Technical Talk, Drainage & Irrigation Department Malaysia, in collaboration with Malaysian Hydrological Society (MHS) and International Hydrological Programme (UNESCO-IHP Malaysia), 19 October 2012, Kuala Lumpur

Natural Hazards and the Changing Climate

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Southeast Asia Disaster Prevention Research Institute
Universiti Kebangsaan Malaysia (SEADPRI-UKM)

SEADPRI-UKM

Established on 1 June 2008

Vision

The leader in Innovative Research and Knowledge Transfer on Holistic Disaster Prevention

Mission

- Conduct holistic research on hazards and disasters at national and regional levels
- Enhance human capital and capacity at national and regional levels, particularly in Southeast Asia
- Support knowledge-based decision making on climatic, geological and technological hazards

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Research Programs

Holistic and integrated approach (science, technology, impact, vulnerability & governance) to reduce risk of:

- Climatic Hazards
- Geological Hazards
- Technological Hazards

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Core Activities

- Research
- Education and Training
  - Masters and Doctoral programs
- Workshop and Training Courses
- Outreach and Networking

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Outline:

1. Hazards and Disasters
2. Highlights from IPCC-SREX
3. Definitions: Conceptual to Operational
4. Policy Context
5. Concluding Remarks

Hazards & Disasters (UNISDR 2004)

Hazards

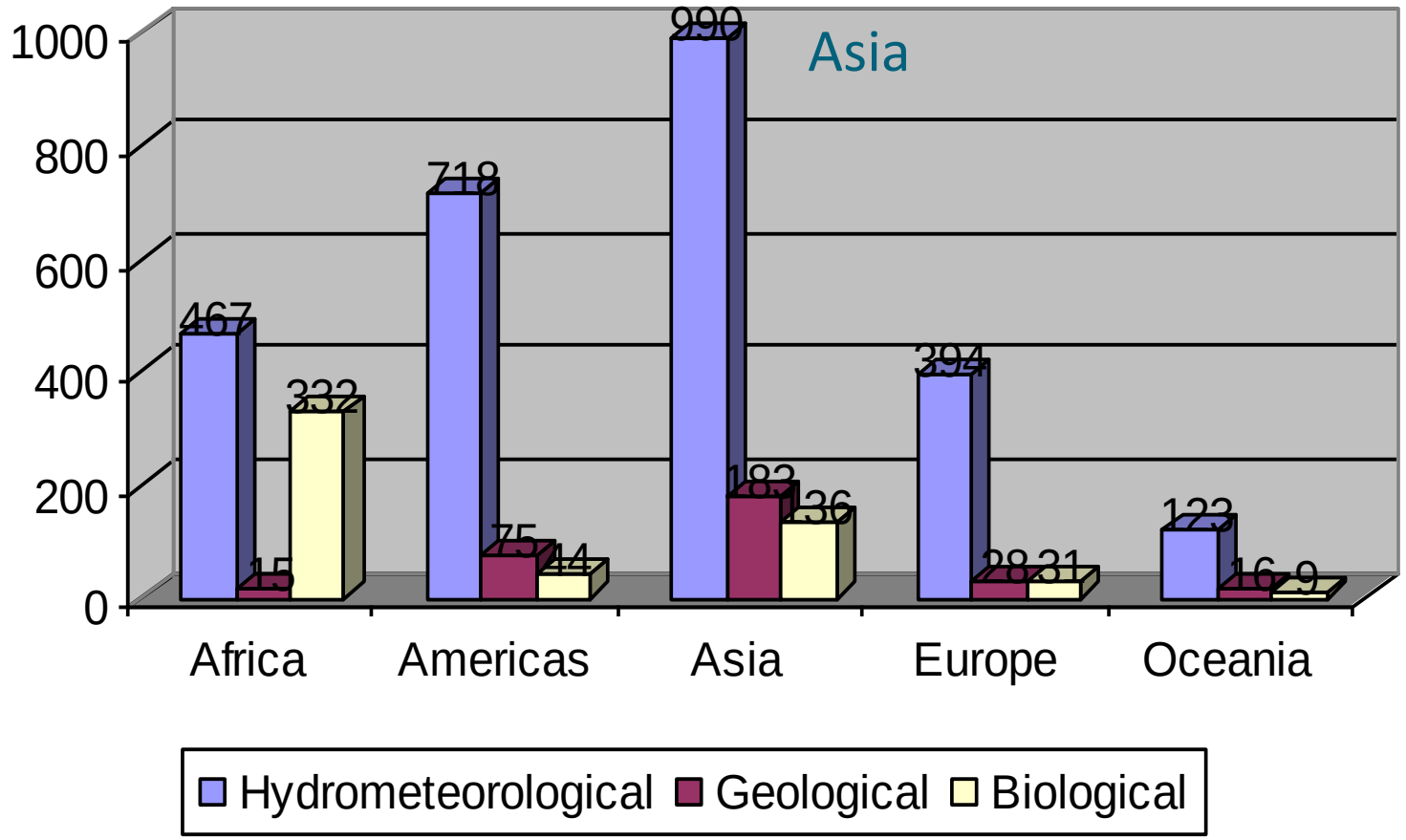
- Potentially disruptive physical events, substance, phenomena or human activities
- May cause the loss of life or injury, property damage, social and economic difficulty or environmental degradation,
- Includes dormant conditions that may represent future threats

Disasters

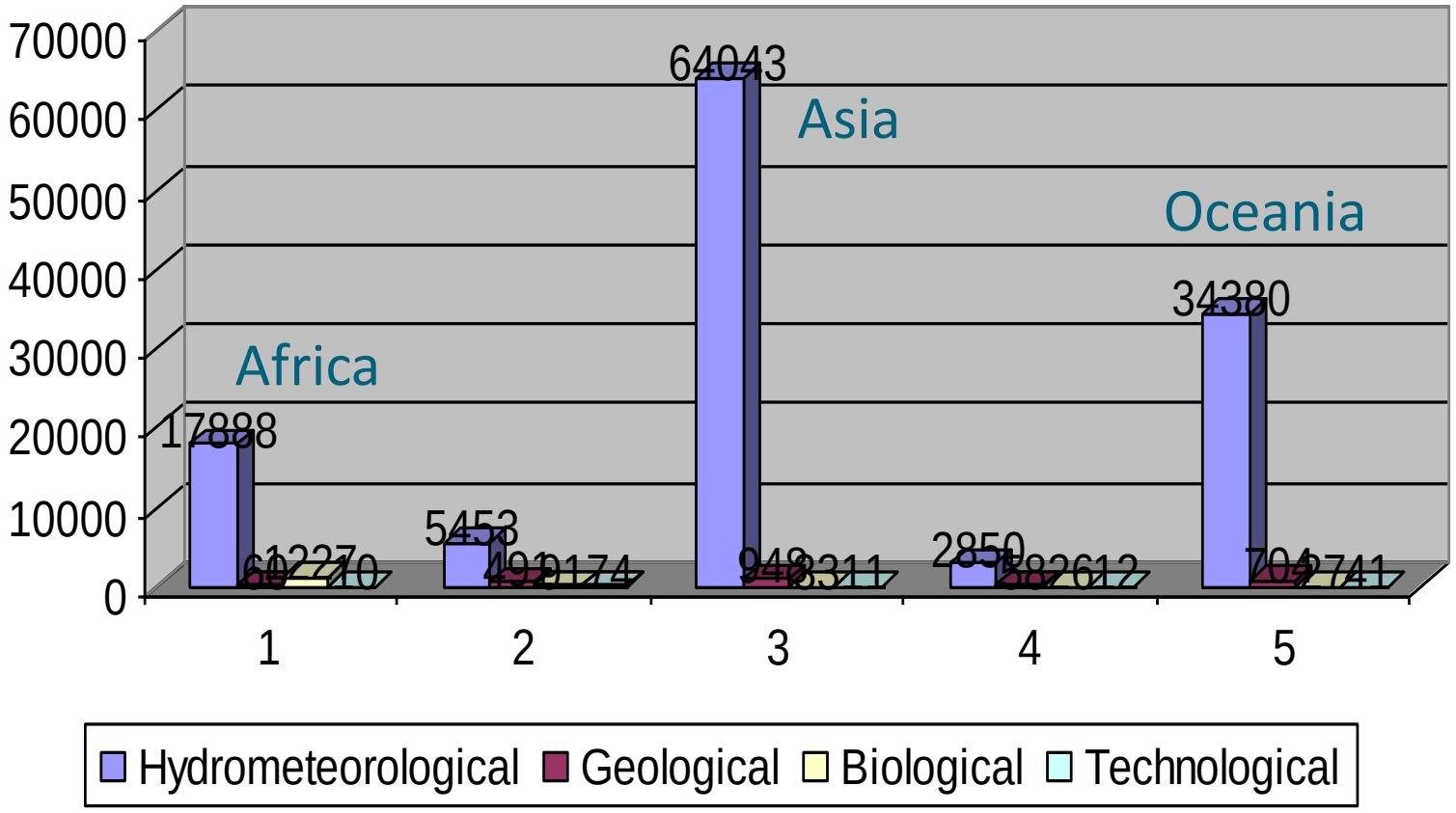
- Consequences of such disruptive events, phenomena or human activities on human life, properties and infrastructure
- Occurs within a specific geographic area in a given period of time.

