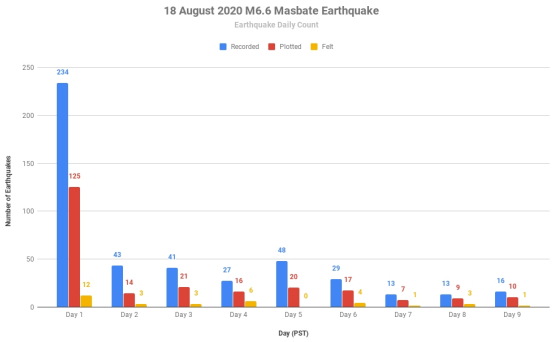
Seismic moment (M_0) = 1.06×10^{19} Nm

(Lon, Lat, Depth) = (124.00°E, 12.00°N, 5 km)

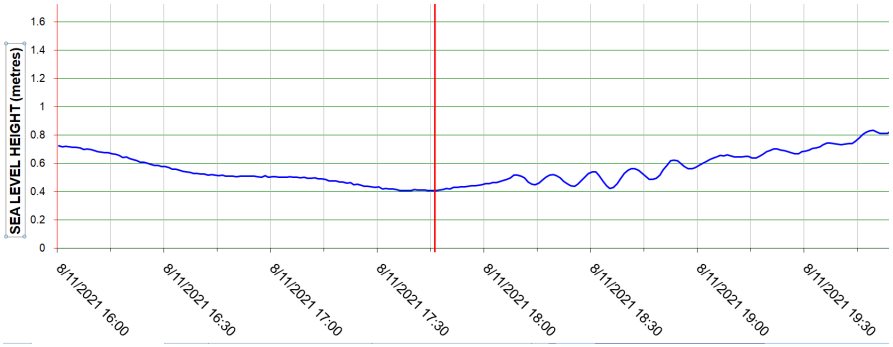
(Strike 1, Dip 1, Rake 1) = (235°, 64°, −174°)

(Strike 2, Dip 2, Rake 2) = (142°, 85°, −26°)

Recorded	464
Plotted	239
Felt	33
Mag. Range	1.6 - 5.1
Ref. Station	CNPS

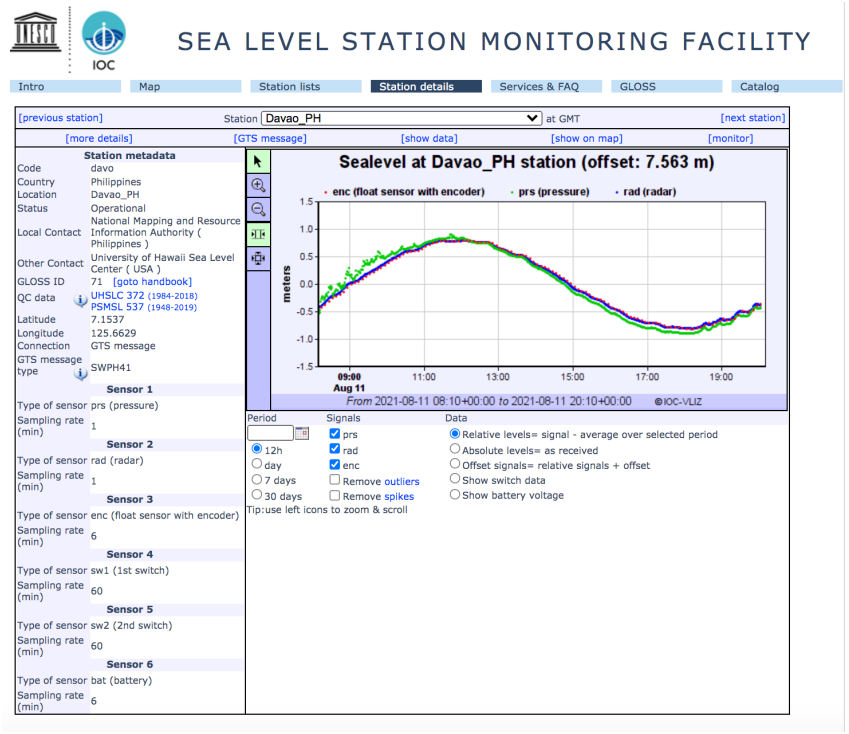


12 Aug 2021 M7.3 Offshore Mati



Mati Sea Level Station

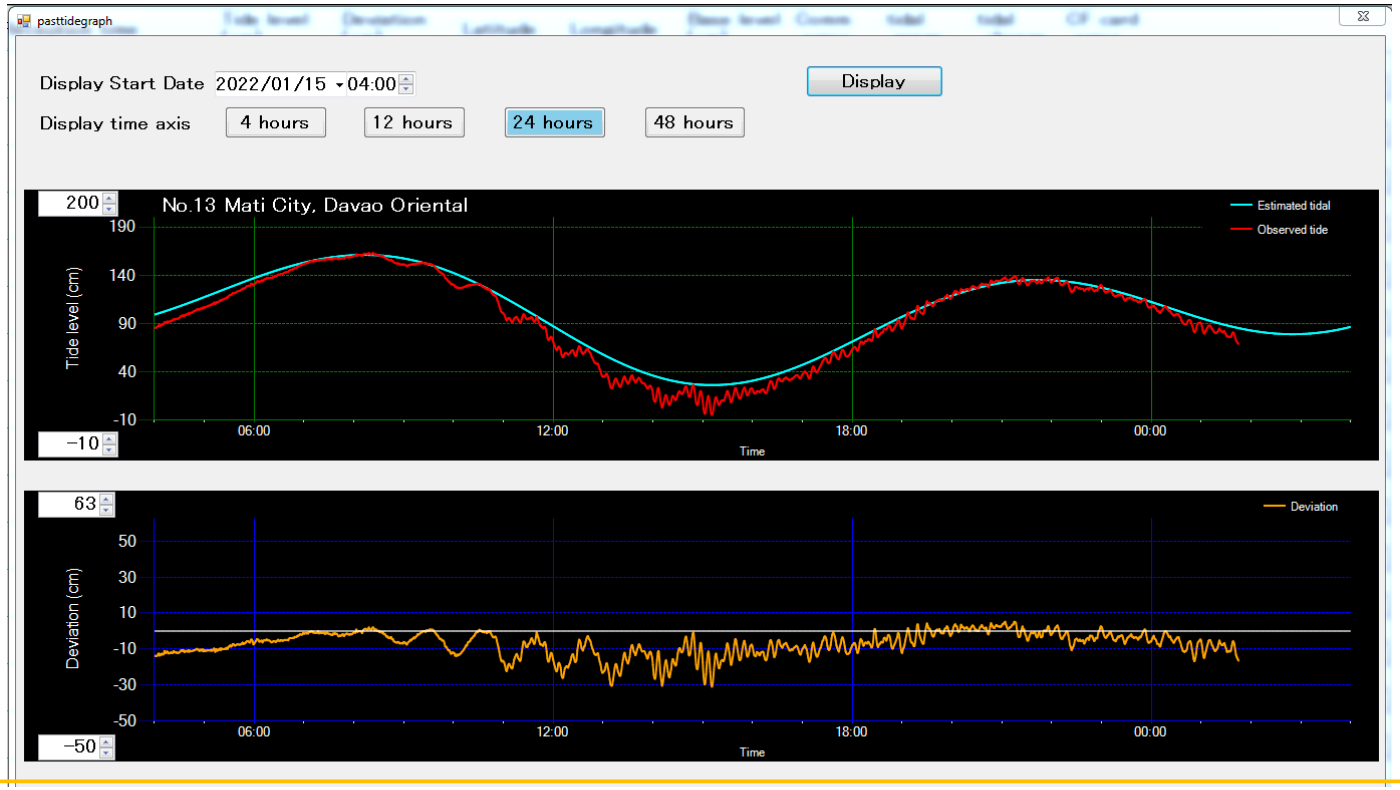
	A	B	C	D	E
1	Date and Time	Sea Level Height (m)		H-Crest to Trough (m)	H-Crest to Trough (cm)
2	8/11/2021 17:46	0.4092	Event Time		
25	8/11/2021 18:09	0.5178	**1st wave (Crest)**	0.0688	6.88
30	8/11/2021 18:14	0.449	1st wave (Trough)		
35	8/11/2021 18:19	0.5191	**2nd wave (Crest)**	0.0823	8.23
41	8/11/2021 18:25	0.4368	2nd wave (Trough)		
46	8/11/2021 18:30	0.5412	**3rd wave (Crest)**	0.1183	11.83
51	8/11/2021 18:35	0.4229	3rd wave (Trough)		
58	8/11/2021 18:42	0.5621	**4th wave (Crest)**	0.0773	7.73
63	8/11/2021 18:47	0.4848	4th wave (Trough)		
69	8/11/2021 18:53	0.6238	**5th wave (Crest)**	0.0619	6.19
74	8/11/2021 18:58	0.5619	5th wave (Trough)		



15 January 2022 Hunga-Tonga Volcanic Eruption and Tsunami

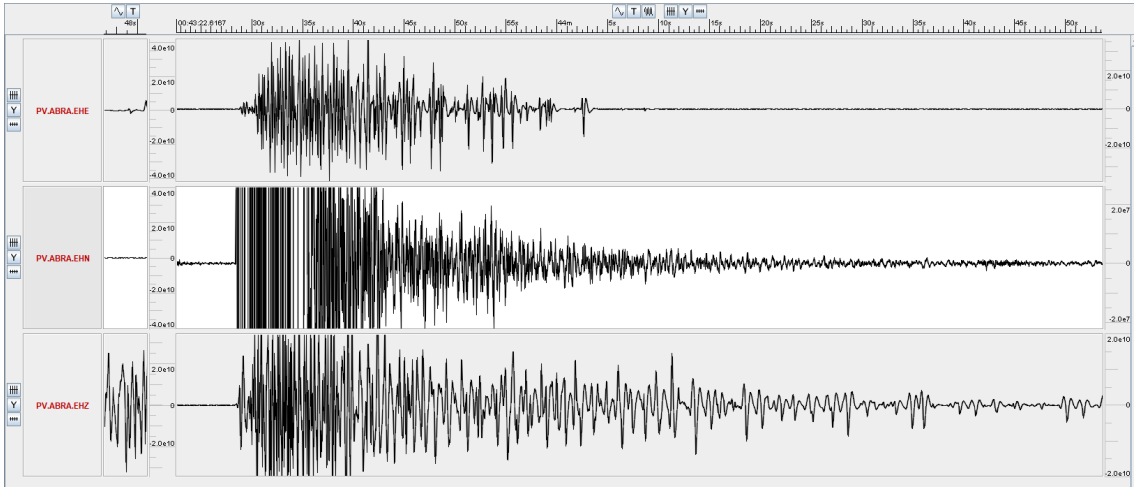
Department of Science and Technology
Philippine Institute of Volcanology and Seismology

Sea-level records



27 July 2022 M7.0 Northwes Luzon Earthquake

Date/Time	:	27 Jul 2022 - 08:43:24 AM
Location	:	17.64°N, 120.63°E - 003 km N 45° W of Tayum (Abra)
Depth of Focus (Km)	:	017
Origin	:	TECTONIC
Magnitude	:	Mw 7.0



DEPARTMENT OF SCIENCE AND TECHNOLOGY
PHILIPPINE INSTITUTE OF VOLCANOLOGY AND SEISMOLOGY
EARTHQUAKE INFORMATION NO. : 3

Date/Time	:	27 Jul 2022 - 08:43:24 AM
Location	:	17.63°N, 120.63°E - 003 km N 50° W of Tayum (Abra)
Depth of Focus (Km)	:	015
Origin	:	TECTONIC
Magnitude	:	Mw 7.0

Reported Intensities :

Intensity VII - Tayum, Bangued, Bucay, Bucloc, Danglas, Dolores, La Paz, Lagangilang, Licuan-Baay, Lubo, Malibcong, Manabo, Peñarrubia, Pilar, Sallapadan, and San Juan, Abra

Intensity VI - Boliney, Dagupman, Lacub, Lagayan, Langiden, San Isidro, San Quintin, Tineg, and Tubo, Abra; City of Baguio; La Trinidad, Mankayan, and Tuba, Benguet; Sagada, Mountain Province; Badoc, Bonna, City of Batac, City of Laoag, Nueva Era, Pinili, and Sarrat, Ilocos Norte; Banayoyo, Bantay, Cacoyan, San Esteban, San Juan, Santa, Santo Domingo, Sinait, and City of Vigan, Ilocos Sur; Balaoan, Bangar, City of San Fernando, and Sudipen, La Union; Lacao, Pangasinan; Peñablanca, Cagayan; Cabugao, City of Cauayan, Roxas, and Santo Tomas, Isabela

Intensity V - City of Manila; City of Malabon; Pidigan, and Villaviciosa, Abra; Conner, Flora, Kabugao, Luna, Pudtol, and Santa Marcela, Apayao; Atok, Bakun, and Itogon, Benguet; Banaue, Lagawe, and Mayoyao, Ifugao; Balbalan, Lubuagan, Pasil, Pinukpuk, Rizal, City of Tabuk, and Tinglayan, Kalinga; Bontoc, Sadanga, and Tadian, Mountain Province; Adams, Bacarra, Bangui, Burgos, Carasi, Currimao, Dingras, Dumalneg, Marcos, Pagudpud, Paoay, Pasuquin, Piddig, San Nicolas, Solsona, and Vintar, Ilocos Norte; Alilem, Burgos, Cabugao, City of Candon, Cervantes, Galimuyod, Gregorio del Pilar, Lidlidda, Magsingal, Nagbukel, Narvacan, Quirino, Salcedo, San Emilio, San Ildefonso, San Vicente, Santa Catalina, Santa Cruz, Santa Lucia, Santa Maria, Santiago, Sigay, Sugpon, Suyo, and Tagudin, Ilocos Sur; Agoo, Aringay, Bacnotan, Bagulin, Bauang, Caba, Luna, Naguilian, Pugo, San Gabriel, San Juan, Santol, and Tubao, La Union; City of Alaminos, Binalonan, Dasol, Labrador, Lingayen, Rosales, City of San Carlos, City of Urdaneta, and Villasis, Pangasinan; City of Dagupan; Abulug, Alcala, Allacapan, Amulung, Aparri, Buguey, Ballesteros, Buguey, Camalaniugan, Claveria, Enrile, Gattaran, Gonzaga, Iguig, Lal-Lo, Lasam, Pamplona, Piat, Sanchez-Mira, Santa Ana, Santa Praxedes, Santa Teresita, Santo Niño, Solana, Tuao, and Tuguegarao City, Cagayan; Alicia, Angadanan, Aurora, Burgos, Delfin Albano, Gamu, City of Ilagan, Mallig, Naguilian, Quezon, Quirino, San Manuel, and Tumauini, Isabela; Bambang, Nueva Vizcaya; Baliuag, Bulacan; City of Cabanatuan, and San Jose City, Nueva Ecija; Mexico, and Santa Ana, Pampanga; Bamban, Concepcion, Ramos, and City of Tarlac, Tarlac; City of Biñan, Laguna

Intensity IV - City of Caloocan; City of Makati; City of Mandaluyong; City of Marikina; Quezon City; Pasay City; City of Pasig; Pateros; City of Valenzuela; Tublay, Benguet; Bauitsta, Binmaley, Bolinao, Bugallon, Burgos, Mabinigui, Manaoag, and Mangaldan, Pangasinan; Benito Soliven, Cordon, Echague, Jones, Ramon, San Agustin, San Guillermo, San Mariano, and San Mateo, Isabela; City of Santiago; Bayombong, and Diadi, Nueva Vizcaya; Cabarroguis, Diffun, Maddela, and Nagtipunan, Quirino; City of Balanga, Bataan; Angat, Bustos, Guiguinto, City of Malolos, City of Meycauayan, Obando, City of San Jose Del Monte, San Rafael, and Santa Maria, Bulacan; Cuyapo, Guimba, and City of Palayan, Nueva Ecija; Arayat, and Guagua, Pampanga; City of Angeles; San Felipe, Zambales; City of Olongapo; City of Imus, Cavite; Famy, Lumban, Santa Cruz, and Santa Maria, Laguna; Rodriguez, and San Mateo, Rizal

Intensity III - City of Las Piñas; City of Muntinlupa; City of Navotas; City of Parañaque; City of San Juan; City of Taguig; Divilacan, Maconacon, and Palanan, Isabela; Dingalan, Aurora; Dinalupihan, and Limay, Bataan; Bulakan, Bulacan; San Antonio, and Zaragoza, Nueva Ecija; Floridablanca, Pampanga; Talisay, and City of Tanauan, Batangas; Carmona, Naic, Noveleta, Silang, and City of Tagaytay, Cavite; Alaminos, Bay, City of Cabuyao, City of Calamba, Magdalena, Pagsanjan, Pakil, Pangil, City of San Pablo, City of San Pedro, and Siniloan, Laguna; Alabat, Calauag, Candelaria, Catanauan, Dolores, General Luna, General Nakar, Gumaca, Lopez, Lucban, Mauban, Mulanay, Pitogo, Polillo, and San Andres, Quezon; City of Lucena; Tanay, Rizal; Capalonga, and Daet, Camarines Norte

Intensity II - Doña Remedios Trinidad, Bulacan; Calatagan, Lemery, Lian, City of Lipa, San Jose, and San Juan, Batangas; City of General Trias, Cavite; Calauan, Kalayaan, Lilio, Luisiana, Nagcarlan, Pila, Rizal, City of Santa Rosa, and Victoria, Laguna; Patnanungan, Quezon; Binangonan, Cainta, and Taytay, Rizal; Nabua, Camarines Sur

Intensity I - Mabitac, and Magdalena, Laguna; Angono, Rizal

Instrumental Intensities:
Intensity VII - City of Vigan, Ilocos Sur

Intensity V - City of Baguio; City of Laoag, Ilocos Norte; Sinait, Ilocos Sur; City of Dagupan; Peñablanca, Cagayan

Intensity IV - City of Tabuk, Kalinga; Pasuquin, Ilocos Norte; Basista, Pangasinan; Claveria, and Gonzaga, Cagayan; City of Ilagan, Isabela; City of Santiago; Bayombong, Nueva Vizcaya; Maddela, Quirino; Baler, Aurora; City of Malolos, Plaridel, and San Ildefonso, Bulacan; City of Cabanatuan, City of Palayan, and San Jose City, Nueva Ecija; Guagua, Pampanga; Ramos, Tarlac; Infanta, and Polillo, Quezon

Intensity III - City of Las Piñas; City of Malabon; City of Navotas; Quezon City; City of Pasig; City of San Juan; Bolinao, Infanta, and Sison, Pangasinan; Bulakan, Guiguinto, and Marilao, Bulacan; Magalang, Pampanga; City of Tarlac, Tarlac; Carmona, and City of Tagaytay, Cavite; Gumaca, Lucban, Mulanay, San Francisco, and City of Tayabas, Quezon; Morong, and Tanay, Rizal

Intensity II - City of Muntinlupa; City of Parañaque; Pateros; Angat, Doña Remedios Trinidad, and Santa Maria, Bulacan; Subic, Zambales; City of Olongapo; Batangas City, Calatagan, and Talisay, Batangas; City of San Pablo, Laguna; Guinayangan, Quezon; City of Lucena; City of Antipolo, Cainta, and Taytay, Rizal; San Jose, Occidental Mindoro; Mercedes, Camarines Norte; City of Iriga, Pili, Ragay, and Sipocot, Camarines Sur

Intensity I - Magallanes, Cavite; Los Baños, Laguna; Angono, Rizal; City of Calapan, Oriental Mindoro; Pasacao, Camarines Sur

Expecting Damage	:	YES
Expecting Aftershocks	:	YES
Issued On	:	28 July 2022 - 12:09 AM
Prepared by	:	PPS/RR/DNC/NBA

IMPORTANT: This will be the only bulletin issued unless additional information becomes available. Always refer to the latest earthquake information posted at the PHIVOLCS official website (https://www.phivolcs.dost.gov.ph).

