



SEMINAR PERUBAHAN IKLIM DAN IMPAK KEPADA KESIHATAN:

SEA LEVEL RISE PROJECTION FOR AND IMPACT OF HEALTHCARE FACILITIES

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23/06/2011

**Coastal & Oceanography Research Centre
Ministry of Energy Transition and Water Transformation (PETRA)**



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NAHRIM
Ministry of Energy Transition and Water Transformation (PETRA)**

NAHRIM's

MAIN FIELD: **WATER R&D AND SERVICES**

WATER



Water Cycle

Water Supply

Rainwater

Surface Water

Groundwater

Lake / Dam

OCEAN & OCEANOGRAPHY



River Estuary & beach
Morphology

Oceanography

Jetty & Port

Hydrodynamic of Mangroves

Sea Level Rise

WATER ENVIRONMENT



Analytical Water Quality

Water Treatment Technology

Drainage Research

Renewable Energy

Sewerage

Integrated *Lake Basin*
Management

National Lake Water Quality
Standards (NLWQS)

Hydroclimate

Physical & Numerical Modeling

Data Collection, Analysis & Monitoring

Product Development & Water Technology

PKPO TECHNICAL EXPERTISE (ON SITE)

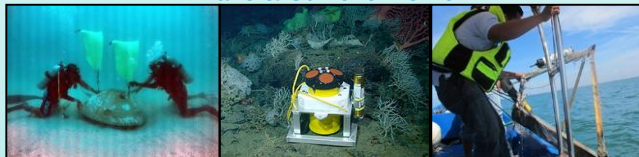
Bathymetry Survey



Tide Measurement



Wave & Current Profile



Land Survey & Beach profile



Wind & Flow Data

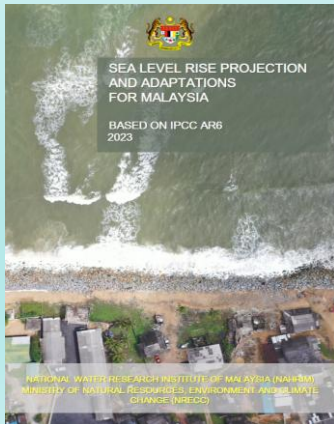


Sediment & TSS Sampling



PKPO

TECHNICAL EXPERTISE (NUMERICAL MODEL)



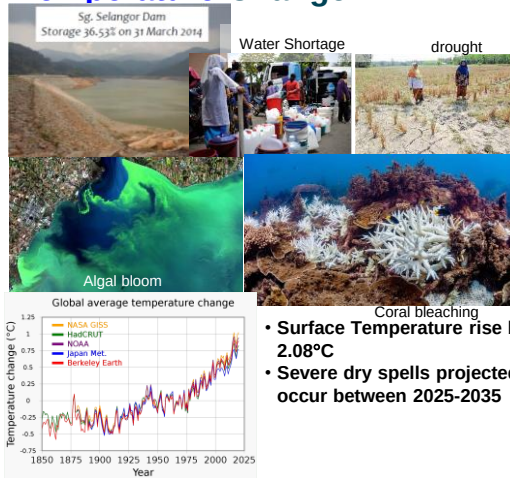
Shoreline Manual



WHAT Climate Change DO GLOBALLY?

• Projected climate change impacts in Malaysia (updated in Nationally Determined Contributions - NDC)

Land & Ocean Temperature Change



Sea Level Rise



- Projected Increase by 0.71m to 0.74m in end 21st century (AR5 RCP8.5 2100)

Storm surges / extreme wave

High intensity & height of waves surges / storms



- With increase in surface temperature & annual precipitation, will affect extreme event during monsoon (NE –Oct- March)

Precipitation intensity change



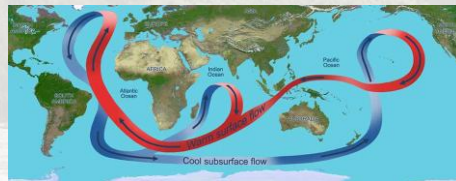
- Average annual precipitation projected increase by 14-25% in end of 21st century



National Water Research Institute of Malaysia / Institut Penyelidikan Air Kebangsaan Malaysia
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SCIENCE OF SEA LEVEL RISE (SLR)

- contributions from the loss of mass glaciers, the surface mass balance, the dynamic response of the Greenland & Antarctic ice sheets melted and changes in land-water (AR5, Church et al. 2013).
- also influences ocean currents (slowing) – if massive amounts of very cold glacial-melt water entering warmer ocean water



❑ Glaciers melting?

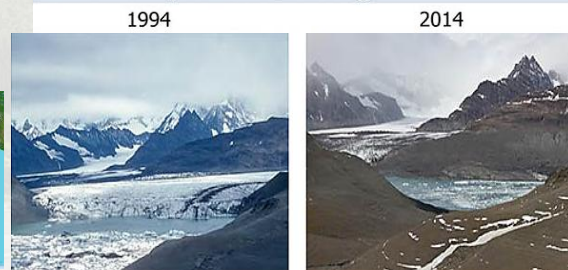
- **Anthropogenic** – Global mean sea level (GMSL) has risen, ≈ 0.2 [0.15 to 0.25 m] since early 1900s (**Industrial revolution**)

- carbon dioxide and other greenhouse gas emissions have raised temperatures, even higher in the poles, and as a result, glaciers are rapidly melting

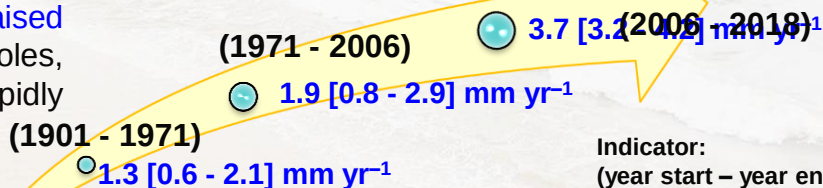
RISE OF SEA LEVELS



The consequences of change



- ❑ Average rate of sea level rise (SLR):

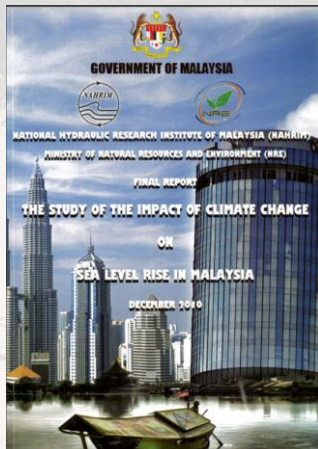


Indicator:
(year start – year end)
Mean [Lower - upper]

SLR RESEARCH IN MALAYSIA

- ❑ NAHRIM has initiate its SLR study on 2009 based on AR4 & completed Malaysian 1st SLR Projection on 2010
 - ❑ 2nd SLR projection based on IPCC AR5 (2013) & Special Report on the Ocean and Cryosphere (SROCC) (2019)
 - ❑ IPCC AR5, published in 2019 contains the latest understanding about SLR – scenarios, methodology, datasets etc.
- Completed An Updated Malaysian's SLR Projection in 2023