Hazards and vulnerability combined create risks that threaten the well-being of a community and without any form of intervention, they always lead to disasters.

Distribution of Natural Disasters by Origin, 1994-2003 Source: OFDA/CRED International Disaster Database



Average number of people affected per million inhabitants,1994-2003 Source: OFDA/CRED International Disaster Database



Hazardous Events & Processes

Hazardous Events

- Intense events that cause abrupt situational change over a specific period of time, which then reverts back to normal.
- Measurable with specific start and ending times.
- Eg. earthquakes, tsunamis, volcanic eruptions, landslides, floods, storms and forest fires

Hazardous Processes

- Insidious and relatively slow, permanent or long lasting
- Unclear start and ending times
- Eg. erosion, soil degradation, desertification and climate change.

The risk of a disaster may increase if a hazardous process influences a hazardous event or vice versa. Eg. climate change is a process that influences hazards.

Hazards and their Responses to Climate Change (Modified after Schmidt-Thome, 2006)

Hydrometeorological Hazards • Avalanche • Extreme temperature • Drought • Forest fire • Flood • Storms and storm surges	Influenced by climate change
Biological Hazards **Technological Hazards** **Environmental Degradation** **Geological Hazards** • Landslides • Subsidence	May be influenced by climate change
• Earthquakes** • Tsunamis** • Volcanic eruptions	Not influenced by climate change

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The IPCC Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation

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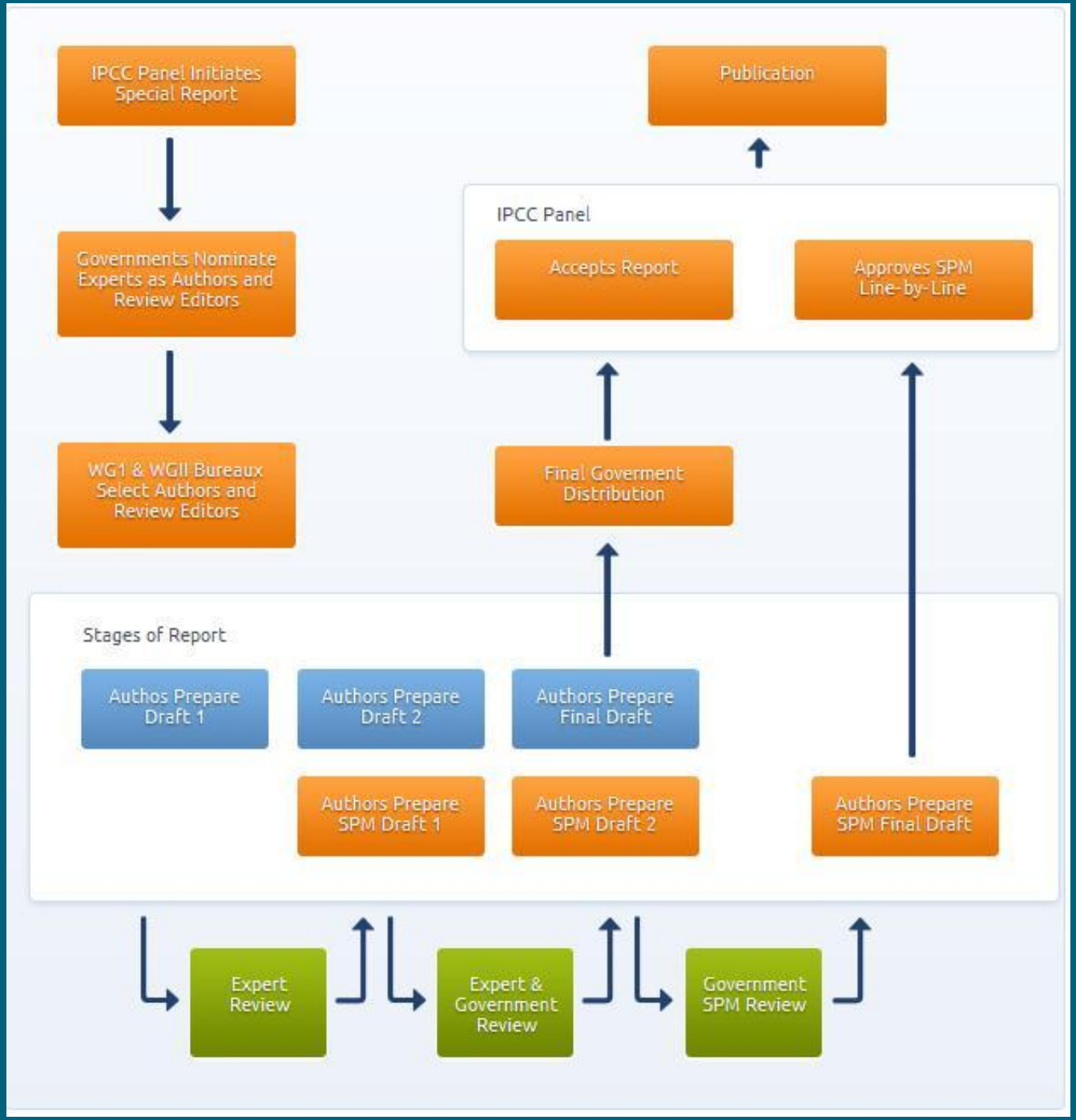
IPCC SREX: The Process



A changing climate leads to changes in extreme weather and climate events

Source: IPCC, 2012

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- Since 1950, extreme hot days and heavy precipitation have become more common.
- There is evidence that anthropogenic influences, including increasing atmospheric greenhouse gas concentrations, have changed these extremes

