



07 – 18 August 2023: 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.

TSUNAMI WARNING SYSTEM AND MITIGATION PLANS IN MALAYSIA

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Malaysian Meteorological Department (MET Malaysia)
Ministry of Natural Resources, Environment and Climate Change (NRECC)

10 AUGUST 2023 | INOUE REGIONAL CENTER (IRC) - NOAA

SCOPE OF PRESENTATION



Photo courtesy of Hezron G. Koro (MET Malaysia)



Photo courtesy of AFP/BERNAMA

01

Earthquake & Tsunami Threats

Seismic and tsunami hazards and risks study in Malaysia

02

Tsunami Early Warning System

MNTEWS and the architecture of the early warning system

03

Disaster Management (DM)

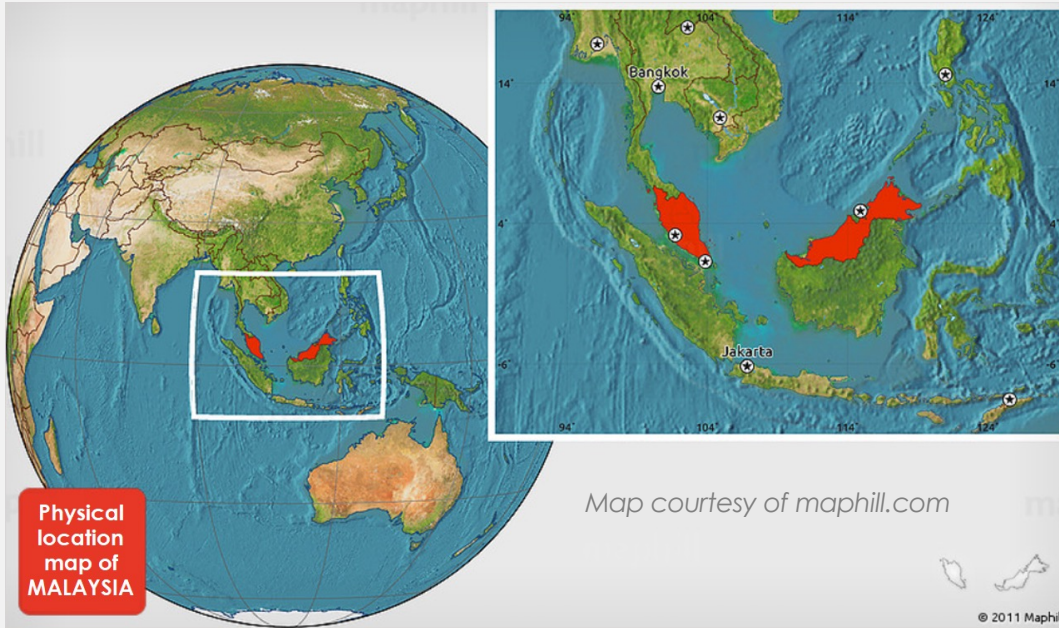
Tsunami warning chain and the mechanism of DM in Malaysia

04

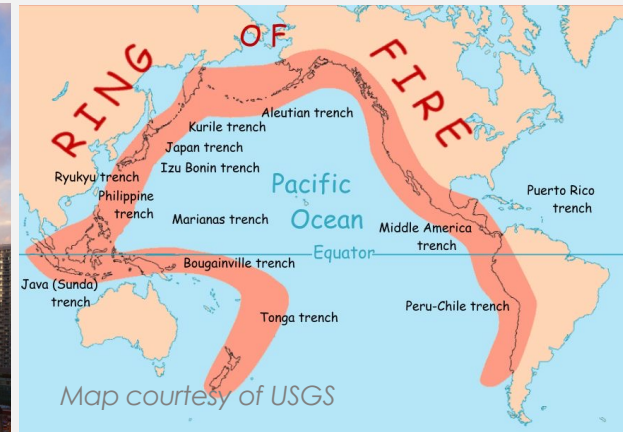
Mitigation Plans

Status, challenges and way forward

Overview



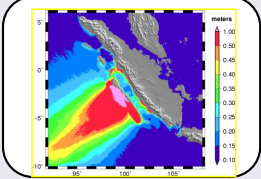
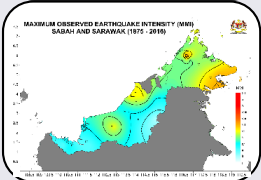
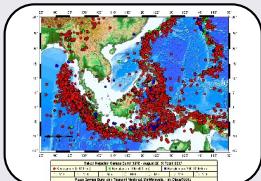
- ❑ Located in the Southeast Asia region
- ❑ Divided in **two geographic parts**; West Malaysia (Malay Peninsular) and East Malaysia (northwestern part of Borneo Island)



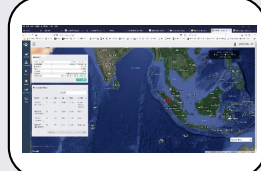
- ❑ Lies outside of the Ring of Fire and of historical tropical cyclone paths
- ❑ Frequent grapples with **floods, storms, landslides, heatwaves, haze, drought and earthquake.**

Main Components Tsunami Early Warning System in Malaysia

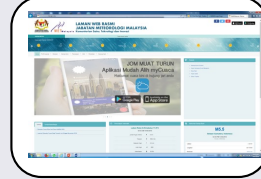
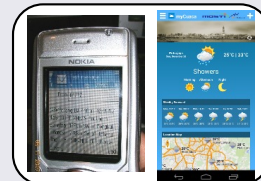
RISK & HAZARD KNOWLEDGE



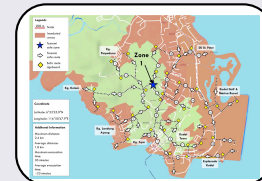
MONITORING & ANALYSES



EFFECTIVE DISSEMINATION

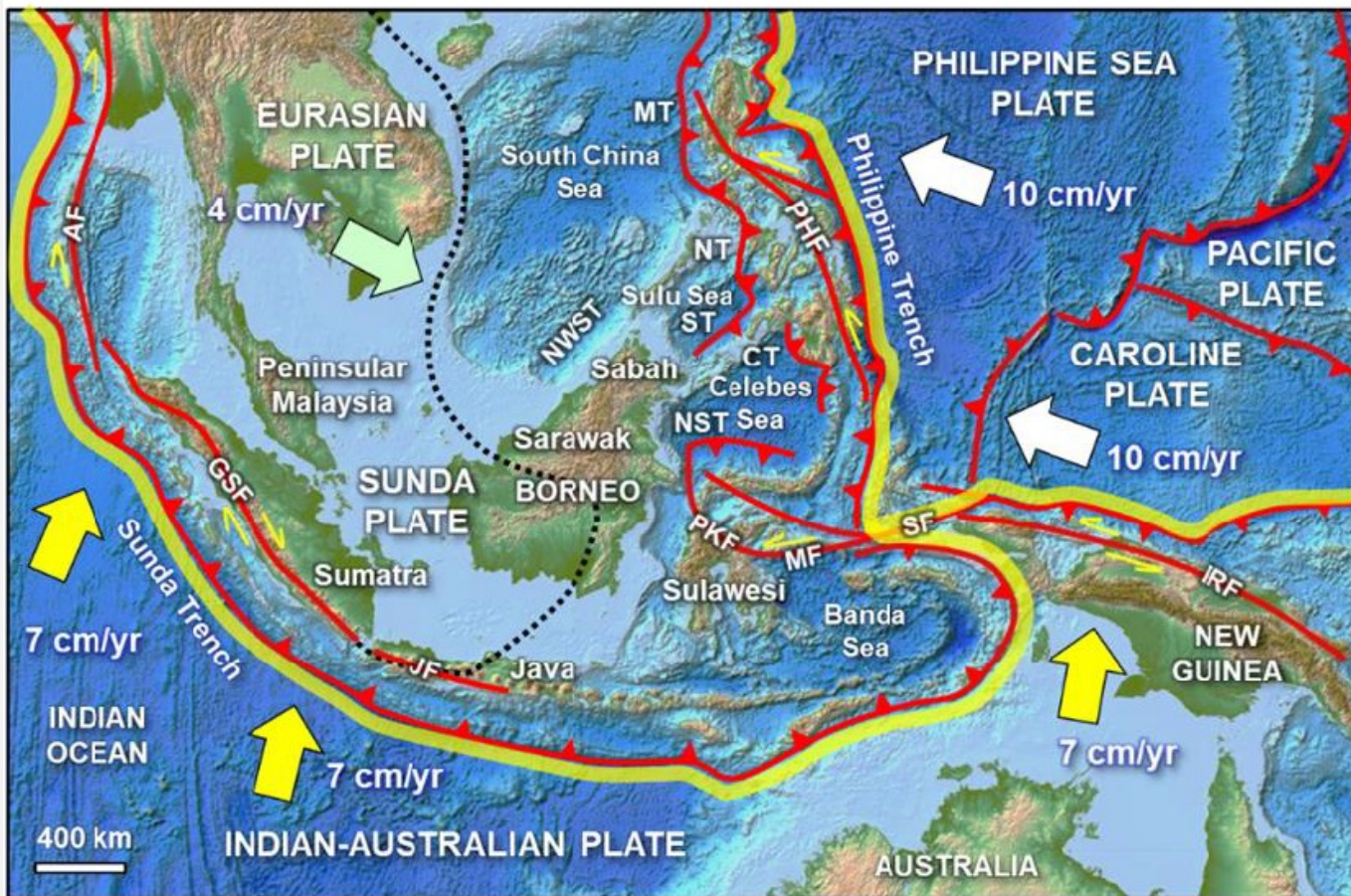


RESPONSE CAPACITY



**SEISMIC AND TSUNAMI
HAZARDS AND RISKS IN MALAYSIA**

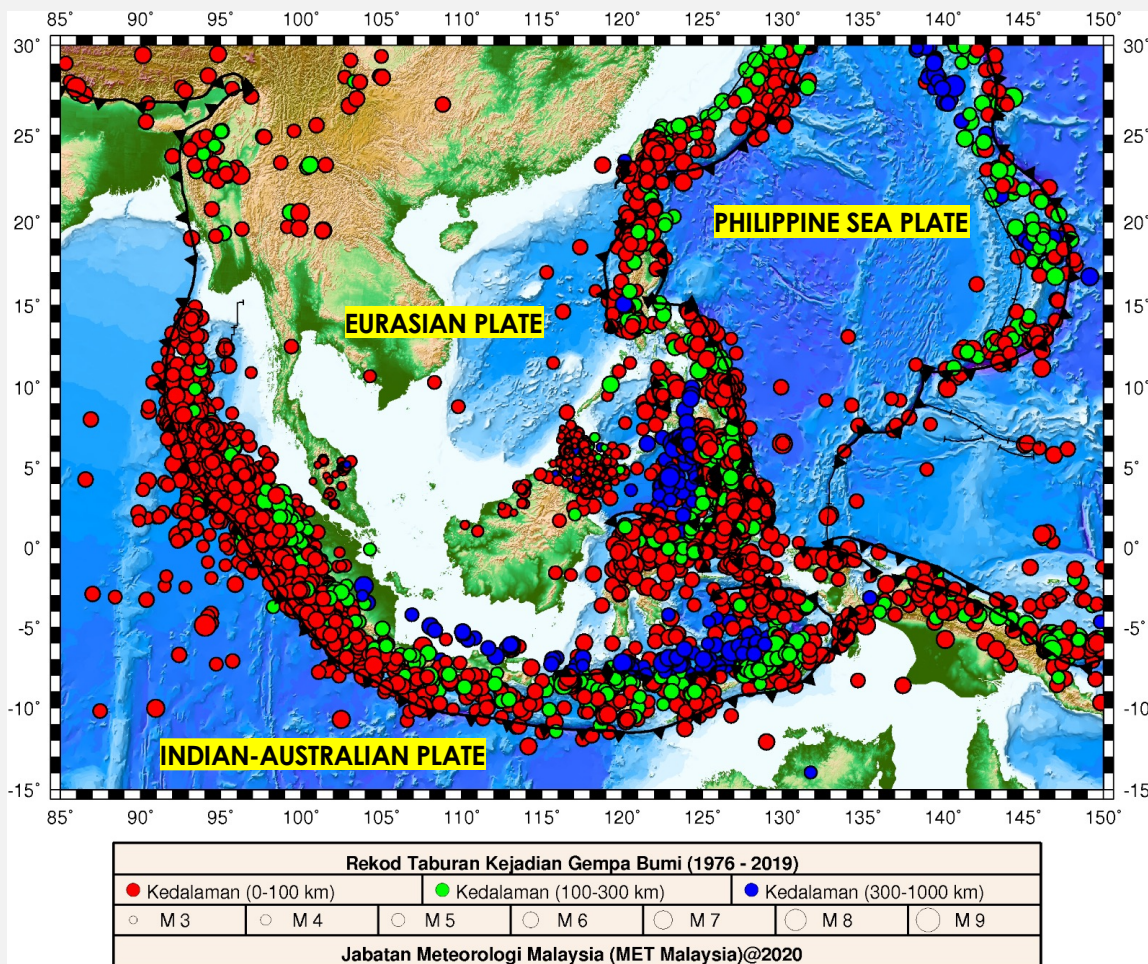
Seismotectonic setting around Malaysia



Map courtesy of Natural Disaster Research Centre, University Malaysia Sabah, Malaysia (NDRC – UMS)