Sea Level Rise Projections (SLR) for Malaysia

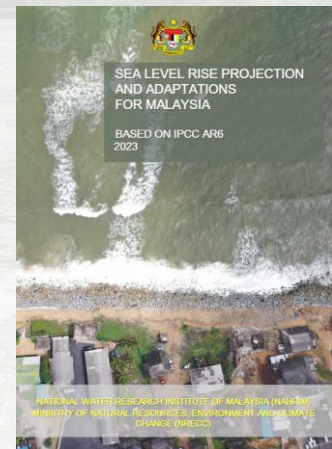


2010: AR4

National Water Research Institute of Malaysia,
NRECC



2017: AR5

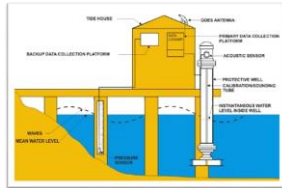


2023: AR6

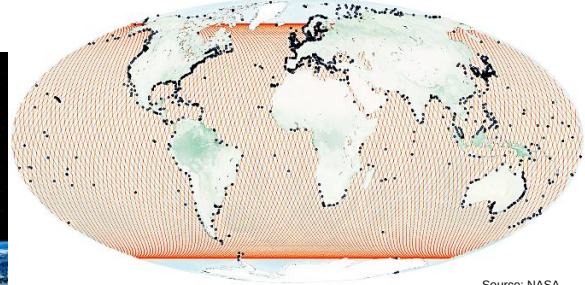


MEASUREMENT OF SEA LEVELS

- **Tide Gauge** (measuring daily tides variations)
- **Satellite altimeters** (utilizing both radar and laser technology)



Satellite altimetry measurements cover significantly more area than tide gauges



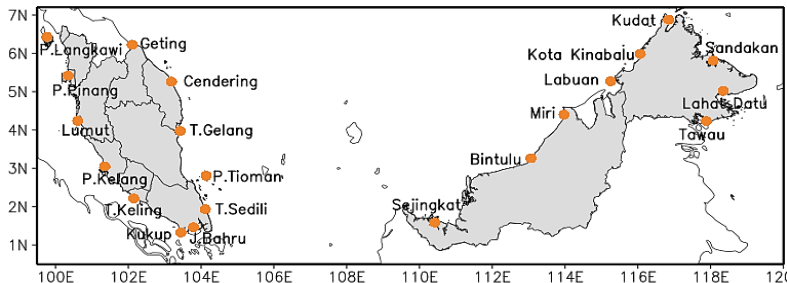
Source: NASA

• PSMSL Tide Gauges Jason-3 Orbits (10 days)

Since 1992, four missions have repeated the same orbit every ten days: TOPEX/Poseidon (1992-2006), Jason-1 (2001-2013), Ocean Surface Topography Mission/Jason-2 (2008-2019), and Jason-3 (2016 to present). Source: IPCC

MALAYSIAN TIDE STATION

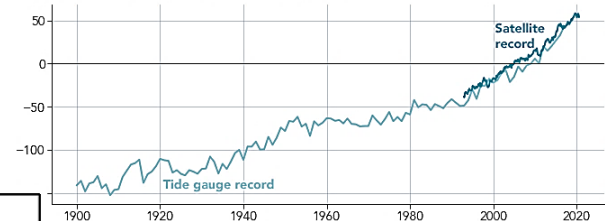
- 21 JUPEM tide stations, 6 stations located at Sabah, 3 at Sarawak & 11 at PM
- Trends estimate based on yearly time-series instead of monthly
- the middle rate range sea level along Sabah coastal, 3.0-4.4 mm/yr (TG), comparable to 4.7- 5.6 mm/yr (altimetry)



Source: <https://earthobservatory.nasa.gov/images/147435/taking-a-measure-of-sea-level-rise-ocean-altimetry>

Tide Gauges and Satellites Agree: Global Mean Sea Level is Rising

Observed change in sea level from 1996-2016 average (mm)



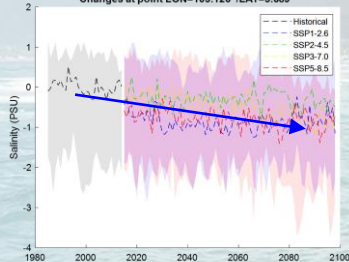
Station	Span	Tide Gauge (mm/year)	Altimetry (mm/year)
Labuan 2	1996 - 2018	3.0 [0.3 – 5.7]	4.7 [3.2 - 6.2]
Kota Kinabalu	1993 - 2018	4.4 [2.3 – 6.4]	4.9 [3.3 - 6.4]
Kudat	1996 - 2018	3.1 [0.4 – 5.8]	5.0 [3.4 - 6.6]
Sandakan	1993 - 2018	4.1 [1.6 – 6.6]	5.0 [3.1 - 6.9]
Lahat Datu	1996 - 2018	3.0 [-0.5 – 6.6]	5.6 [3.0 - 8.1]
Tawau	1993 - 2018	3.8 [1.0 – 6.6]	5.1 [2.7 - 7.5]

MALAYSIAN's SLR PROJECTION (AR6 IPCC)

- ❑ Based on **latest IPCC AR6** (Chapter 9) with **archived 6 CMIP6 model** with **best high accuracy** (Ocean 25-100km, Atmospheric 50-100km resolution)
- ❑ **Seasonality** (monsoon) & **ENSO** dominant (La Nina/El Nino)
- ❑ Shared Socioeconomic Pathways (**SSPs**) is a **dataset for quantitative projections** & related **Integrated Assessment scenarios - used alongside** the Representative Concentration Pathways (**RCPs**) to **analyze** the **feedbacks** between **climate change** and **4 factors** (socioeconomic factors, world population growth, economic development & technological progress)
- ❑ **SST** is expected to **increase 0.5°C to ~3°C** but **salinity decrease** with **big drop** value at **Northern of Strait Malacca** by end of 21st century
- ❑ **current speed** - **decreasing** over the **open water SCS**, but **increasing** over the coastal area (**eastern Johor**)