Source: IPCC, 2012

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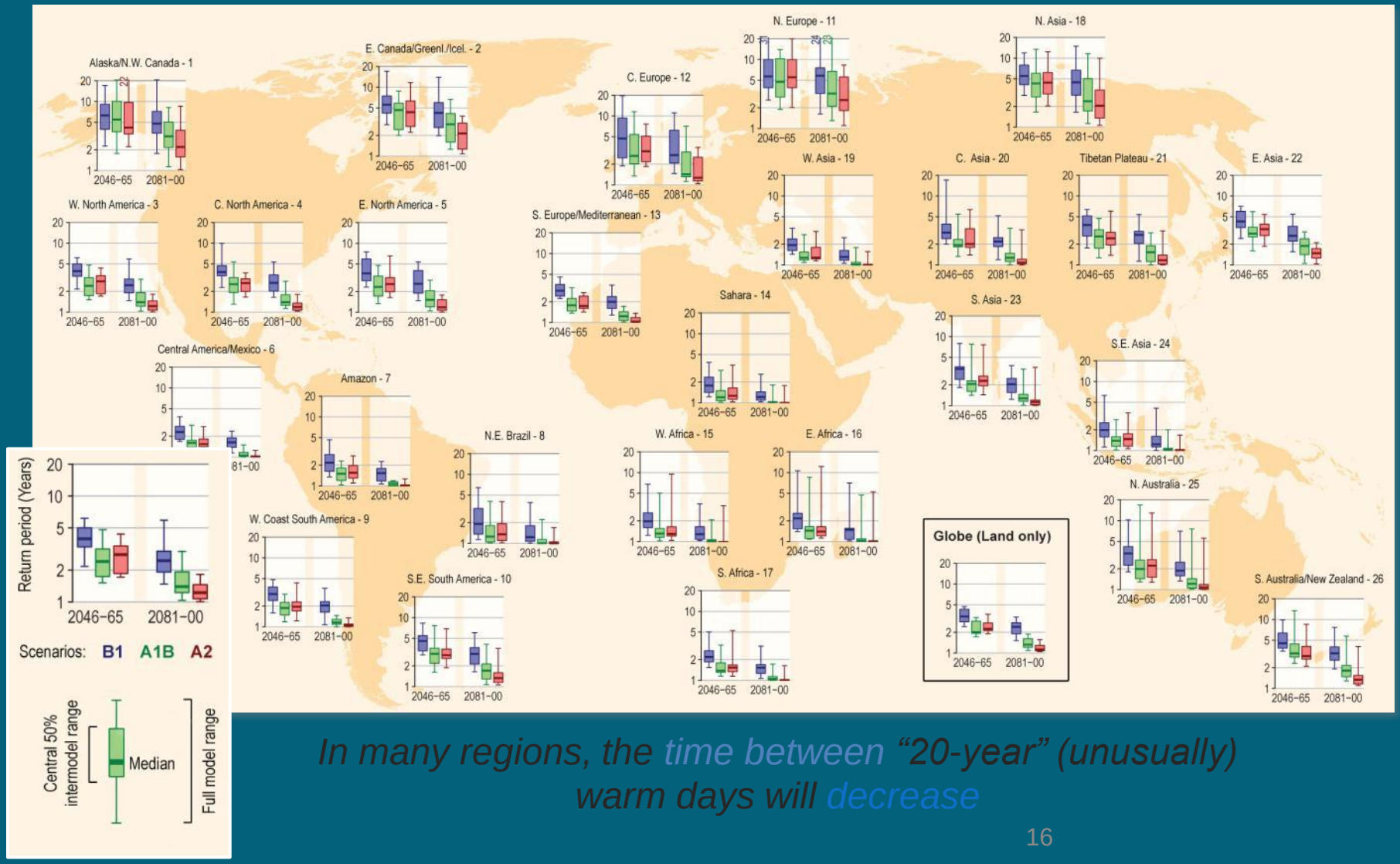
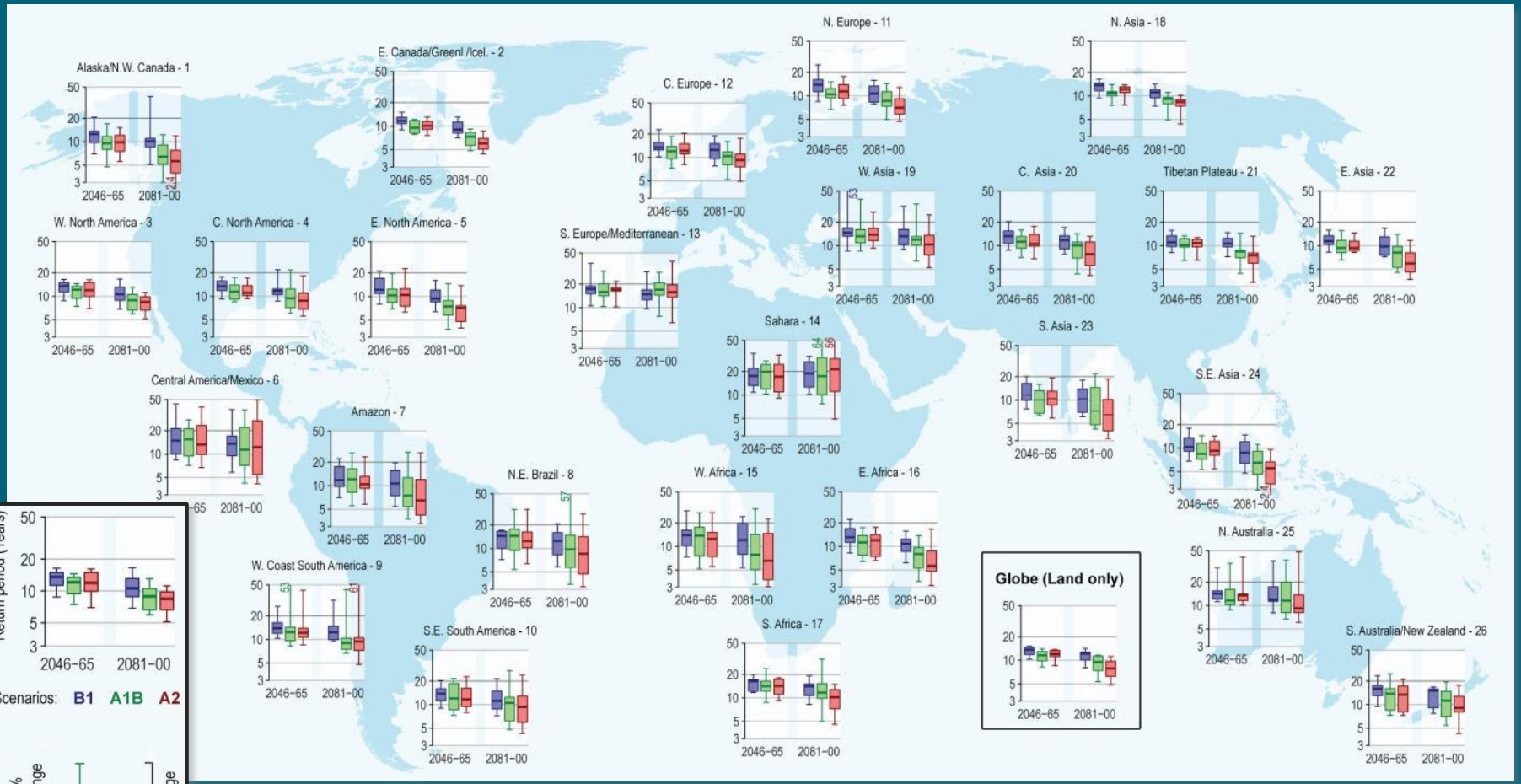
Climate models project more frequent hot days throughout the 21st century



In many regions, the time between "20-year" (unusually) warm days will decrease

Climate models project more heavy rain events throughout the 21st century



In many regions, the time between "20-year" (unusually intense) rainstorms will decrease

Impacts from weather and climate events depend on:

nature and severity of event

vulnerability

exposure

For exposed and vulnerable communities, even non-extreme weather and climate events can have extreme impacts

- Africa's largest recorded cholera outbreak
- over 90,000 affected
- over 4,000 killed
- began following onset of seasonal rains
- vulnerability and exposure increased risk