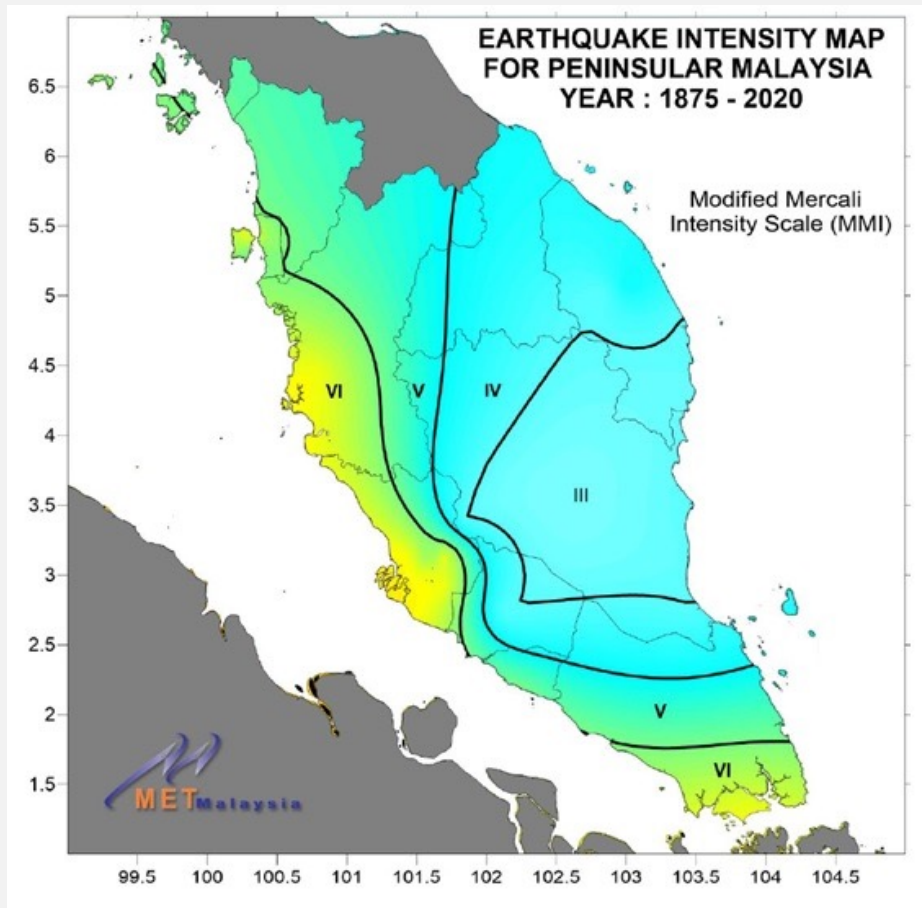
- ❑ Earthquake in Malaysia are closely associated with the **plate movement** in this region
- ❑ **Peninsular Malaysia** sitting on the Sunda Shelf lies passively behind Great Sumatran Fault Zone and Sunda Trench Subduction Zone.
- ❑ **Sabah and Sarawak** sitting on the semi-stable South China Sea Basin, influenced by active mobile belts in Celebes and Philippines.

Earthquakes distribution in Malaysia



- Malaysia affected by both **local** and **regional** earthquakes.
- Major earthquakes originating from Sumatra - Indonesia have been felt several times in **Peninsular Malaysia**. The effect is small, but it is still of concern, especially to vulnerable high rise buildings.
- Earthquakes from the Sulu and Celebes seas are periodically felt as slight tremors in **Sabah**.
- Rare earthquake occurring in Kalimantan - Indonesia is felt as slight tremors in **Sarawak**.

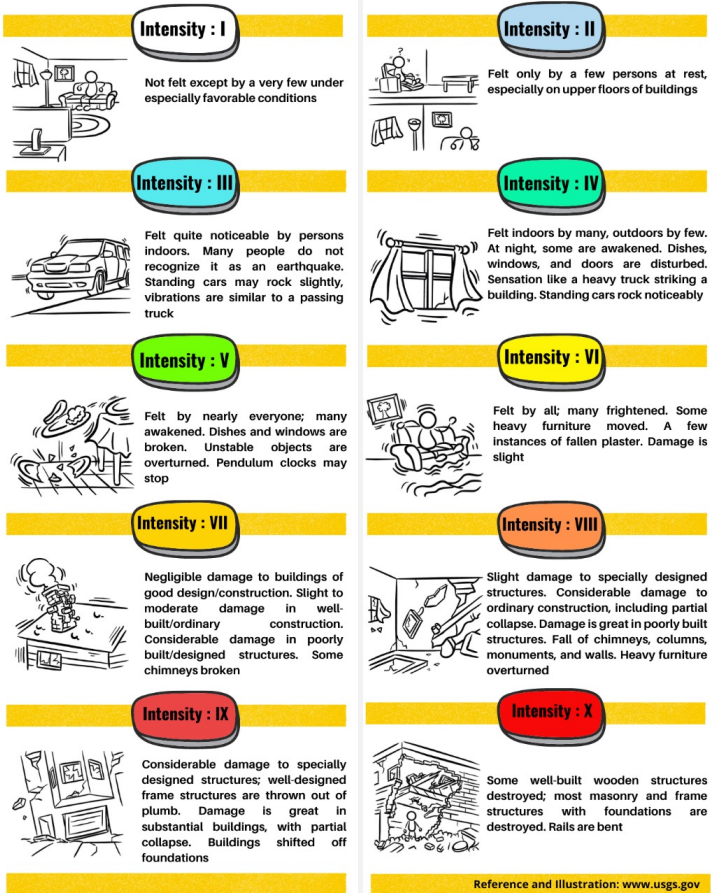
Earthquake Intensity Map



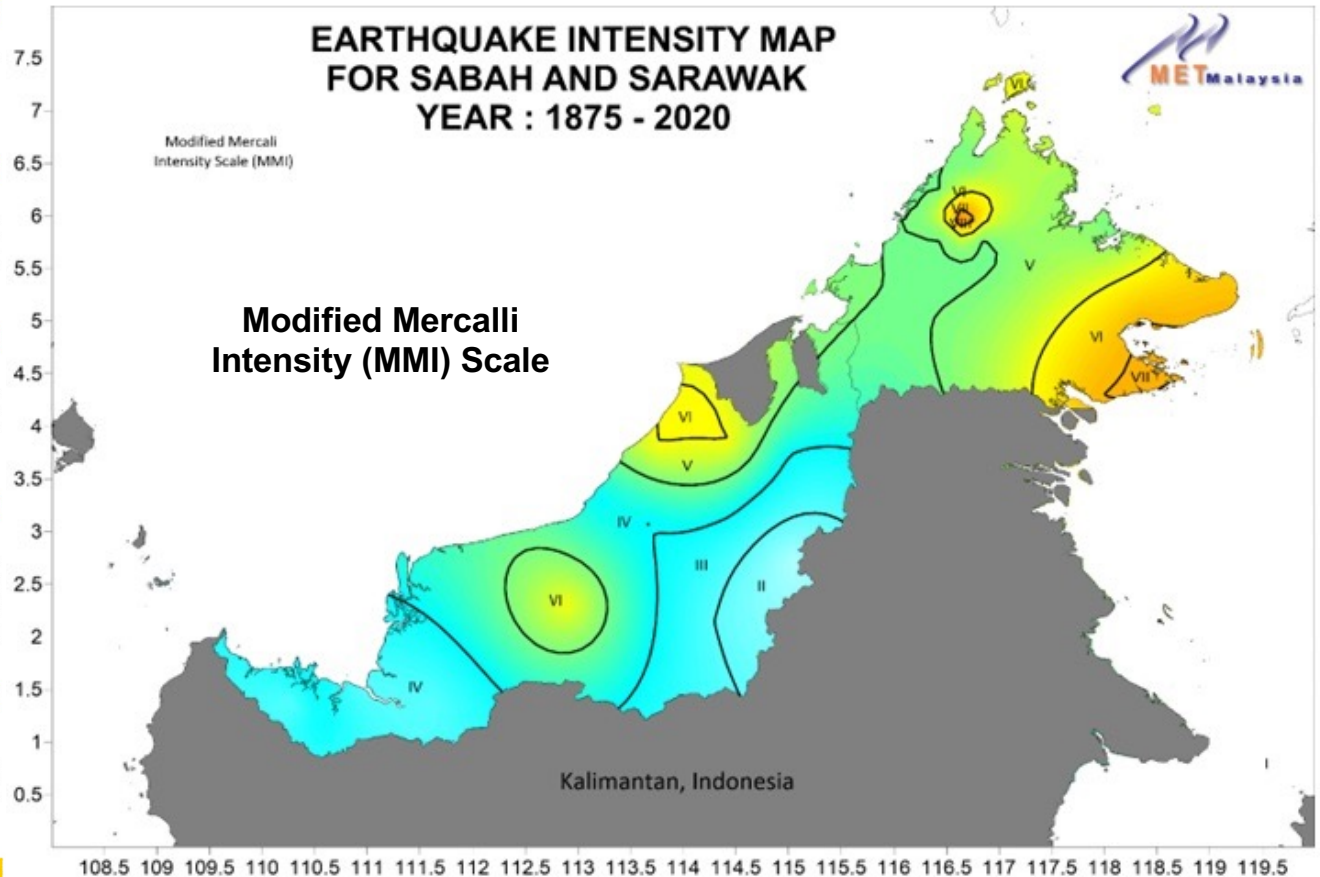
<p>Intensity : I</p> <p>Not felt except by a very few under especially favorable conditions</p>	<p>Intensity : II</p> <p>Felt only by a few persons at rest, especially on upper floors of buildings</p>
<p>Intensity : III</p> <p>Felt quite noticeable by persons indoors. Many people do not recognize it as an earthquake. Standing cars may rock slightly, vibrations are similar to a passing truck</p>	<p>Intensity : IV</p> <p>Felt indoors by many, outdoors by few. At night, some are awakened. Dishes, windows, and doors are disturbed. Sensation like a heavy truck striking a building. Standing cars rock noticeably</p>
<p>Intensity : V</p> <p>Felt by nearly everyone; many awakened. Dishes and windows are broken. Unstable objects are overturned. Pendulum clocks may stop</p>	<p>Intensity : VI</p> <p>Felt by all; many frightened. Some heavy furniture moved. A few instances of fallen plaster. Damage is slight</p>
<p>Intensity : VII</p> <p>Negligible damage to buildings of good design/construction. Slight to moderate damage in well-built/ordinary construction. Considerable damage in poorly built/designed structures. Some chimneys broken</p>	<p>Intensity : VIII</p> <p>Slight damage to specially designed structures. Considerable damage to ordinary construction, including partial collapse. Damage is great in poorly built structures. Fall of chimneys, columns, monuments, and walls. Heavy furniture overturned</p>
<p>Intensity : IX</p> <p>Considerable damage to specially designed structures; well-designed frame structures are thrown out of plumb. Damage is great in substantial buildings, with partial collapse. Buildings shifted off foundations</p>	<p>Intensity : X</p> <p>Some well-built wooden structures destroyed; most masonry and frame structures with foundations are destroyed. Rails are bent</p>