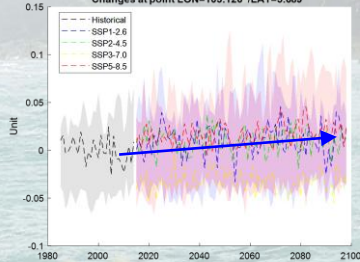
Salinity - decrease

Changes at point LON=103.126°/LAT=5.689°



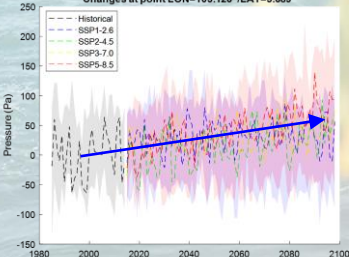
Current Speed - increase

Changes at point LON=103.126°/LAT=5.689°



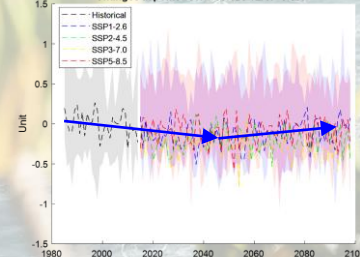
Sea level Pressure - increase

Changes at point LON=103.126°/LAT=5.689°



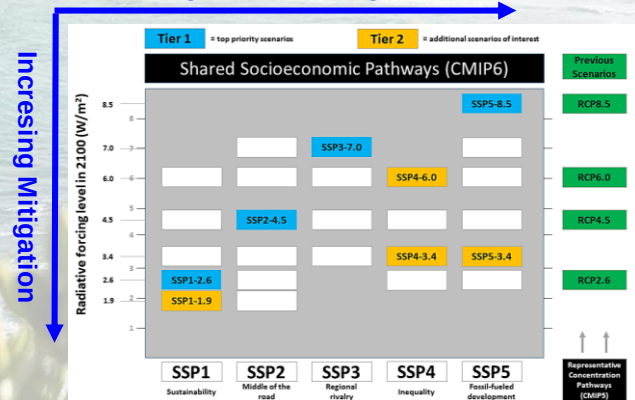
Wind Speed – slightly increase

Changes at point LON=103.126°/LAT=5.689°

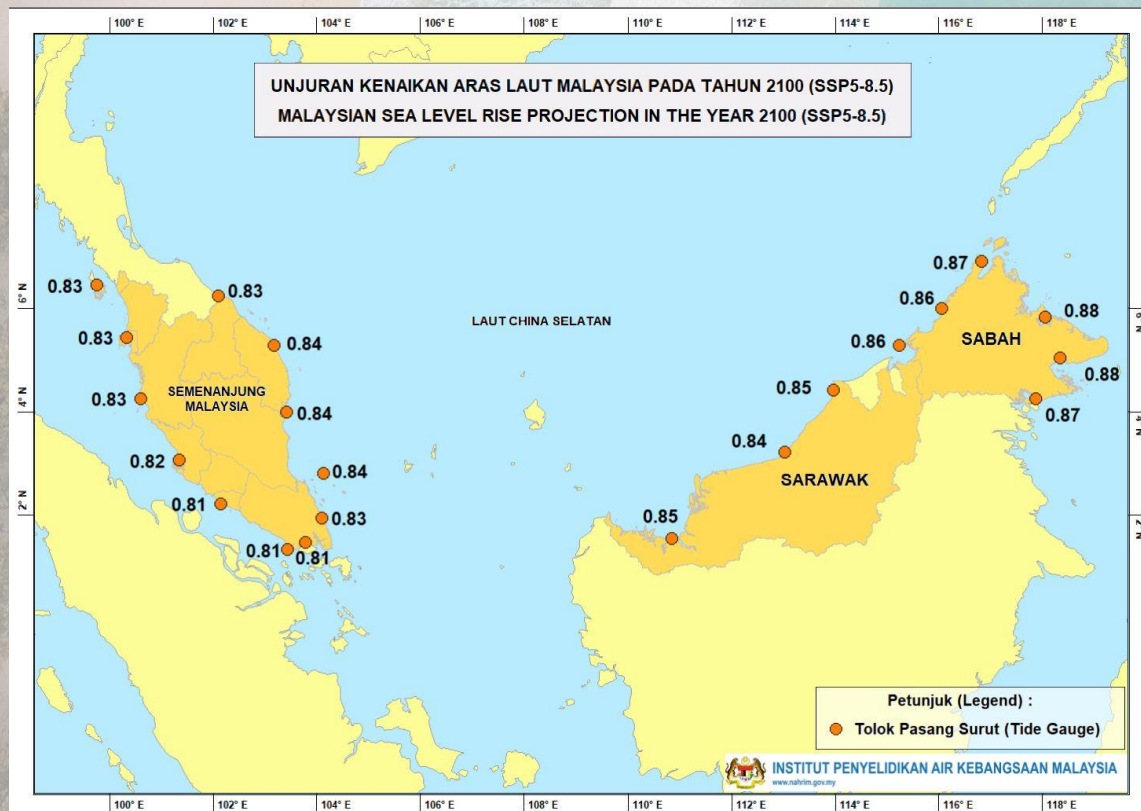


SSP1	Sustainability – Taking the Green Road (Low challenges to mitigation and adaptation)
SSP2	Medium challenges to mitigation and adaptation
SSP3	High challenges to mitigation and adaptation
SSP4	Low challenges to mitigation, high challenges to adaptation
SSP5	High challenges to mitigation, low challenges to adaptation

Mitigation Challenges



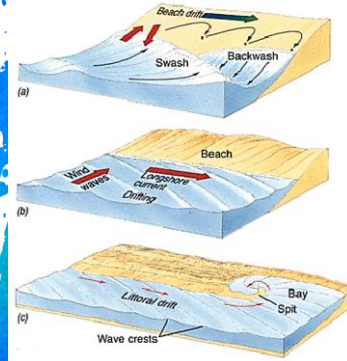
- ❑ latest projections is higher than that in NAHRIM (2019) by about 0.1- 0.14 m rise.
- ❑ On median value in 2100 by SSP5-8.5, SLR along Sabah coastal are in range 0.86m - 0.88m, 0.84 – 0.85m along Sarawak while
 - ❑ MHHW (most likely annual event) – most of the low-lying area & estuary will be inundate



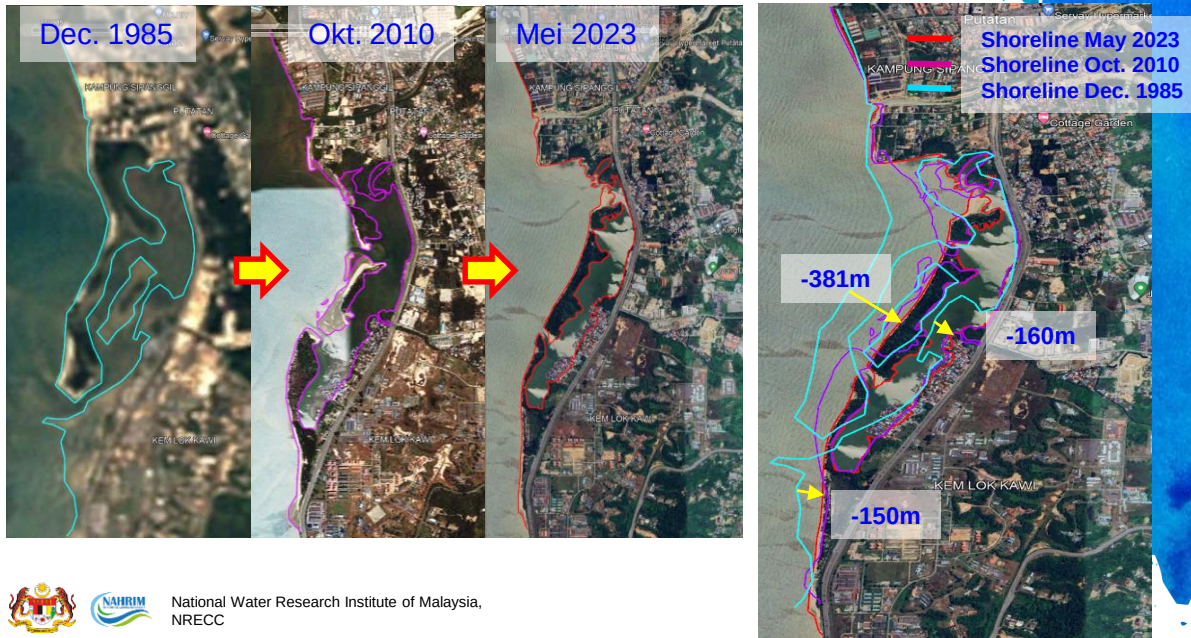
WHY DO SLR MATTERS TO US?

A) SHORELINE EVOLUTION

- ❑ changes & movement of the shore sediment budget due to **changes in hydrodynamic** characteristic
 - **Erosion & deposition**
 - **beach profile** shifts **landwards** and **upwards**, taking material from the shoreline and **depositing** it in the **nearshore zone**
- ❑ **extreme SLR**, allows **extreme waves** to **crash closer** to the coast, therefore transmit more wave energy, **encourages severe erosion**