Impacts of climate extremes can be felt locally or regionally

Source: IPCC, 2012

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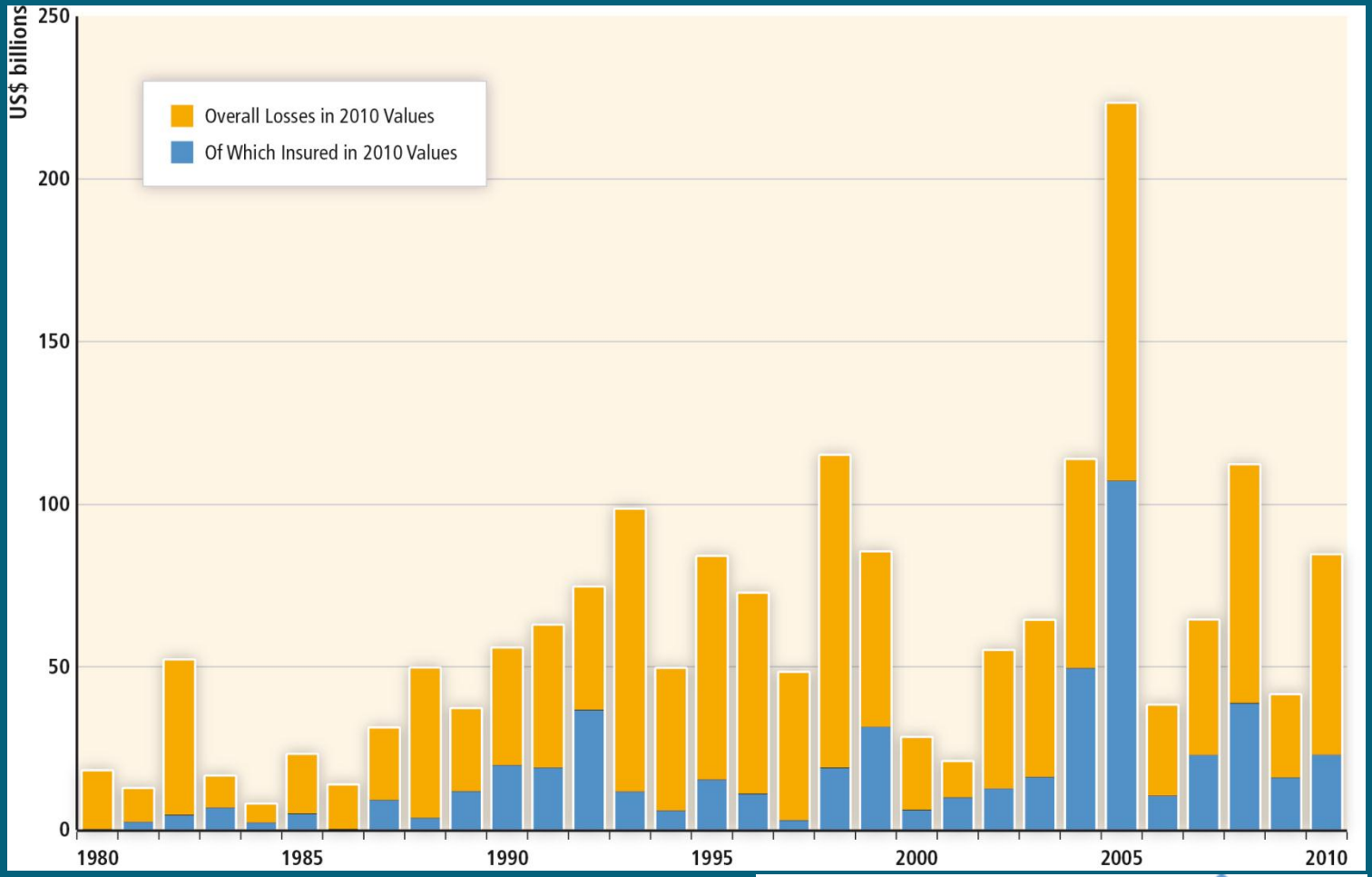
AGRICULTURE	**"Mongolian herdsmen face starvation"** *March 14, 2000,* ***BBC World News***
ENERGY	**"Heatwave hits French power production"** *August 12, 2003,* ***The Guardian***
WATER	**"Drought returns to haunt Ethiopia"'** *May 19, 2008,* ***Reuters***
PUBLIC HEALTH	**"Cholera confirmed in Pakistan flood disaster"** *August 14, 2010,* ***Associated Press***
TOURISM	**"Alpine resorts feel heat during record warm spell"** *December 08, 2006,* ***CNN World News***
TRANSPORTATION	**"Flash flooding causes train to derail"** *July 30, 2001,* ***Chicago Sun Times***

Economic losses from climate-related disasters have increased, with large spatial and interannual variations



- Economic losses - higher in developed countries
- Fatalities - higher in developing countries

Source: IPCC, 2012

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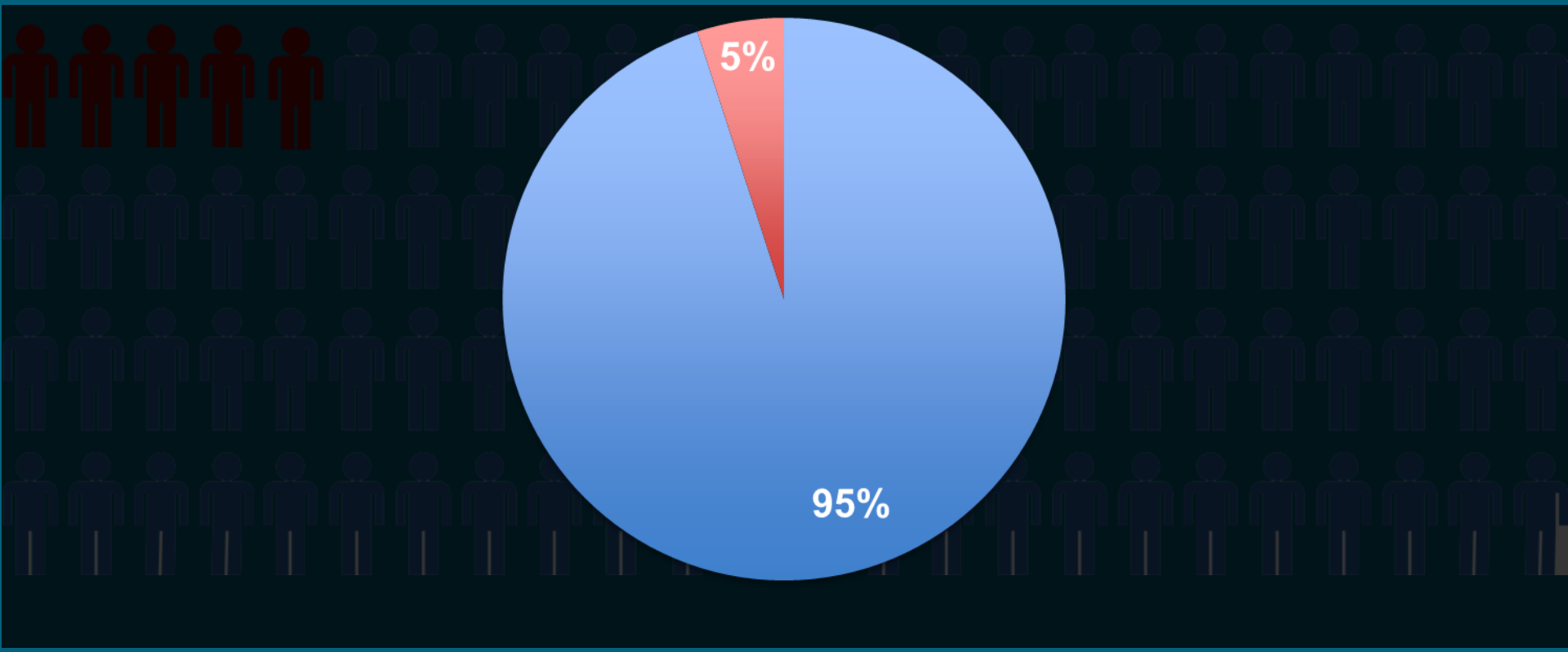
Fatalities are higher in developing countries



From 1970-2008, over **95%** of natural-disaster-related deaths occurred in developing countries

Source: IPCC, 2012

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Effective risk management and adaptation are tailored to local and regional needs and circumstances

- Changes in climate extremes vary across regions
- Each region has unique vulnerabilities and exposure to hazards
- Effective risk management and adaptation address the factors contributing to exposure and vulnerability

Source: IPCC, 2012

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Managing the risks: hurricanes in the USA and Caribbean

Risk Factors

- population growth
- increasing property value
- higher storm surge with sea level rise


Hurricane Katrina, 2005

Risk Management/ Adaptation

- better forecasting
- warning systems
- stricter building codes
- regional risk pooling

Projected globally: *likely* increase in average maximum wind speed and associated heavy rainfall (although not in all regions)

Source: IPCC, 2012

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Managing the risks: flash floods in Nairobi, Kenya

Risk Factors

- rapid growth of informal settlements
- weak building construction
- settlements built near rivers and blocked drainage areas

Risk Management/ Adaptation

- reduce poverty
- strengthen buildings
- improve drainage and sewage
- early warning systems

Projected: *likely* increase in heavy precipitation in East Africa

Source: IPCC, 2012

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Managing the risks: sea level rise in tropical SIDS

Risk Factors

- shore erosion
- saltwater intrusion
- coastal populations
- tourism economies

Risk Management/ Adaptation

- early warning systems
- maintenance of drainage
- regional risk pooling
- relocation