Reference and Illustration: www.usgs.gov

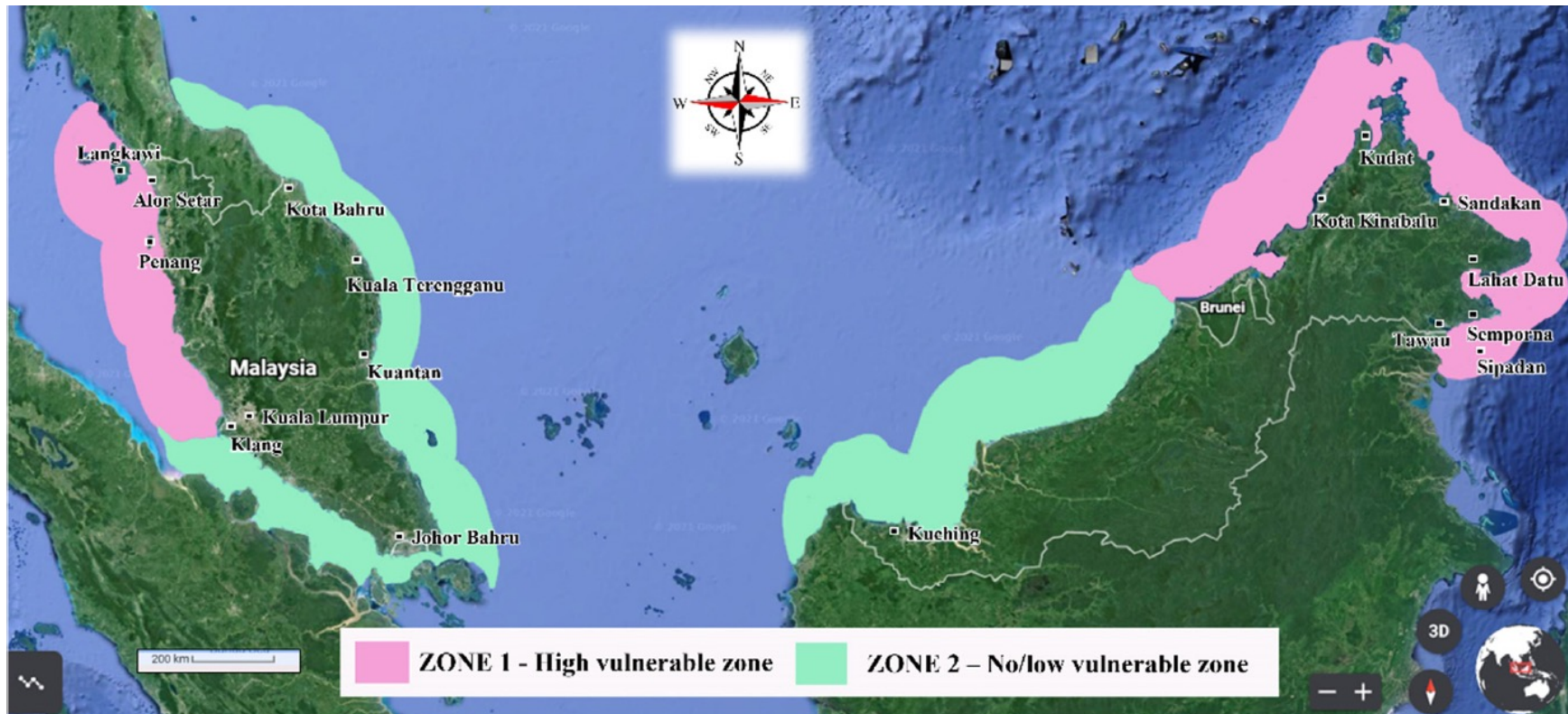
Earthquake Intensity Map



Reference and illustration: www.usgs.gov



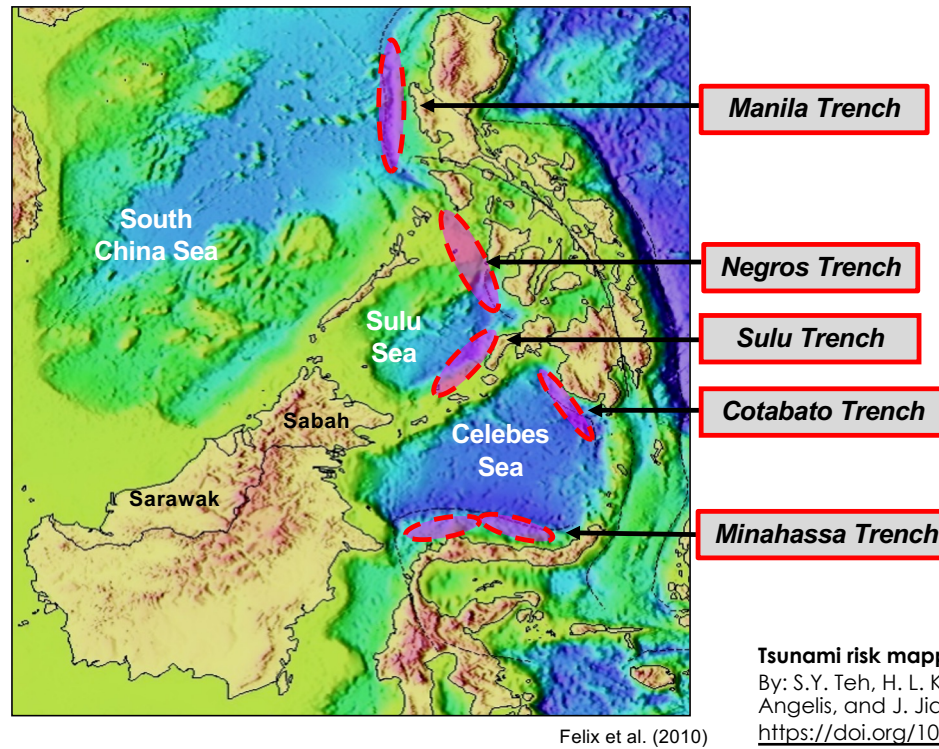
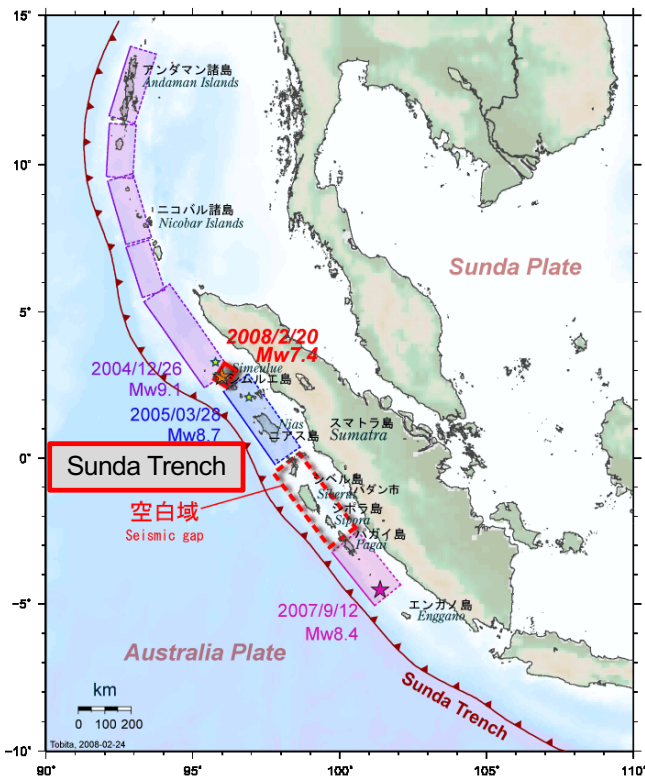
Tsunami risk zones in Malaysia



MOSTI. Seismic and Tsunami Hazards and Risks Study in Malaysia; Academy of Sciences Malaysia (ASM): Kuala Lumpur, Malaysia, 2009; pp. 1–46.

Potential tsunamigenic zones

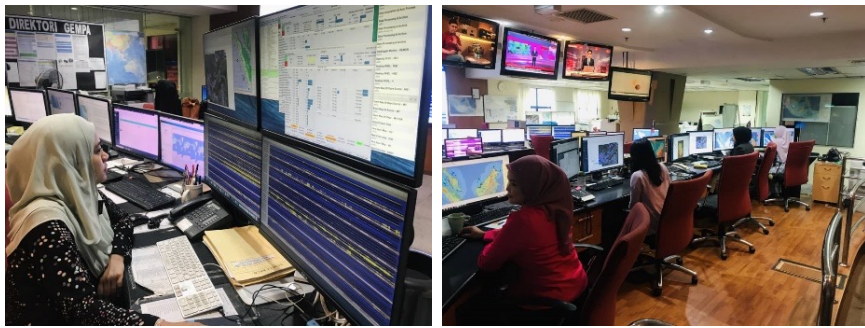
Of particular concern to Malaysia are **tsunamigenic earthquakes** occurring along the northern part of the Sunda Trench. Further, the Manila Trench in the South China Sea has been identified as another source of potential tsunamigenic earthquakes that might trigger large tsunamis.



Tsunami risk mapping simulation for Malaysia
 By: S.Y. Teh, H. L. Koh, Y.T. Moh, D. L. De Angelis, and J. Jiang
<https://doi.org/10.2495/DMAN110011>

DEVELOPMENT OF TSUNAMI EARLY WARNING SYSTEM IN MALAYSIA

Tsunami Early Warning System in Malaysia



- Early warning system for tsunami was not in place prior to 2004
- Only after Indian Ocean Tsunami of 26 Dec 2004, MNTTEWS was established in **2005**
- Main objective is to warn early detection, assessment and rapid alerting to various stakeholders and public so that effective respond can be made to save lives

Malaysian National Tsunami Early Warning System (MNTEWS)



Lessons learnt from 26 Dec 2004 Earthquake and Tsunami

- ❑ MNTEWS was established in 2005.
- ❑ To detect, locate, and determine the magnitude of earthquakes occurring inside and outside Malaysia
- ❑ Real-time continuous monitoring of earthquake occurrences and tsunami on a 24/7 basis.
- ❑ Issuance of information, advisory, early warning and warning on the occurrence of earthquake and tsunami that threaten the security and safety of Malaysia.

Architecture of MNTEWS

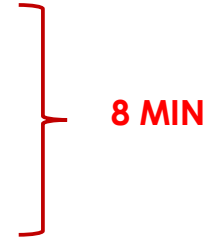
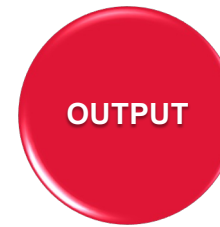
DATA ACQUISITION



DATA PROCESSING



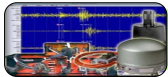
DISSEMINATION AND RESPONSE CAPACITY



8 MIN

MNTEWS

REAL TIME MONITORING



- SEISMIC NETWORK



- TIDE GAUGE NETWORK



- COASTAL CAMERA SYSTEM

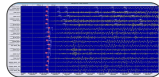


- PTWC/NWPTAC/JMA/SCSTAC



- GSN/IRIS

SOFTWARE & APPLICATION



- SEISMIC SOFTWARE



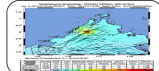
- ADMIS SYSTEM



- TIDE TOOL SYSTEM



- IDMS SYSTEM



- SHAKEMAP

RESPONSE CAPACITY



- SMS, EMAIL & FAX



- MYGEMPA/WEBSITE



- TSUNAMI SIREN

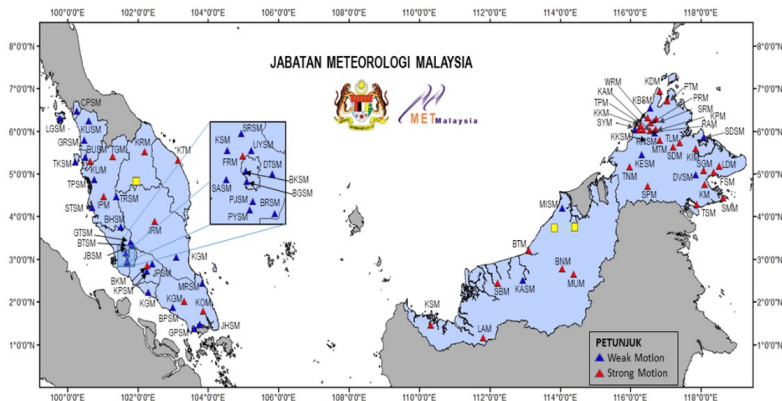


- RESPONSE CAPACITY

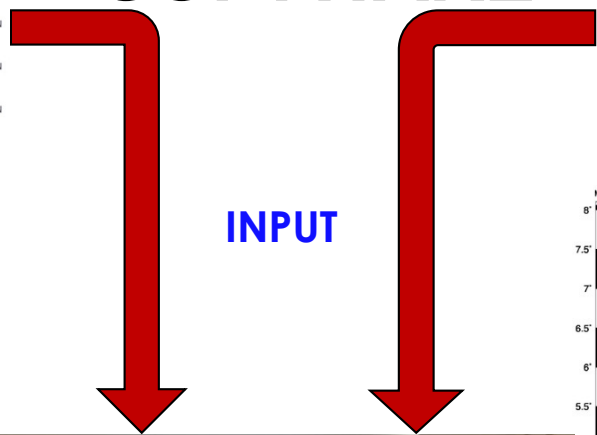


- TV & RADIO

SEISMIC PROCESSING SOFTWARE



Local seismic station



INPUT



International seismic stations

JABATAN METEOROLOGI MALAYSIA
KEMENTERIAN SUMBER ASLI, ALAM SEKITAR DAN PERUBAHAN IKLIM

Jalan Sultan, 46667 Petaling Jaya, Selangor Darul Ehsan, Malaysia

Tel : +603-79678000
Faks : +603-79578052
Emel : seismo@met.gov.my
Web Site : www.met.gov.my

JMM/POCG(O)/BK-27B

Ruj. kami: JMM.APL15/442/19 Jld (68)/(91)

Dikeluarkan pada pukul 9:12 pagi, 31 Mei 2023

MAKLUMAT GEMPA BUMI

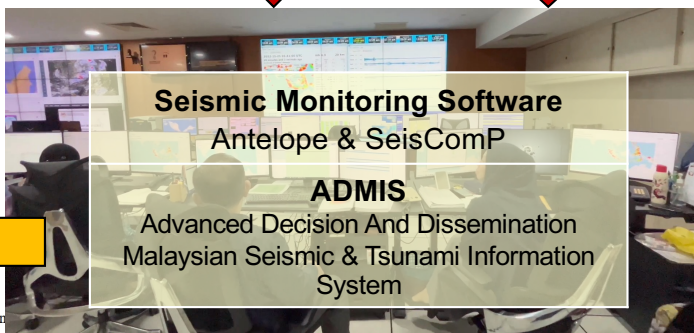
Satu gempa bumi sederhana telah berlaku dengan maklumat parameter berikut:

Waktu Kejadian : 8:58 pagi, 31 Mei 2023
Koordinat : 0.9° Selatan 98.7° Timur
Lokasi : Selatan Sumatera, Indonesia
Magnitud : 5.0
Jarak : 55km Barat Laut dari Siberut, Indonesia
Kedalaman : 52 km

Penilaian
Tiada ancaman tsunami kepada Malaysia

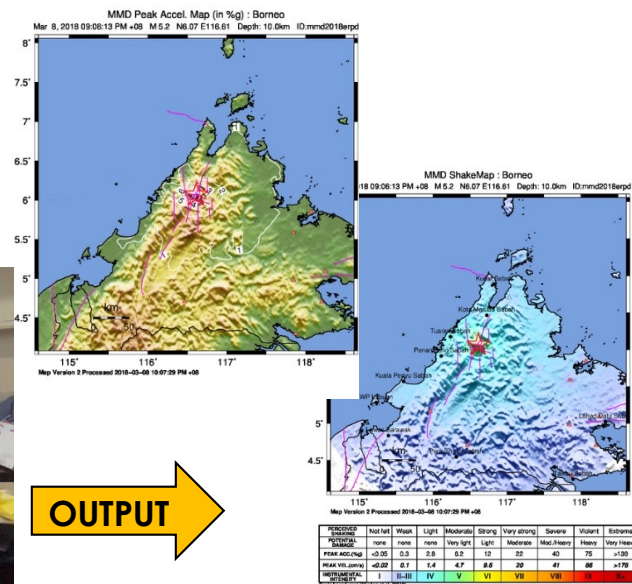
Ini adalah maklumat akhir yang dikeluarkan oleh jabatan berkaitan kejadian gempa bumi tersebut melainkan jika terdapat perkembangan lanjut atau maklumat tambahan.