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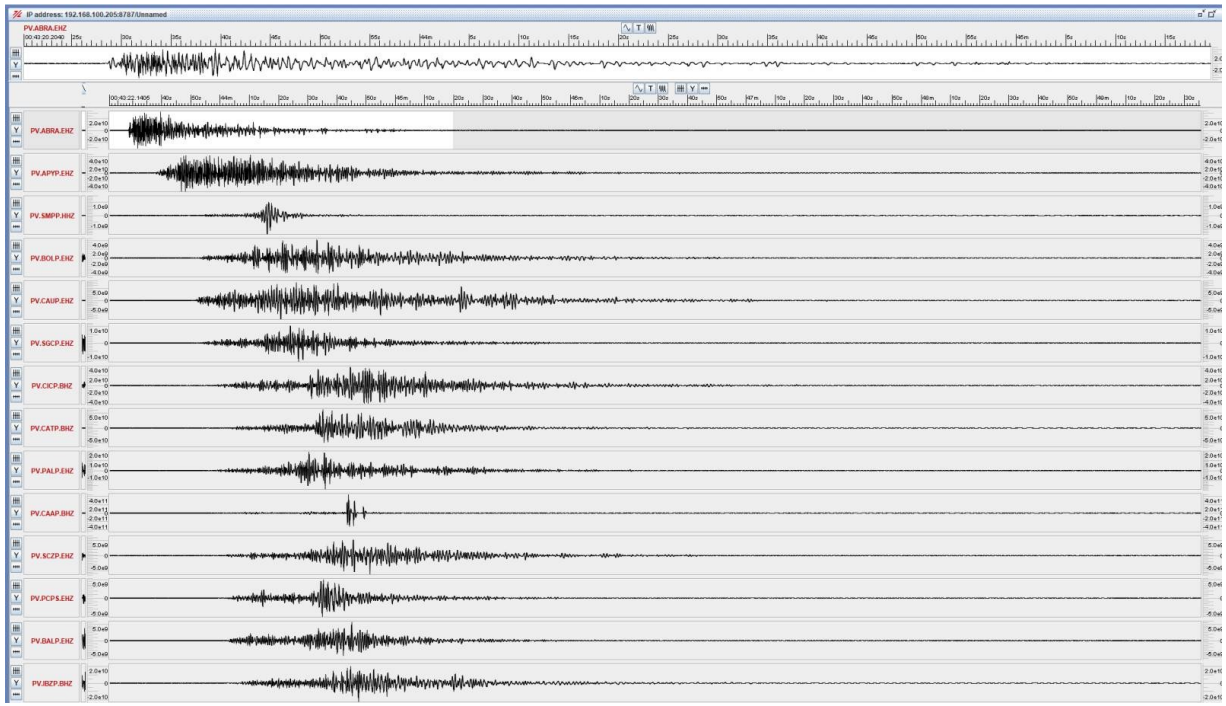
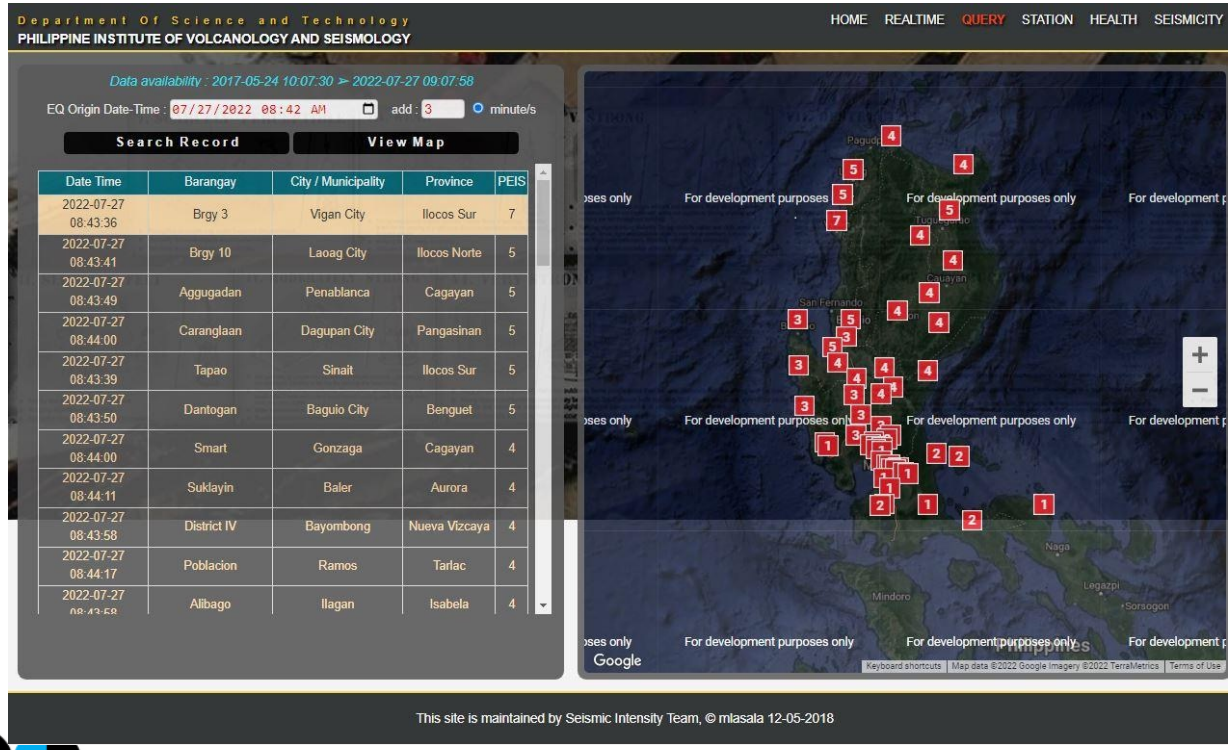
Brpadband and Short-period Seismograms

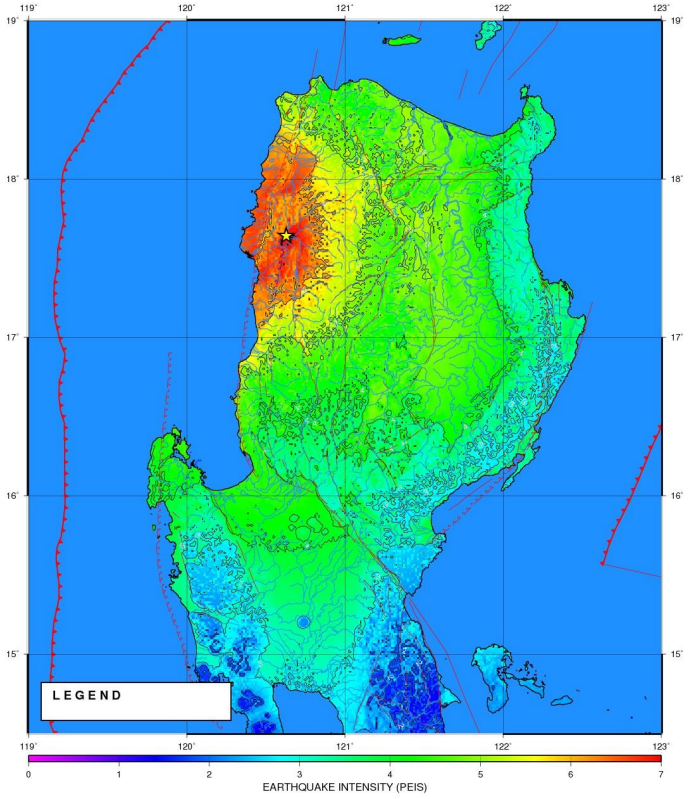


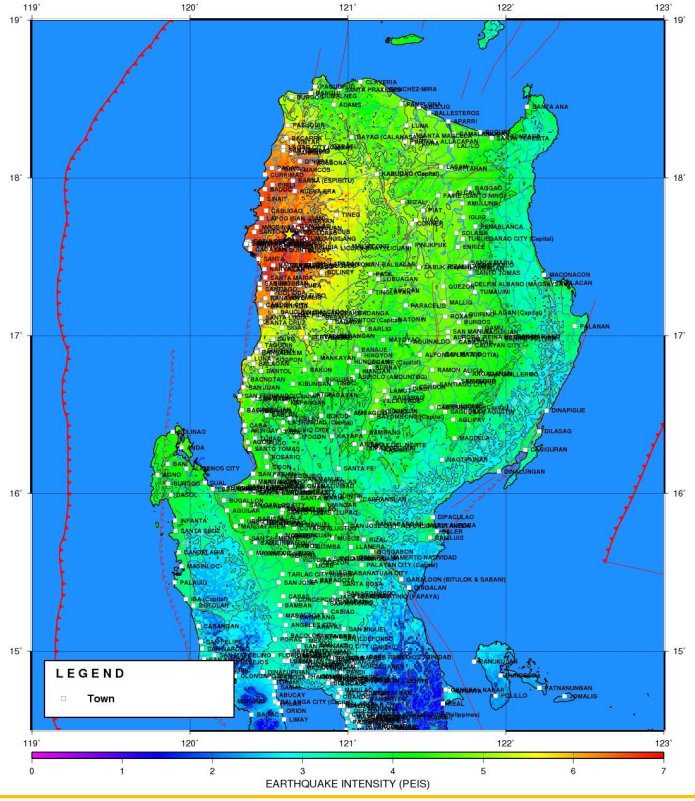
Instrumental Intensities



Angat, Bulacan

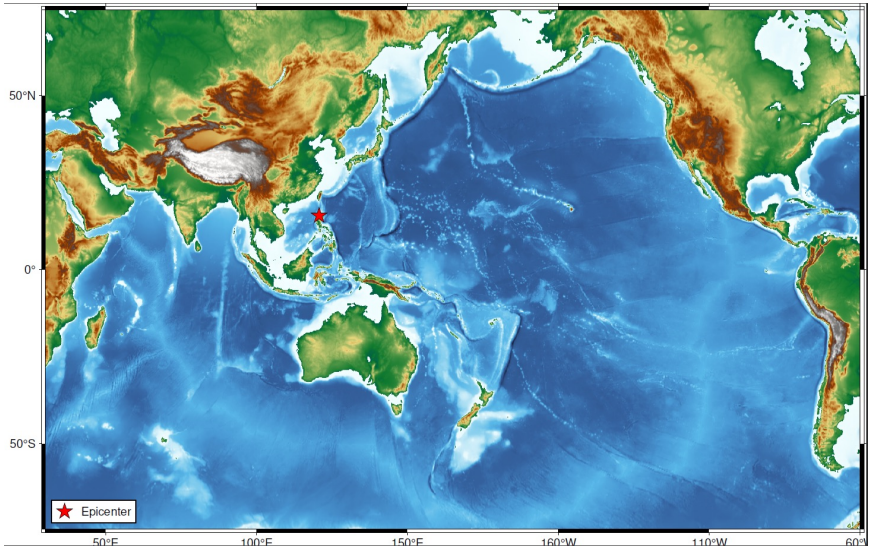
Calculated and Observed Intensities





Tsunami Information

Date/Time : 27 Jul 2022 - 08:43:24 AM
Location : 17.64°N, 120.63°E - 003 km N 45° W of Tayum (Abra)
Depth of Focus (Km) : 017
Origin : TECTONIC
Magnitude : Mw 7.0



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Republic of the Philippines
DEPARTMENT OF SCIENCE AND TECHNOLOGY
PHILIPPINE INSTITUTE OF VOLCANOLOGY AND SEISMOLOGY

TSUNAMI INFORMATION NO. 2

NO TSUNAMI THREAT

No tsunami threat to the Philippines from this earthquake.

PRELIMINARY EARTHQUAKE PARAMETERS

Date and Time : 27 Jul 2022 - 08:43:24 AM
Location : 17.64°N, 120.63°E - 003 km N 45° W of Tayum (Abra)
Depth (km) : 017
Magnitude : Mw 7.0

EVALUATION

No destructive tsunami threat exists based on available data. This is for information purposes only and there is no tsunami threat to the Philippines from this earthquake. However earthquakes of this size may generate unsual sea level disturbances that may be observe along coasts near earthquake epicenter of Abra province.

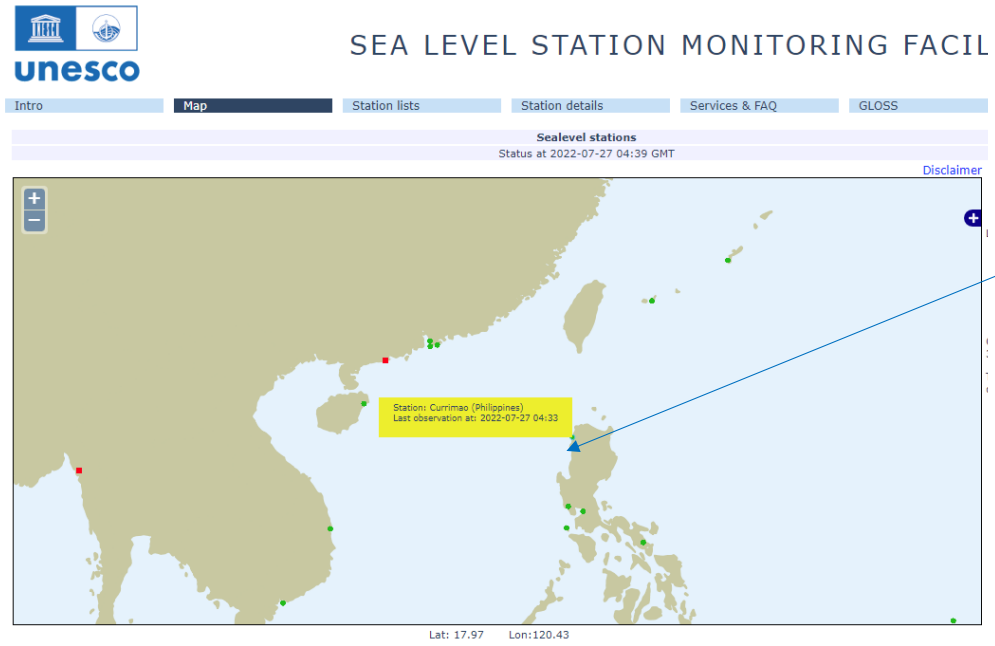
RECOMMENDED ACTION

No action required.

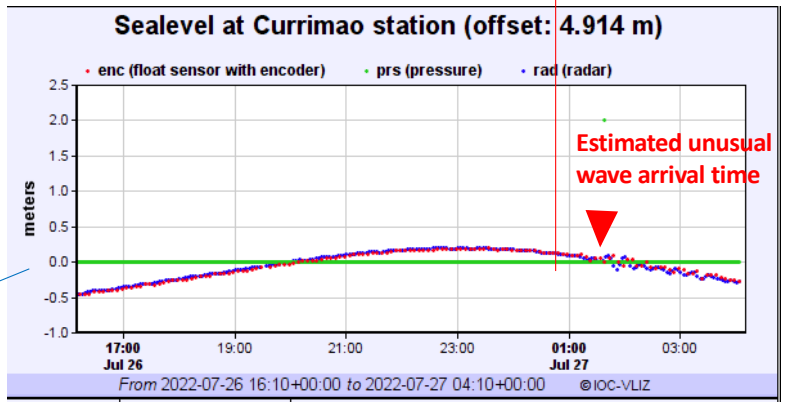
Issued on: 27 Jul 2022 - 11:10:48 AM
Issued by: RGA/RJP/LJAG/KRV/MAMG/KMG

IMPORTANT This will be the only tsunami information issued unless additional information becomes available. Always refer to the latest tsunami information posted at the PHIVOLCS official website (https://www.phivolcs.dost.gov.ph/).

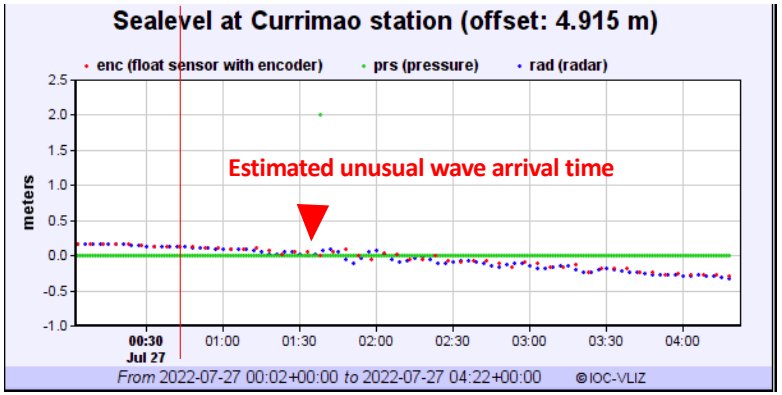
RIMES Sea Level Station



Estimated Time of Event (0043z)

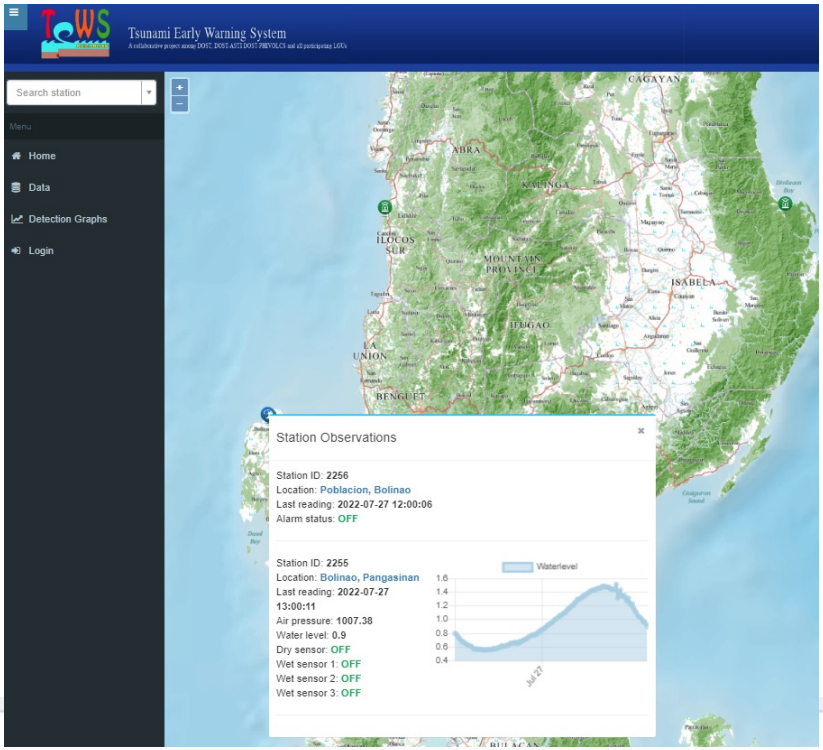


Estimated Time of Event (0043z)

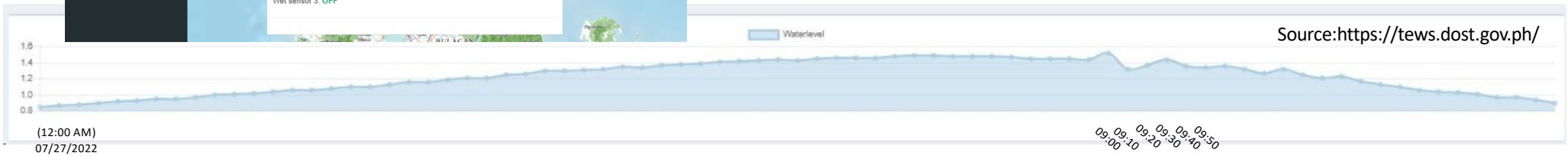


SOURCE: http://www.ioc-sealevelmonitoring.org/map.php

DOST-PHIVOLCS TeWS Sea Level Station



Date/Time	Water level	
2022-07-27 08:40:10	1.45	
2022-07-27 08:50:11	1.45	
2022-07-27 09:00:11	1.44	
2022-07-27 09:10:11	1.52	0.08m
2022-07-27 09:20:12	1.32	-0.20m
2022-07-27 09:30:13	1.37	0.05m
2022-07-27 09:40:11	1.44	0.07m
2022-07-27 09:50:12	1.36	-0.08m
2022-07-27 10:00:10	1.34	-0.02m
2022-07-27 10:10:13	1.36	0.02m
2022-07-27 10:20:11	1.32	-0.04m



Source:https://tews.dost.gov.ph/

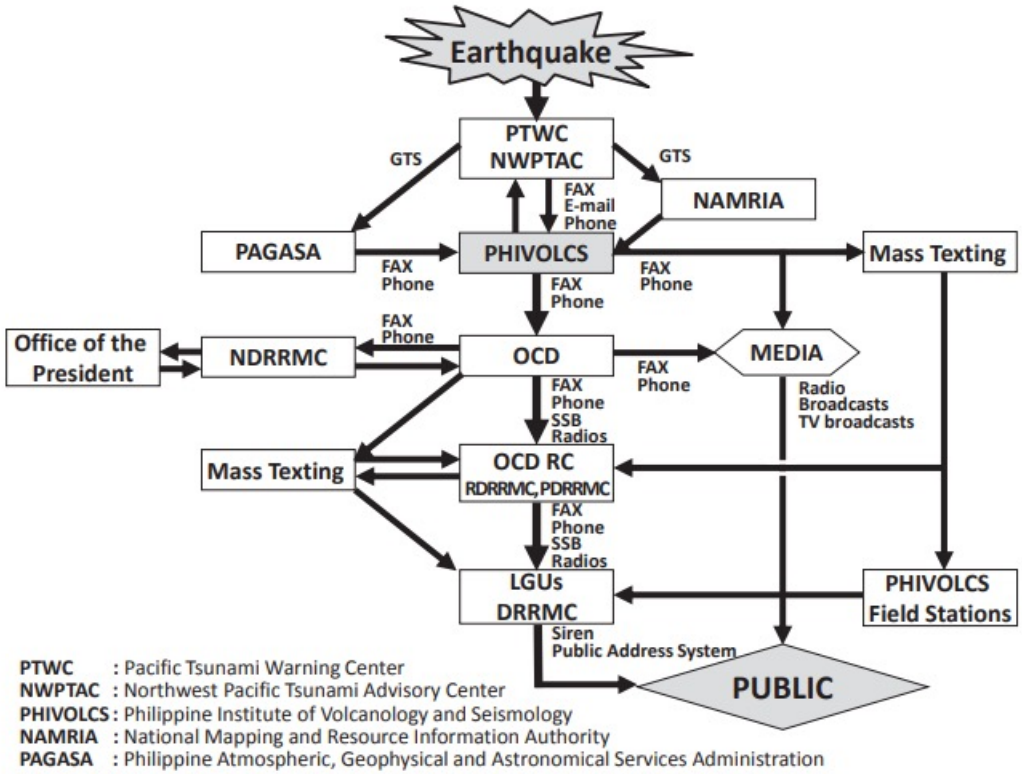
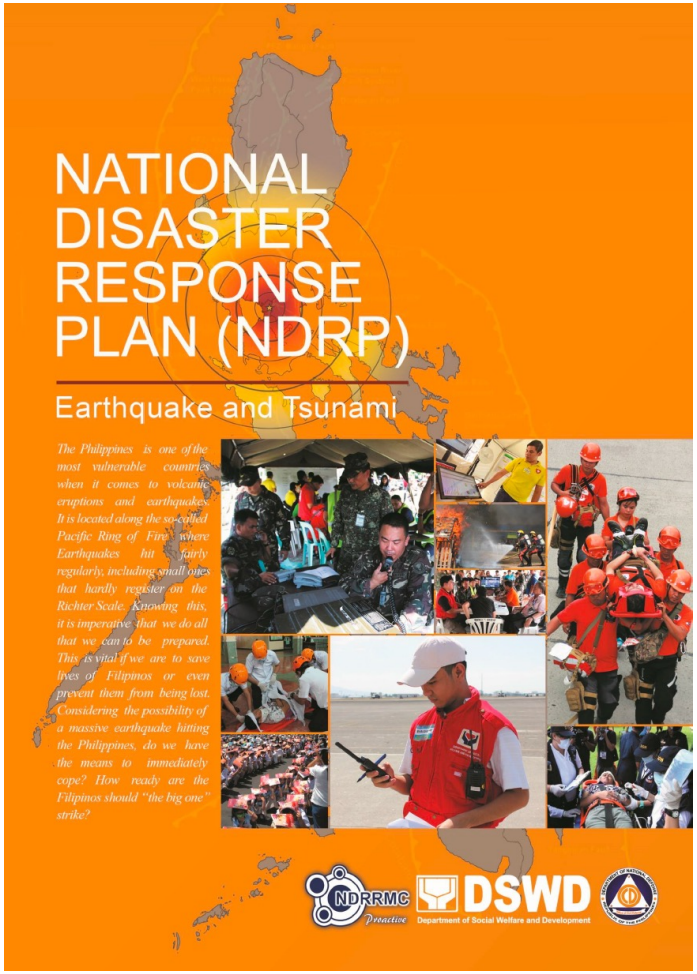
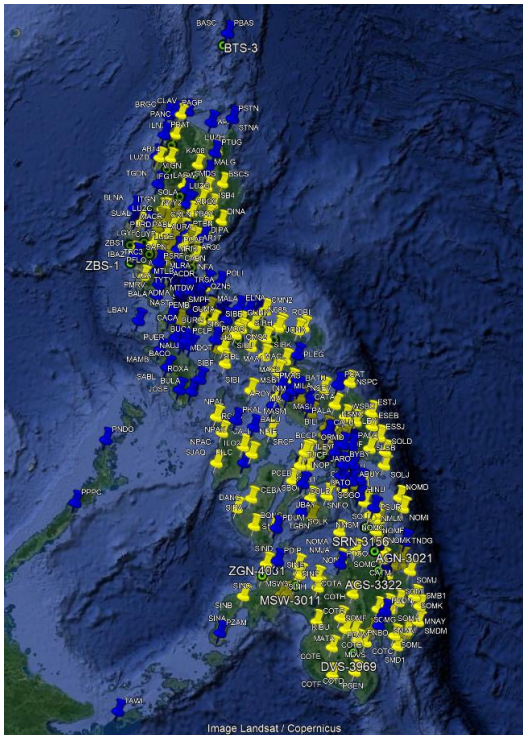


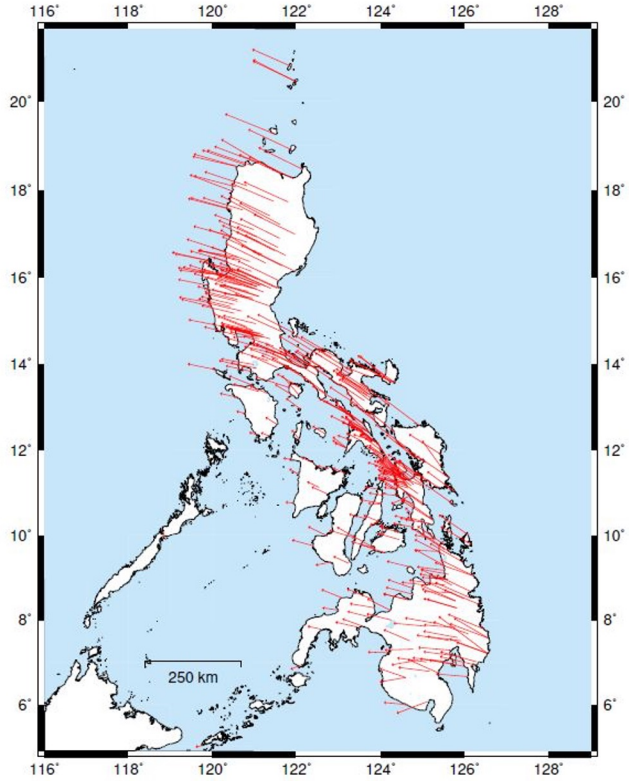
Fig. 2. Earthquake and tsunami information flow in the Philippines.