Projected globally: *very likely* contribution of sea level rise to extreme coastal high water levels (such as storm surges)

Source: IPCC, 2012

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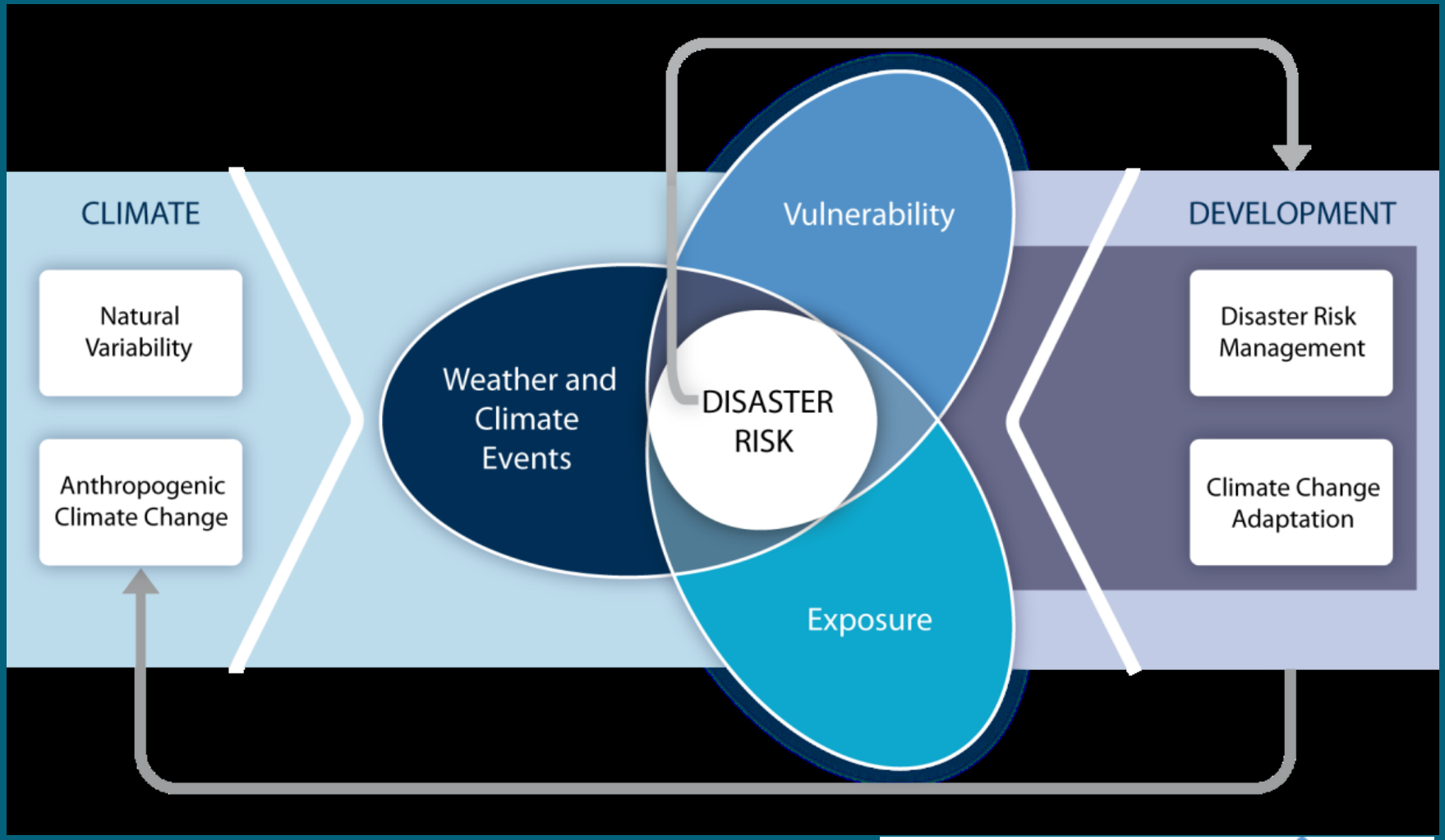
Increasing vulnerability, exposure, or severity and frequency of climate events increases disaster risk



Disaster risk management and climate change adaptation can influence the degree to which extreme events translate into impacts and disasters

Source: IPCC, 2012

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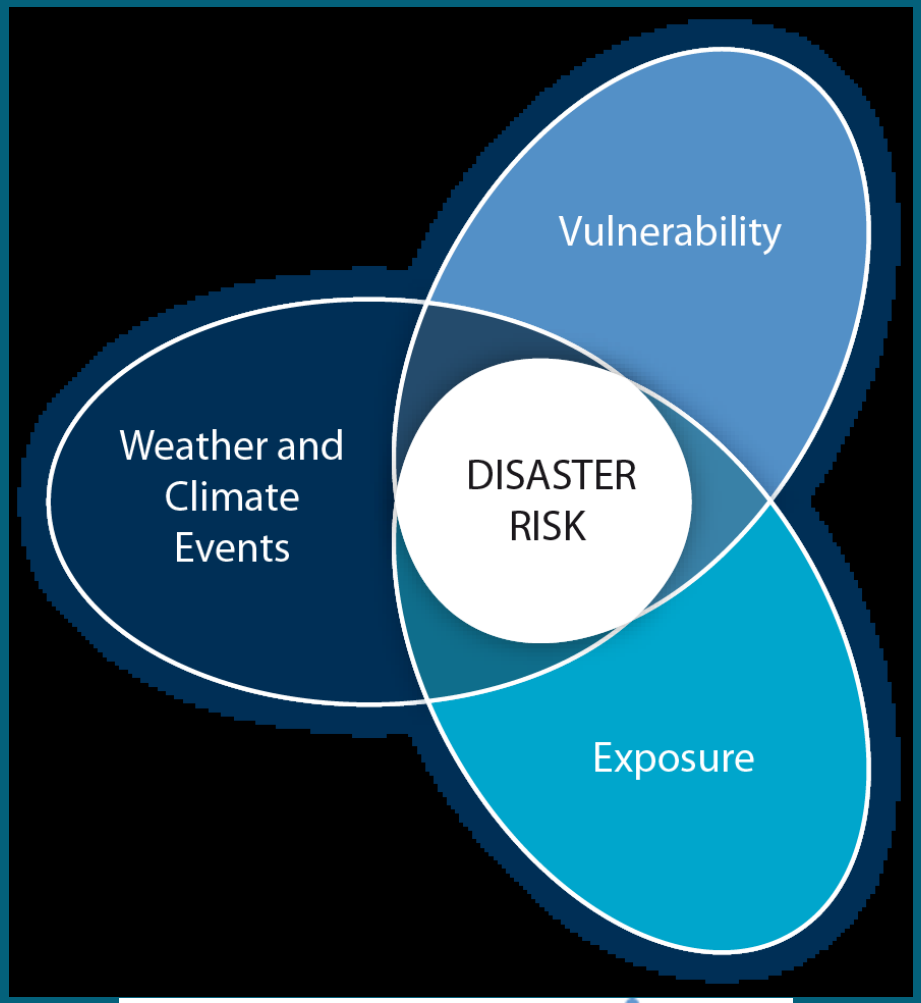
Information on vulnerability, exposure, and changing climate extremes can together inform adaptation and disaster risk management

- Improved forecasting for warning systems
- Reduction of greenhouse gas emissions