Earthquake Bulletin



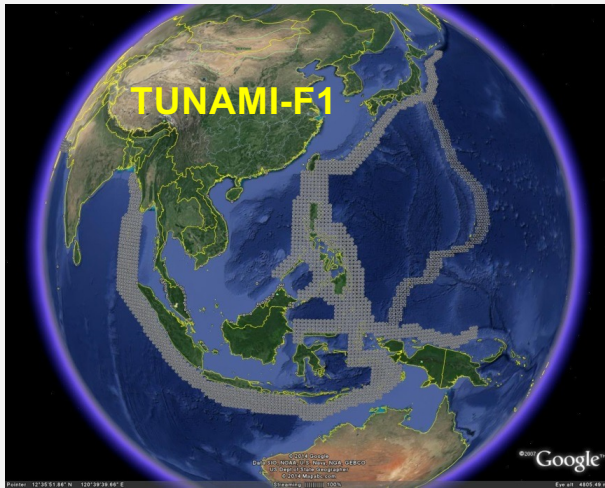
OUTPUT

OUTPUT



ShakeMap (Intensity, PGA)

TSUNAMI MODELLING AND DATABASE



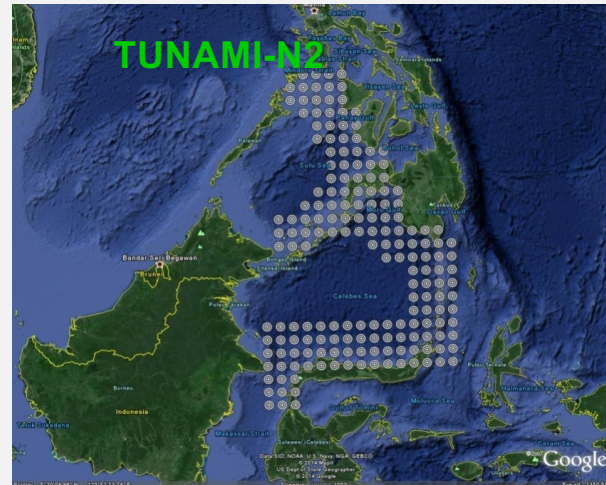
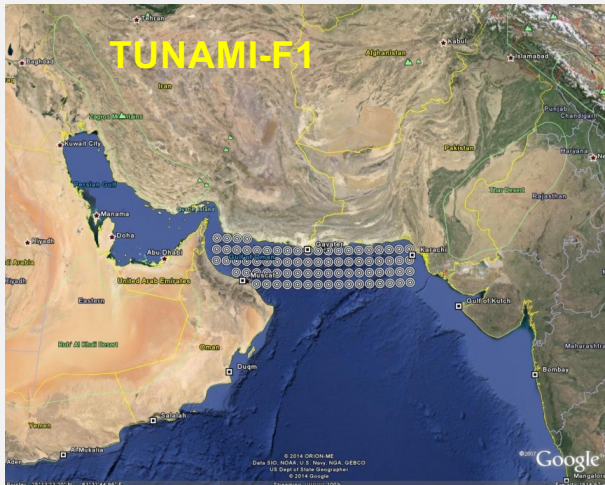
TUNAMI MODEL, TOHOKU UNIVERSITY, JAPAN

TUNAMI-N2 Simulation

- 181 Simulation Points x 20 scenarios
- Total scenarios = 3,620

TUNAMI-F1 Simulation

- 2,233 Simulation Points x 20 scenarios
- Total scenarios = 44,660



Σ : **48,280** scenarios

(M _w)	Depth (km)
6.5	0
7.0	20
7.5	40
8.0	60
8.5	60

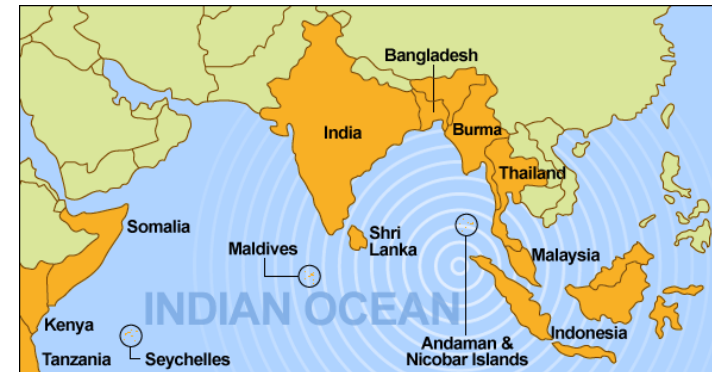
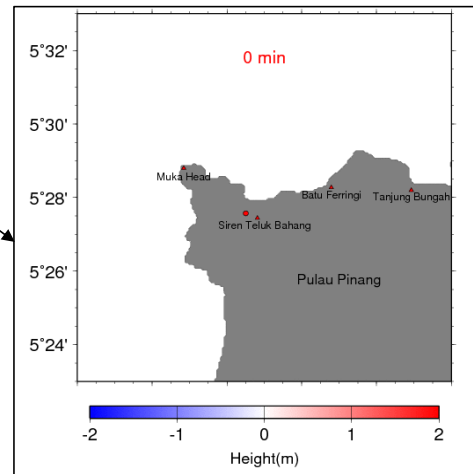
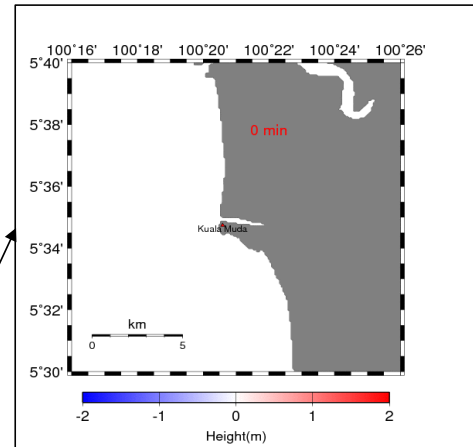
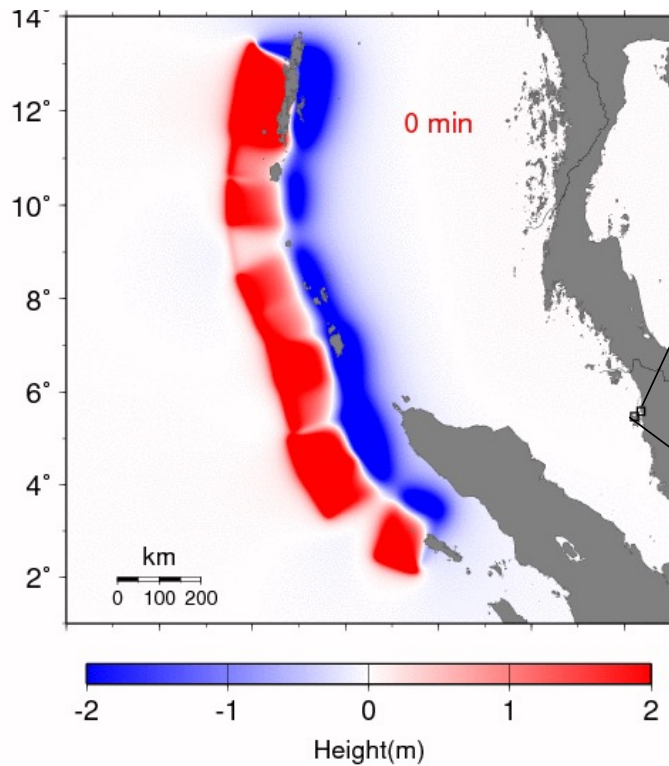
Forecasting: Pre-computed tsunami database using TUNAMI codes & Tsunami Travel Time (TTT).

Tsunami modeling

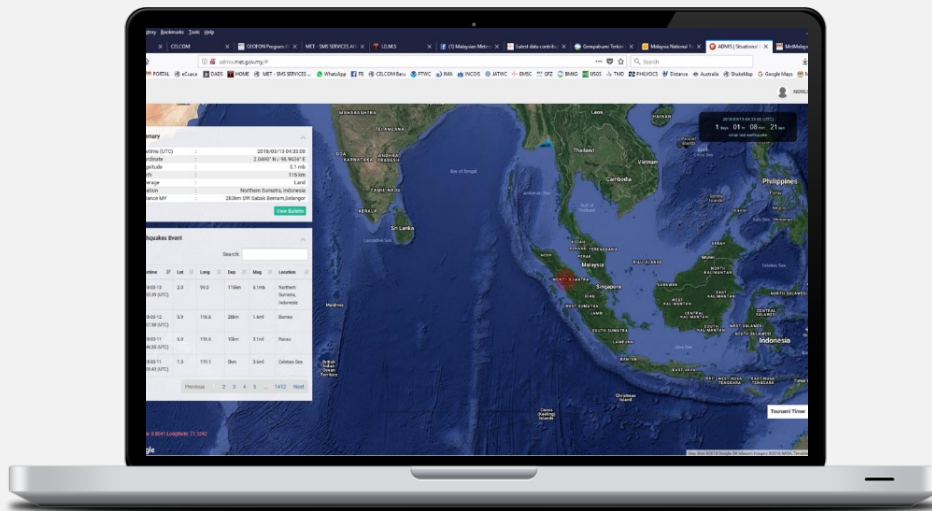
example of Indian Ocean Tsunami (M9.3, 26 Dec 2004)

- ❑ Kedah, P. Pinang, Perak & Selangor
- ❑ 68 dead, 5 missing
- ❑ Loss and damage amounting > RM100M

Source: Laporan Penyelidikan Pasca Tsunami 26 Dis 2004 (JPS)



ADMIS | Decision support system



**Advanced Decision and Dissemination
Malaysian Seismic and Tsunami Information
System (ADMIS)**



Integration of decision support system and dissemination of information and warning according to the SOP



Automatic solution, to reduce mistake in generating earthquake bulletin and tsunami warning

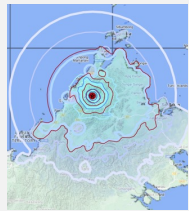


Dissemination of earthquake bulletin / information and tsunami warning via multi-channel platform example SMS, fax, website, e-mail and social media



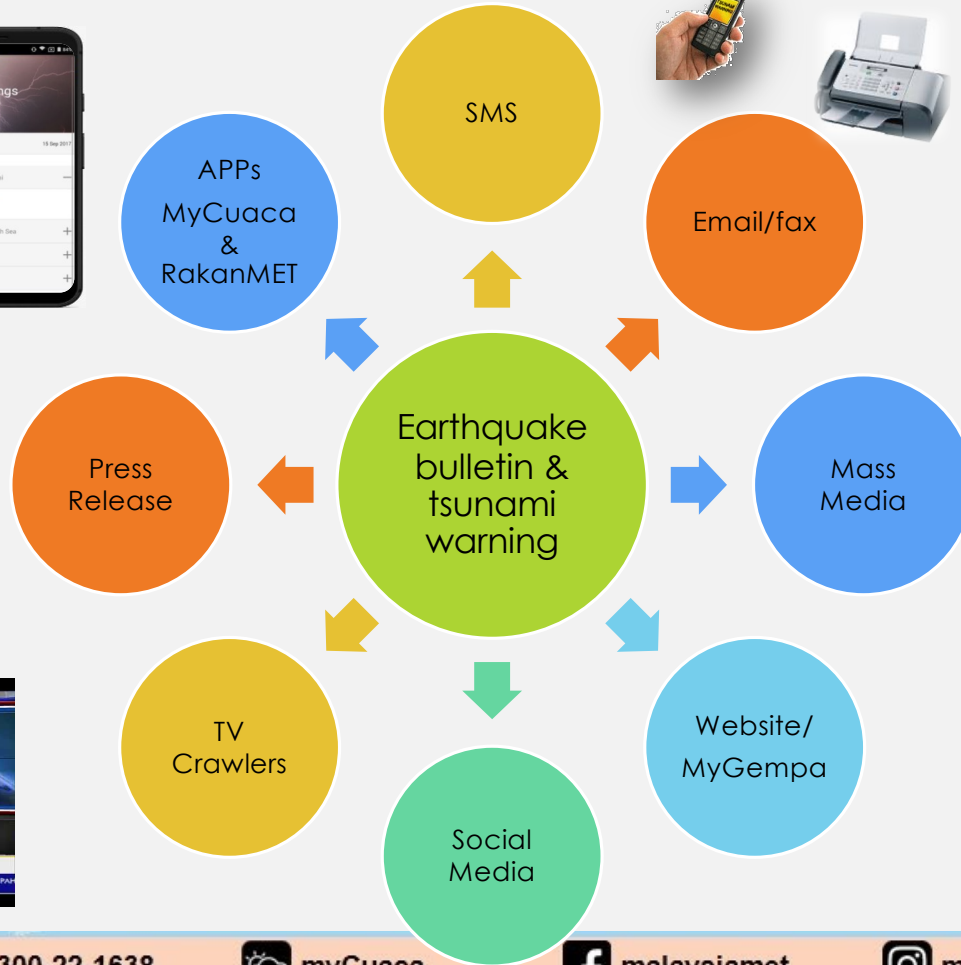
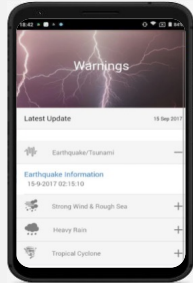
Able to generate tsunami travel time and tsunami height in real time

DISSEMINATION COMPONENT

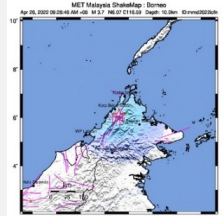


Jabatan Meteorologi Malaysia
@metmalaysia

Gempa bumi sederhana telah berlaku di Semenanjung Minahassa, Sulawesi pada jam 9:25 pagi, 29 Mei 2021
Koordinat : 1.3° Utara dan 120.2° Timur
Magnitud : 5.5 skala Richter
Jarak : 245km Utara dari Palu, Indonesia
Kedalaman : 12 km
Tiada ancaman tsunami kepada Malaysia. MET Malaysia.