GPS Network



T. Bacolcol, 2018



Continuous sites (blue) and campaign sites (yellow)

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Publications for Structural Resilience

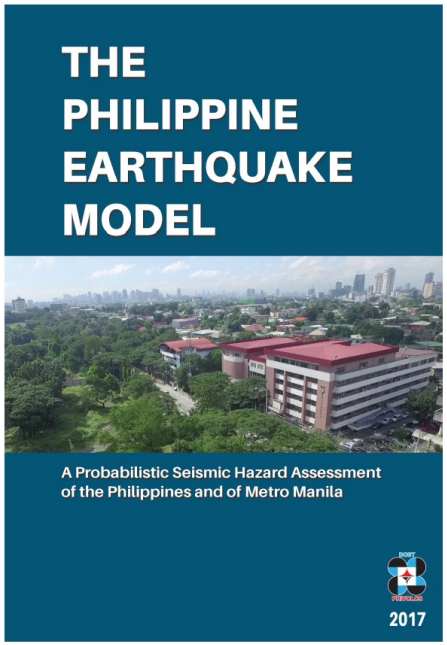
Philippine Earthquake Model (PEM)

Probabilistic Seismic Hazard Analysis (PSHA) of the Philippines and Metro Manila

- An alternative reference for seismic designs of structures
  - For the Philippines – local condition is **stiff soil** (Class D; generalized)
  - For Metro Manila – **Vs30** (shear wave velocity of the upper 30 meters of soil layers)

Usage
- Regular Structures (houses, buildings, etc)

Return Periods
- 475/500 years mean recurrence interval (MRI)



Spectral Acceleration Maps of the Philippines (SAMPH)

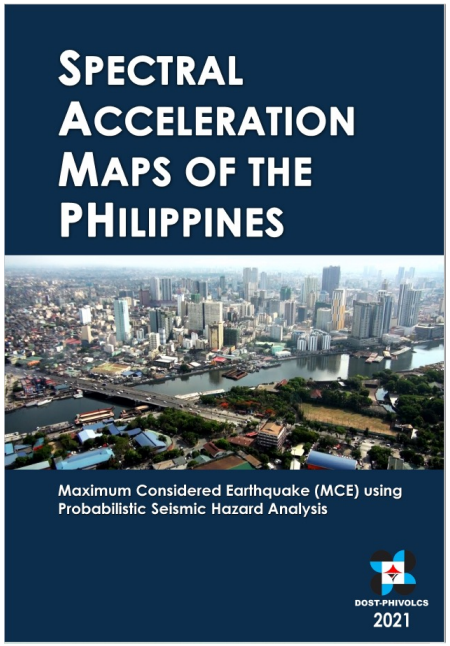
Maximum Considered Earthquake (MCE) using Probabilistic Seismic Hazard Analysis

Will be adopted in the **revision of the Seismic Provisions in the National Structural Code of the Philippines (NSCP)** 8th Edition on 2022

Rock site as site condition

Usage
- Regular Structures (houses, buildings, etc)
- Essential Facilities (hospitals, evacuation centers, predetermined emergency supplies and resource facilities, etc)
- Critical Structures (water and power plant/distribution network, communication towers and grid, dams bridges, etc.)

Return Periods
- 2475/2500 years MRI or maximum credible earthquake (MCE) spectral values at: SA (0.2 seconds) or short period, S_s
- SA (1.0 second) or 1-second period, S_1



Publications for Structural Resilience

Site Response Atlases from other areas

Contents

- Active Faults Map
- Geologic Maps from Mines and Geosciences Bureau
- Peak Ground Acceleration Maps of the study areas
- Vs 30 Model Maps
- Short-Period Microzonation Maps
- Long-Period Microzonation Maps

Usage

- Rock-site amplification factors
- Soil-structure resonance (which occurs when the period of the ground coincides with the period of the structure)

Tsunami Awareness in the Philippines

- Unlike earthquakes where we have words for it [***e.g. lindol, ginginid, linog, terremoto, temblor***], there is no Filipino word for a tsunami
- It is often referred to as "tidal waves" and confused with storm surges [TS Yolanda]

- Recent large events [e.g. 2004 Indonesia, 2011 Japan] and the media improved the awareness of these events;

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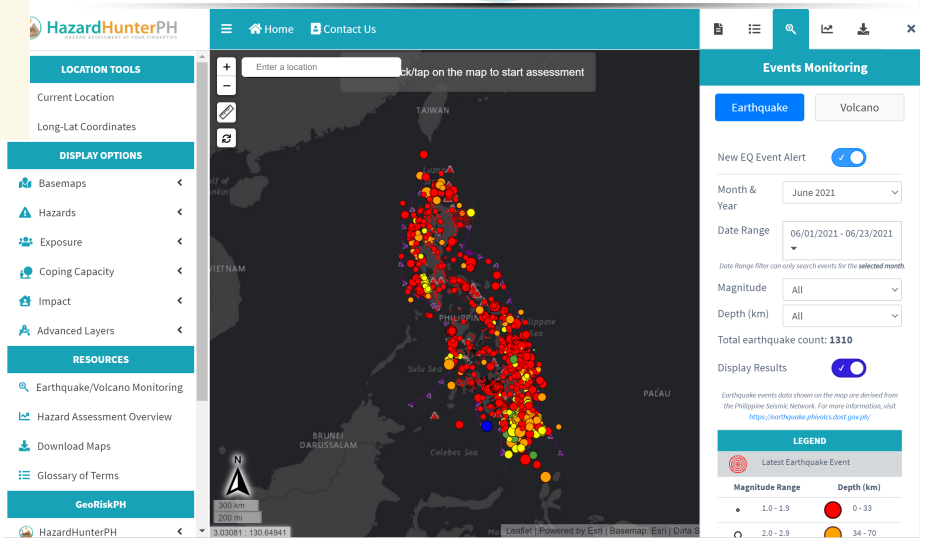
Philippine Institute of Volcanology and Seismology

Information Platform

VolcanoPH iNFO
MOBILE APPLICATION

GET IT ON Google Play

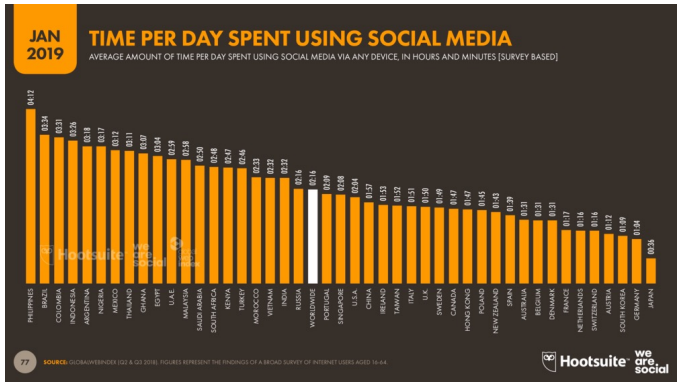
VolcanoPH iNFO
DOST-PHIVOLCS

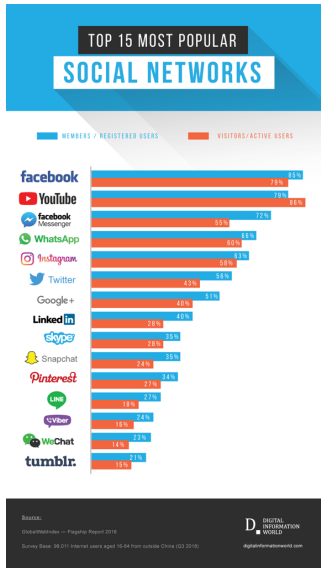


Social Media: New Frontier

- Public use social media;
- **Twitter and Facebook are among the widely used for public alerts**; but others are commonly used (i.e. WhatsApp, Facebook Messenger, Telegram, etc.)
- Twitter users – follow those who transmit exclusive and new information => **opportunity for authorities to communicate during crisis situation**
- **Twitter meets requirement for early warning: Wide reachability, Speed of Communication** and the authority needs to ensure the information quality;
- It needs a dedicated official person to manage, take care and respond . It needs specific SOP and Template.

PHIVOLCS Facebook page	Used to broadcast and share information about events related to earthquakes, volcanoes and tsunami events.
@phivolcs_dost Twitter account	Emergency information focus only; primary Twitter account during an earthquakes and tsunami events.





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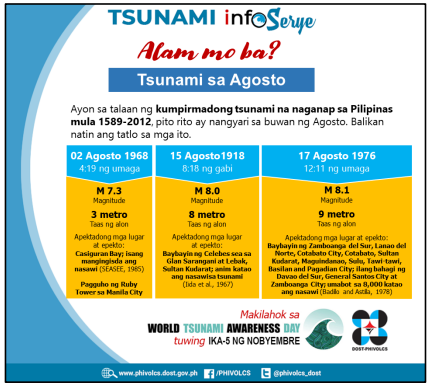
Education and Outreach

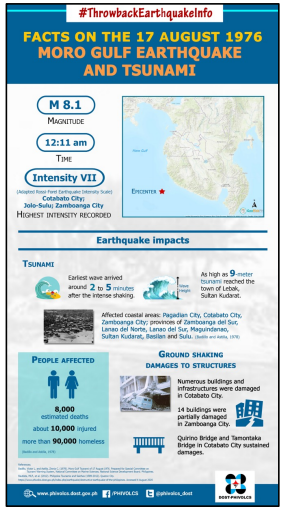
Evacuation Planning Workshop, IEC, and installation of Tsunami Siren in Kiamba, Sarangani. (February 14-24, 2022)

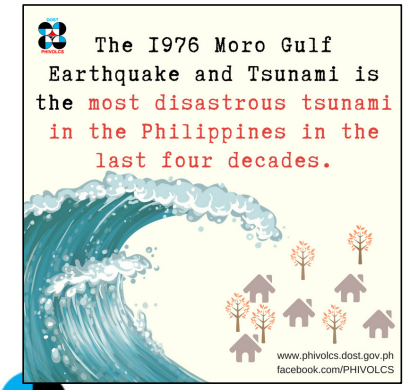
Education and Outreach

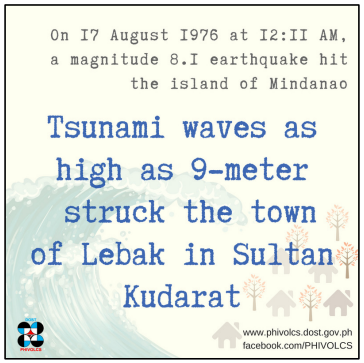
Department of Science and Technology
Philippine Institute of Volcanology and Seismology

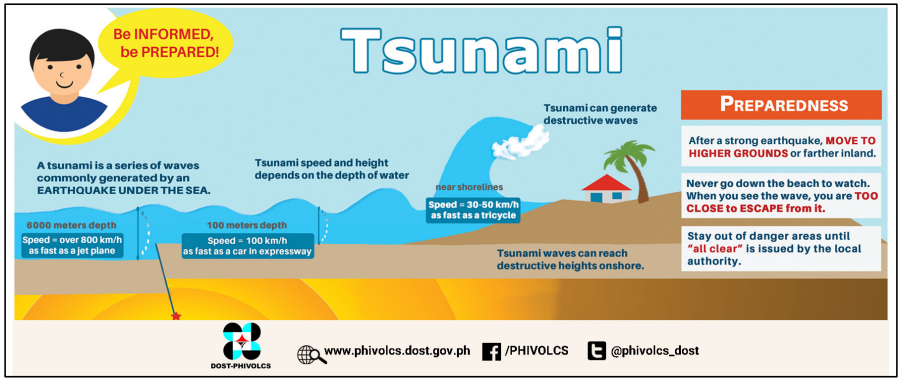
Education and Outreach











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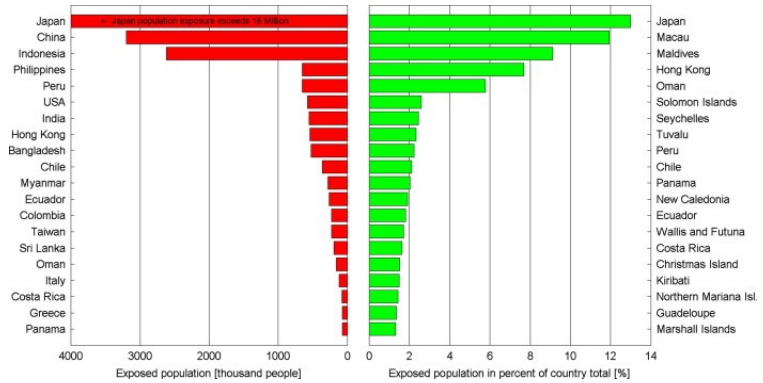
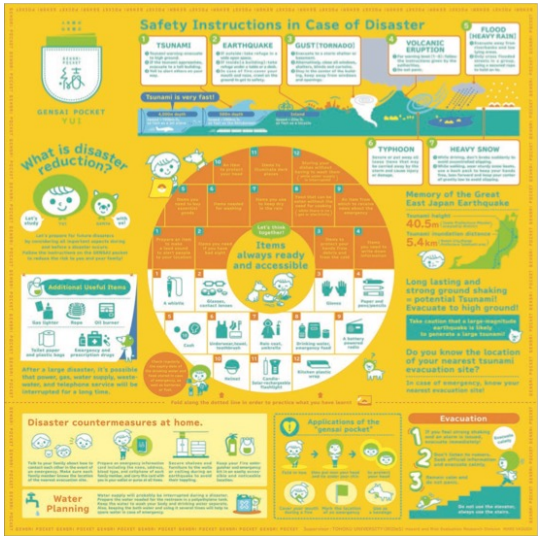
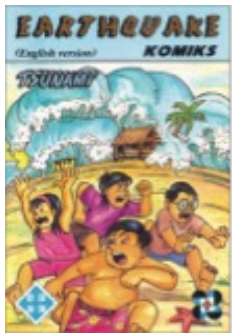
Education and Outreach





IRIDes disaster preparedness handkerchief

Tsunami marker in Sabang beach and sculpture of people who evacuated in Ermita Hill during the Tromba marina incident in Baler, Aurora



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- **Enhancing Tsunami Preparedness for Effective Community Response**

Education, Awareness, Preparedness Campaigns

Educational materials (print, digital, video, you tube) seminars, drills, press conferences, media programs

Guidelines for Earthquake and Tsunami Preparedness

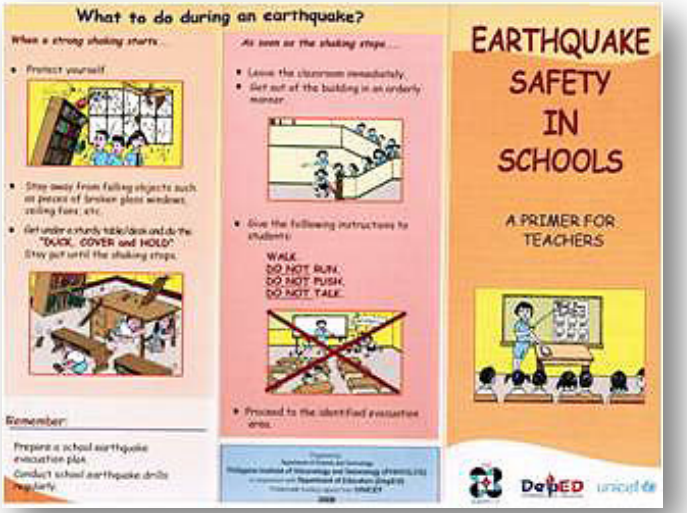
HOW TO CONDUCT AN EARTHQUAKE DRILL IN SCHOOL

PHILIPPINE INSTITUTE OF VOLCANOLOGY AND SEISMOLOGY

Introduction

Objectives

STAGE 1



What to do during an earthquake?

When a strong shaking starts...

- Protect yourself
- Stay away from falling objects such as pieces of broken glass windows, ceiling fans, etc.
- Get under a sturdy table/desk and do the "DUCK, COVER and HOLD"

Stay put until the shaking stops.

As soon as the shaking stops...

- Leave the classroom immediately.
- Get out of the building in an orderly manner.
- Give the following instructions to students:

WALK.
DO NOT RUN.
DO NOT PUSH.
DO NOT TALK.

- Proceed to the identified evacuation area.

Remember:

Prepare a school earthquake evacuation plan.

Conduct school earthquake drills regularly.

EARTHQUAKE SAFETY IN SCHOOLS

A PRIMER FOR TEACHERS

DepED unicef

Philippine Institute of Volcanology and Seismology (PHIVOLCS)
Department of Science and Technology (DOST)

DEVELOPING A TSUNAMI-PREPARED COMMUNITY

TSUNAMI RISK MITIGATION PROGRAM

Together we can save lives

In the past, people have assumed that emergency planning and preparedness is the sole responsibility of the government. But as proven in the many disasters that have occurred in recent years, positive community response to a crisis can save more lives especially if all sectors in the community have a role to play in its disaster risk mitigation efforts.

The role of national government agencies is to help the local government units and the communities by developing and implementing national programs that would capacitate the communities for disaster preparedness. These include advocacy to policy makers and planners to integrate specific disaster mitigation plans in the national development plan and generating and providing the right information that can be used towards developing a disaster-resilient nation. However, the activities at the national level alone will not save any lives if people at the community level will not use the information made available and are not prepared mentally and physically to respond. For the case of tsunami hazard after a strong earthquake, the coastal communities must take on the responsibility for their own safety.

Why tsunami preparedness?

Specific interest is put on the importance of tsunami preparedness in the community level, as **there is not sufficient time for warning from the national level in case of near-shore or locally-generated tsunamis.** This fact has time and again been observed after major disasters such as the 1976 August Moro Gulf and 1994 November Oriental Mindoro tsunamis. In these events, it took only 2 to 5 minutes at the earliest up to 20 minutes after the earthquakes for the tsunami waves to hit the shores of Moro Gulf and Oriental Mindoro. Residents of the coastal communities must be prepared to evacuate and move to higher ground once signs of impending tsunami are observed.

But how does a community go about preparedness and planning for tsunami? There are various steps leading to a **tsunami-prepared community.** Openly discussing facts about tsunami disasters will actually increase awareness and interest instead of propagating speculations that could lead to spread of rumors if the issue on tsunami hazard is avoided. Any tsunami preparedness planning need not be expensive. There is no such thing as poor community that would not be able to prepare for tsunami as many risk-reduction activities are more people-driven. Lastly, tsunamis are considered infrequent but high-impact type events, and it is important to keep in mind that tsunami disasters can destroy any progress that a community has attained in an instant.

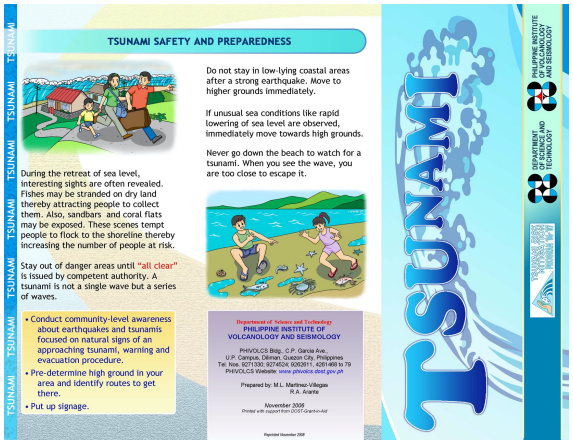
A jeepney in South Cotabato smashed by tsunami after the 1976 August Moro Gulf Earthquake

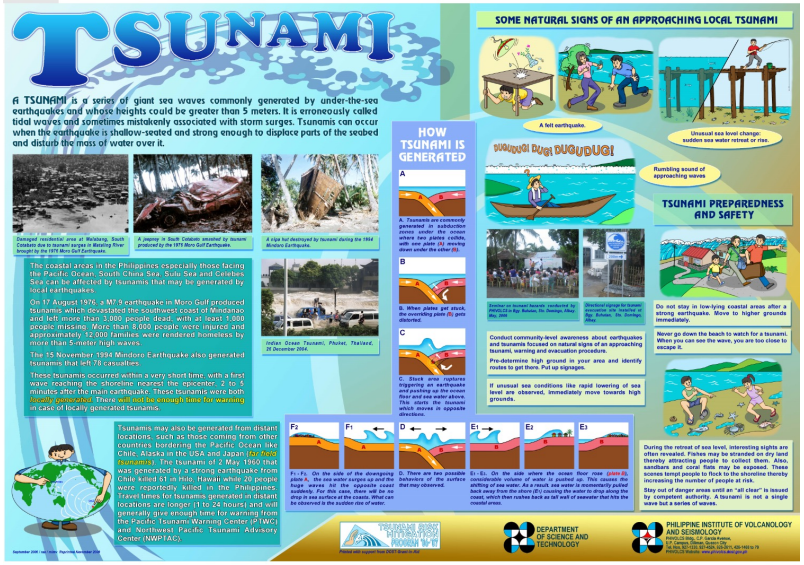
KNOW THE HAZARD

What is a tsunami? A tsunami is a series of sea waves commonly generated by under-the-sea earthquakes and whose heights could be greater than 5 meters. For so long, it has been erroneously called tidal waves and still often mistakenly associated with storm surges (tall coastal waves due to strong winds during a storm event). Tsunamis can occur when the earthquake is shallow-seated and strong enough to vertically displace parts of the seabed and disturb the mass of water over it.