- Poverty reduction
- Better education and awareness
- Sustainable development

- Asset relocation
- Weather-proofing assets
- Early warning systems

Source: IPCC, 2012

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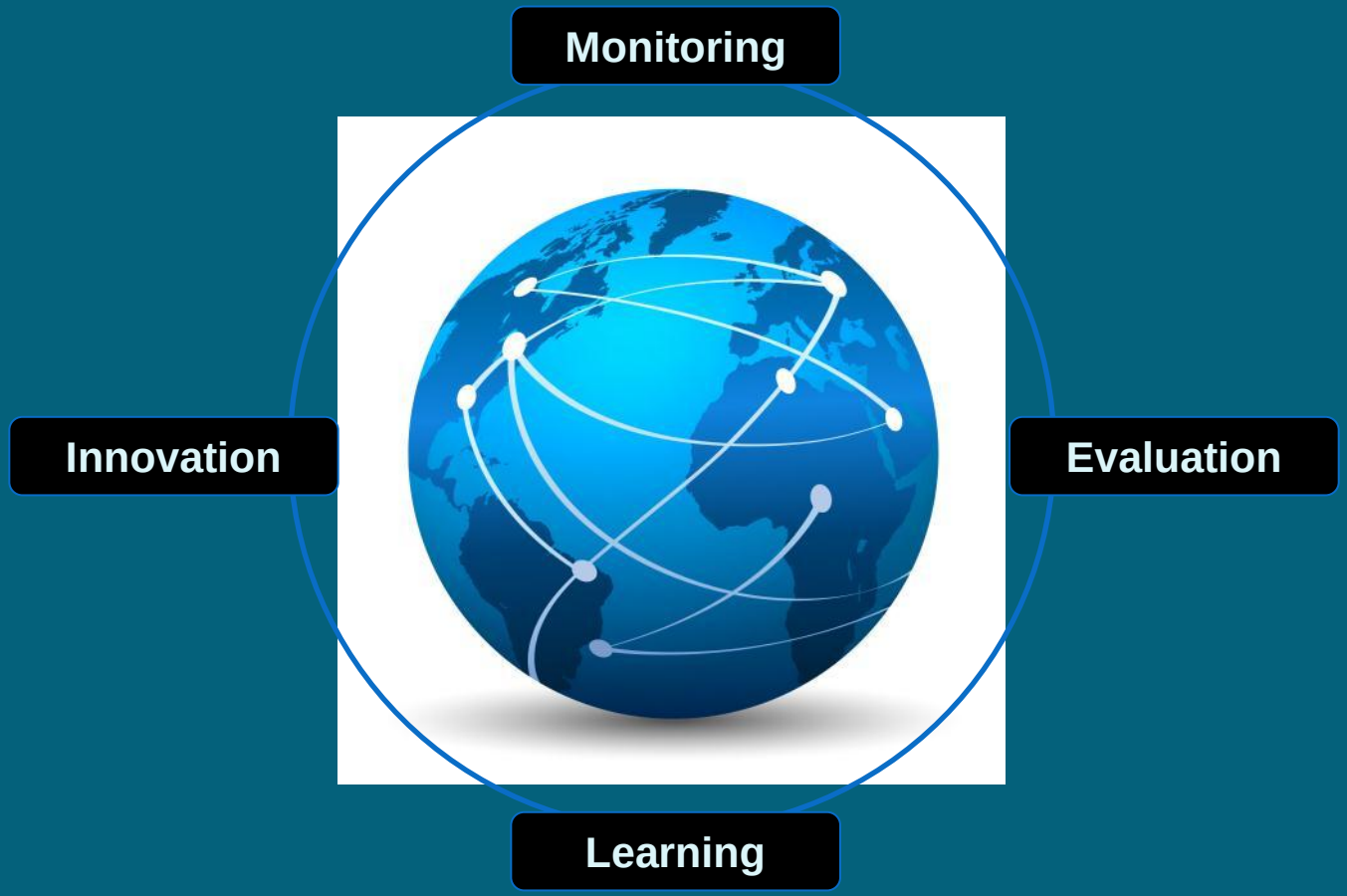
Managing risks of disasters in a changing climate benefits from an iterative process



Learning-by-doing and low-regrets actions can help reduce risks now and also promote future adaptation

Source: IPCC, 2012

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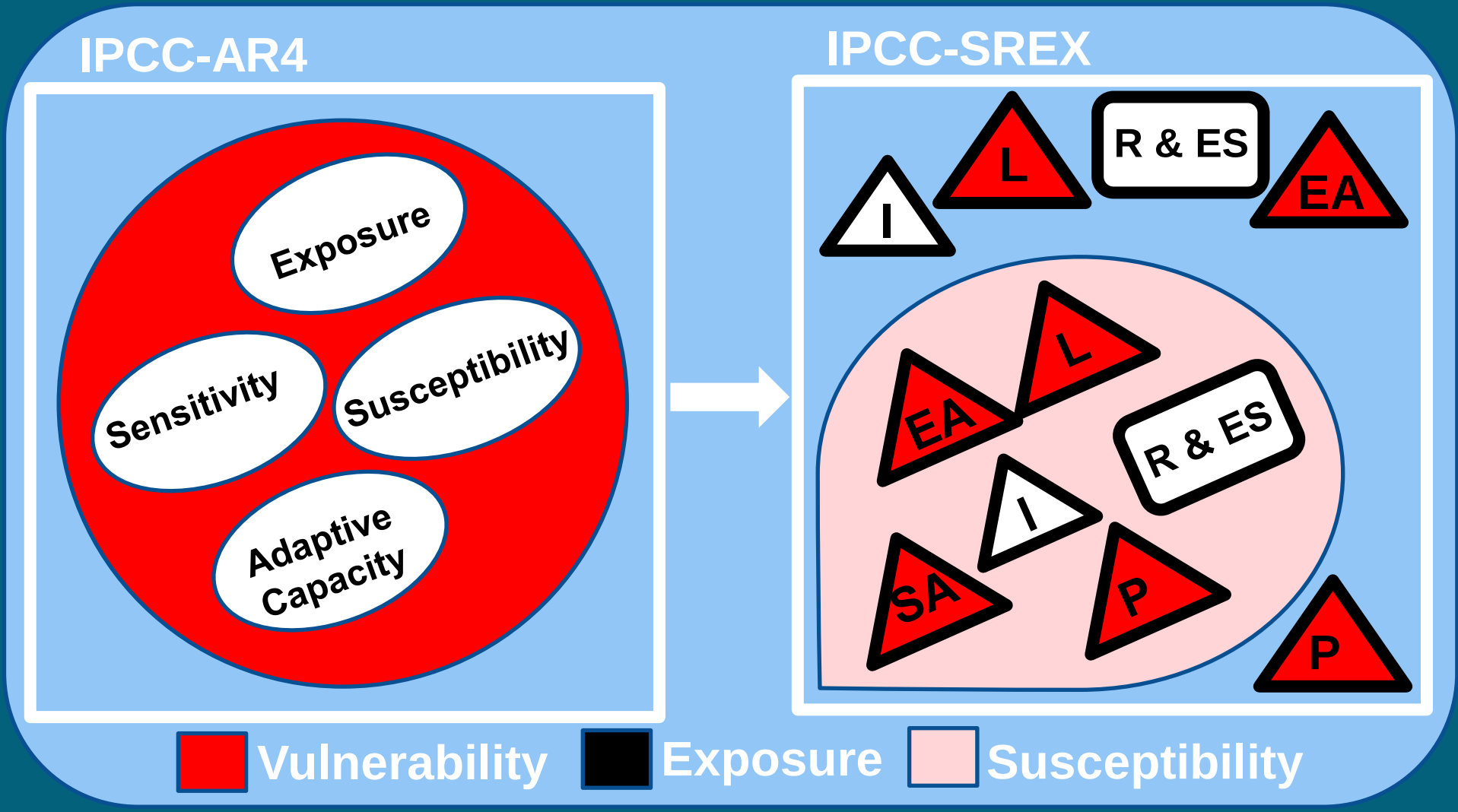
Notional Linkages of Concepts



I= Infrastructure; SA= Social Assets; EA= Economic Assets; L= Livelihood; P= People; R= Resources ; ES= Ecosystem Services (Source: Pereira, 2012)