Kategori	Petunjuk	Tindakan
AMARAN TSUNAMI	Ketinggian tsunami dijangka 0.5 meter atau lebih di pantai Malaysia.	Berpindah ke tempat selamat seperti ke tempat yang lebih tinggi atau tempat berpindahan sementara yang telah ditetapkan.
NASHAT TSUNAMI	Ketinggian tsunami dijangka kurang daripada 0.5 meter di pantai Malaysia.	Menjauhi kawasan pantai dengan segera.
PEMBATALAN/PENAMATAN TSUNAMI	Tidak terdapat ancaman tsunami atau ancaman tsunami telah berakhir.	Patuhi arahan pihak berkuasa: - Putuh ke rumah jika selamat - Berpindah ke tempat berpindahan sementara jika terdapat kerosakan.



Response Capacity



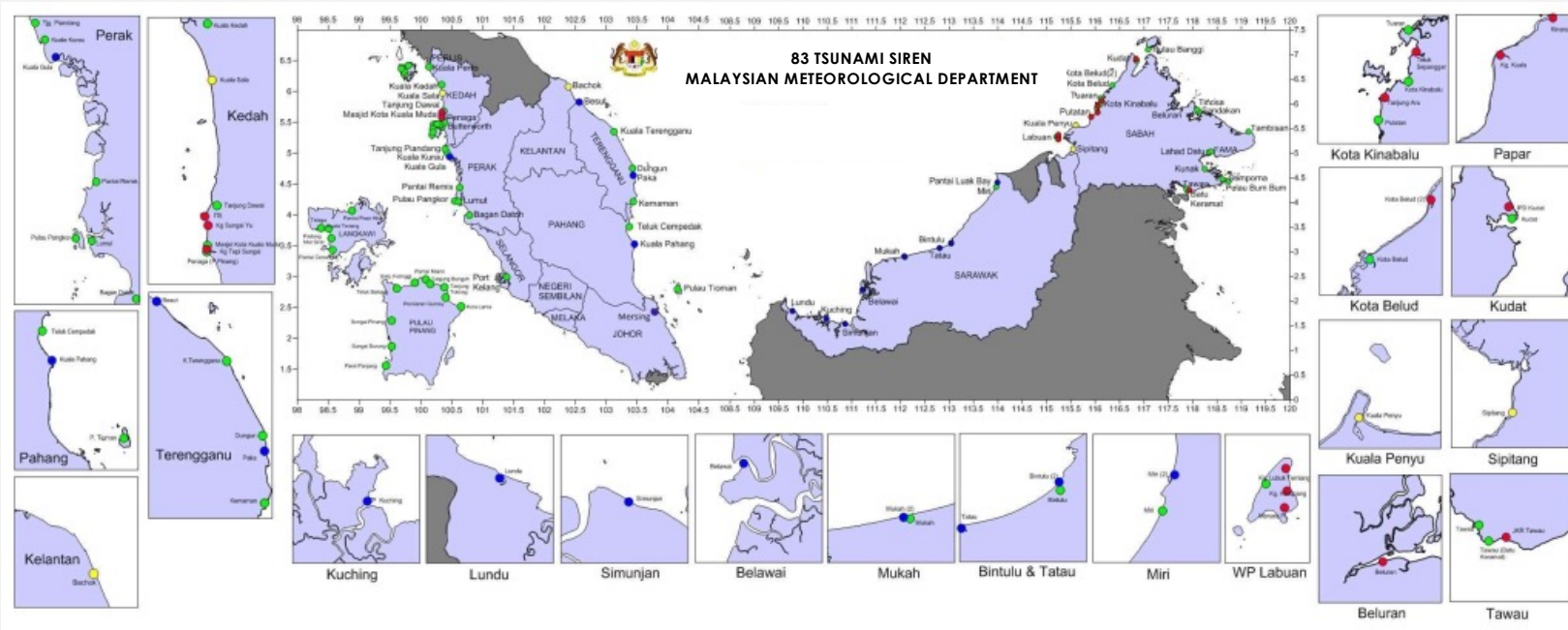
TSUNAMI SIREN

LOCATION

42 PENINSULAR

11 SARAWAK

30 SABAH & WP LABUAN



83 TSUNAMI SIREN



Tsunami Siren

**Different siren tone or sound and voice message
in both language Malay and English**



PERCUBAAN PERCUBAAN 1 2 3 4 5



NASIHAT TSUNAMI

**Jauhi daripada pantai dan muara
sungai.**



AMARAN TSUNAMI

**Pindah ke tempat selamat dengan
serta-merta.**



**AMARAN TSUNAMI ditamatkan.
Tiada lagi ancaman tsunami.**

TESTING TESTING 1 2 3 4 5

TSUNAMI ALERT

**Keep away from the beach and river
mouth.**

TSUNAMI WARNING

**Evacuate immediately to a safe
location.**

**TSUNAMI WARNING Is cleared.
There is no more tsunami threat.**

DISASTER MANAGEMENT SYSTEM IN MALAYSIA

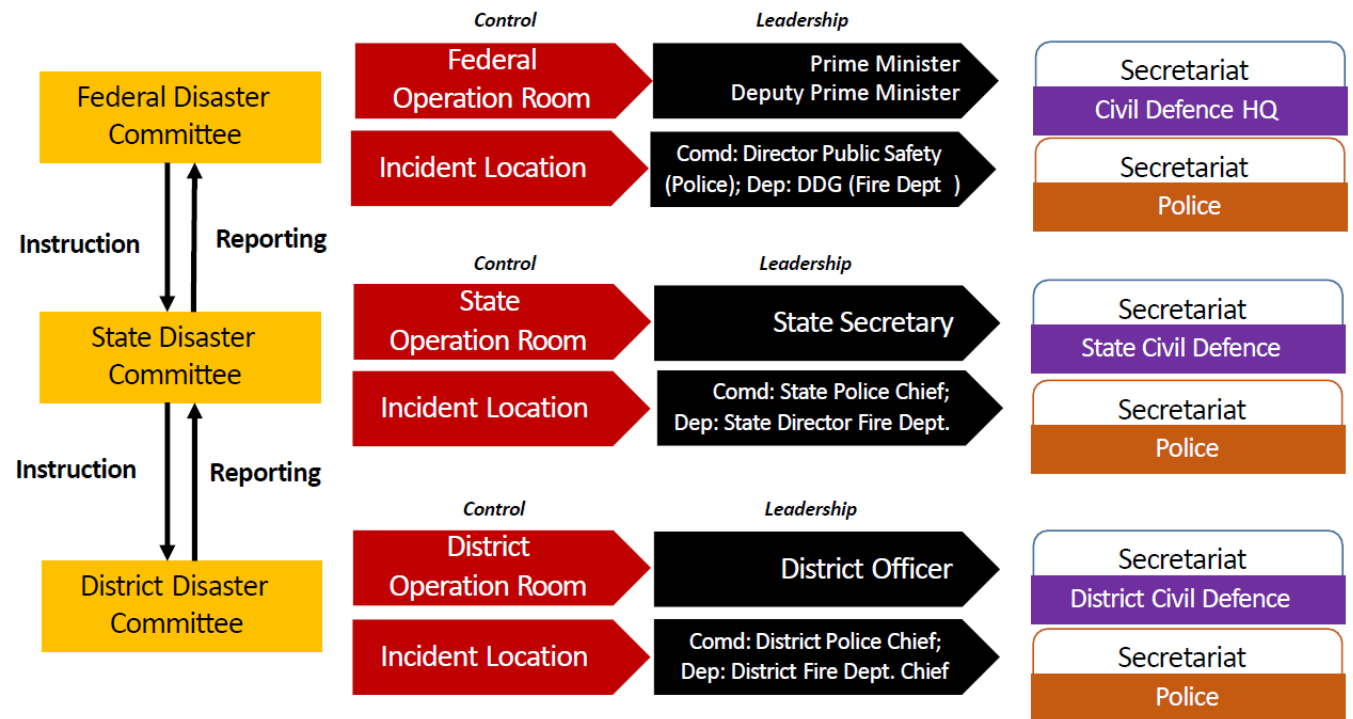
MECHANISM OF DM IN MALAYSIA

National Disaster Management Agency (NADMA Malaysia) is the Lead Government Agencies in Disaster Response

Level III disaster response involves more than one state or is of a complex nature that requires federal-level resources, coordination, or foreign aid.

Level II describes a disaster response that involves more than one district in the same state and requires pooled state resources with limited federal assistance.

Level I signifies that agencies within one district are able to respond to a disaster in their area with little or no outside help.



Disaster Response by Federal, State, and Local Level

Timeline for the first warning message (Minutes after EQ)

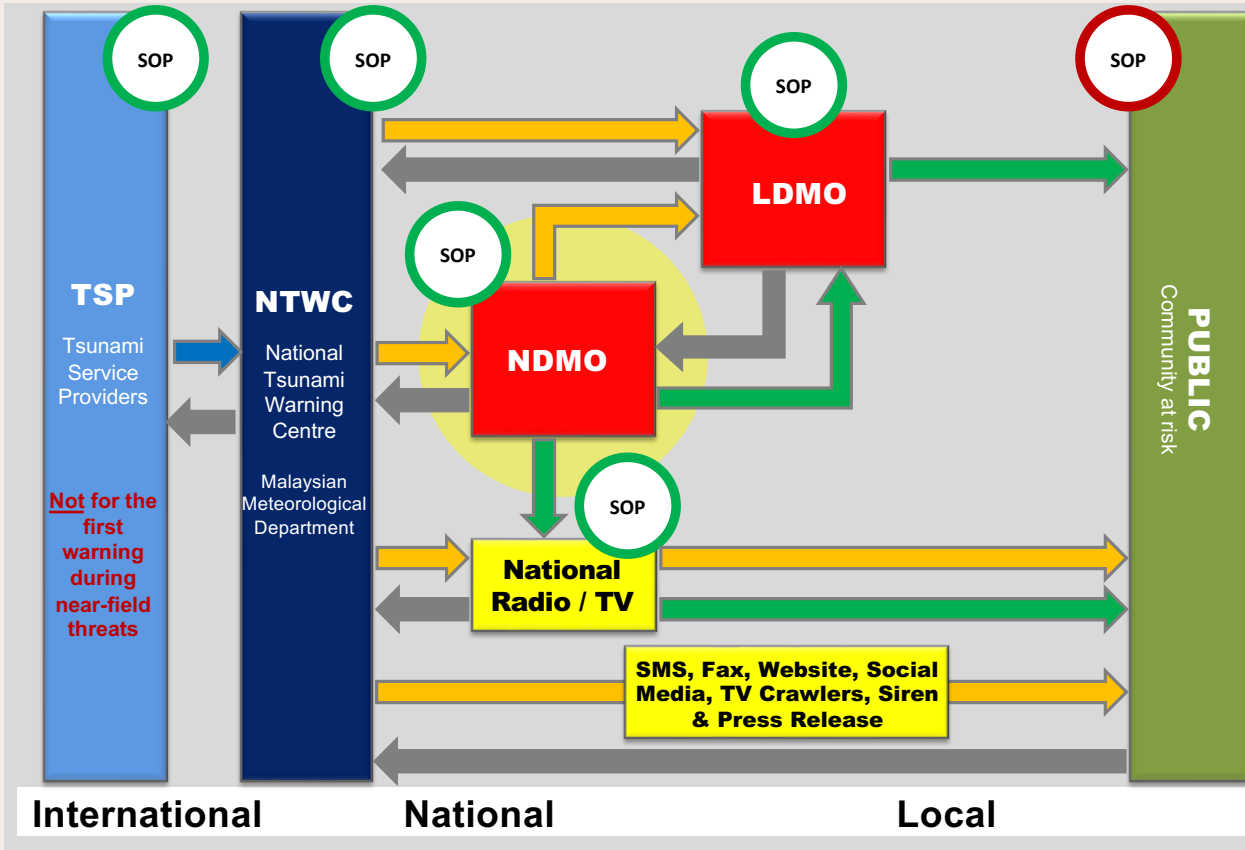
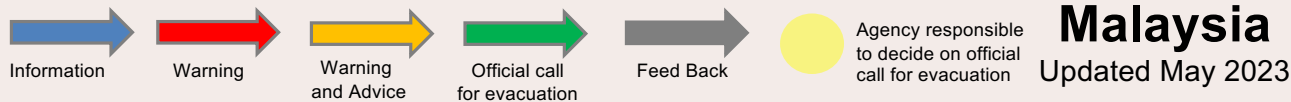