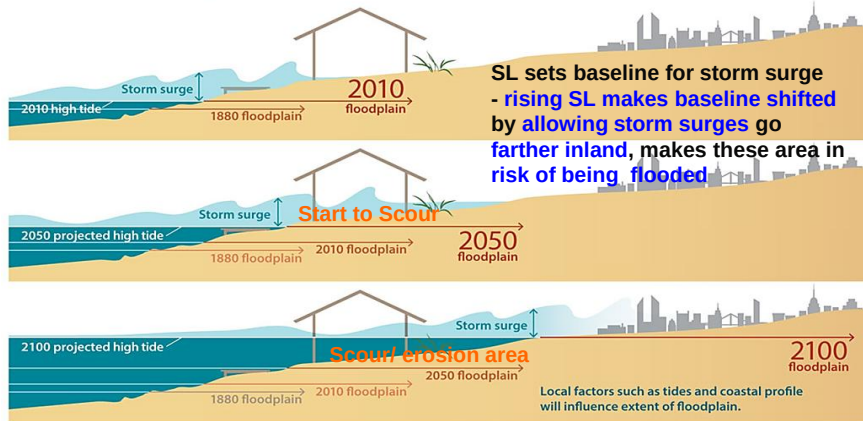


Lok Kawi beach

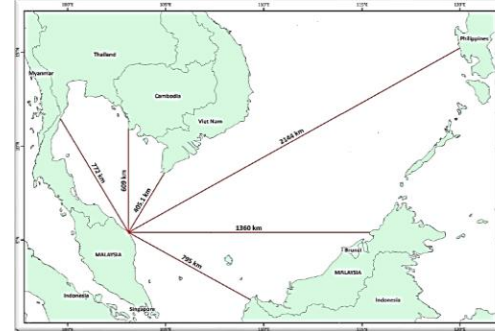


B) STORM SURGE (*Pusuan Ribut*) / Runup

Storm Surge and High Tides Magnify the Risks of Local Sea Level Rise



© Union of Concerned Scientists 2013; www.ucsusa.org/sealevelrisescience

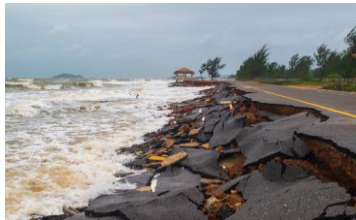


- Wind fetch length - crucial factor in building up the wind energy
- extend further inland & cause more damage as water levels are higher & nearshore steepness (runup) induces scour & erosion
- Damages properties, loss of life



Storm Surge / Runup

- Additional impact of large waves and extreme high tides
- high intensity & frequent, might affect on front toe scouring and damage of the coastal structure



scouring & sank of the coastal road at Terengganu

Kejadian akibat cuaca buruk di Jeti Base Camp, Pulau Gaya (Taman Tunku Abdul Rahman) hari ini.



Pulau Gaya 14/7/22

AIR PASANG: LEBIH 100 RUMAH ATAS AIR ROBOH DI KAMPUNG FOREST



Orbitak 'trembula' penera akibat air pasang besar di Kampung Terna Dua malam tadi. Semasa 130 orang pes 13 keluarga terpaksa berpindah ke masjid kerana rumah mereka musnah akibat air laut pasang bermula kira-kira 10.30 malam tadi.

25/12/2022 04:14 PM

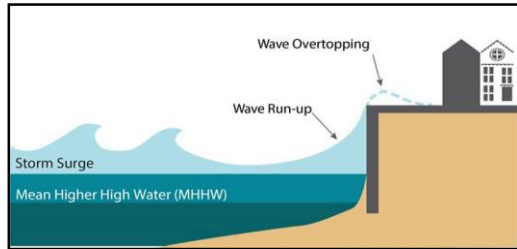
EARTH BUND BREACH



Kuala Selangor, 2022

- Breaching of earth bund at coastal area, allow sea water inundate inland area
- Stagnant water- degraded soil quality in long term

C) WAVE OVERTOPPING & COASTAL FLOODING



Inundation at Beluran

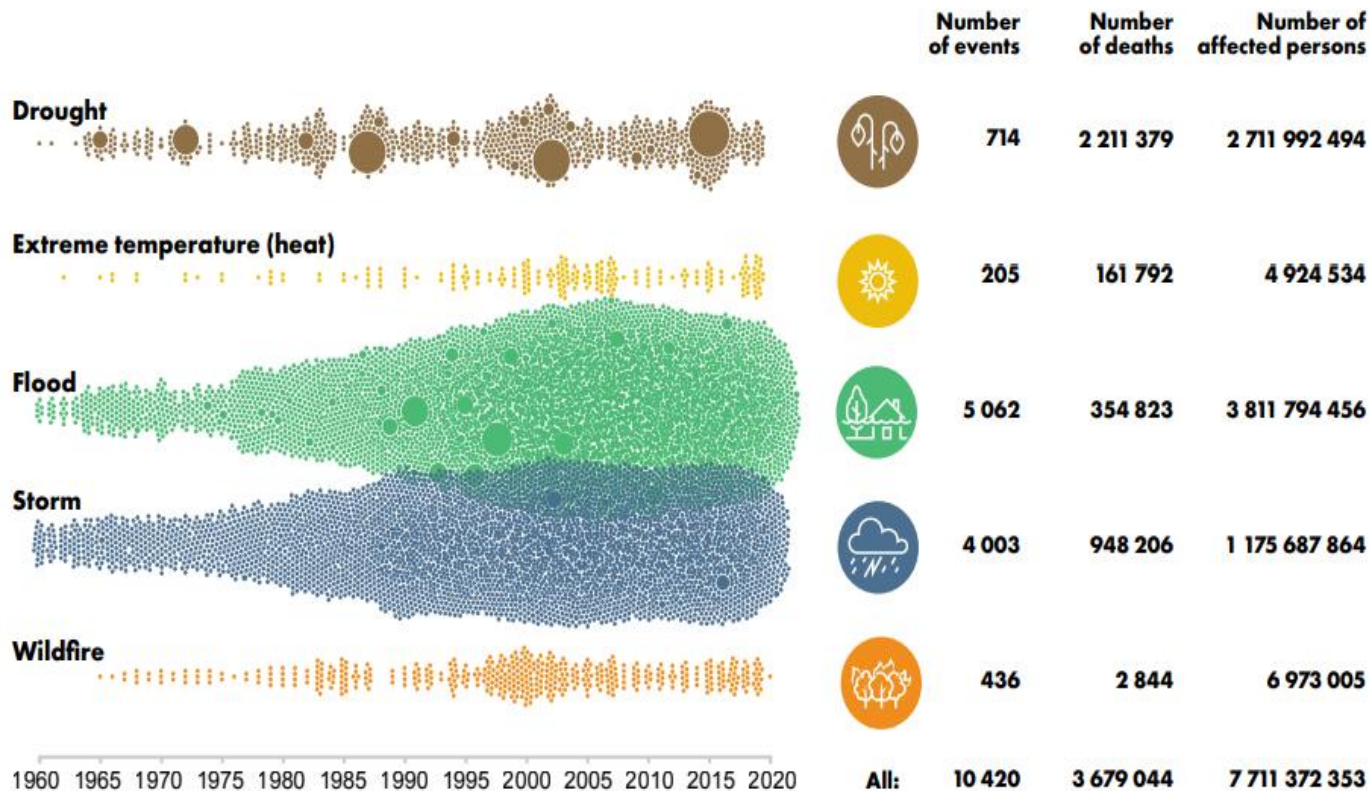
- **Flooding will occur in areas** that **don't currently have flooding** before
- Some area will become **permanently flooded**
- **Affect & damage soil** – quality decrease for agriculture
- **paralyzing economic**, transportation and logistics systems
- **Health** - Water diseases borne
- **corrosion** process - salt water damages property



Kuching Waterfront, 2015



Bintulu, 2014



Note: Each dot represents an event; circle size represents the number of affected persons.

Sources: (24); graphs produced with RAW Graphics (25).

D) HABITAT LOSS & DECREASES LAND AREA

- ❑ Rising seas **reduce** the **size of mudflats, marshes & intertidal habitats** - **no upland area is available for migration**, these habitats **will lost** as sea level rise

P. Upeh, Melaka –losing turtle nesting area



Mangroves area - Pantai Wawasan to Teluk Bakong, Batu Pahat

Nesting in gravel area – predator accessible (cant shovel ddeep), broken eggs (crushed by a pile of stones)

E) SALT WATER INTRUSION

- ❑ **Higher SL** cause **higher groundwater levels** - **increase in salinity** will contaminate **ground water**, harms **wells**, **septic systems**, **vegetations**, reduces **soil quality**
- ❑ Might **unlock nutrients** from **fertilizers**, makes **algae bloom** & when algae **die**, causing **depleted oxygen levels**, which can result in **harmful effects** on coastal **ecosystems** and **wildlife**.