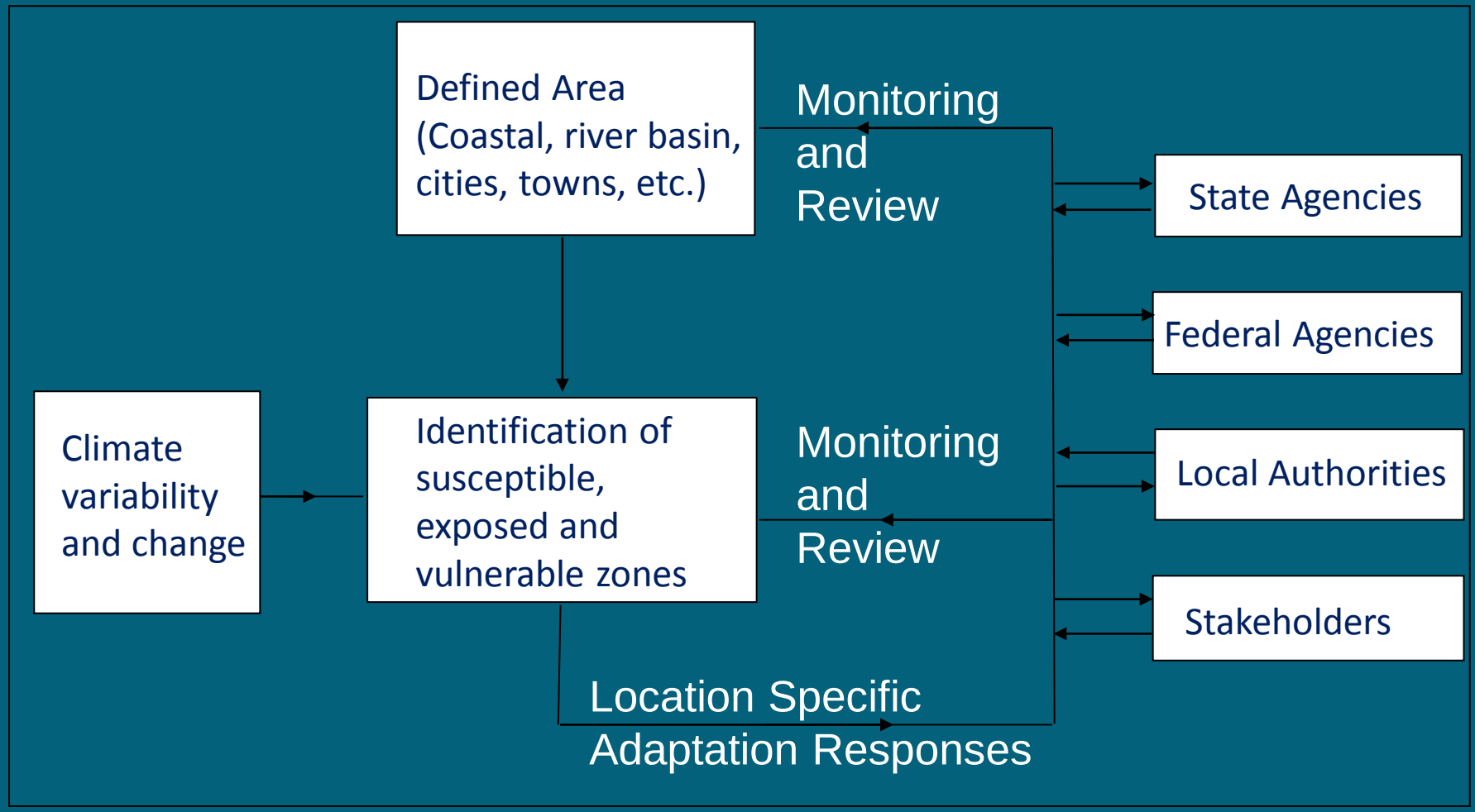
Approaches to adaptation (Sources: Vicuna and Dracup, 2007; Arnell, 2010; Fünfgeld and McEvoy, 2011; Moench et al., 2011; Kenny, 2011).

Approaches	Limitations
Top-down climate impact assessment	▪ Uncertainty - climate models are not able to give accurate local scenarios for many climatic variables. ▪ Process of downscaling is resource intensive and time consuming. ▪ Limited use for short and medium term decision making at local levels. ▪ Under-emphasizes the role of autonomous adaptation.
Bottom-up vulnerability assessment	▪ Difficult to compare the results from different assessments and different areas. ▪ Can be skewed towards a “predict and prevent” paradigm based in structural interventions if stakeholder interests is neglected. ▪ Limited capacity and communication among stakeholders on understanding the difference between climate projection modelling and climate impacts modelling.

Adaptation Practices

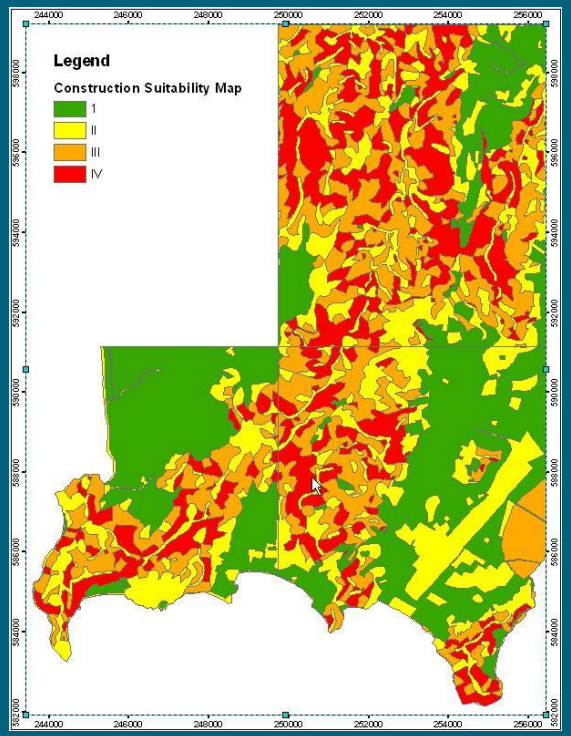
Initiative	Top-Down Approach: Climate Modelling	Bottom-up Approach: Vulnerability Assessment	Adaptation Measures
Sydney Coastal Councils Group, Australia (Smith et al., 2008)	Based on best available science involving climate and other scientists, engineers and planners.	Based on primary and secondary data sources. Focused on identifying institutional barriers at the local level.	Mainstreaming into development plans at local levels. Strengthening adaptive capacity through local demonstration projects.
Gorakphur, India (Wajih et al., 2010)	Downscaled from GCM (CGCM3, CNRM, CSIRO and MIUM)	Based on primary data (surveys)	Surveillance and monitoring of basic delivery services, pilots, school programmes, citizen mobilization.
Lao-Oi District, Thailand (Chinvanno and Kerdsuk, 2012)	Regional model used, downscaled from GCM (ECHAM 4, PRECIS)	Based on primary and secondary data sources.	Mainstreaming into local development plans. Improving coordination and communication between local provincial and national levels.
Asian Cities Climate Change Resilience Network, ACCCR (Cities in India, Indonesia, Vietnam and Thailand) (Moench et al., 2011)	No local level projections and minimal historical data	Based mainly on primary data sources. Focused on major existing hazards.	Strengthening adaptive capacity through awareness building, local sector-based studies.

Proposal: A Spatially Contextualised Approach for Local Adaptation



Geological Terrain Mapping in Malaysia

- A systematic method of landform or terrain mapping and evaluation for landuse planning and construction suitability determination.
- Developed by Minerals and Geoscience Department of Malaysia. Modified from HK GCO.
- Integrates data from remote sensing analysis and field mapping in the GIS.
- Objectives:
  - Preparation of a terrain classification map
  - Preparation of a construction suitability map
  - Provide systematic input for development planning
  - Preparation of other thematic maps for use by engineers and town planners.
- The main product is a Construction Suitability Map, where an area is classified into 4 classes (Class I, Class II, Class III & Class IV).
- Adopted by NRE as a guideline for highland & hill slope development.