Diagram Concept of Tsunami Warning Chain in Malaysia



Warning Chain

MITIGATION PLANS



Mitigation Plan

01

Development of Seismic Hazard Map

Lead by Department of Mineral and Geoscience

02

Development of National Seismic Building Code

Lead by Department of Standards Malaysia (EU8)
Design for Structures for Earthquake Resistance

03

Awareness & Standard Operating Procedure

Lead by National Disaster Management Agency of Malaysia

04

Planning Guideline in High-Risk EQ Area

Lead by Department of Town and Country Planning PLANMalaysia

05

Research, Scientist & Technical Agencies

University, technical agencies, task team etc

Risk Management

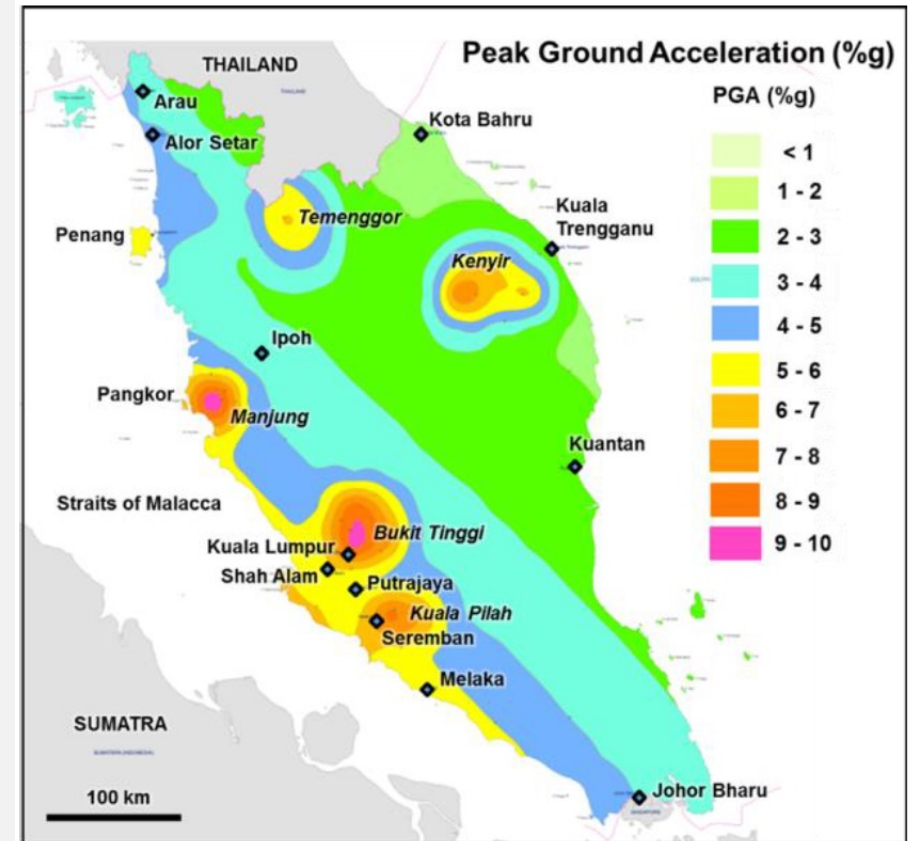


Development of Seismic Hazard Map

- ❑ The seismic hazard map shows the probable peak ground acceleration (PGA) values for different parts of Malaysia.
- ❑ The seismic hazard map was developed by a group of local experts on earthquake comprising of various government agencies, non-government agencies and universities.
- ❑ The analysis is based on **Probabilistic Seismic Hazard Assessment (PSHA)** using active fault lines mapped by JMG and earthquakes from the MET Malaysia database and the United States Geological Survey (USGS) earthquake database.
- ❑ In **late 2017 the first edition of seismic hazard map of Malaysia was published** by JMG and used in the Malaysia National Annex MS EN1998:2015 Eurocode 8; Design for Structures for Earthquake Resistance – Part 1: General Rules, Seismic Actions and Rules for Buildings.

Seismic Hazard Map: Peninsular

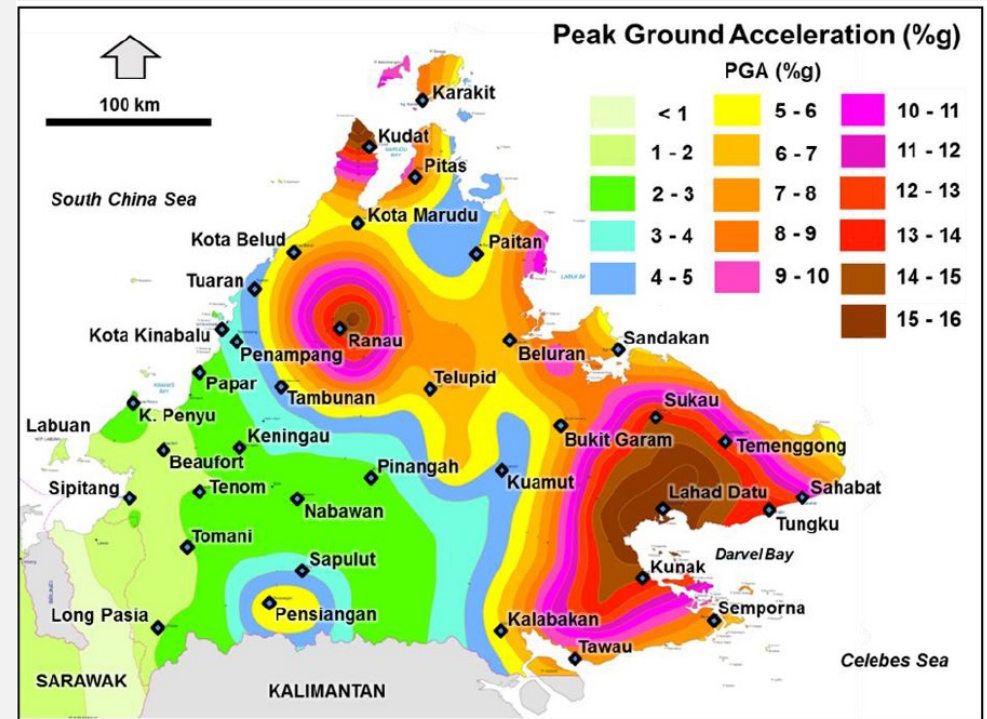
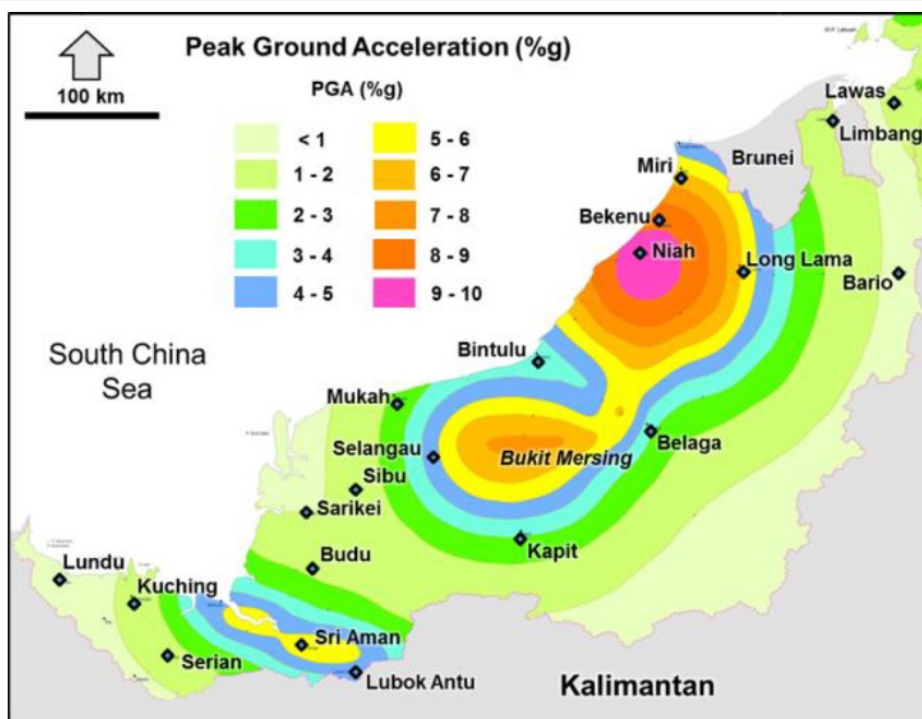
- ❑ Seismic hazard is the hazard associated with potential earthquakes in a particular area.
- ❑ The JMG produce the regional Seismic Hazard Map of Malaysia.
- ❑ The map is used by various stakeholders for land-use planning, mitigation, and emergency response. For example:
 - local town planners/building officials – to set appropriate building & retrofitting standards
 - Government/civil defense – to plan for disaster recovery
 - Professionals – to conduct detailed site assessments.
- ❑ Seismic hazard map shows the relative hazards in different areas. The maps are made by considering what we currently know about:
 - i. Past faults and earthquakes,
 - ii. The behavior of seismic waves as they travel through different parts of the crust, and
 - iii. The near-surface site conditions at specific locations of interest.



Seismic hazard map of 475 year return period PGA on rock for Peninsular Malaysia.

Source: Department of Minerals and Geoscience - JMG (2018)

Seismic Hazard Map: Sabah & Sarawak

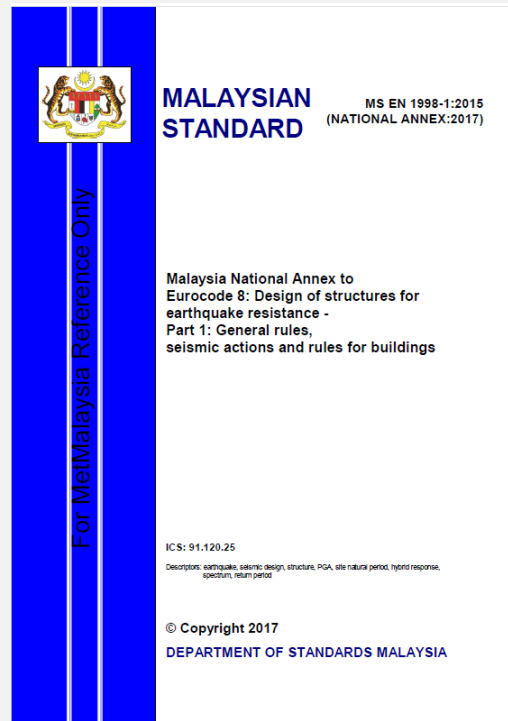


Seismic hazard map of 475 year return period PGA on rock for Sarawak and Sabah.
 Source: Department of Minerals and Geoscience - JMG (2018)

Malaysian Standard & National Annex

Development of National Seismic Building Code

Building codes are designed to create quality assurance and durability, with the objective to minimize economic loss due to material and structural deterioration and to provide basic comfort and safety conditions.



In earthquake-prone areas, building codes are complemented by seismic codes, specifying the calculation methods and strength values of key structural elements to avoid building collapse during an earthquake.

Introduction to Eurocodes – Eurocode 8 : BS EN 1998

- Part 1: General rules, seismic actions and rules for buildings ✓
- Part 2: Bridges ✓
- Part 3: Assessment and retrofitting of buildings ✓
- Part 4: Silos, tanks and pipelines ✓
- Part 5: Foundations, retaining structures and geotechnical aspects ✓
- Part 6: Towers, masts and chimneys ✓



Public Awareness Programme | 2006 - 2022

Year	Tsunami Drill		Awareness Campaign	
	No. of Series	Involvement	No. of Event	Involvement
2006	1	2,000	0	0
2007	1	1,000	5	480
2008	0	0	15	2,169
2009	1	1,000	13	2,694
2010	0	0	3	438
2011	4	2,500	5	793
2012	2	1,480	7	1,208
2013	2	1,372	7	1,014
2014	2	1,674	8	1,488
2015	0	0	6	1,159
2016	1	1,200	2	1,550
2017	2	1,150	2	1,150
2018	2	5,200	4	3,129
2019	1	1,200	10	2,900
2020	0	0	12	7,997*
2021	0	0	13	22,918*
2022	0	0	7	6,930*
Σ	19	19,776	119	58,017



*virtual programme (pandemic)

Tsunami Drill | Putatan Sabah 2016



Tsunami Drill | Tawau Sabah 2018



Public Awareness Programme | 2006 - 2022



Awareness Materials

WHAT IS BODY WAVE?

P WAVE
P Wave or compressional wave, is a seismic body wave that moves alternately compressing and stretching the transmitting medium back and forth in the direction the wave is moving.

S WAVE
S Wave or shear wave, is a seismic body wave that shakes perpendicular to the direction the wave is moving.

BASIC TERMINOLOGY OF GEOPHYSICS

MAINSHOCK
The largest earthquake in a sequence, sometimes preceded by one or more foreshocks, and almost always followed by many aftershocks.

FORESHOCK
Relatively smaller earthquakes that precede the largest earthquake in a series, which is termed the mainsack. Not all mainsacks have foreshocks.

AFTERSHOCK
Earthquakes that follow the largest shock of an earthquake sequence. They are smaller than the mainsack and within 1-2 rupture lengths distance from the mainsack.