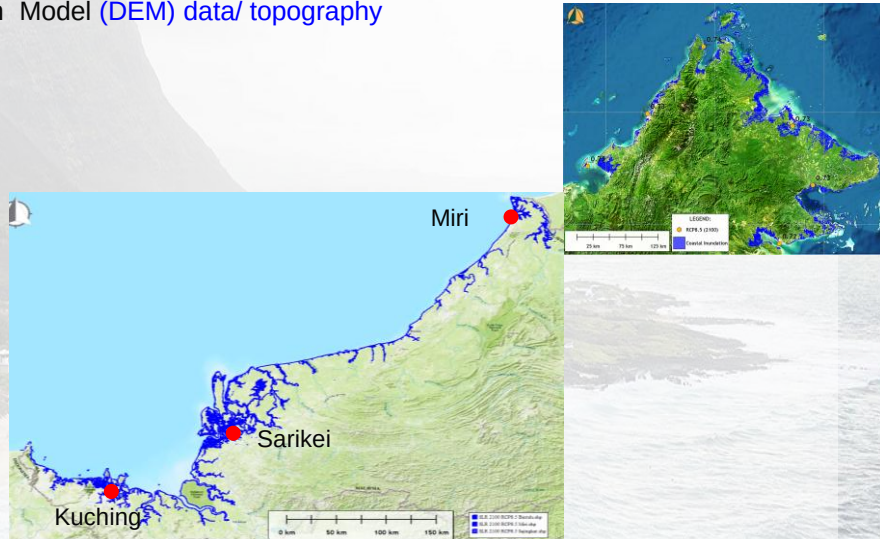


MODEL – STATIC & NUMERICAL

❑ STATIC MODEL

- Early assessment of coastal hazards is undertaken through **static modelling analysis**, referred to as 'bathtub' method using a **Geographical Information System (GIS)**
 - Easy to produce **inundation risk maps for Malaysia** shorelines under SLR scenario
- Consider **only Digital Elevation Model (DEM) data/ topography**

State	Total area of inundation due to sea level rise (RCP 8.5 for 2100)
	km ²
Perlis	53.05
Kedah	661.30
Pulau Pinang	319.02
Perak	1,185.80
Selangor	1,545.60
Negeri Sembilan	40.60
Melaka	73.27
Johor	1,166.40
Pahang	108.09
Terengganu	237.89
Kelantan	81.80
Sabah	2,512.13
Labuan	10.64
Sarawak	1,299.34
TOTAL	9,294.93

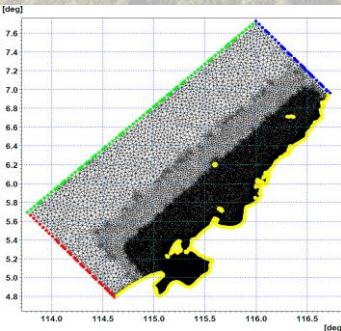
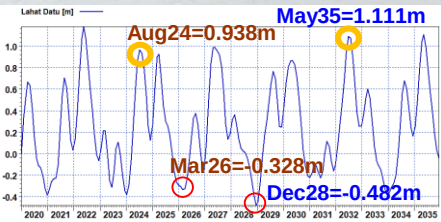
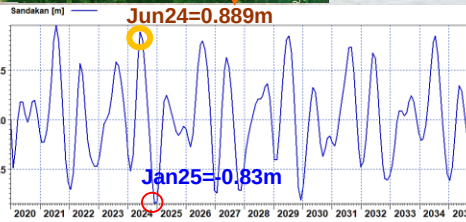
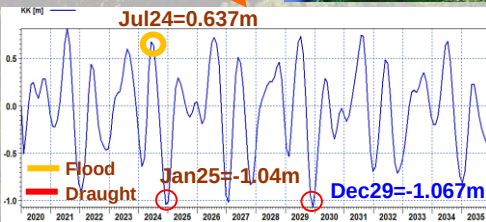
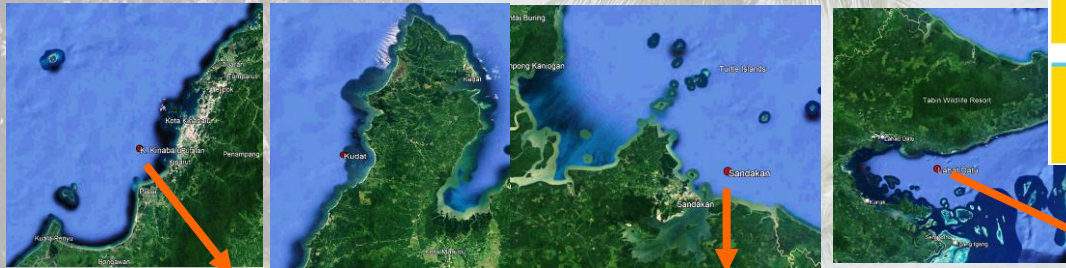
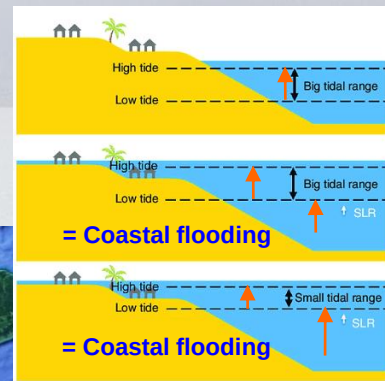


❑ NUMERICAL MODEL

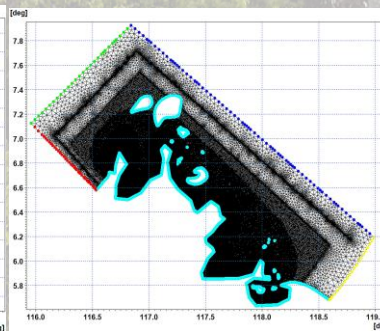
- **Comprehensive: Hydrdynamic data** (tide, current, bathymetry) + **DEM data**
- More complex: **Simulation (MIKE 21 FM) & Calibration Model** → **Processed in GIS** (Inundation Map – Potential Risk)
- In progress

DYNAMIC OF SEA LEVEL (Numerical Model)

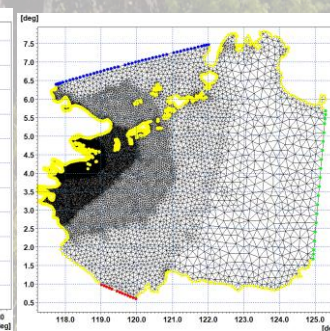
- Every 2-3 years, there will be highest tide occur along Sabah's coastal



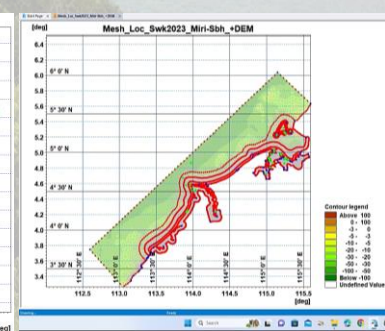
Kota Kinabalu



Kudat - Sandakan



Lahat Datu



Miri - Sabah

LATEST EXTREME EVENT (STORM SURGES/RUNUP)

Kg. Forest, Sabah



Lebih 100 buah rumah musnah akibat ombak susulan air laut pasang besar di Kampung Forest, Sandakan, Sabah pada 24 Disember 2022. Foto Facebook BERNAMA