The coastal areas in the Philippines can be affected by tsunamis that may be generated by local earthquakes. Locally-generated tsunamis can occur within very short time, with the first waves reaching the nearest shoreline from the epicenter in 2 to 5 minutes after the main earthquake, before any official warnings can be transmitted from the national level to the community level.

Tsunami Information Materials



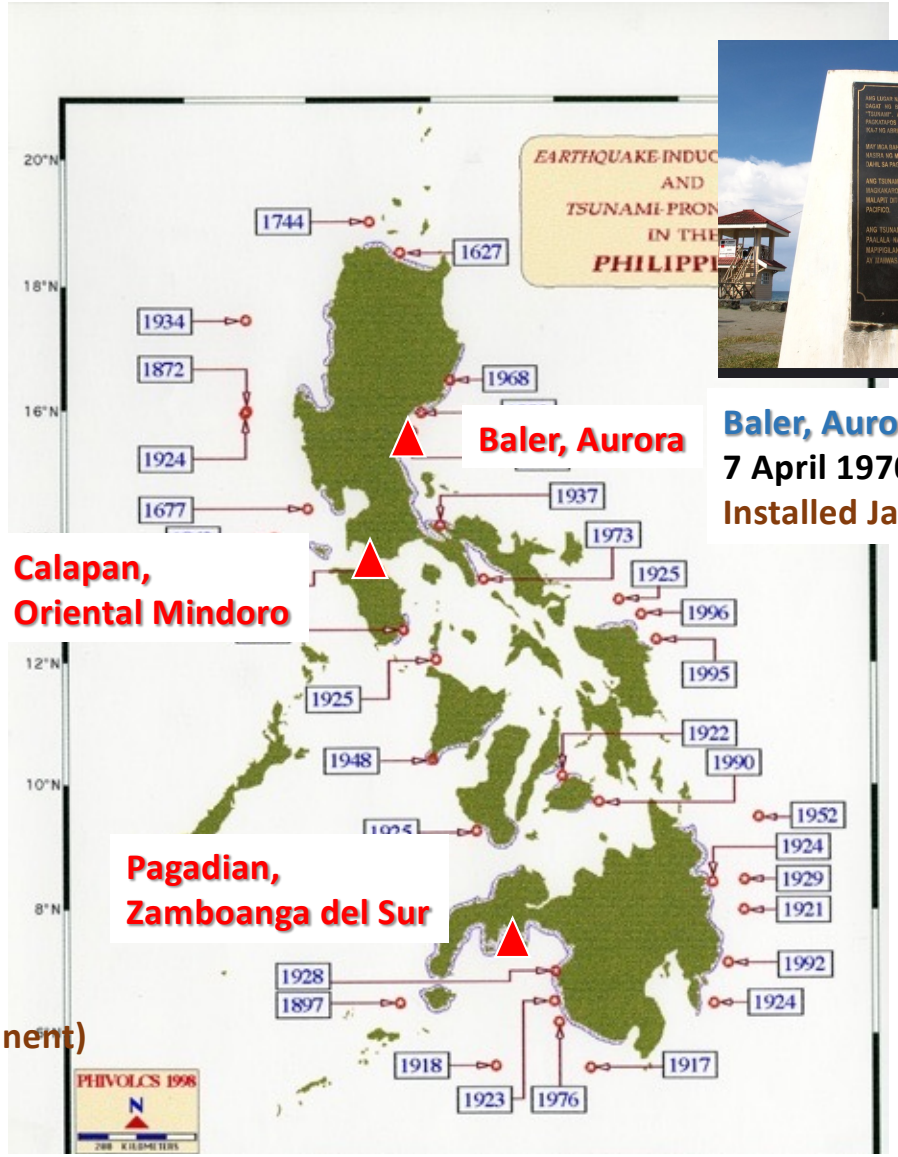


Tsunami Information Materials: Learning from experiences of others

3 known Tsunami Markers

Wawa, Calapan
Oriental Mindoro
15 Nov 1994
Installed 2014

Pagadian
1976 Moro Gulf Earthquake
installed Aug 2017(?) (permanent)
Unveiled 2006- temporary



Baler, Aurora
7 April 1970
Installed January 2005

Exercises & Drills

- **Quarterly Communications Test**
  - PHIVOLCS Main Office and Field stations
  - Metro-Manila Development Authority
- **Quarterly Nationwide Simultaneous Earthquake Drill (NSED)**

Department of Science and Technology
Philippine Institute of Volcanology and Seismology

Partner Organizations

- **Emergency Operations Center of Partner Agencies**
  - Office of Civil Defense
  - Department of Social Welfare and Development
  - Philippine Coast Guard
  - Philippine Red Cross & Red Crescent
  - Philippine Disaster Resilience Foundation

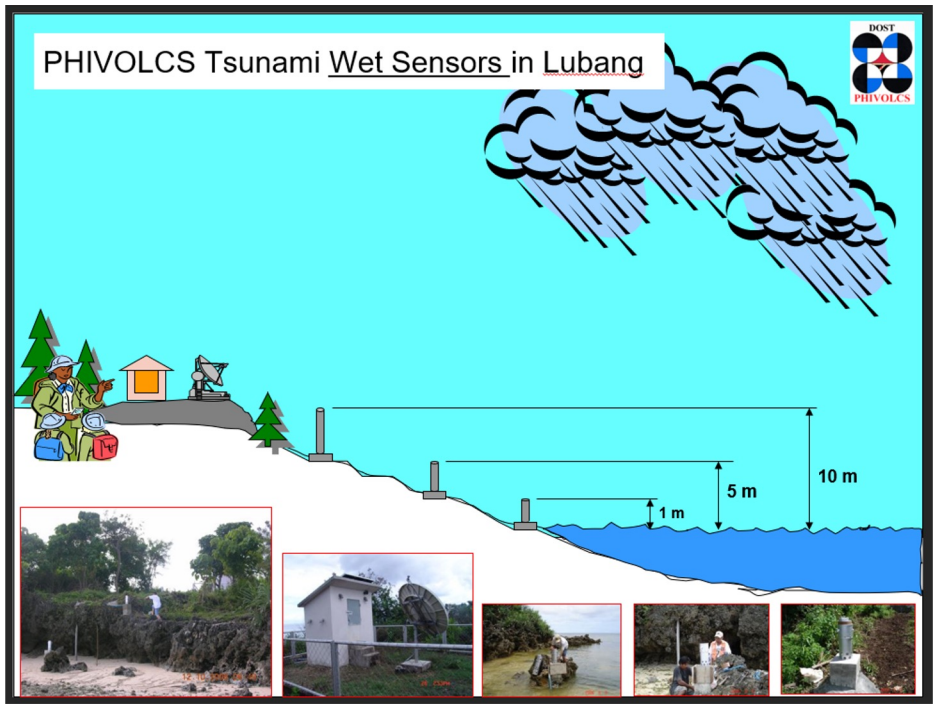
DOST-PHIVOLCS National Initiatives

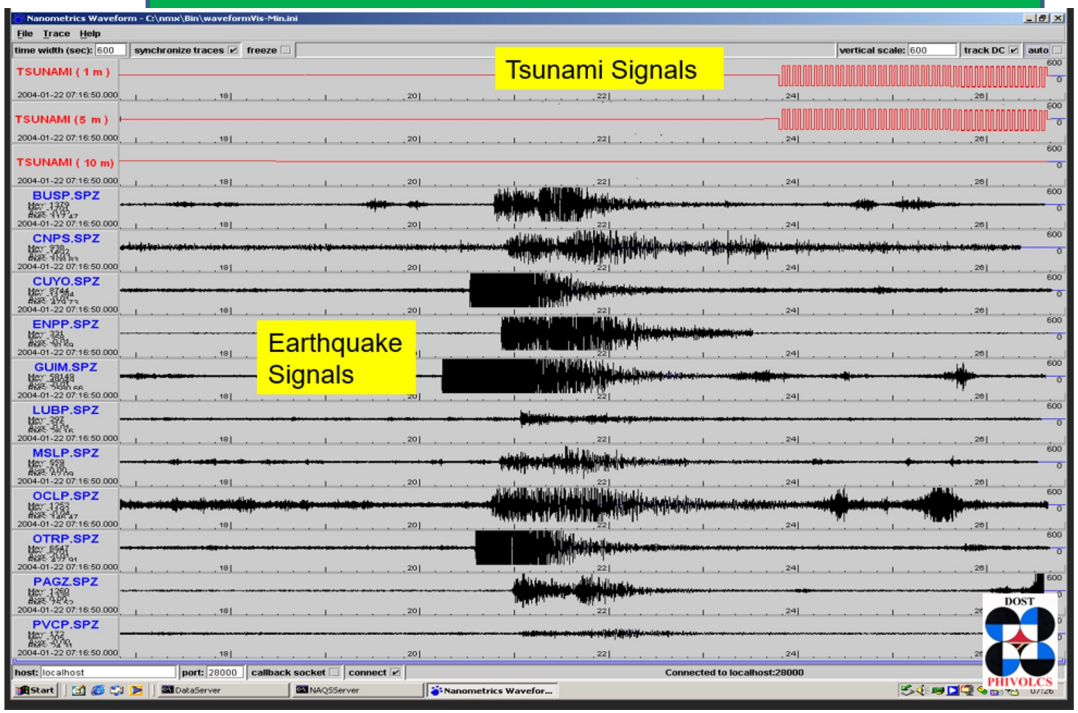
YEAR	Major Program/s / Projects	Outputs (Tsunami-related)	Funding/ Partners
2005	Establishment of a Local Tsunami Warning System for Manila Bay and vicinity	• Development of cost-effective tsunami detection instrument (wet and Dry sensors)	Finland Government
2006-2007	Tsunami Risk Mitigation Program	• Nationwide Tsunami Hazard Maps (1:50,000 scale) • 4 Pilot sites for Detailed Maps, and IECs (Vigan, Iloilo City, Pagadian City and Calapan, Mindoro) • Development of information materials	DOST-GIA

2005

FINLAND GOVERNMENT

Establishment of a Local Tsunami Warning System for Manila Bay and vicinity

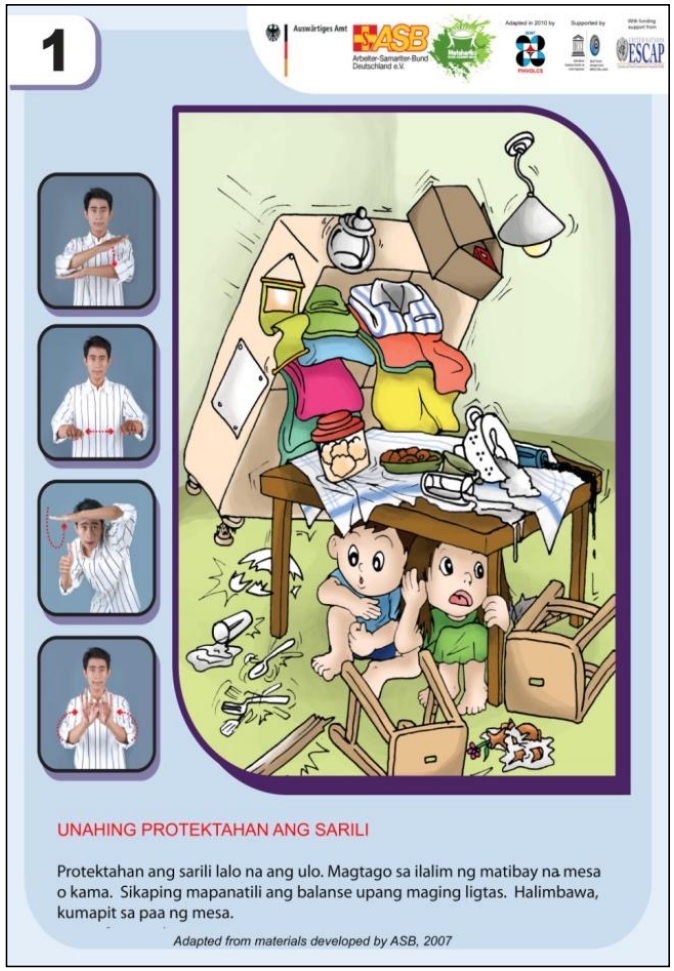




DOST-PHIVOLCS National Initiatives

YEAR	Major Program/s /Projects	Outputs (Tsunami-related)	Funding/ Partners
2006-2009	(READY PROJECT) Hazards mapping and assessment for Effective Community-Based Disaster Risk Management	• Tsunami Hazards Maps for 15 Provinces • Tsunami CBEWS in 21 sites (conduct of tsunami drills, installation of signaes, installation of warning bells • Development of information materials	UNDP-AusAID Multi-agency: MGB-DENR, NAMRIA-DENR, PAGASA, PHIVOLCS, OCD
2010-2011	Tsunami Awareness and Preparedness Tools and Assessment and Materials Development	• Exchange and adaptation of Tsunami Information Materials (4 participating SEA countries: Philippines, Indonesia, Thailand and Timor Leste)	UNESCO (Jakarta)-UNESCAP

Tsunami Information Materials



Earthquake Safety for Deaf (11-page flashcards)

Indonesia materials translated to Filipino for field testing

Aah…Ngayon Alam Ko Na!
(16-page picture story flashcards)

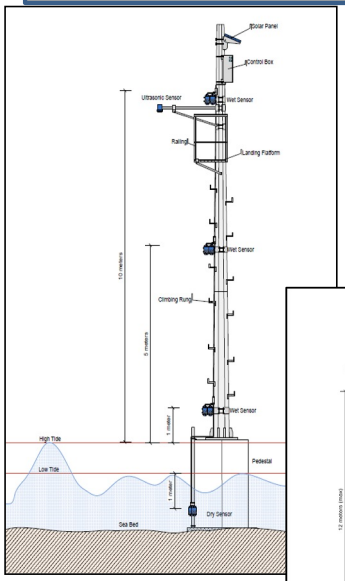
DOST-PHIVOLCS National Initiatives

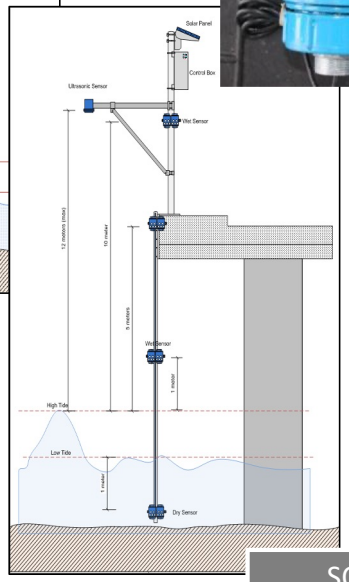
YEAR	Major Program/s /Projects	Outputs (Tsunami-related)	Funding
2010-2012 2013-2014	Establishment of a Cost-Effective Local Tsunami Early Warning System for Selected High-Risk Coastal Communities of the Philippines	• Installed Tsunami Detection in 5 sites • Alerting systems in 20 sites • Conduct of IECs • Development of Evacuation Maps for host barangays	DOST-GIA PHIVOLCS-GAA
2010-2015	Enhancement of Earthquake and Volcano Monitoring and Effective Utilization of Disaster Mitigation Information in the Philippines	• Tsunami Scenario Database (30,000 scenarios) • 4 Comics (based on Tsunami Survivors' Stories)	JICA-JST SATREPS
2013-2018	Improvement of Tsunami Monitoring Hazards Assessment Service	• 19 JMA-type sea level monitoring equipment installed • Online Platforms	JICA Grant-Aid for Disaster Mngt PHIVOLCS-GAA

2010-2012
2013-2014

DOST-GIA
PHIVOLCS-GAA
ASTI

Establishment of a Cost-Effective Local Tsunami Early Warning System for Selected High-Risk Coastal Communities of the Philippines





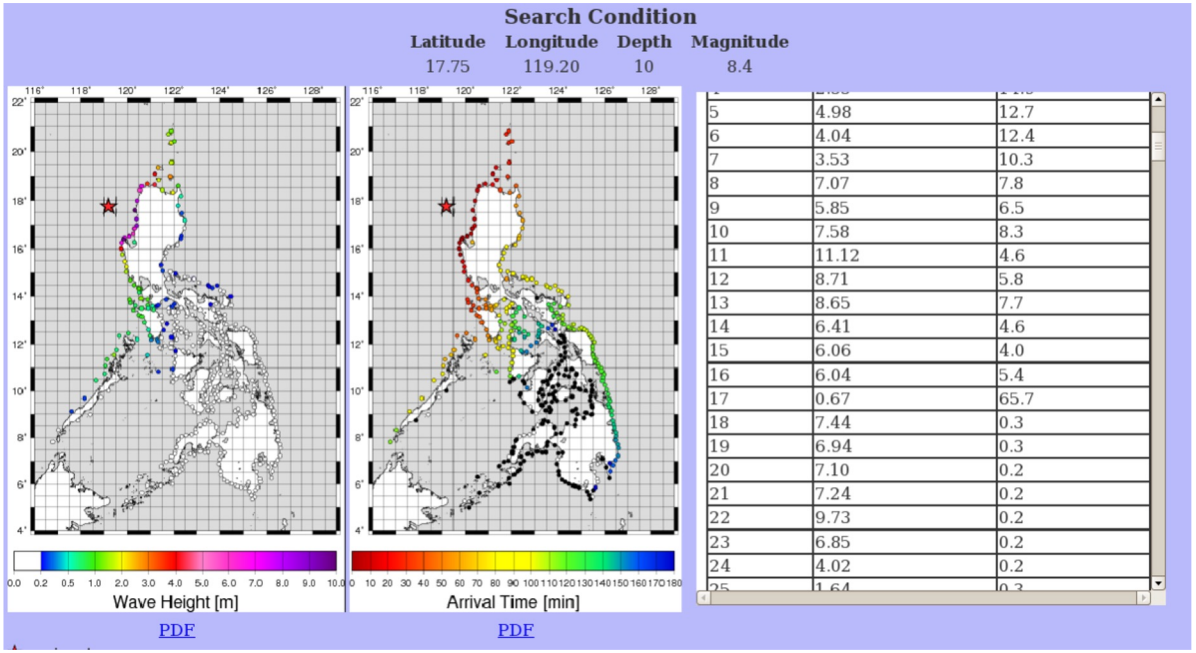
SOURCE: DOST-ASTI MASID

TSUNAMI EVACUATION MAP
Barangay Buhatan, Sto Domingo, Albay

2010-2015

JICA-JST SATREPS

Enhancement of Earthquake and Volcano Monitoring and Effective Utilization of Disaster Mitigation Information in the Philippines

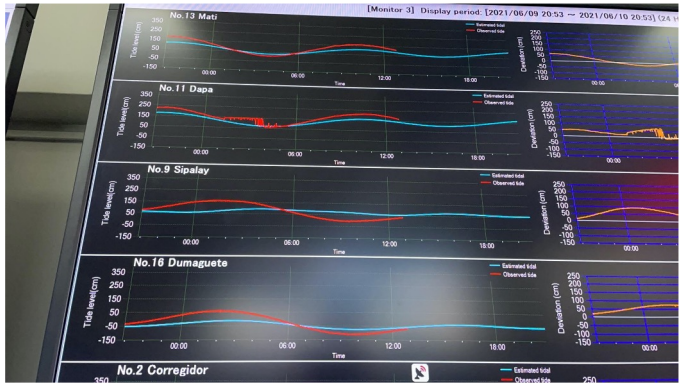


5	4.98	12.7
6	4.04	12.4
7	3.53	10.3
8	7.07	7.8
9	5.85	6.5
10	7.58	8.3
11	11.12	4.6
12	8.71	5.8
13	8.65	7.7
14	6.41	4.6
15	6.06	4.0
16	6.04	5.4
17	0.67	65.7
18	7.44	0.3
19	6.94	0.3
20	7.10	0.2
21	7.24	0.2
22	9.73	0.2
23	6.85	0.2
24	4.02	0.2

2013-2018

JICA Grant-Aid for Disaster Mngt PHIVOLCS-GAA

Improvement of Tsunami Monitoring



DOST-PHIVOLCS National Initiatives

YEAR	Major Program/s /Projects	Outputs (Tsunami-related)	Funding
2018-present	GeoRisk Philippines Initiative (Geospatial Information Management and Analysis Project for Hazards and Risk Assessment in the Philippines)	• Online Platforms for hazards assessment, for collection of exposure information and coping capacity measures	DOST-GIA
2019- present	Tsunami Hazard Mapping Program	• More detailed Tsunami Hazard Maps	PHIVOLCS-GAA
2019-2021	National Harmonized Tsunami DRR Initiatives-Tsunami Summit	• Baseline data for mapping out of Tsunami DRR initiatives of LGUs	PHIVOLCS- GAA
2022- present	Tsunami Ready Philippines	• National Tsunami Ready Board	PHIVOLCS GAA

2018-

- Many national-level led programs on tsunami DRR
- RA 10121 of 2010 :
  - Institutionalization of DRRMOs
  - LGU initiatives (pilots, replications)-
- Need for baseline data of LGU initiatives

National Consultation Workshop for Harmonized Tsunami Program 2019

- Venue for a coordinated multi-agency, multi-stakeholder discussion
- Identify current, ongoing initiatives of various organizations on Tsunami DRR
- Identify timetable of implementation of existing Tsunami DRR activities from various organizations for more coordinated activities