Reference: United States Geological Survey, 2000

BASIC TERMINOLOGY OF GEOPHYSICS

FAULT
A fault is a fracture or zone of fractures between two blocks of rock. Faults allow the blocks of crust on either side to move relative to one another parallel to the fracture.

TYPES OF FAULT

- NORMAL FAULT**
- THRUST FAULT**
- STRIKE SLIP FAULT**

Reference and Adaptation: United States Geological Survey, 2000

TSUNAMI INFORMATION

MEANING
"Tsunami" is a Japanese word that means "harbour wave".

HEIGHT
Tsunami can reach 300 to 400 feet or more in height.

SPEED
Tsunami waves travel at about 500 miles per hour.

THE FIRST WAVE MAY NOT BE THE LARGEST OR THE BIGGEST
Tsunami wave to arrive

MOVEMENT
In some cases, a tsunami may cause the water to recede, exposing the ocean floor.

MAIN TSUNAMI SOURCES
Tsunami can be generated by several sources, but the most common is the sudden movement of the ocean floor.

BAGAIMANA TSUNAMI BERLAKU?

1. Preparasi antara ahli di kawasan pantai untuk menghadapi ancaman tsunami. (Preparation of experts in coastal areas to face tsunami threats.)

2. Gelombang tsunami yang bertolak akan bergerak bersebelahan dengan tanggapan yang sangat tinggi. (Tsunami waves will move with very high response.)

3. Apabila gelombang itu mencapai kawasan pantai, ia akan menjadi lebih besar. (When the waves reach the coast, they will become larger.)

4. Apabila gelombang tsunami mencapai kawasan pantai, ia akan menjadi lebih besar. (When tsunami waves reach the coast, they will become larger.)

GEMPA BUMI

FAKTA

- Lebih 500 gempa bumi berlaku di Malaysia pada tahun 2019.
- Lebih 500 gempa bumi berlaku di Malaysia pada tahun 2019.

FIKSYEN

- Malaysia adalah negara yang selamat dari gempa bumi.
- Malaysia adalah negara yang selamat dari gempa bumi.

TSUNAMI

NATURAL WARNING SIGNS OF TSUNAMI

- FEEL**: Feel the ground shaking severely for a long time.
- SEE**: See unusual disappearance of ocean water or becoming work of water.
- HEAR**: Hear the roaring sound similar to that of a train or jet aircraft.

ACTION
Immediately leave the coastal area! Move to higher ground or inland.

EARTHQUAKE INTENSITY SCALE MODIFIED MERCALLI INTENSITY (MMI)

Intensity	Effects
I	Not felt by most people.
II	Felt by some people.
III	Felt by many people.
IV	Felt by almost everyone.
V	Some objects are displaced.
VI	Some objects are displaced.
VII	Some objects are displaced.
VIII	Some objects are displaced.
IX	Some objects are displaced.
X	Some objects are displaced.

TSUNAMI NATURAL WARNING SIGNS

FEEL: Feel the ground shaking severely for a long time. **RUN**

SEE: See unusual disappearance of ocean water or becoming work of water. **RUN**

HEAR: Hear the roaring sound similar to that of a train or jet aircraft. **RUN**

IMMEDIATELY LEAVE LOW-LYING COASTAL AREAS! MOVE TO A HIGHER GROUND

SISTEM AMARAN AWAL TSUNAMI NASIONAL MALAYSIA (SAATNM)

POCGN Pusat Operasi Cuaa dan Amaran Tsunami MET Malaysia

KOMPONEN SAATNM

- PERKHIDMATAN DATA
- PERKHIDMATAN BANGUNAN
- PERKHIDMATAN PERALATAN
- PERKHIDMATAN PERKHIDMATAN

SAFETY MEASURES IN THE EVENT OF A TSUNAMI

FEEL: Feel the ground shaking severely.

SEE: See rapid fall in sea level or unusual disappearance of ocean water.

HEAR: Hear the roaring sound similar to that of a train or jet aircraft.

RUN: Immediately leave low-lying coastal areas, move to a higher ground.

EARTHQUAKE INTENSITY SCALE MODIFIED MERCALLI INTENSITY (MMI)

Intensity Scale
The intensity of an earthquake on the surface and the geological effects.

MMI Scale
The scale is designated by Roman numerals I to X.

EARTHQUAKE SAFETY STEPS

BEFORE

- Secure your space by identifying hazards and securing moveable items.
- Plan to be safe by creating your emergency plan and deciding how you will communicate.
- Organize emergency supplies in convenient locations.

DURING

- Drop, Cover, and HOLD ON or other recommended actions if you feel shaking to get an alert.
- Improve safety after earthquakes by evaluating if necessary, helping the injured, and preventing further injuries or damage.

AFTER

- Reconnect and Restore daily life by reuniting with others, repairing damage, and rebuilding community.

STAY ALERT Ready with Emergency Go Bag

1 House 1 Emergency Go Bag

- Important documents
- Cash
- Telephone & power bank
- Hygiene kit
- First aid & medicine
- Whistle
- Non-perishable foods
- Water
- Crank-powered radio

SAFETY MEASURES IN THE EVENT OF AN EARTHQUAKE

DURING AN EARTHQUAKE

- Don't panic
- Drop, Cover and hold
- If driving, stop in a safe place

AFTER THE TREMORS STOP

- Find a way out
- Move away from buildings and clutter
- Gather in a safe place

Proses AMARAN TSUNAMI di Malaysia

Sistem Tabak Papan Surut Sistem Amaran Tsunami (SATNM)

Sistem Sebaran Awam di Pantai: SIREN TSUNAMI

PENGESANAN GEMPA BUMI di MALAYSIA

1. PENGESANAN
2. ANALISIS
3. PERHABAN

WHAT IS SURFACE WAVE?

RAYLEIGH WAVE
Rayleigh Wave is a seismic surface wave causing the ground to shake in an elliptical motion.

LOVE WAVE
Love Wave is a surface wave having a horizontal motion that is transverse to the direction the wave is traveling.

National SOP on Disaster Management Earthquake & Tsunami



JLID V

**PERATURAN TETAP OPERASI
PENGENDALIAN BENCANA
GEMPA BUMI**

Majlis Keselamatan Negara
Jabatan Perdana Menteri
PUTRAJAYA



JLID VI

**PERATURAN TETAP OPERASI
PENGENDALIAN BENCANA
TSUNAMI**

Majlis Keselamatan Negara
Jabatan Perdana Menteri
PUTRAJAYA

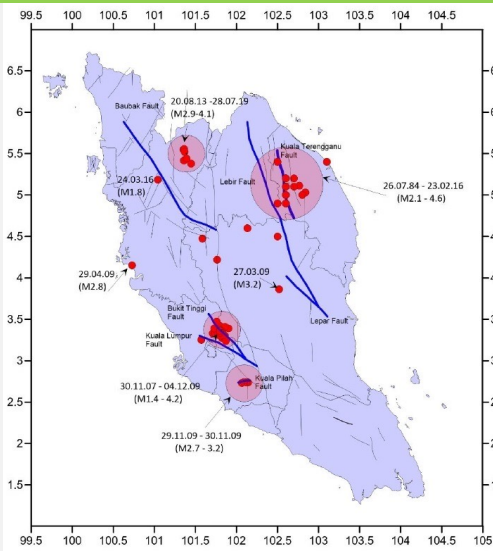
Under **Directive No. 20**, disasters are to be managed by DM committees at three levels including the federal level, as well as the state and district level committees.

National SOP – revised on 2022 (tsunami) and 2023 (earthquake)

The image features a background of a complex network diagram with numerous nodes and connecting lines. A prominent blue horizontal band spans the middle of the image, containing the text "Thank you" in white. There are also two grey rectangular blocks, one positioned above and one below the blue band, centered horizontally.

Thank you

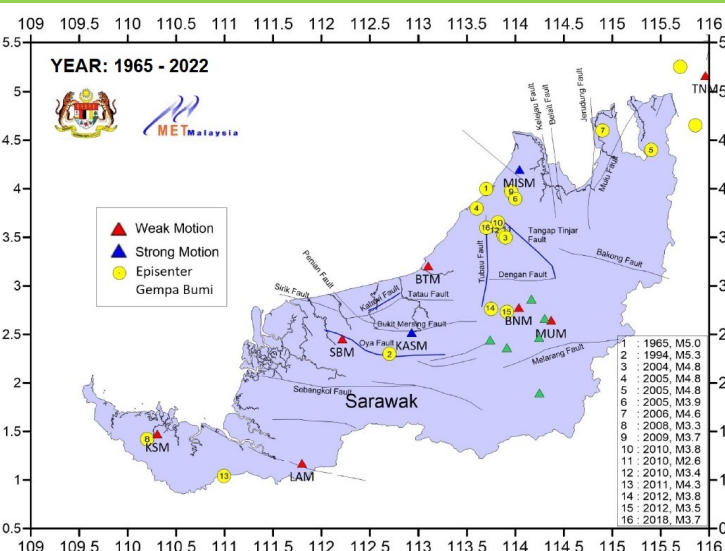
Distribution of local earthquakes



Peninsular

- ❑ Kenyir, Terengganu (1984-2016, M2.1 - 4.6)
- ❑ Bukit Tinggi, Pahang (2007-2009, M1.4 - 4.2)
- ❑ Kuala Pilah, N.Sembilan (2009, M2.7 - 3.2)
- ❑ Temenggong, Perak (2013-2019, M2.9 - 4.1)

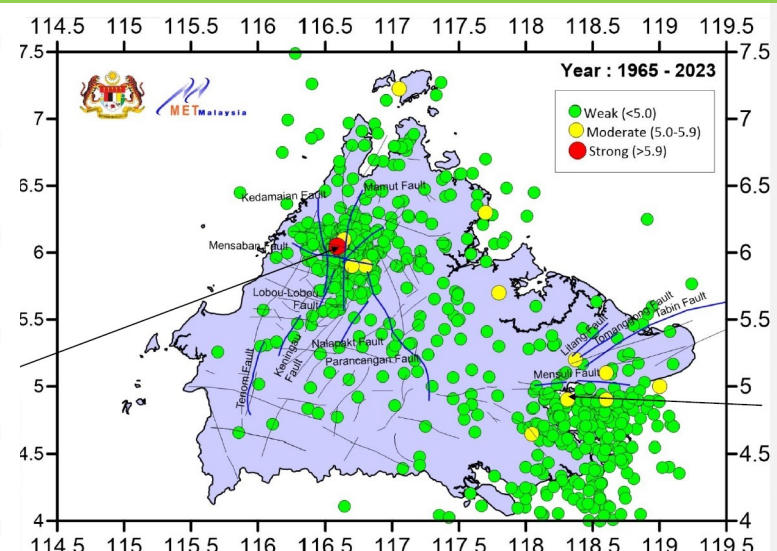
Minor tremors and shaking of high rise buildings, but have not resulted in any significant damage.



Sarawak

- ❑ EQ felt are mostly related to local EQs
- ❑ 14 weak EQs & 2 moderate EQs; M5.0 (1965) and M5.3 (1994)
- ❑ The EQs appear to be related to the local faults line; mostly located around Niah & Selangau area.

Caused minor damage to buildings.

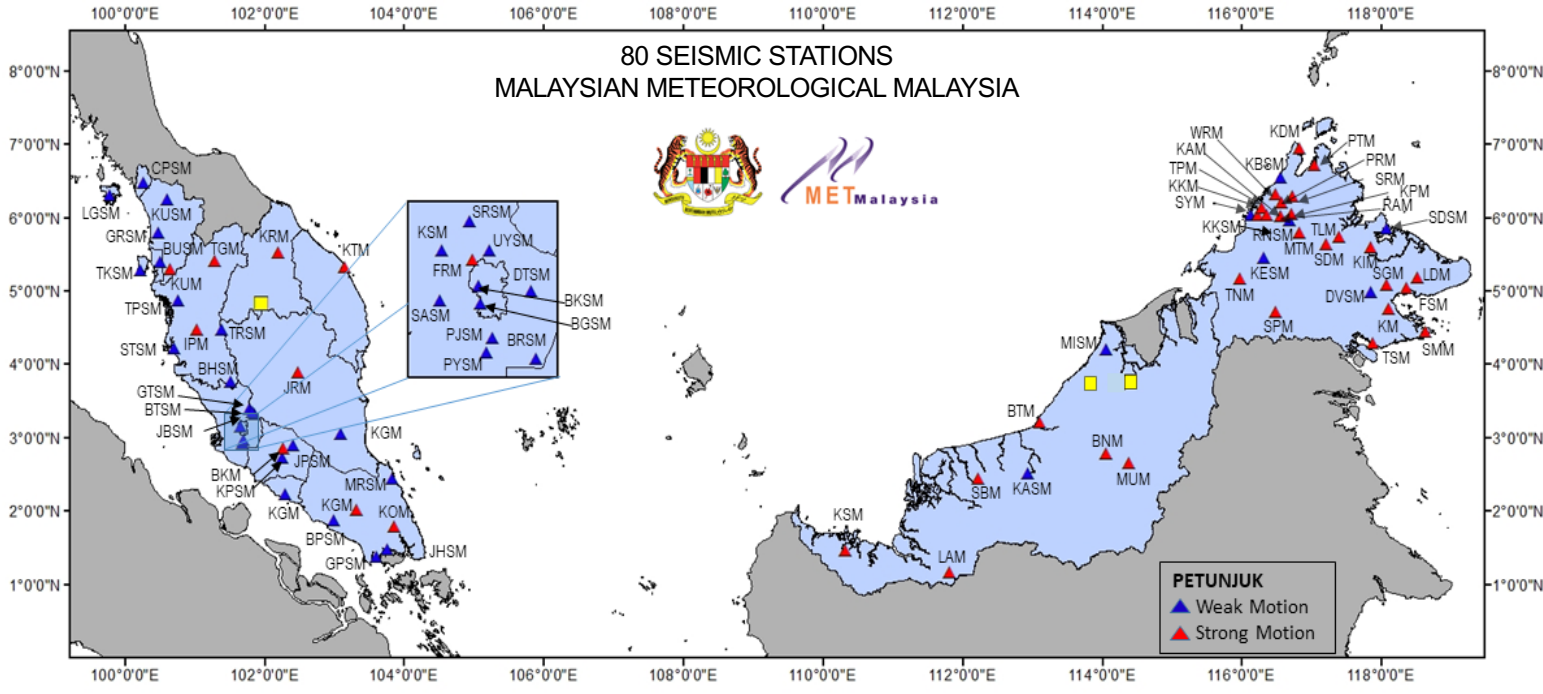


Sabah

- ❑ Mostly generated locally; some located over the Sulu and Celebes seas.
- ❑ Most EQs have magnitude less than 5.0
- ❑ Jun 2015 at Ranau - strongest EQ of M6.0
- ❑ Majority of the EQ concentrated in Lahad Datu, Ranau and Kudat area.
- ❑ Associated with active fault faults lines