BERNAMA

Amaran air pasang besar, penduduk pesis Sandakan dinasihati pindah

© December 25, 2022 2:24 pm



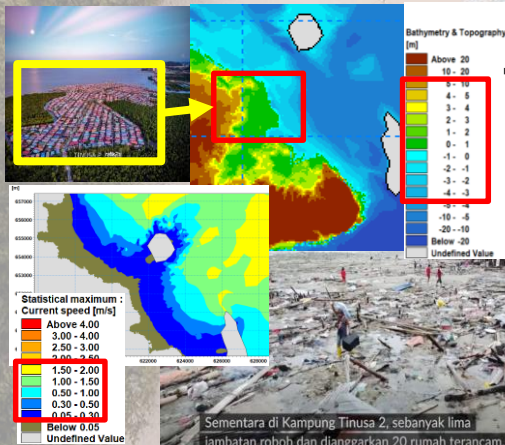
Lebih 100 rumah musnah dan dianggarkan 500 kediaman lagi terancam apabila ombak kembaran an laut pasang besar di kawasan setinggan di Kampung Forest, Sandakan, Sabah pada 24 Disember 2022. Foto BERNAMA

BERNAMA

38 lagi rumah roboh di Sandakan susulan air pasang, fenomena sama diramal berulang malam ini

© December 26, 2022 4:06 pm

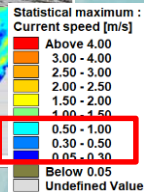
Kg. Tinusa 2, Sabah



Tg. Aru, Sabah

3 daerah terjejas banjir, ombak besar di Sabah

Oleh Iwan Abdullah - Disember 24, 2022 @ 5:49pm
bernewsgha.com.my



- Waves >1m height , cause damage to more fragile coastal infrastructure and buildings through scouring & debris load impact & deposition
- Low-lying area (-3 to 5m MSL)

- ≈60% (static model) shown Tg. Aru Island inundate risk along -1m depth to 4m from MSL
- Maximum current speed can go up to 1m/s on north

Miri, Sarawak

Drinking Horse, Jan. 2020



21st Feb. 2020 (from seafront view)



Piles of Drinking Horse's ruins

Saltwater Intrusion

Rajang Case Study

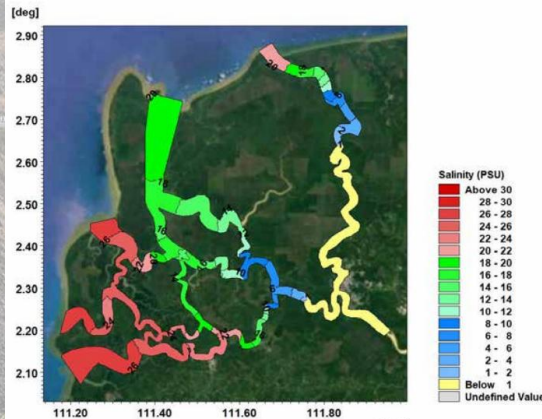
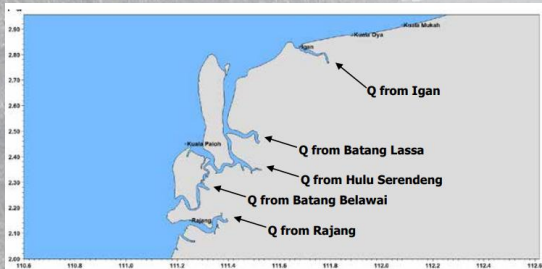


Figure 117: Salinity pattern in Rajang river network

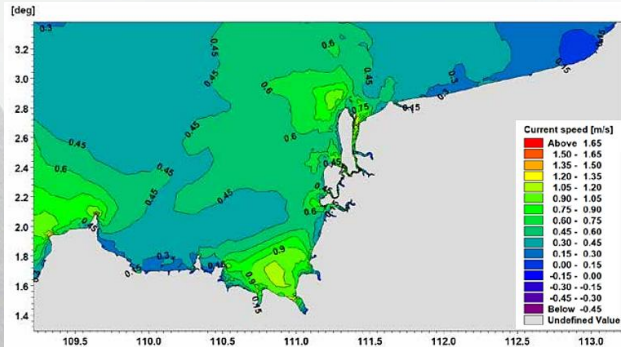


Figure 112: Maximum current at and around project site

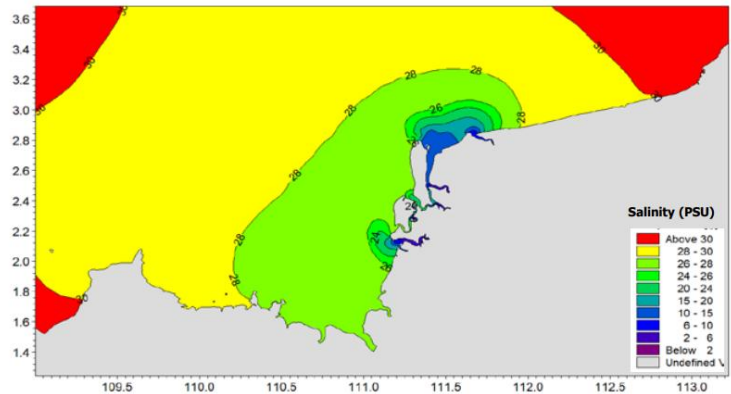


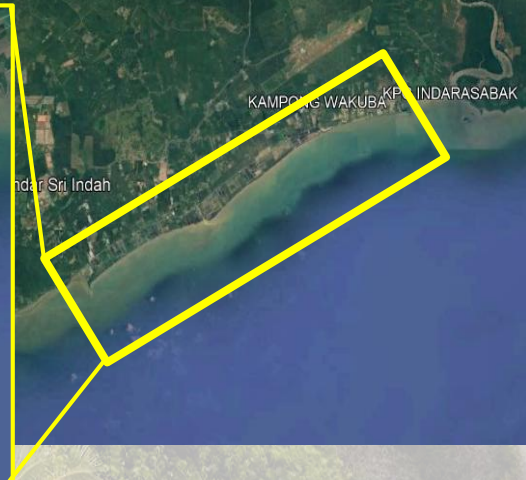
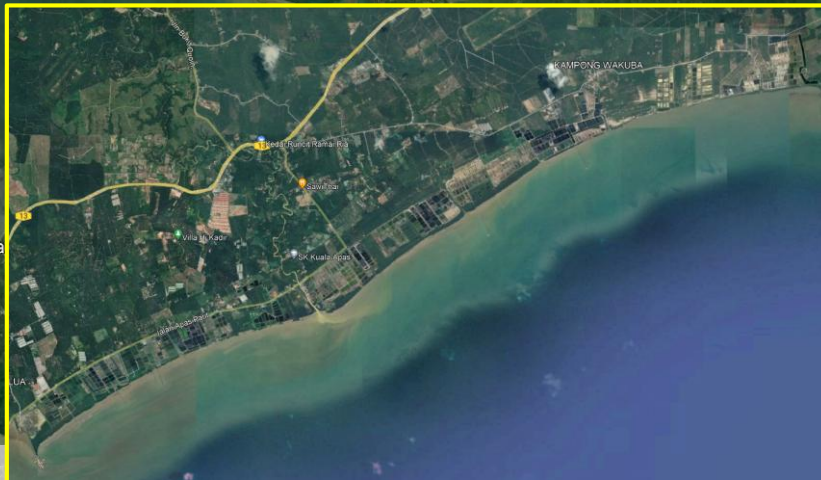
Figure 115: Salinity pattern in the Rajang estuary and in the sea when low from upstream

- Higher of SL with low upstream encourage salt water & current changes & move further to the inland



- Intensive aquaculture comes with environmental drawbacks
 - residual production effluent - major source of pollution & can degrade water quality in the surrounding ecosystem
 - increase the phosphorous & nitrogen load (algae bloom) in the water (oxygen depleted), harm the surrounding environment)

COASTAL WATER POLLUTION



CHECKLISTS TO ASSESS VULNERABILITIES IN HEALTH CARE FACILITIES IN THE CONTEXT OF CLIMATE CHANGE



Resilience

- the **ability** of communities, ecosystems, and infrastructure to withstand and **recover from the impacts of rising sea levels**.