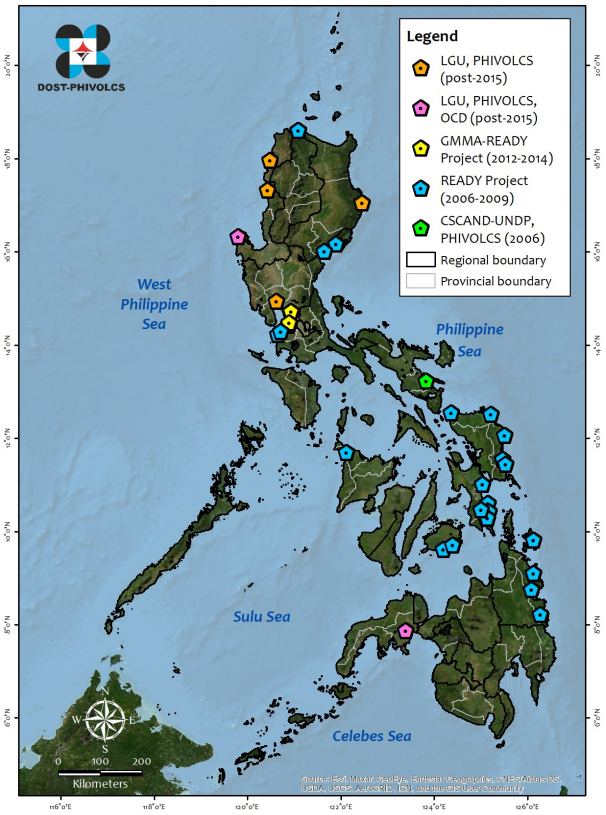
National Harmonized Tsunami DRR 2020 (virtual, focus on Clusters 1,2,3 (Mindanao)

- Platform/venue for a coordinated multi-agency, multi-stakeholder discussion
- Toolkit/manual/unified template for reporting past accomplishments, current initiatives and short-term plans/programs on Tsunami DRR
- Create and maintain platform for reporting Tsunami DRRM-related initiatives that is accessible to all partners

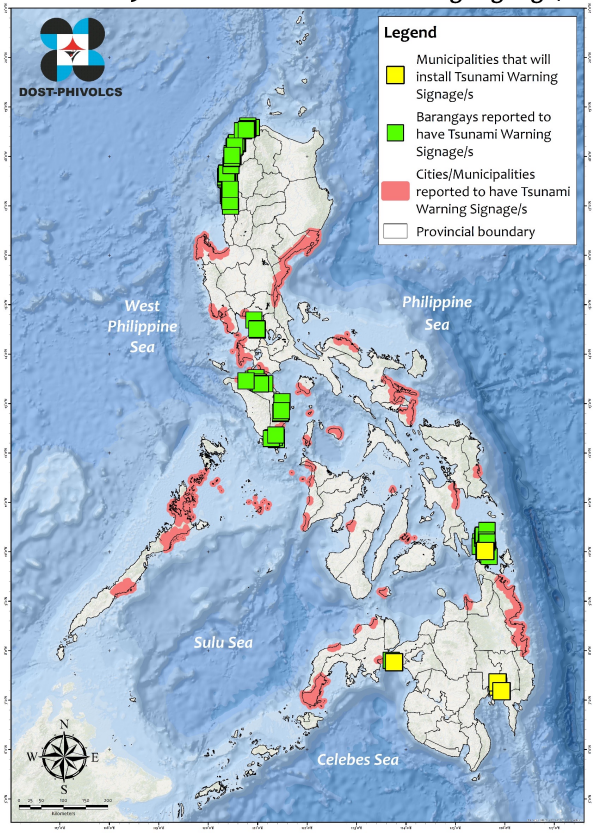
National Harmonized Tsunami DRR 2021 (virtual, Clusters 1-9)

- Platform/venue for a coordinated multi-agency, multi-stakeholder discussion
- Toolkit/manual/unified template for reporting past accomplishments, current initiatives and short-term plans/programs on Tsunami DRR
- Create and maintain platform for reporting Tsunami DRRM-related initiatives that is accessible to all

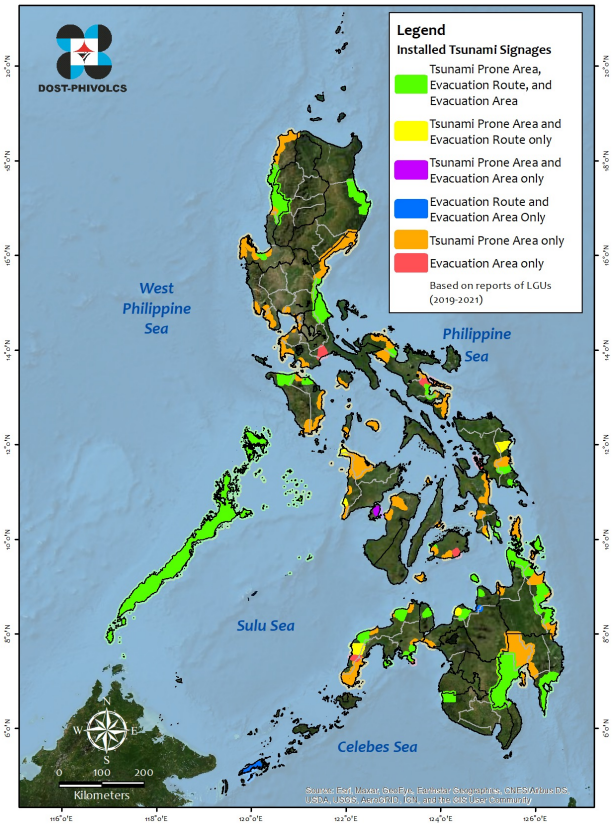
Community-Based Early Warning System (CBEWS) Projects (2006-2019)



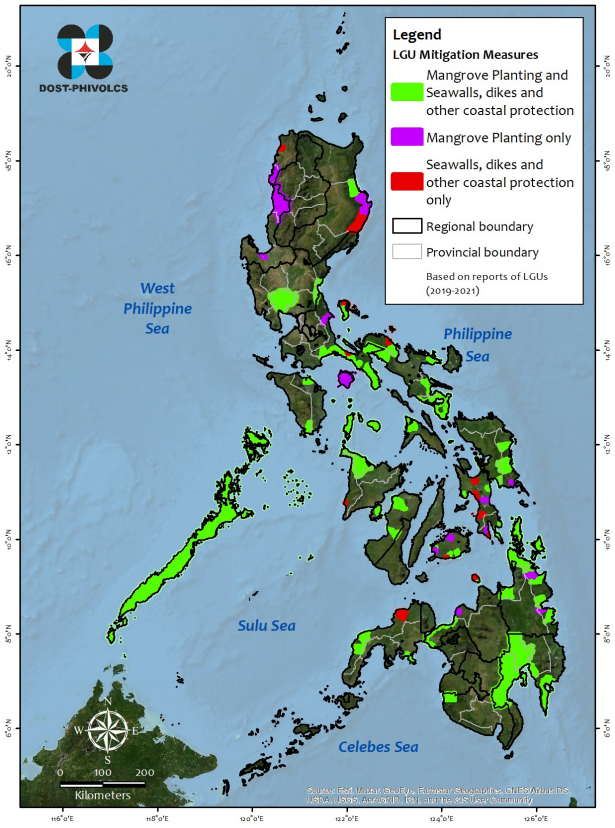
WTAD 2019: LGUs with Tsunami Warning Signage/s



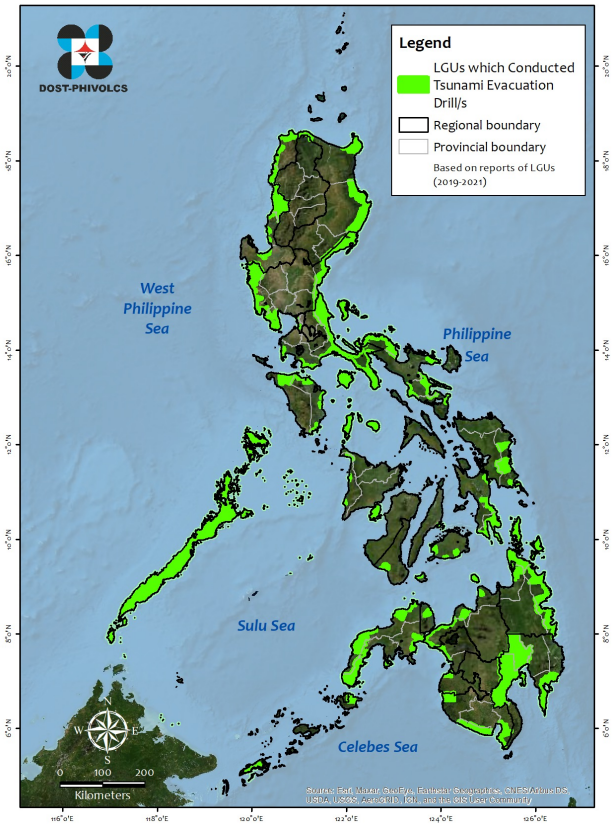
Tsunami Summit 2021: LGUs with Installed Tsunami Signages



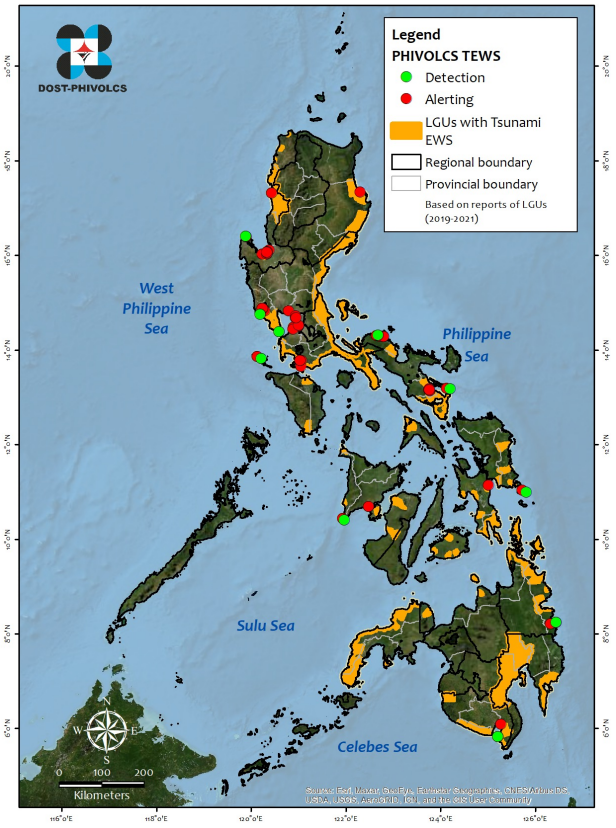
Tsunami Summit 2021: LGUs with Tsunami Mitigation Measure/s

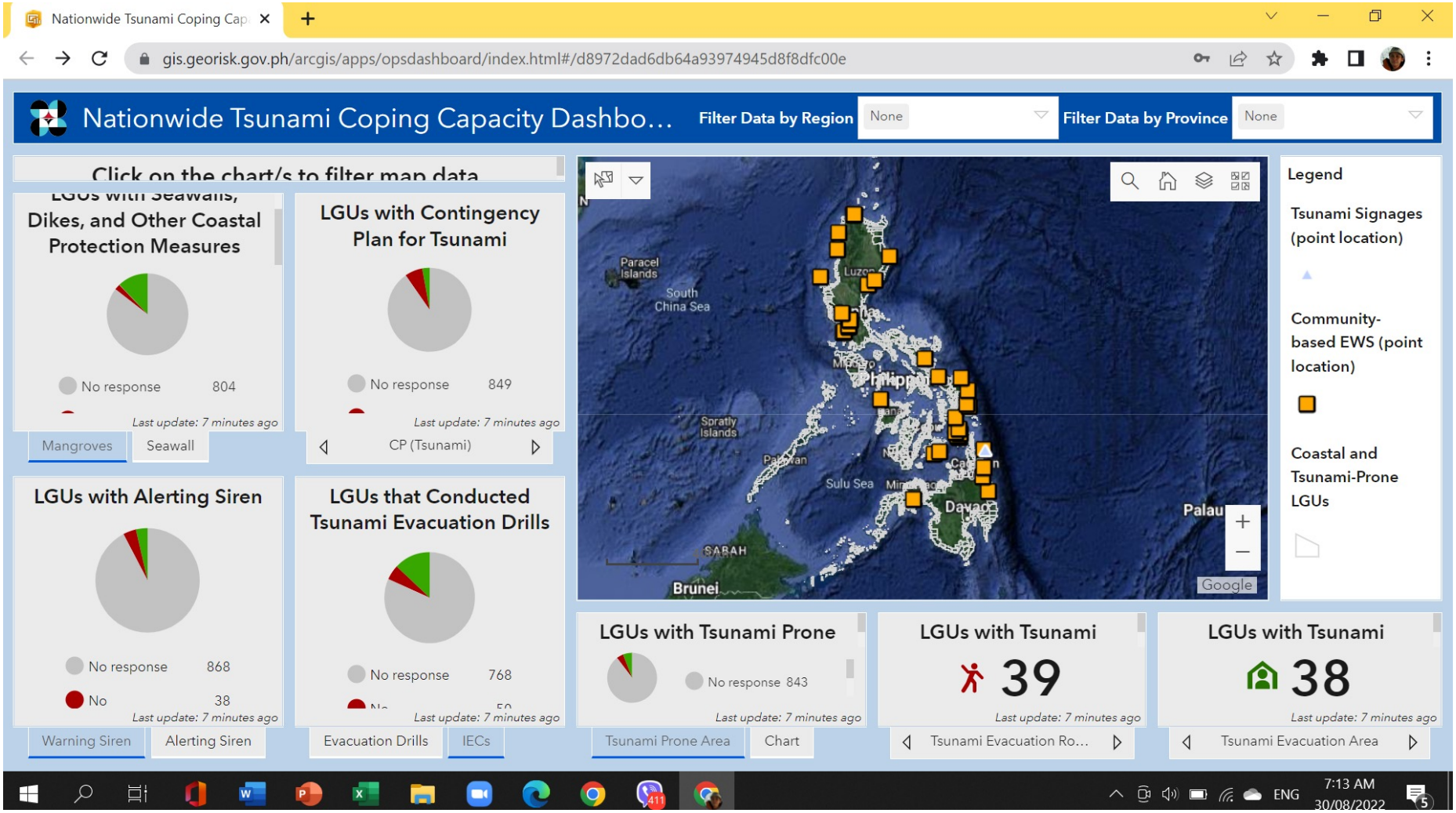


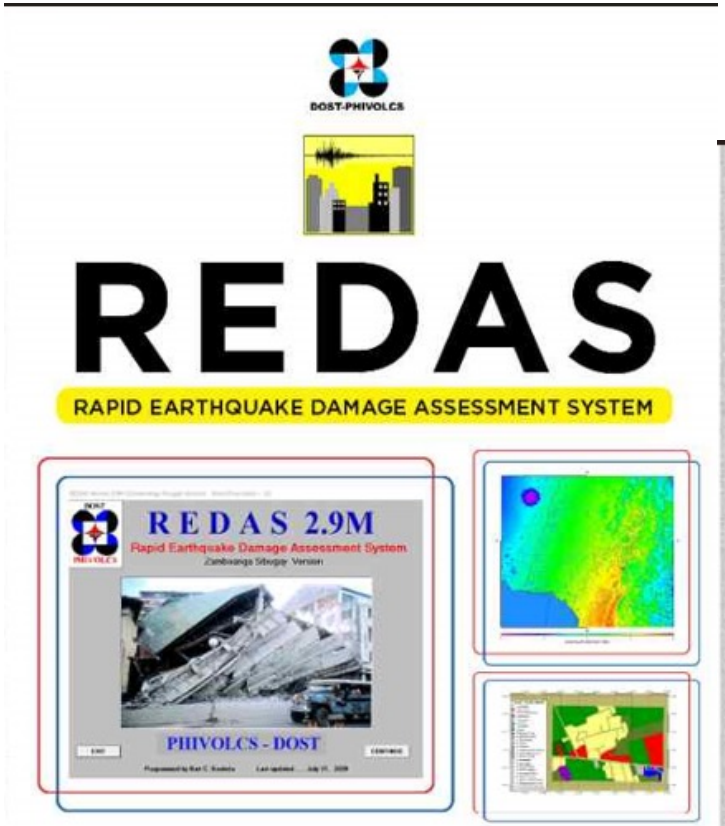
Tsunami Summit 2021: LGUs with Tsunami Evacuation Drill



Tsunami Summit 2021: LGUs with Tsunami Early Warning System




Nationwide Tsunami Coping Cap
gis.georisk.gov.ph/arcgis/apps/opsdashboard/index.html#/d8972dad6db64a93974945d8f8dfc00e
Nationwide Tsunami Coping Capacity Dashbo...
Filter Data by Region
None
Filter Data by Province
None
Click on the chart/s to filter map data
LGUs with Seawalls, Dikes, and Other Coastal Protection Measures
No response 804
Last update: 7 minutes ago
Mangroves
Seawall
LGUs with Contingency Plan for Tsunami
No response 849
Last update: 7 minutes ago
CP (Tsunami)
LGUs with Alerting Siren
No response 868
No 38
Last update: 7 minutes ago
Warning Siren
Alerting Siren
LGUs that Conducted Tsunami Evacuation Drills
No response 768
Last update: 7 minutes ago
Evacuation Drills
IECs
Paracel Islands
South China Sea
Luzon
Spratly Islands
Palawan
Sulu Sea
Davao
Palau
SABAH
Brunei
Google
Legend
Tsunami Signages (point location)
Community-based EWS (point location)
Coastal and Tsunami-Prone LGUs
LGUs with Tsunami Prone
No response 843
Last update: 7 minutes ago
Tsunami Prone Area
Chart
LGUs with Tsunami
39
Last update: 7 minutes ago
Tsunami Evacuation Ro...
LGUs with Tsunami
38
Last update: 7 minutes ago
Tsunami Evacuation Area
ENG
7:13 AM
30/08/2022



IMPACT ASSESSMENT MODULES

1. **SHAke (Earthquake Impact Assessment Module)**
   - computes for earthquake impacts
2. **SWIFT (Severe Wind Impact Forecasting Tool)**
   - computes impacts from severe wind hazard, in partnership with the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA)
3. **FLoAT (Flood Loss Assessment Tool)**
   - computes impact from floods, in partnership with the Mines and Geosciences Bureau
4. **TsuSIM (Tsunami Simulation and Impact Module)**
   - simulates tsunami hazard, computes for its impacts, and plots tsunami evacuation map
5. **CropDAT (Crop Damage Assessment Tool)**
   - estimates agricultural damages due to severe wind and flood hazards
6. **QLIST (Quick Lahar Impact Simulation Tool)**
   - computes impacts due to lahars

MONITORING AND WARNING TOOLS

1. **ETAM (Earthquake and Tsunami Alerting Module)**
   - a tool for monitoring earthquakes, plotting tsunami evacuation map, and reporting intensities
2. **SRM (Satellite Rainfall Monitor)**
   - a tool for near-real-time monitoring of rainfall in any part of the Philippines on 24-7 basis. It can also be used to retrieve and evaluate historical rainfall data from 2000 to present.

EXPOSURE DATABASE DEVELOPMENT

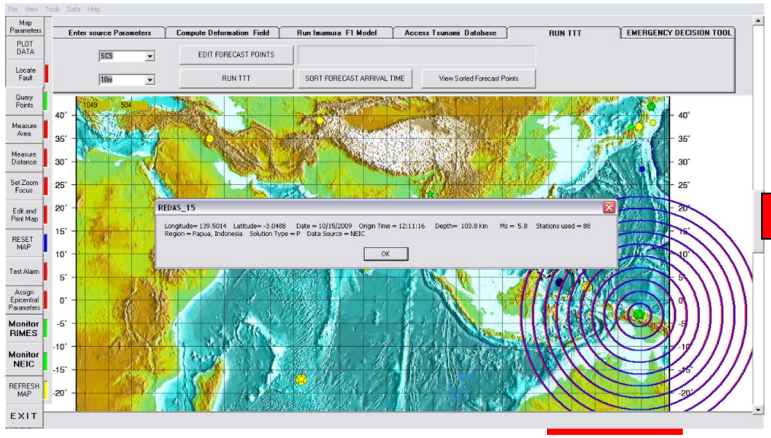
EDM (Exposure Data Mapper)
- a web-based and mobile surveying tool in building exposure database for use in multi-hazard impact assessment, in collaboration with the public

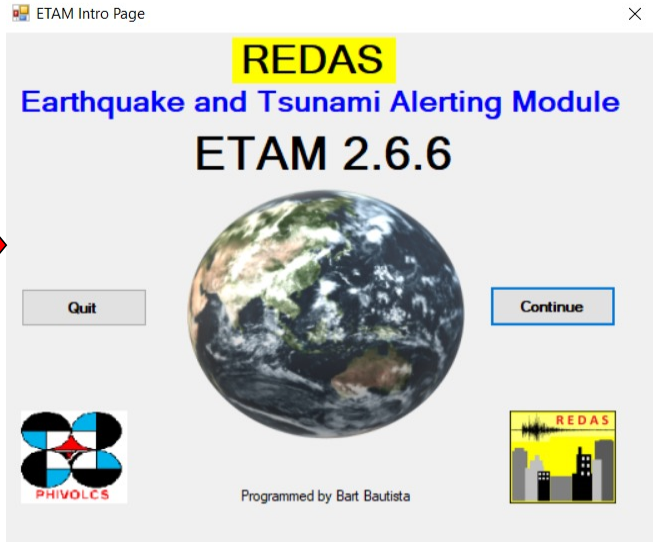
2002-2004 DOST-GIA funded

2006 - present
REDAS Trainings for LGUs and other partners

2019
TsuSim Module

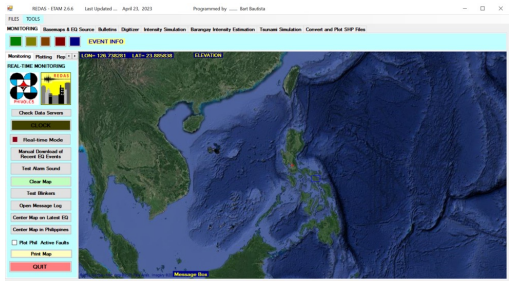
REDAS Earthquake and Tsunami Alerting Module (ETAM)