Caused considerable damage to buildings and killed 18 people

SEISMIC STATIONS NETWORK



LOCATION

42 PENINSULAR

28 SABAH

10 SARAWAK

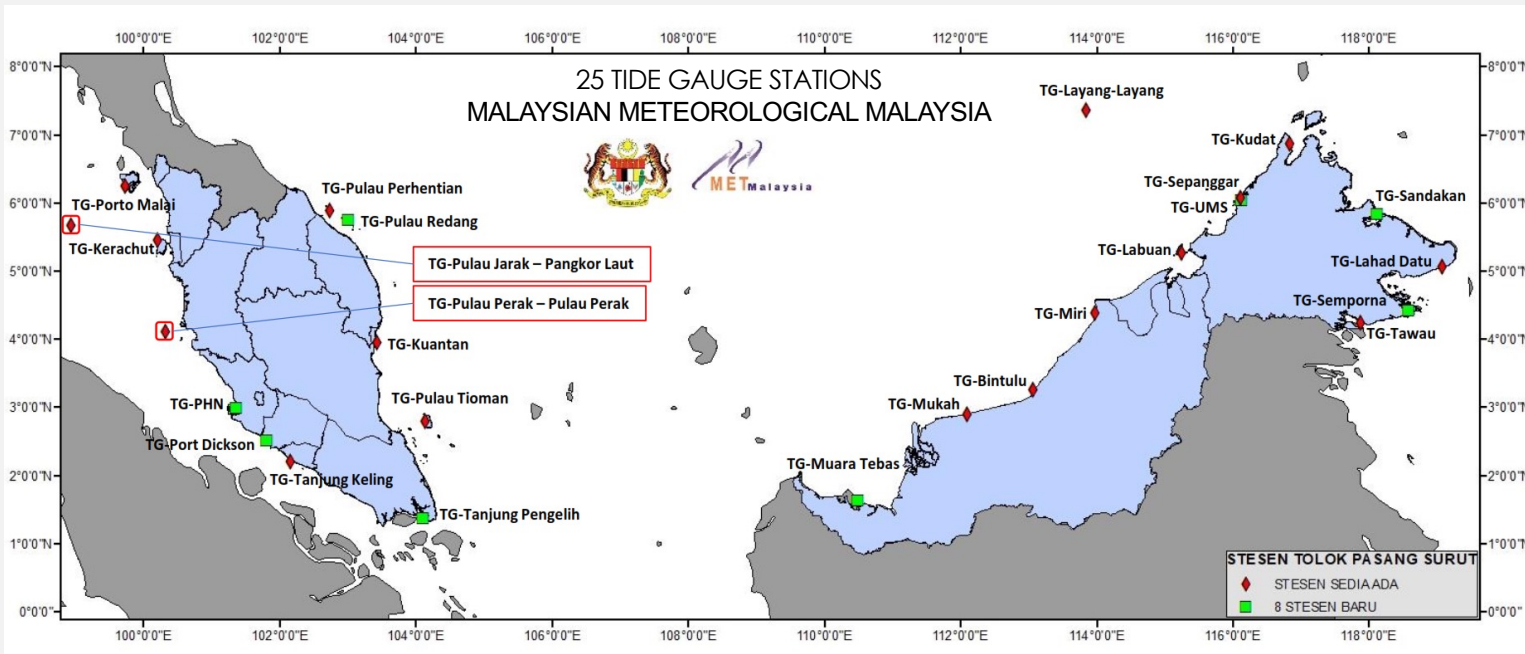


80 SEISMIC STATIONS

43 WEAK MOTION (3C)

37 STRONG MOTION (1C)

TIDE GAUGE STATIONS NETWORK

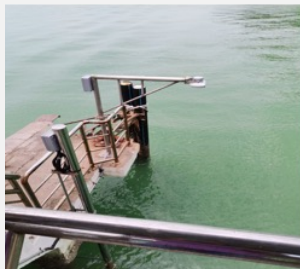


LOCATION

12 PENINSULAR

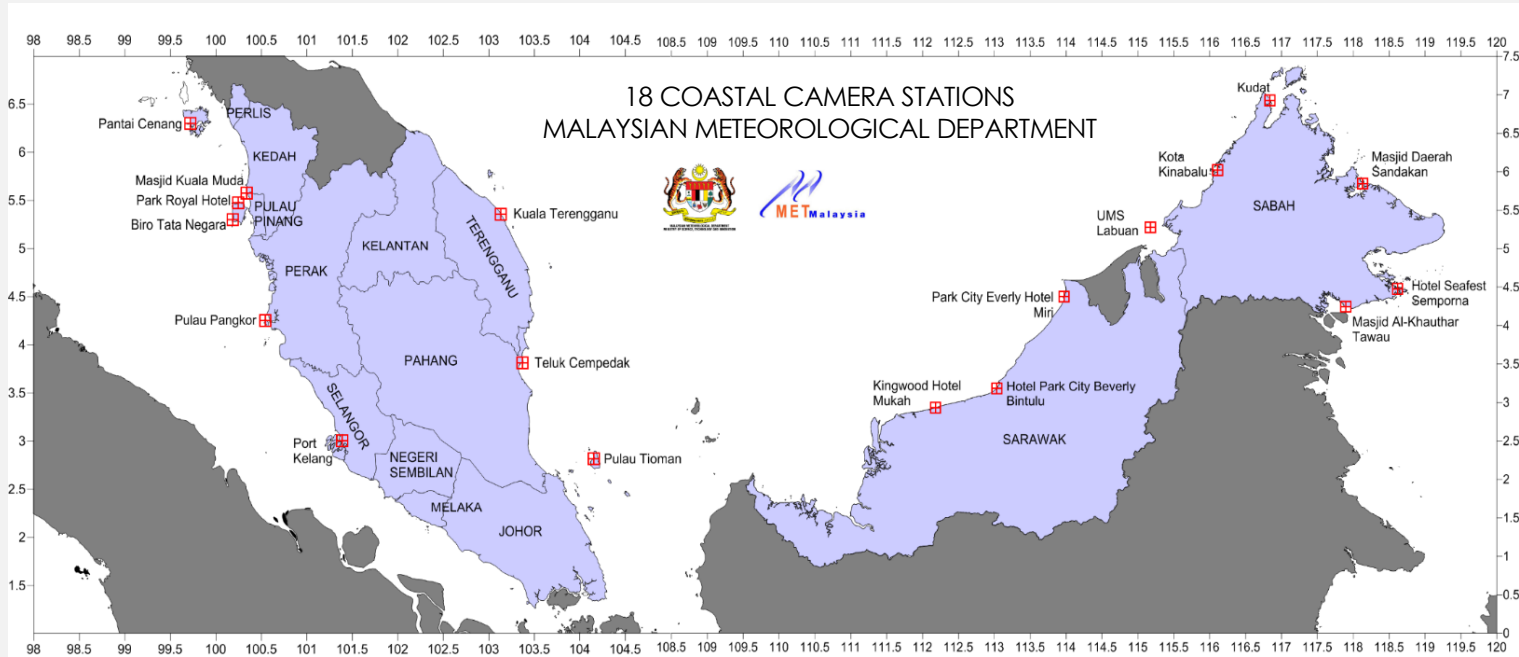
4 SARAWAK

9 SABAH



25 TIDE GAUGE STATIONS

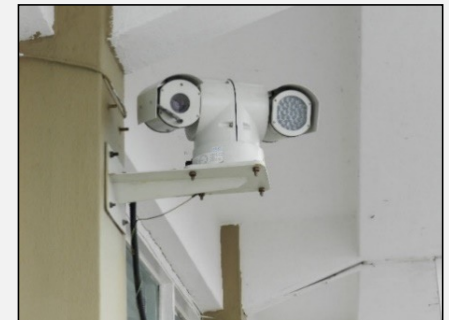
COASTAL CAMERA (CCTV) SYSTEM



LOCATION

- 9 PENINSULAR
- 3 SARAWAK
- 6 SABAH

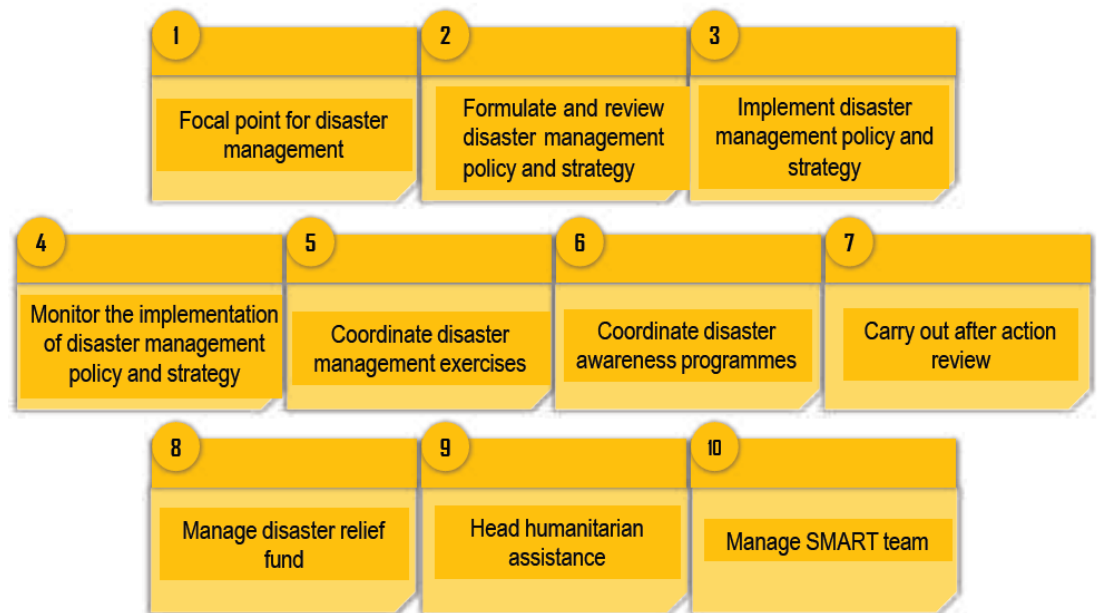
18 CCTV COASTAL CAMERA



ORGANIZATIONAL STRUCTURE FOR DISASTER MANAGEMENT IN MALAYSIA

National Disaster Management Agency (NADMA Malaysia) is the Lead Government Agencies in Disaster Response

- ❑ NADMA oversees all facets of management of disaster risks in Malaysia.
- ❑ NADMA is also the secretariat of the Central Disaster Management Committee (JPBP) and plans preparedness activities.
- ❑ NADMA is in charge of disaster management (DM) at the national level.



The roles of NADMA Malaysia

SMART: Special Malaysia Disaster Assistance and Rescue Team

DIRECTIVE ORDER NO. 20

Under **Directive No. 20**, disasters are to be managed by DM committees at three levels including the federal level, as well as the state and district level committees.

- ❑ During a disaster, the district offices in the affected areas coordinate evacuation activities with the support of the Malaysian Fire and Rescue Department and Malaysian Civil Defence Force.
- ❑ The Malaysia Red Crescent Society (MRCs), NGOs, non-profit organizations, and various other agencies may be involved.
- ❑ The Malaysian Armed Forces, Royal Malaysia Police, and other local government agencies conduct evacuations, establish emergency shelters, operationalize evacuation centers, and provide relief assistance.
- ❑ During a response operation, authorities may deploy the SMART into affected areas to carry out search and rescue operations (SAR).

The main agencies involved in DM include:

- Malaysian Armed Forces
- Royal Malaysian Police
- Malaysia Civil Defense Force (APM)
- Fire and Rescue Department
- Social Welfare Department
- Malaysian Meteorological Department (MET Malaysia)
- Department of Irrigation and Drainage (DID)
- Ministry of Health (MOH)
- Civil Aviation Authority Malaysia
- Ministry of Science, Technology, and Innovation
- Atomic Energy Licensing Board
- Malaysian Remote Sensing Agency
- Department of Mineral and Geosciences Malaysia
- Malaysian Maritime Enforcement Agency