Mitigation

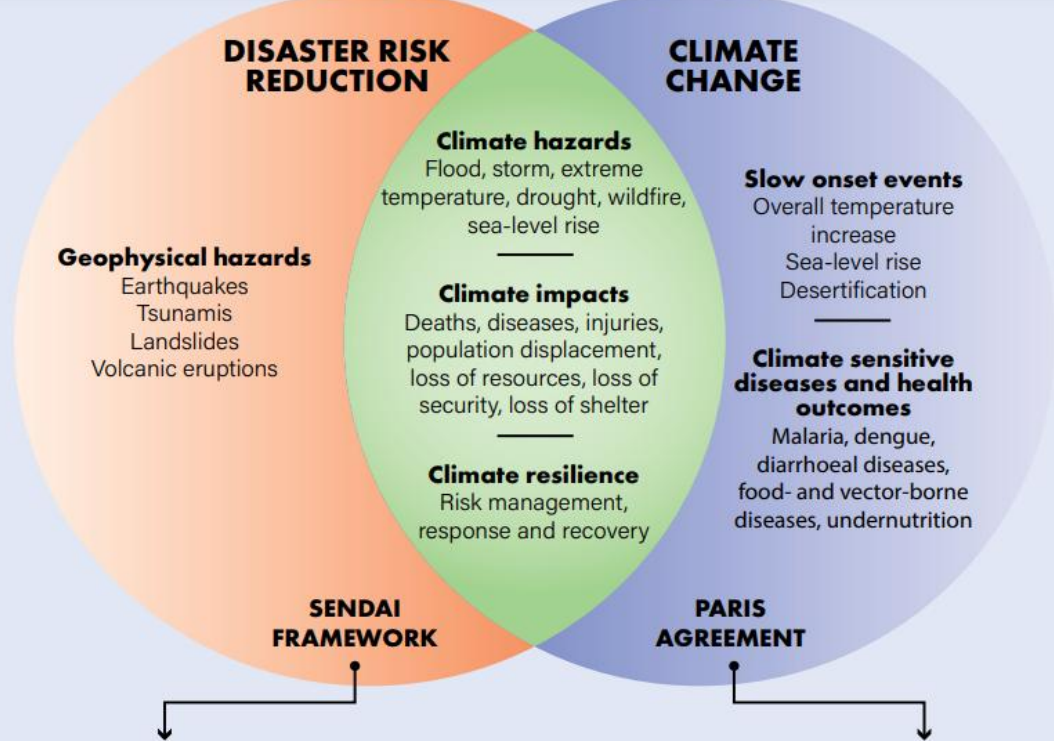
- Tackle to reducing the **causes of climate change**, which contributes to sea level rise

Adaptation

- Making adjustments** to social, economic, and environmental practices to minimize the risks posed by rising sea levels

	Immediate		Mid-Term		Long-Term	
	Health Impacts	Strategies	Health Impacts	Strategies	Health Impacts	Strategies
Direct	Drowning	Public awareness Rescue	Complications of injury	Early medical care	Mental health (Loss and grief)	Support and counseling
	Injury - Trauma Injury—debris, collapsed building, car crash, etc. - Electrical Injury - Burns and Explosions Injury	Building construction standards Evacuation Public awareness	Infection—skin and eye infections, fecal-oral injections	Early medical care	Chronic diseases	Effective health care
	Hypothermia	Rescue Awareness	Poisoning—Chemical contamination	Risk management Decontamination	Disability	Early intervention Rehabilitation
	Animal Bites	Rescue	Mental health—shock	Support and counseling		
Indirect	Health risks associated with the displacement of patients, disabled persons, seniors, children, etc. (e.g., heart attack, illness, deterioration)	Rescue Safe health services	Communicable diseases— - Over-crowding - Vector - Exposure to infectious diseases - Animal bites	Clean food and water Safe waste disposal Refugee care Immunization program	Malnutrition—poverty, damage of property	Economic recovery Aid and assistance programs

Table 2—Immediate, mid-term, and long-term direct and indirect health consequences of floods



Paragraph 13:

Addressing climate change as one of the drivers of disaster risk, represents an opportunity to reduce disaster risk in a meaningful and coherent manner

SUSTAINABLE DEVELOPMENT GOALS

Goal 13, Take urgent action to combat climate change and its impacts

Goal 11, Make cities and human settlements inclusive, safe, resilient and sustainable

Article 7.1 and Article 8.1

Article 7.1 enhancing adaptive capacity, strengthening resilience and reducing vulnerability to climate change

Article 8.1 averting, minimizing and addressing loss and damage associated with the adverse effects of climate change, including extreme weather events and slow onset events

CLIMATE HAZARD	CLIMATE-SENSITIVE DISEASES (INFECTIOUS DISEASES)	CLIMATE-SENSITIVE HEALTH OUTCOMES (NONCOMMUNICABLE DISEASES AND UNINTENTIONAL INJURIES)	POSSIBLE EXPOSURE PATHWAYS
SEA-LEVEL RISE 	Diarrhoeal diseases; cholera; hepatitis A; vectorborne diseases; zoonotic diseases; respiratory infections	Deaths; drowning, electrical shock; mental health (acute traumatic stress, anxiety and depression); cardiovascular diseases (hypertension); chronic respiratory diseases (asthma, COPD, respiratory allergies); protein-energy malnutrition; kidney disease	Increased saline water intrusion; freshwater contamination; flooded health care facilities; damaged health care facilities due to erosion; lack of power; food contamination; flooded sewage and waste systems; loss of crop productivity due to inundation or salinization; permanently displaced populations

The Problem of Statements:

- Frequency and magnitude of extreme weather
- Caring for patients during and after disasters (flood)
- No clean drinking water for patient (saltwater intrusion)
- Less guidance for developing comprehensive adaptation strategies for health care systems
- Healthcare facilities contributes to co2 emissions due to energy intensive 24 operation services and high demand on natural resources (energy, water and food procurement)
- Emergency management: status of healthcare services to sustain adversity risk of sea level rise
- Determining vulnerability to the health impacts of flooding is complex
- Across Southeast Asia, about 64 million people live within 5 meters (16.4 feet) above sea level.

Economic Burden on Healthcare Systems

- **Rising Insurance Costs:** With increasing risks of flooding, insurance premiums for healthcare facilities in coastal areas are skyrocketing, adding financial strain to healthcare systems.
- **Global Health Cost:** The World Health Organization (WHO) has warned that by 2030, climate-related health costs could reach \$2-4 billion per year globally, much of this due to impacts on healthcare facilities in flood-prone areas.

Loss of Healthcare Personnel and Resources

- **Personnel Shortages:** Frequent flooding can lead to burnout among healthcare workers, pushing them to relocate from high-risk coastal areas, exacerbating healthcare workforce shortages.
- **Resource Shortages:** Coastal flooding can disrupt the supply chain for essential medical supplies and pharmaceuticals, limiting the ability of healthcare providers to treat patients during crises.