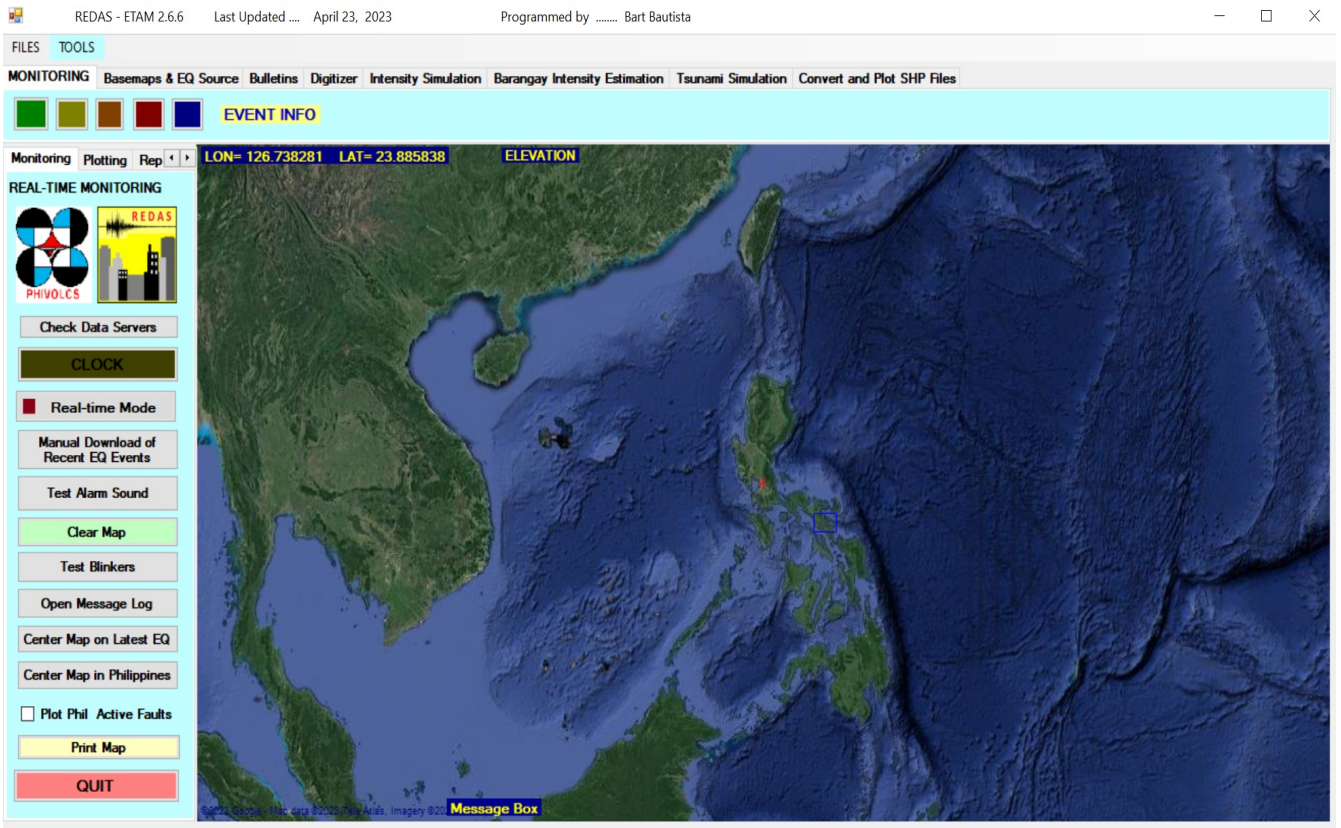
Old REDAS ETAM

New REDAS ETAM



DOST DOST-PHIVOLCS REDAS

ETAM 2.6.6 (Latest Version)



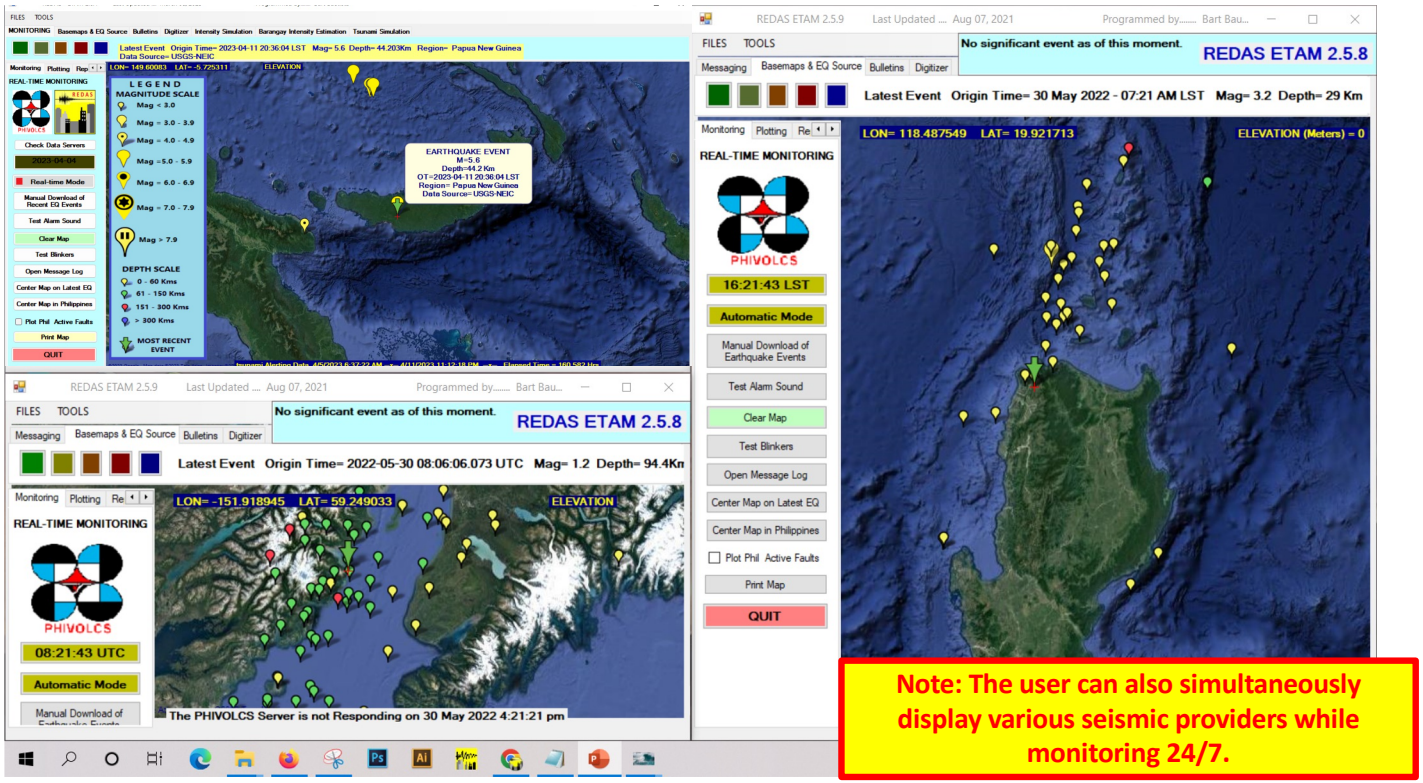
- Can be used for monitoring earthquakes and reporting intensities
- Can use different types of basemaps (Open Street Map, Google Satellites, Google Hybrid Map)
- Calculate intensities per barangay, plot focal mechanism solutions, plot and simulate liquefaction and earthquake induced landslides

DOST DOST-PHIVOLCS REDAS

Real-time Mode:

Fetch data on regular intervals.

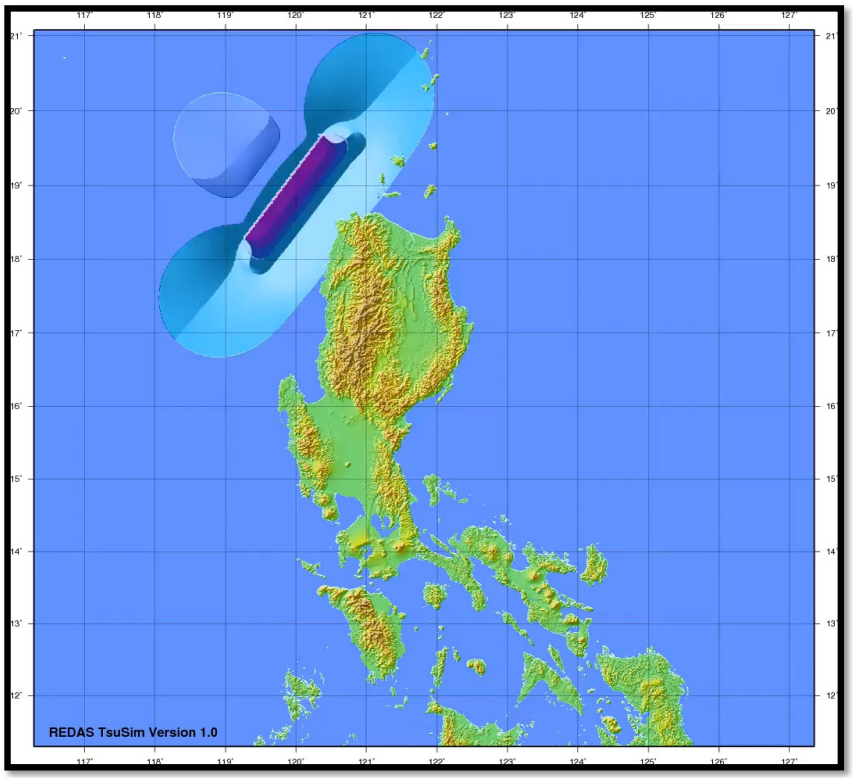
Centers on the latest earthquake event

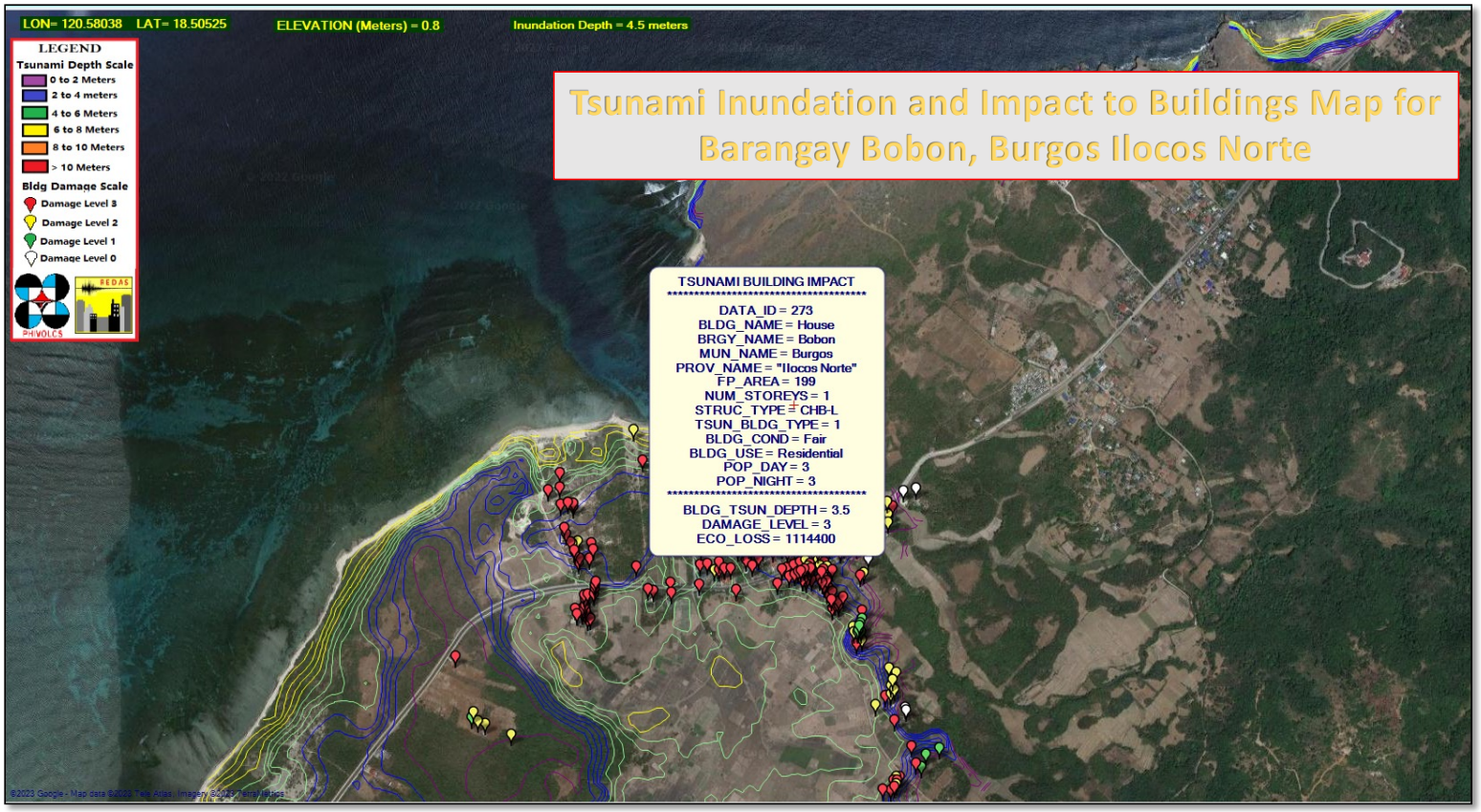


Note: The user can also simultaneously display various seismic providers while monitoring 24/7.

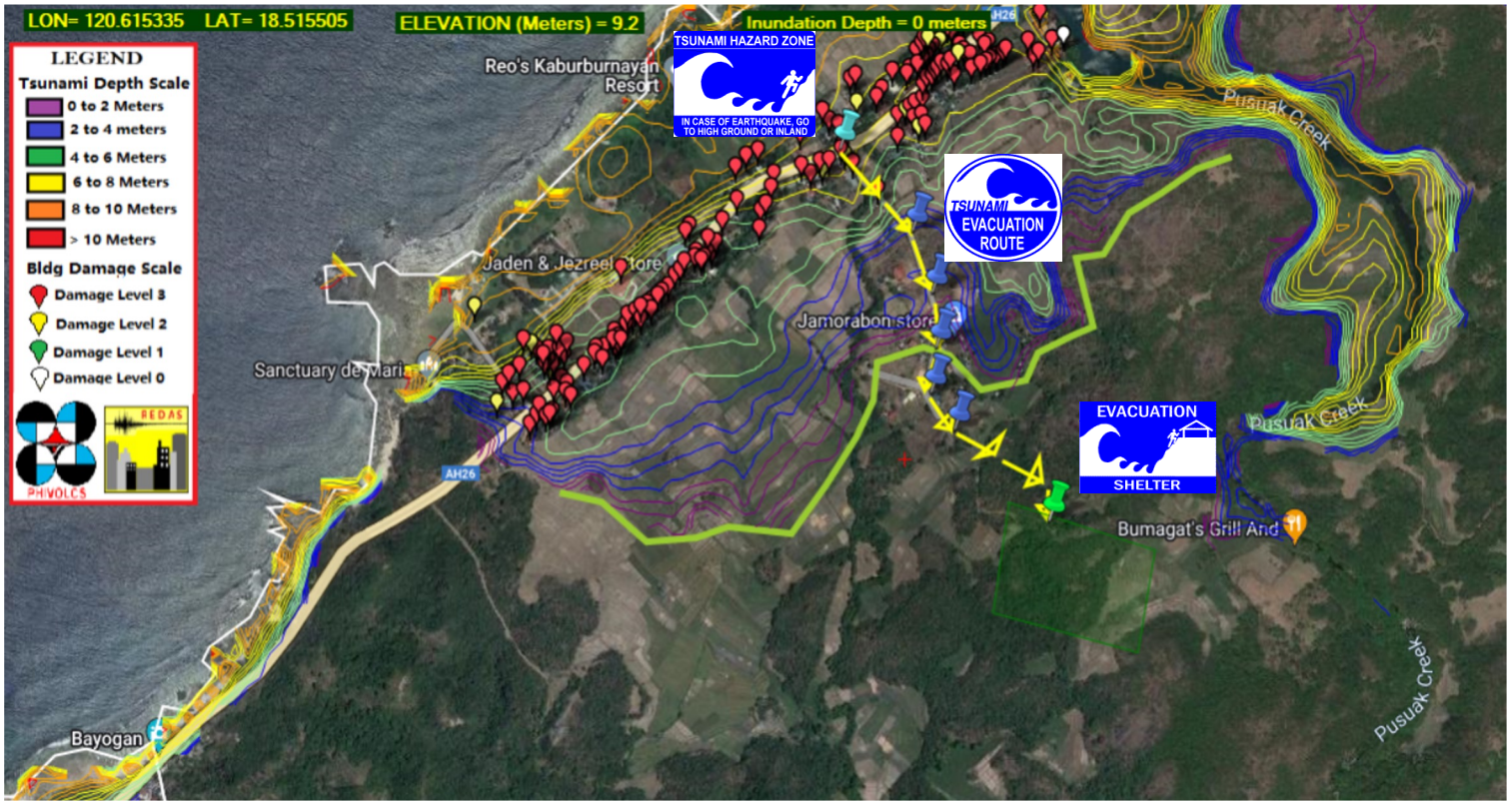
REDAS Tsunami Simulation Module (REDAS-TSUSIM)

- **Tsunami Simulation Animation of Magnitude 8.4 Manila Trench Segment 2 Earthquake Scenario**




LON= 120.58038 LAT= 18.50525
ELEVATION (Meters) = 0.8
Inundation Depth = 4.5 meters
LEGEND
Tsunami Depth Scale
0 to 2 Meters
2 to 4 meters
4 to 6 Meters
6 to 8 Meters
8 to 10 Meters
> 10 Meters
Bldg Damage Scale
Damage Level 3
Damage Level 2
Damage Level 1
Damage Level 0
Tsunami Inundation and Impact to Buildings Map for Barangay Bobon, Burgos Ilocos Norte
TSUNAMI BUILDING IMPACT
DATA_ID = 273
BLDG_NAME = House
BRGY_NAME = Bobon
MUN_NAME = Burgos
PROV_NAME = "Ilocos Norte"
FP_AREA = 199
NUM_STOREYS = 1
STRUC_TYPE = CHB-L
TSUN_BLDG_TYPE = 1
BLDG_COND = Fair
BLDG_USE = Residential
POP_DAY = 3
POP_NIGHT = 3
BLDG_TSUN_DEPTH = 3.5
DAMAGE_LEVEL = 3
ECO_LOSS = 1114400

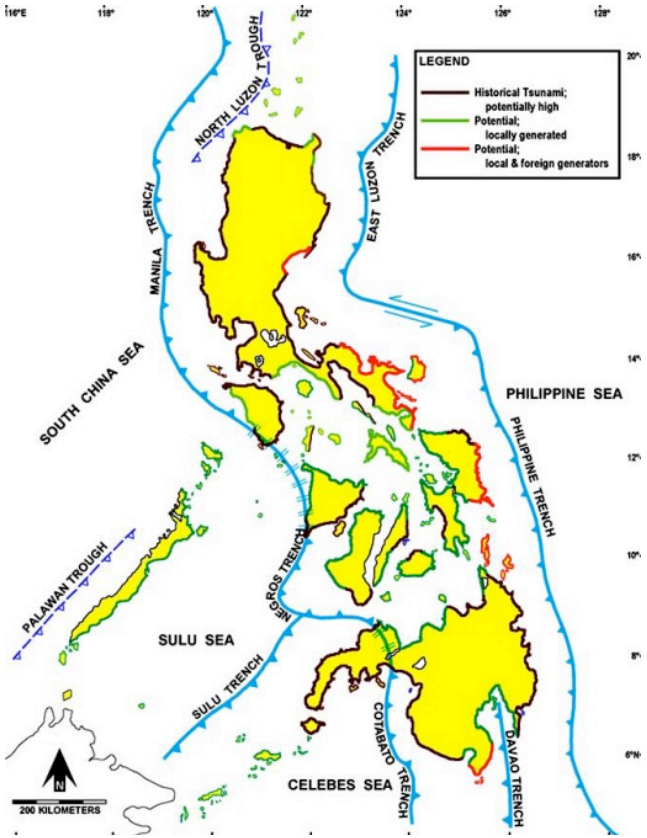
TSUNAMI EVACUATION MAP USING REDAS TSUSIM

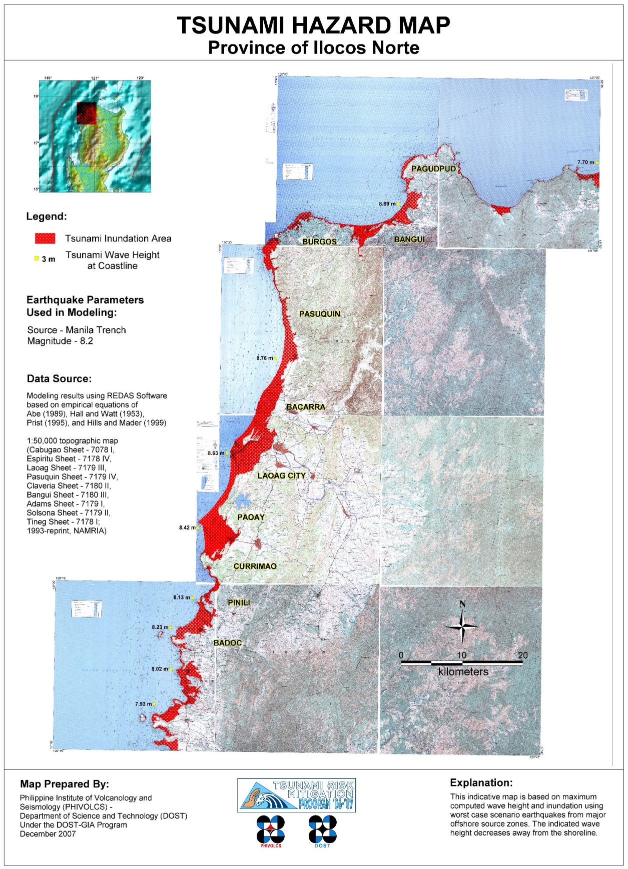


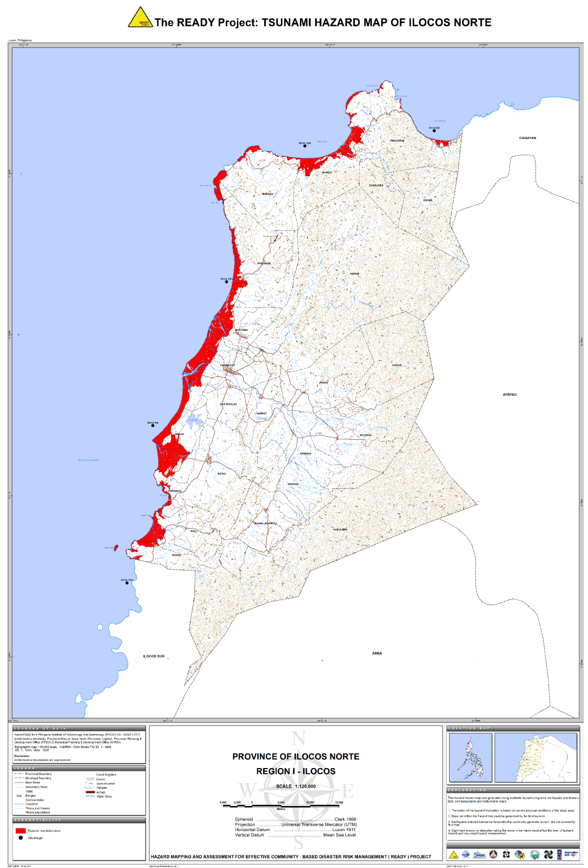
Early Tsunami Hazard Map of PHIVOLCS

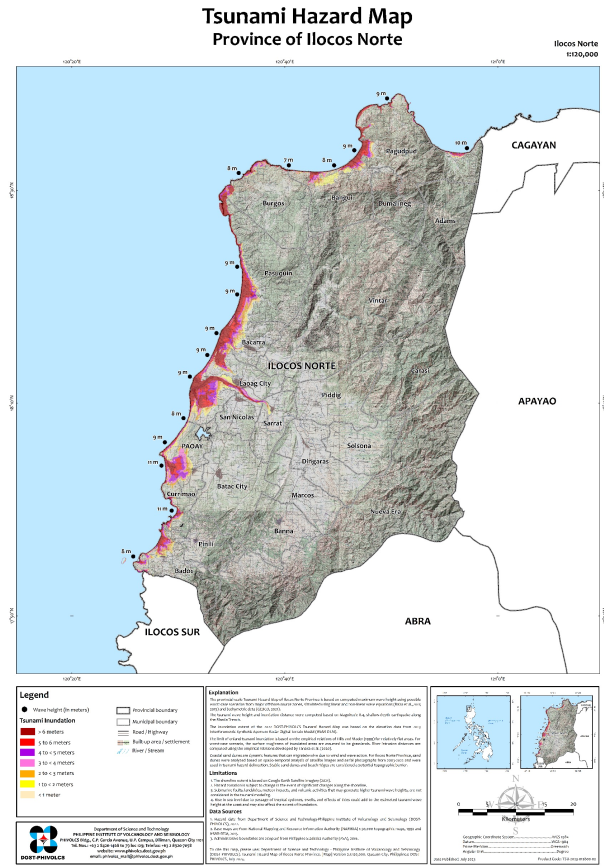
Indicative Tsunami Hazard Map for the Philippine Archipelago

- Describes tsunamis that can affect coastal communities
  - Tsunami Potentially High (Historical Tsunamis)
  - Potential
    - Local generators
    - Local and foreign generators

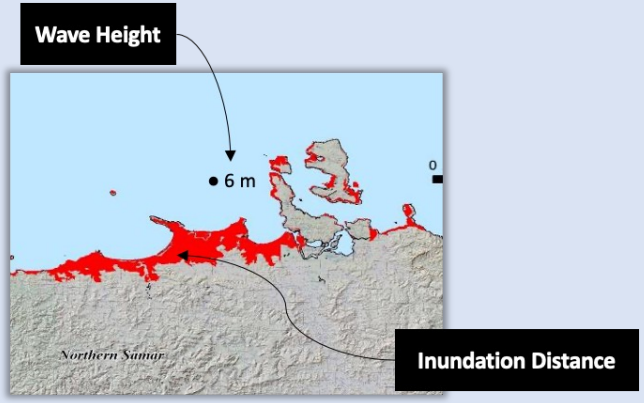



TSUNAMI HAZARD MAP
Province of Ilocos Norte
Legend:
Tsunami Inundation Area
3 m Tsunami Wave Height at Coastline
Earthquake Parameters Used in Modeling:
Source - Manila Trench
Magnitude - 8.2
Data Source:
Modeling results using REDAS Software based on empirical equations of Abe (1989), Hall and Watt (1953), Prist (1995), and Hills and Mader (1999)
1:50,000 topographic map (Cabugao Sheet - 7078 I, Espiritu Sheet - 7178 IV, Laoag Sheet - 7179 III, Pasuquin Sheet - 7179 IV, Claveria Sheet - 7180 II, Bangui Sheet - 7180 III, Adams Sheet - 7179 I, Solsona Sheet - 7179 II, Tineg Sheet - 7178 I; 1993-reprint, NAMRIA)
PAGUDPUD
7.70 m
8.69 m
BURGOS
BANGUI
PASUQUIN
8.76 m
BACARRA
8.63 m
LAOAG CITY
PAOAY
8.42 m
CURRIMAO
8.13 m
PINILI
8.23 m
BADOC
8.02 m
7.93 m
N
0 10 20
kilometers
Map Prepared By:
Philippine Institute of Volcanology and Seismology (PHIVOLCS) - Department of Science and Technology (DOST) Under the DOST-GIA Program December 2007
TSUNAMI RISK MITIGATION PROGRAM
PHIVOLCS
DOST
Explanation:
This indicative map is based on maximum computed wave height and inundation using worst case scenario earthquakes from major offshore source zones. The indicated wave height decreases away from the shoreline.


The READY Project: TSUNAMI HAZARD MAP OF ILOCOS NORTE
CAGAYAN
APAYAO
ILOCOS SUR
ABRA
PROVINCE OF ILOCOS NORTE
REGION I - ILOCOS
HAZARD MAPPING AND ASSESSMENT FOR EFFECTIVE COMMUNITY - BASED DISASTER RISK MANAGEMENT (READY) PROJECT


Tsunami Hazard Map
Province of Ilocos Norte
Ilocos Norte
1:120,000
CAGAYAN
Pagudpud
Burgos
Dumalneg
Adams
Pasuquin
Vintar
Bacarra
ILOCOS NORTE
Laoag City
Piddig
Carasi
APAYAO
San Nicolas
Sarrat
PAOAY
Solsona
Dingaras
Currimao
Batac City
Marcos
Nueva Era
Banna
Pinili
Badoc
ILOCOS SUR
ABRA
Legend
Wave height (in meters)
Tsunami Inundation
Provincial boundary
Municipal boundary
Road / Highway
River / Stream
Explanation
Limitations
Data Sources
DOST-PHIVOLCS

Previously generated Tsunami Hazard Maps



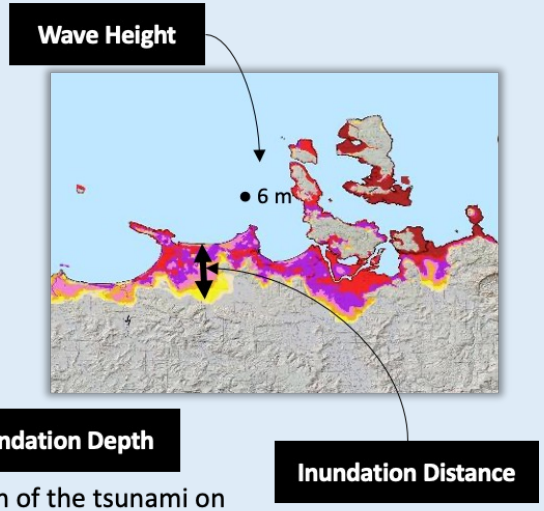
Different methodologies, basemaps, and modeling software and empirical equations

2007 DOST-GIA Project:
Tsunami Propagation and Inundation: Empirical relations based

2013 READY Project:
Tsunami Propagation: Numerical Modeling-based (TUNAMI-N2), empirical relations; validated coastal roughness for some areas, some areas are not based on worst-case scenario

2016 TsuHaMEI:
Enhancement of 2007 DOST-GIA and READY Projects

Harmonized Tsunami Hazard Maps



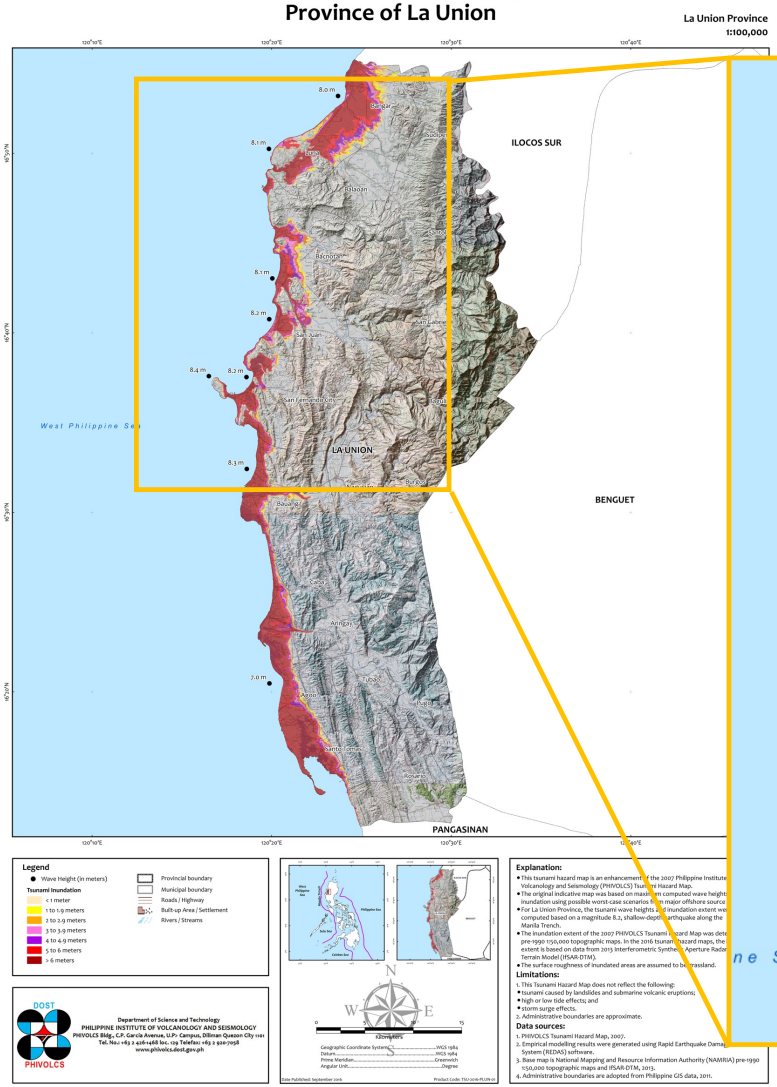
Depth of the tsunami on a specific area Represented by the colors

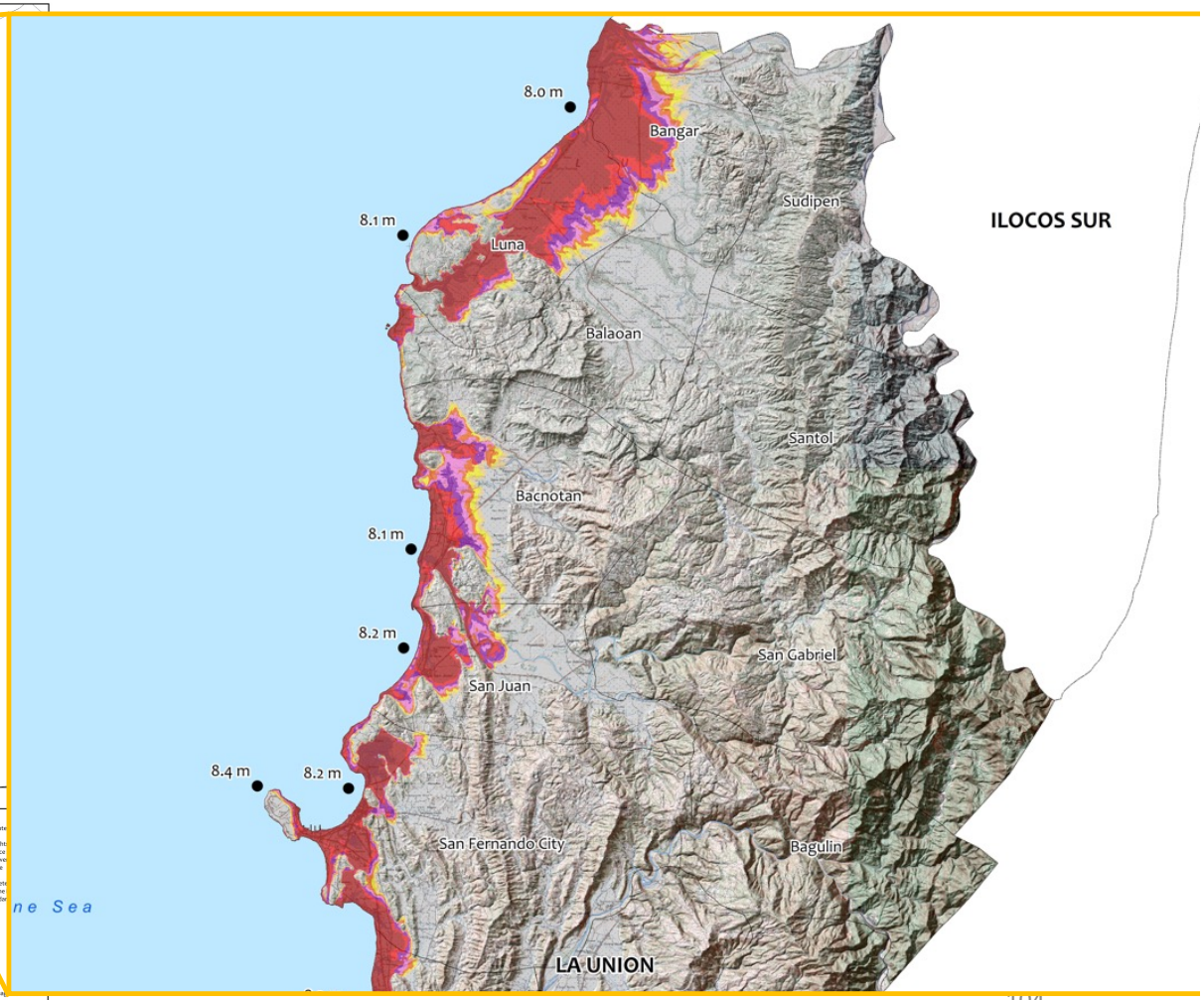
Harmonized methodologies, basemaps, modeling software and empirical equations using an improved methodology of the *Tsunami Hazard Mapping in the Philippines (TsuHMP)* Project
2019 – Present:

TsuHMP: Tsunami Propagation: Numerical Modeling-based (JAGURS) - source to coast modeling approach; GIS-based tsunami inundation using IfSAR as basemap

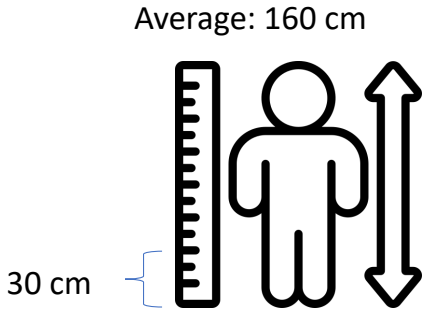
Tsunami Hazard Map

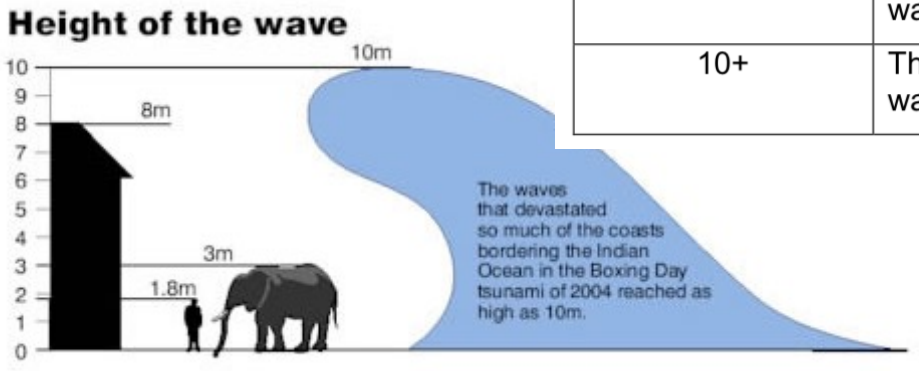
Province of La Union





Inundation depth





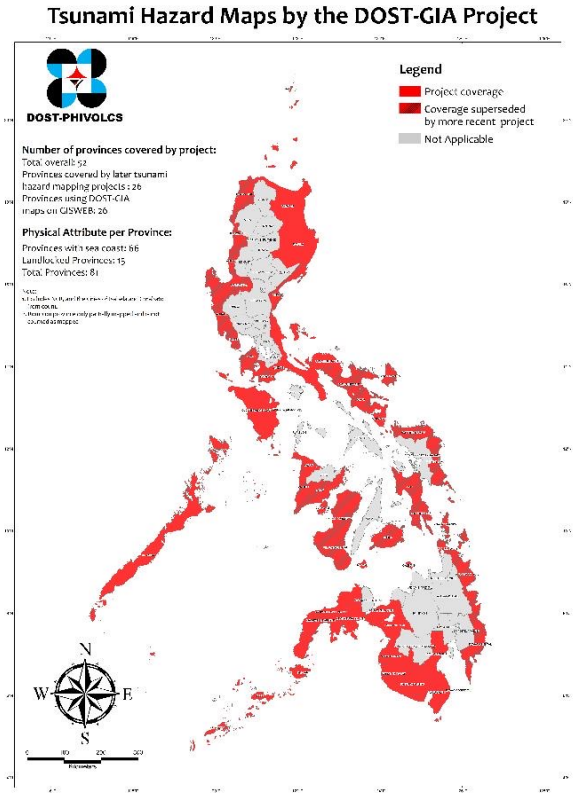
Inundation Height (meters)	Damage Description
1+	Most of the people caught by the tsunami may perish. People can lose their balance and vehicles begin to float in as little as 30 cm of water.
2+	More than half of structures may be completely damaged
3+	Evacuation will be difficult or not possible. More than half of structures may be completely damaged or washed away.
5+	Second floor and part of the third floor of buildings will be under water.
10+	Third floor and part of fourth floor of buildings will be under water. Many structures may be washed away.

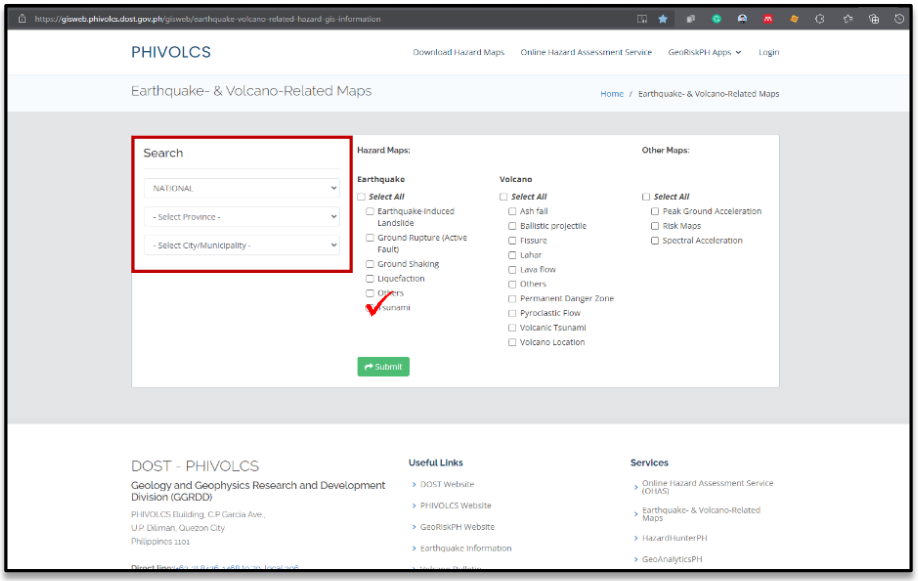
Inundation height in relation to damage it could cause

Status of Tsunami Hazard Maps in the Philippines

Out of the 83 provinces in the Philippines (including the National Capital Region),

- **26** have enhanced inundation maps [latest version published in 2016-present]
- **30** have simple inundation maps [latest version published in 2006-2014]
- **11** are yet to be published [ongoing production and approval]
- **16** do not have tsunami threat [far enough from the shore and/or highly elevated]




https://gisweb.phivolcs.dost.gov.ph/gisweb/earthquake-volcano-related-hazard-gis-information
PHIVOLCS
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NATIONAL
- Select Province -
- Select City/Municipality -
Hazard Maps:
Earthquake
Select All
Earthquake-Induced Landslide
Ground Rupture (Active Fault)
Ground Shaking
Liquefaction
Others
Tsunami
Volcano
Select All
Ash fall
Ballistic projectile
Fissure
Lahar
Lava flow
Others
Permanent Danger Zone
Pyroclastic Flow
Volcanic Tsunami
Volcano Location
Other Maps:
Select All
Peak Ground Acceleration
Risk Maps
Spectral Acceleration
Submit
DOST - PHIVOLCS
Geology and Geophysics Research and Development Division (GGRDD)
PHIVOLCS Building, C.P Garcia Ave.,
U.P. Diliman, Quezon City
Philippines 1101
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GeoRiskPH Website
Earthquake Information
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Online Hazard Assessment Service (OHAS)
Earthquake- & Volcano-Related Maps
HazardHunterPH
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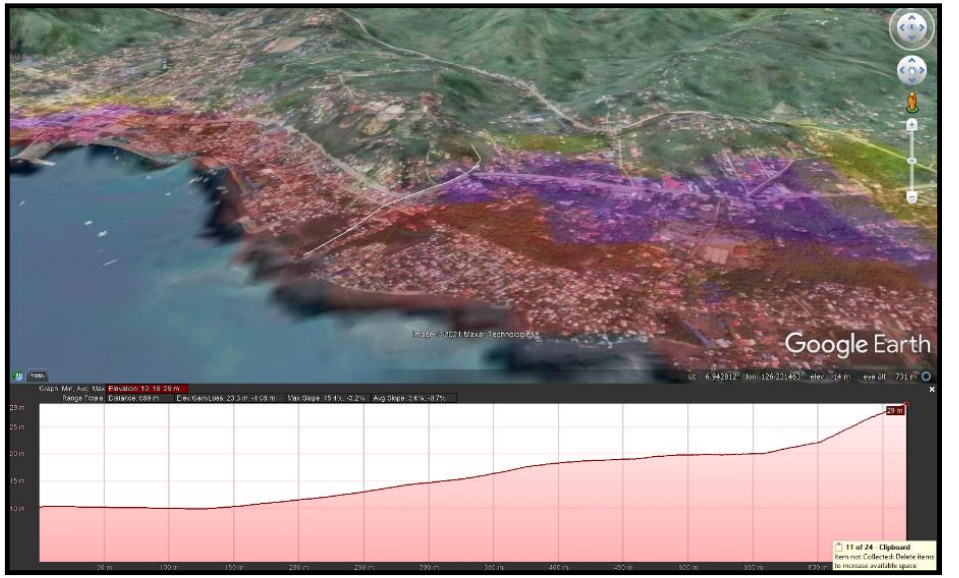
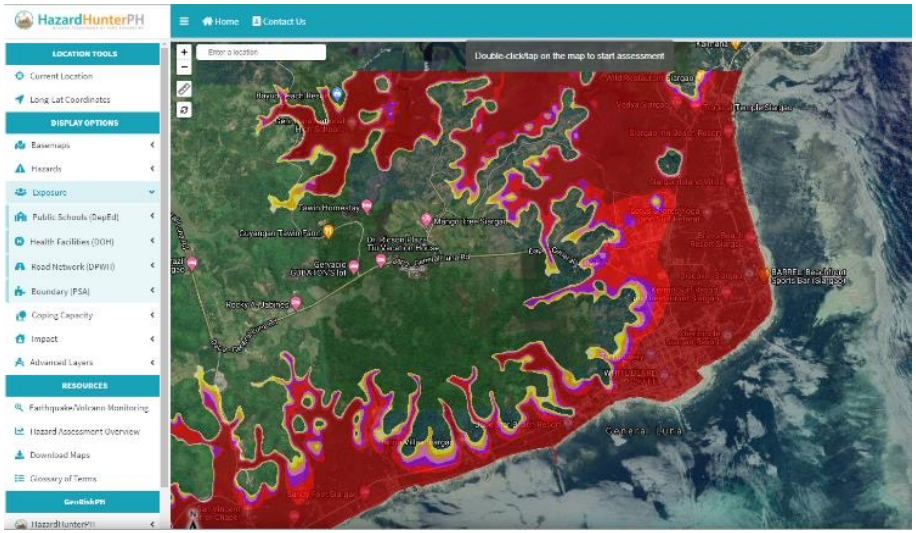