ACTION/ ADJUSTMENT TO ADAPT WITH SLR

ADAPTATION 1) Protection on Coastal Structure/ infrastructure



Protection

- Maintaining the **existing shoreline** due to the significant **land use** within the zone, as long as **structural integrity** and **stability** are **not affected**
- use **hard structure to protect shoreline** (i.e. revetments, groynes, offshore breakwaters, artificial headlands, and protective beaches or provide enough **monsoon drain**)



Penampang monsoon drain, 2021



Sea wall at Sandakan Jetty, 2012

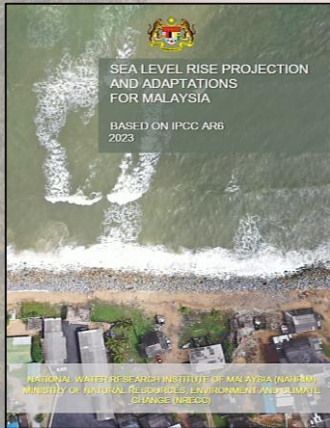


Rock armour, Sabah Electricity SB area, 2012

Contd. Protection on Coastal Structure/ infrastructure

GUIDELINE ON SEA LEVEL RISE (SLR) & ADAPTION FOR MALAYSIA (NAHRIM, 2023)

- designing structures **considering safe threshold levels** for coastal structures as an **adaptation to SLR**
 - appropriate **design elevation** or height **above current SL** - ensuring **long-term resilience**.
 - provide **flood protection** against increased **storm surge** and **coastal flooding** due to higher sea levels - resist and mitigate floodwaters
 - involve **considering** the **rate of shoreline erosion** and **establishing setback distances/ buffers** to account for future shoreline changes
 - **Safe threshold levels** for **coastal infrastructure adaptation** to SLR encompass **enhancing** the overall **resilience** of the structures.
 - crucial to **engage** with local communities, **stakeholders**, and experts to incorporate local knowledge, values, and concerns



ADAPTATION - 2) Accommodation

Accommodation



- Continuous usage of land in the dangerous area without protecting it but elevating building and raising the platform

Resort at Mabul



Mabul Jetty



Stamin River Jetty at Lundu



Village in Muara Tebas, Sarawak



ADAPTATION - 3) Nature-based Solution (NBS)/Ecosystem-based Adaptations (EbA)



a) Mangroves are resilient to SLR.

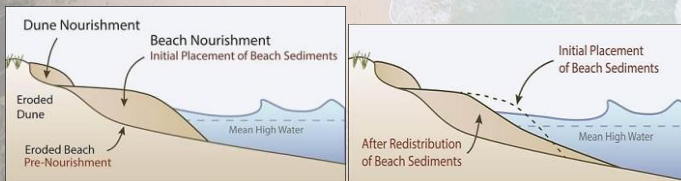
- SLR - cause increase in mud-flat levels at mangroves.
- roots - **adapt to increase in mud-flat levels**, since the rate of increase is slow, thus **new trees can colonize new mudflats**.



Mangroves at Kg. Forest shoreline

d) Dunes

- The dunes act as **natural reservoirs** - help to **replenish the beach profile** during extreme wave conditions
- **Vegetation** will **trap this sand movement** and cause the dunes to **build up**.



Replanting or Restoration:

b) Casuarina Tree (Rhu)

- A **very effective sand-dune stabiliser** and for preventing coastal erosion.
- Can contribute for tourism

c) Beach Nourishments/Sand motor

- the practice of **adding sand** or **sediment to beaches** to **combat erosion and increase beach width**.
- The process involves **dredging material** (sand, gravel, small pebbles) from a source area (offshore, near-land or inland) to feed the beach where erosion is occurring.

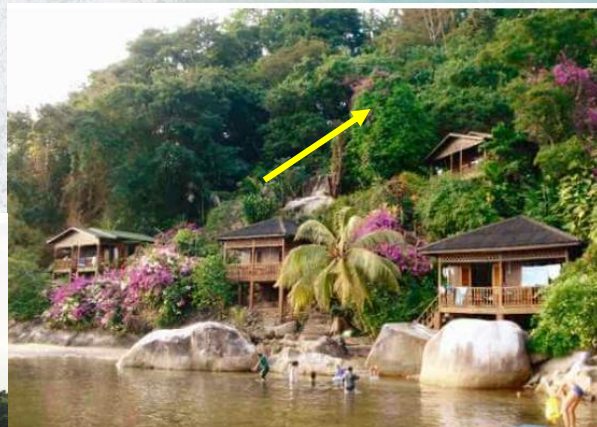
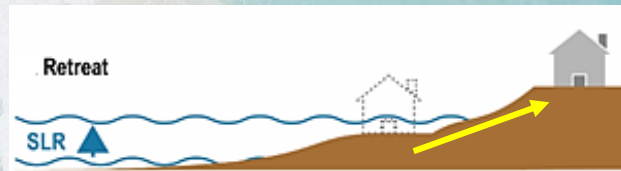


Myk. Beku, Johor

ADAPTATION - 4) Retreat/ Relocate/ Move to Higher Ground



Highest Area at Perhentian Island, Terengganu



Langkawi Island



Gaya Island, KK

NO ADAPTATIONS – DO NOTHING?

Coastal inundation – suitable topographic area



Inundation at Beluran

Affect on the local community's income/ sources



Flooding on the road at Batang Lupar, Sarikei, Sarawak

Gone valuables tourism area



Affect on development area/ villagers houses/ life treat



Upper neck of the Drinking Horse

Remnant of Drinking Horse's
Lower mouth

Compliance With Existing Local Laws, Legislations And Policy



Agencies & Legislation

Agencies that has involved with the coastal management & its act

AGENSI TERLIBAT DALAM PENGURUSAN PERSISIRAN PANTAI

AGENCIES INVOLVED IN COASTAL MANAGEMENT



List of the legislation related to the Coastal management

LEGISLATIONS RELATED TO COASTAL MANAGEMENT



Kanun Tanah Negara, 1965 [Akta 56]

National Land Code, 1965 [Act 56]

Akta Kualiti Alam Sekeliling, 1974 [Akta 127]

Environment Quality Act, 1974 [Act 127]

Akta Perancangan Bandar dan Desa, 1976 [Akta 172]

Town and Country Planning Act, 1976 [Act 172]

Akta Perikanan, 1985 [Akta 317]

Fisheries Act, 1985 [Act 317]

Akta Pemuliharaan Tanah, 1960 [Akta 385]

Land Conservation Act, 1960 [Act 385]

Akta Perhutanan Negara, 1984 [Akta 313]

National Forestry Act, 1984 [Act 313]

Akta Taman Negara, 1980 [Akta 226]

National Park Act, 1980 [Act 226]

Akta Pembangunan Mineral, 1994 [Akta 525]

Mineral Development Act, 1994 [Act 525]

Akta Jalan, Parit dan Bangunan, 1974 [Akta 133]

Street, Drainage and Building Act, 1974 [Act 133]

Akta Kawasan Larangan dan Tempat Larangan, 1959 [Akta 298]

Protected Areas and Protected Places Act, 1959 [Act 298]

Akta Pelantar Benua, 1966 (Disemak 1972) [Akta 83]

Continental Shelf Act, 1966 (Amendments 1972) [Act 83]

Akta Kerajaan Tempatan, 1976 [Akta 171]

Local Government Act, 1976 [Act 171]

Akta Warisan Kebangsaan, 2005 [Akta 645]

National Heritage Act, 2005 [Act 645]

Source: PLANMalaysia

MALAYSIA'S SLR PROJECTIONS – ADAPTATION, PLANNING /COASTAL MANAGEMENT

- ❑ Refer to **GUIDELINE ON SEA LEVEL RISE (SLR) ADAPTION FOR COASTAL DEVELOPMENT** (NAHRIM, 2023)
 - Accounted designing coastal structure/ development with 5 considerations & focus designing that withstand the impacts and associated coastal hazards
- ❑ Adaptation should go the ‘adaptation pathways’ (dynamic approach) and priority considered on necessary on local condition (Adapt to risk)
- ❑ Communities engagement, local Action Plans & Disaster Management
- ❑ **MUST** have strong / essential to refer to policy, legislations & EIA Requirements/ guideline regarding climate change & SLR which compliance coastal development with legally framework (zoning & landuse), local laws & regulations

THANK YOU



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Lat 3.001500°



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