Google Earth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DISPLAY OPTIONS
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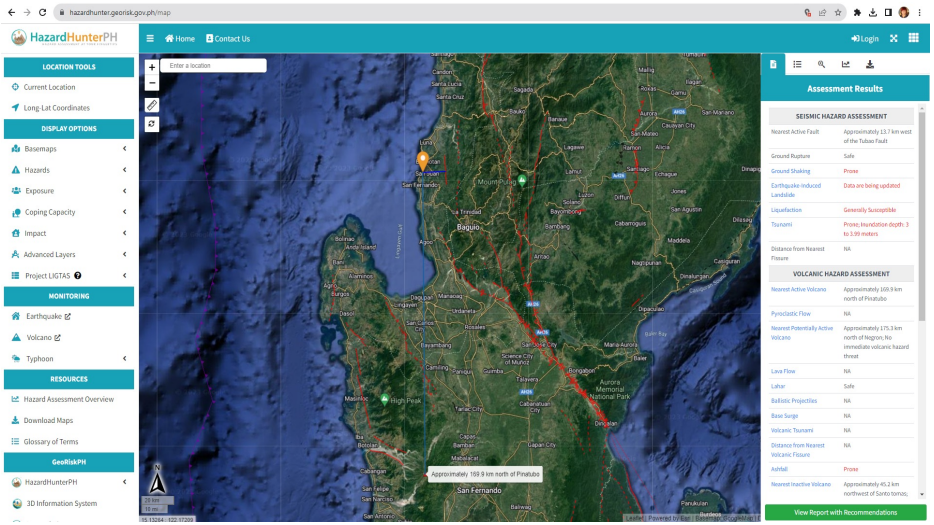
Health Facilities (DOH)
Road Network (DPWH)
Boundary (PSA)
Coping Capacity
Impact
Advanced Layers
RESOURCES
Earthquake/Volcano Monitoring
Hazard Assessment Overview
Download Maps
Glossary of Terms
GeoRiskPH
Enter a location
Double-click/tap on the map to start assessment


hazardhunter.georisk.gov.ph/map
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GeoRiskPH
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SEISMIC HAZARD ASSESSMENT
VOLCANIC HAZARD ASSESSMENT
View Report with Recommendations

How to use tsunami hazard maps

1. Evacuation Plans:

- Horizontal Evacuation Routes
  - Plotting routes going away from the hazard or perpendicular to the coastal area
  - Shortest distance to the safest place
  - Least traffic
  - Plotting important elements at risk
  - Plotting population incapable of evacuating on their own (PWD, pregnant, senior citizens, children)

- Vertical evacuation
  - Structural integrity of the evacuation area
  - Capacity
  - Supply storage

How to use tsunami hazard maps

2. Distribute

- Schools
- Churches
- Communities / Barangays
- Houses

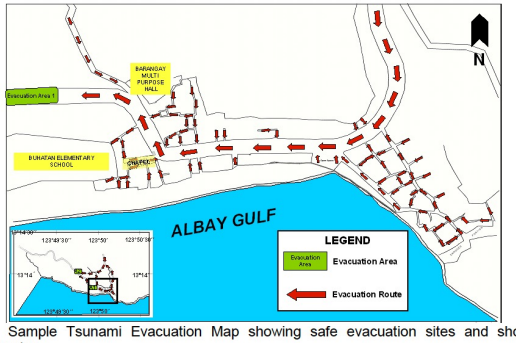
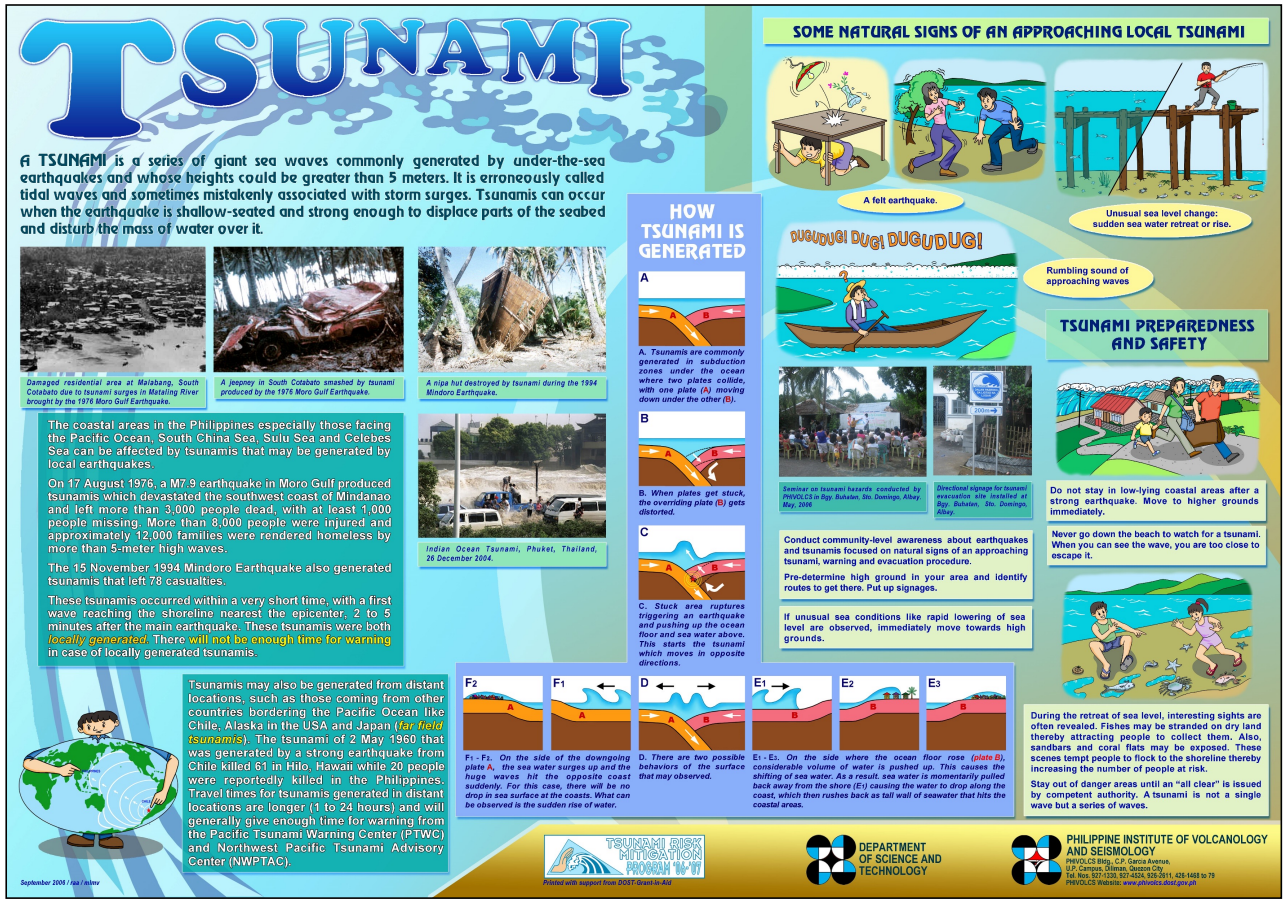


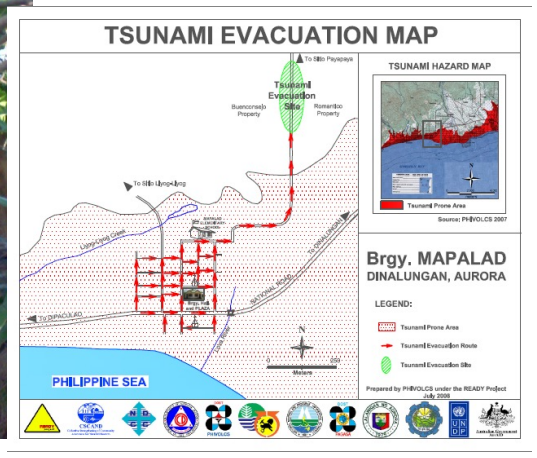
Figure 4.6. Sample Tsunami Evacuation Map showing safe evacuation sites and shortest evacuation routes.



Establish community-based early warning system for tsunami and conduct tsunami preparedness drills in communities

Evacuation plans and maps

- *Signage installation*
- *IEC seminars*
- *Community Drills*



Establishment of Community-based EWS for Tsunami

Various Tsunami Signage – READY Project

Hazard Prone Area Signage

Directional Signage

Evacuation Site Signage

2022

UNESCO/IOC Tsunami Ready Recognition Programme

The Tsunami Ready Recognition Programme is an international community-based recognition programme developed by Intergovermental Oceanographic Commission (IOC) of UNESCO. It aims to build resilient communities through awareness and preparedness strategies that will protect life, livelihoods and property from tsunamis in different regions.

http://itic.ioc-unesco.org/index.php?option=com_content&view=category&id=2234&Itemid=2758

Societal Outcome:
A Safe Ocean

- 2017: UN
  - 2021-2030 Ocean Decade- Decade of Ocean Science for Sustainable Development
- 2022: IOC Assembly
  - IOC Ocean Decade Tsunami Programme

Tsunami Ready Recognition Programme

TSUNAMI READY RECOGNITION PROGRAMME

GOAL: Improved coastal community preparedness for tsunami and to minimize the loss of life, livelihoods and property.

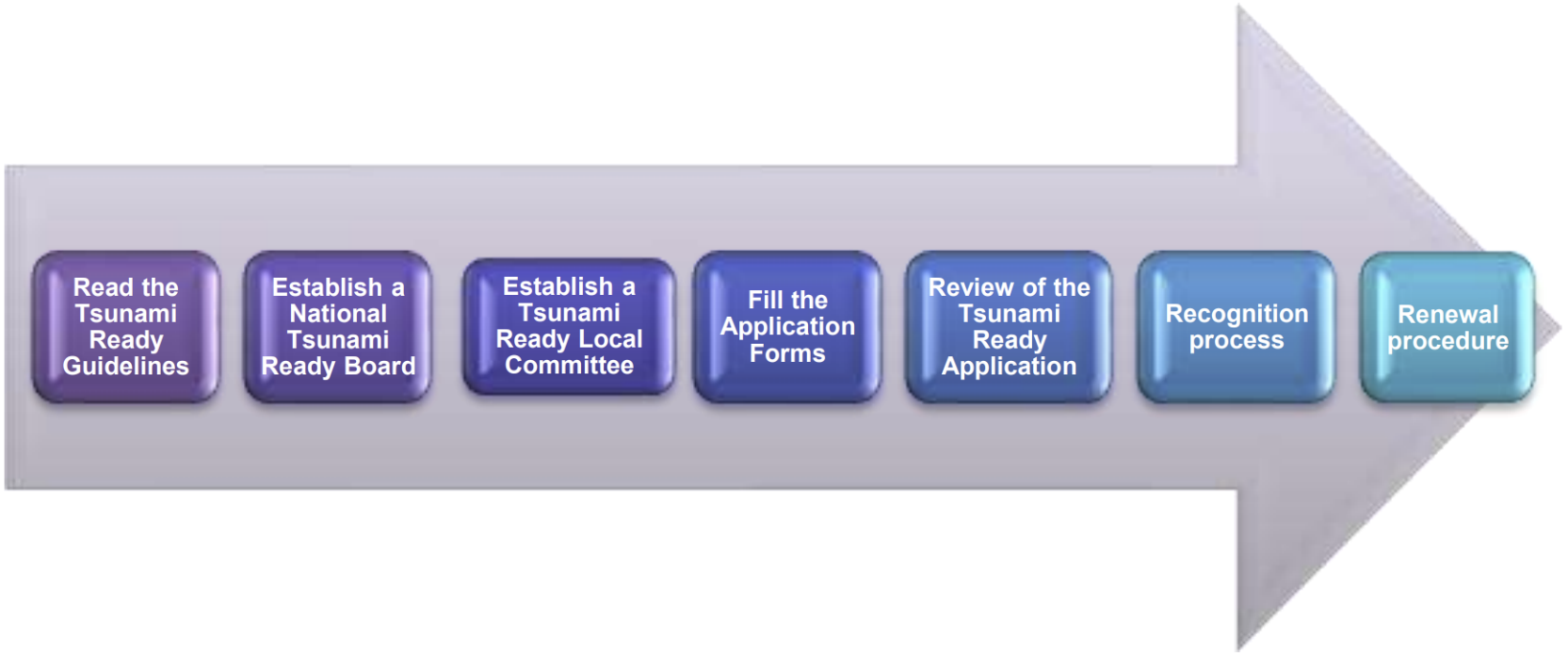
Achieved through a **collaborative effort** to meet a **standard level of tsunami preparedness** through the fulfillment of a **set of established indicators**

- Communities must meet all 12 indicators
- Communities will be recognized as “Tsunami Ready” by UNESCO/IOC
- The recognition is renewable every four years

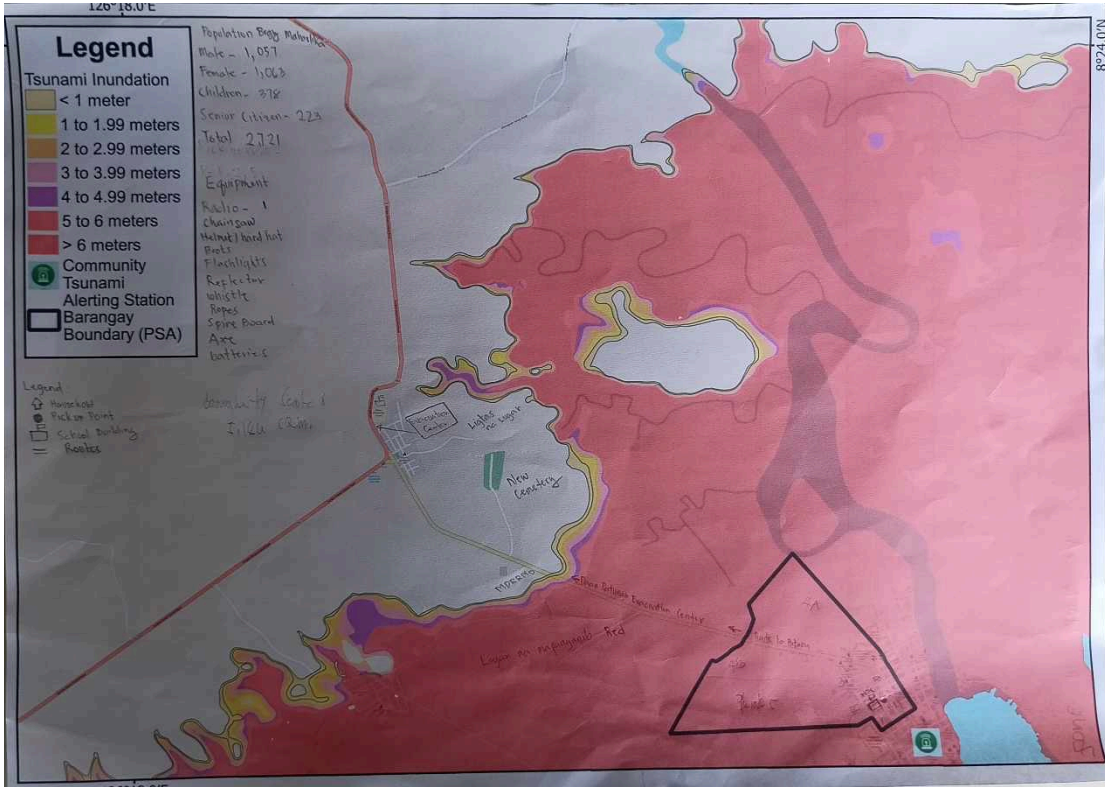
- TRRP is voluntary, performance-based community recognition programme that promotes an understanding of the concept of readiness as an active collaboration among:
  - national and local warning and emergency management agencies, and government authorities, scientists, community leaders and the public

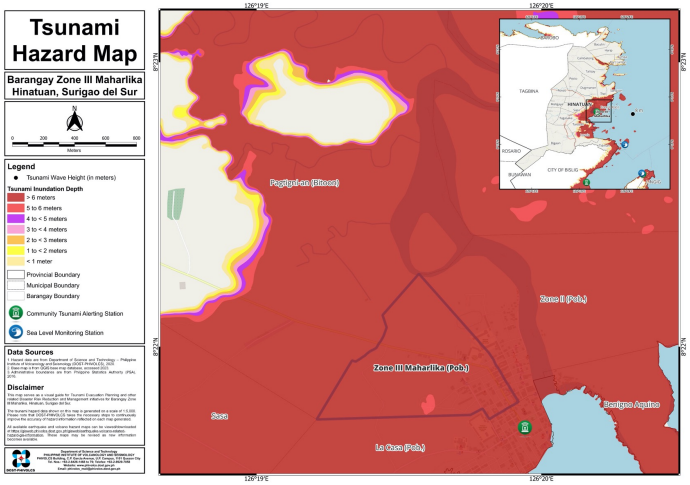
	TSUNAMI READY INDICATORS
I	**ASSESSMENT (ASSESS)**
1	**ASSESS-1**. Tsunami hazard zones are mapped and designated.
2	**ASSESS-2**. The number of people at risk in the tsunami hazard zone is estimated.
3	**ASSESS-3**. Economic, infrastructural, political, and social resources are identified.
II	**PREPAREDNESS (PREP)**
4	**PREP-1**. Easily understood tsunami evacuation maps are approved.
5	**PREP-2**. Tsunami information including signage is publicly displayed.
6	**PREP-3**. Outreach and public awareness and education resources are available and distributed.
7	**PREP-4**. Outreach or educational activities are held at least 3 times a year.
8	**PREP-5**: A community tsunami exercise is conducted at least every two years.
III	**RESPONSE (RESP)**
9	**RESP-1**. A community tsunami emergency response plan is approved.
10	**RESP-2**. The capacity to manage emergency response operations during a tsunami is in place.
11	**RESP-3**. Redundant and reliable means to timely receive 24-hour official tsunami alerts are in place.
12	**RESP-4**. Redundant and reliable means to timely disseminate 24-hour official tsunami alerts to the public are in place.

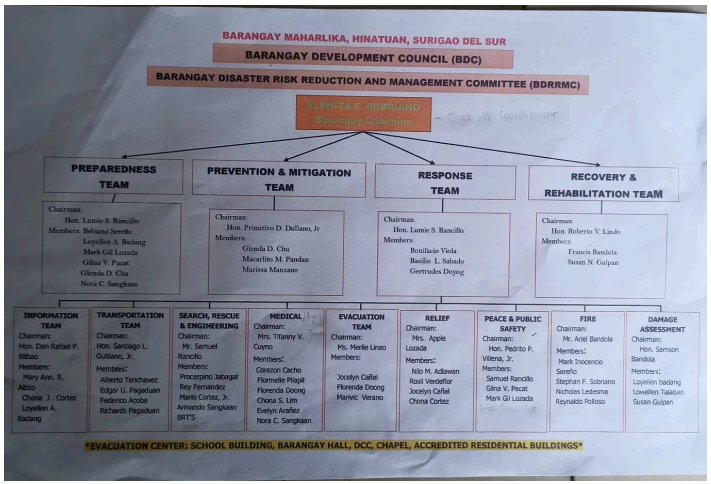
Steps to get the Tsunami Ready Recognition



Developing a Tsunami Prepared Community







Barangay Zone III Maharlika, Hinatuan, Surigao del Sur

The 1976 M8.1 Moro Gulf Earthquake & Tsunami

Tsunami Accounts:

Sequence of Events

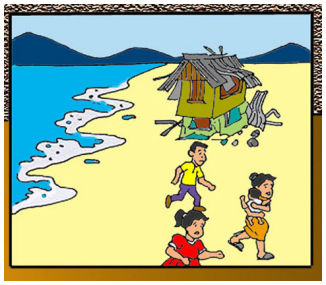
- *A violent shock that awaken people and made standing & walking difficult*
- *Unusually deep recession of the sea*
- *A strong prolonged approaching sound*
- *Arrival of waves!!!*

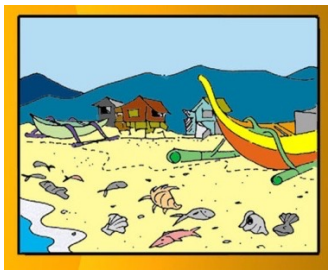
SHAKE

DROP

ROAR

Natural Signs of an impending local tsunami





Way Forward

- Modernization of DOST-PHIVOLCS
- Expansion and Maintenance of the Philippine Seismic and Tsunami Network
- Incorporation of GPS and Subsea Networks
- Implementation of Tsunami Ready Philippines
- Adoption of Guidelines for Vertical Evacuation
- Updating of Tsunami Scenario Database and Hazard Maps
- Finalization of Tsunami Evacuation Maps and Response Plans
- Development of Warning and Advisory Protocols for Non-Seismic Tsunami Events
- Capacity Building of Local Government Units (LGUs) with PHIVOLCS-Developed Tools and Platforms
- International Collaboration for Research and Development

- ***Special acknowledgements to our Tsunami Project Leaders over the years especially Mr. Narag, Engr. Lanuza, Dr. Bautista, Dr. Villegas, Ms. Salcedo, Ms. Mangahas and the rest of DOST-PHIVOLCS team***

Science, Technology and Innovation for a Resilient Philippines

Maraming salamat po, mabuhay!

Earthquake & Tsunami (24/7):

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- +63-2-8426-1468 loc 307 / 308
- +63-2-8927-1087 (FAX)
- +63-947-404-7797 (VIBER)

Volcano (24/7):

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Philippine Institute of Volcanology and Seismology