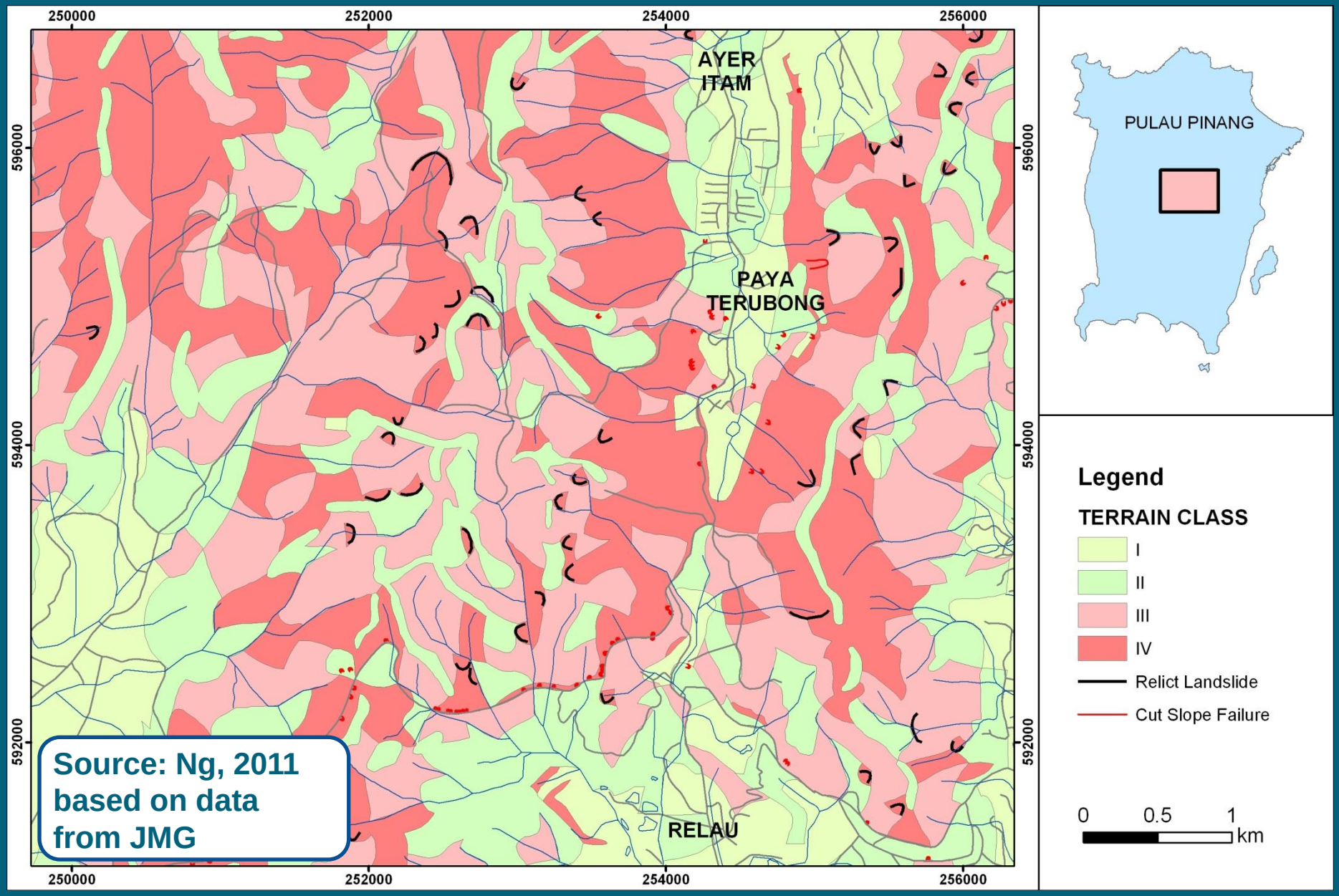


Type and Density of Development

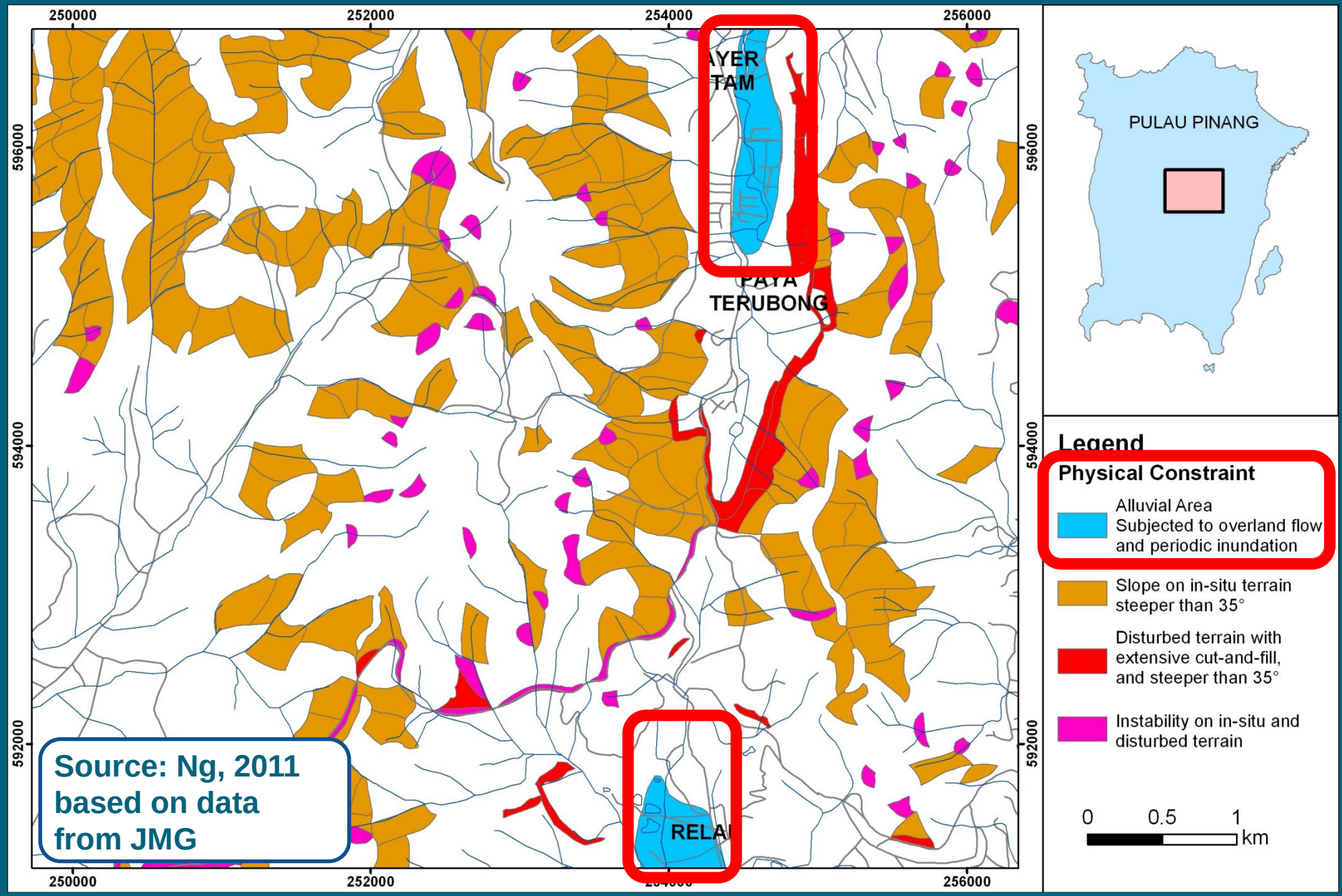
- Class I & II – no restriction but must follow all relevant by-laws, guidelines & codes of local authorities
- Class III – restricted development (20% in S'gor)
  Detached house, up to 3 storey, maximum 6 unit/acre
  Semi-detached house, up to 3 storey, maximum 8 unit/acre
  Link house, up to 3 storey, maximum 12 unit/acre
  Link commercial, plith – 100%, plot ratio – 50%
  Detached office & institution, plith – 50%, plot ratio 50%
- Class IV – development not allowed except for critical infrastructures

Construction Suitability Class	CLASS I	CLASS II	CLASS III	CLASS IV
Geotechnical Limitation	Low	Moderate	High	Extreme
Hazard Level	Low	Moderate	High	Very High
Suitability for Development	High	Moderate	Low	Probably Unsuitable
Engineering Costs for Development	Low	Normal	High	Very High
Intensity of Site Investigation Required	Normal	Normal	Intensive	Very Intensive

Landslide Susceptibility (CS Map)



Landslide Susceptibility (PC Map)



Floodplain – Issues and Challenges

Flood-prone areas (UN Guideline for Reducing Flood Losses, 1998)

(i) Floodway – no structures

(ii) Floodplain – generally defined as the extent of the 100-year event; requires flood protection and flood proofing, [JPS-Urban Stormwater Management Manual]

(iii) Areas beyond floodplain – generally defined as the extent of the 500-year event; may be subject to flooding, need to ensure flood proofing of "critical facilities" (hazardous material facilities, water & waste facilities, hospitals, schools, airports, emergency services, fire stations, major computer centres)

Weakness

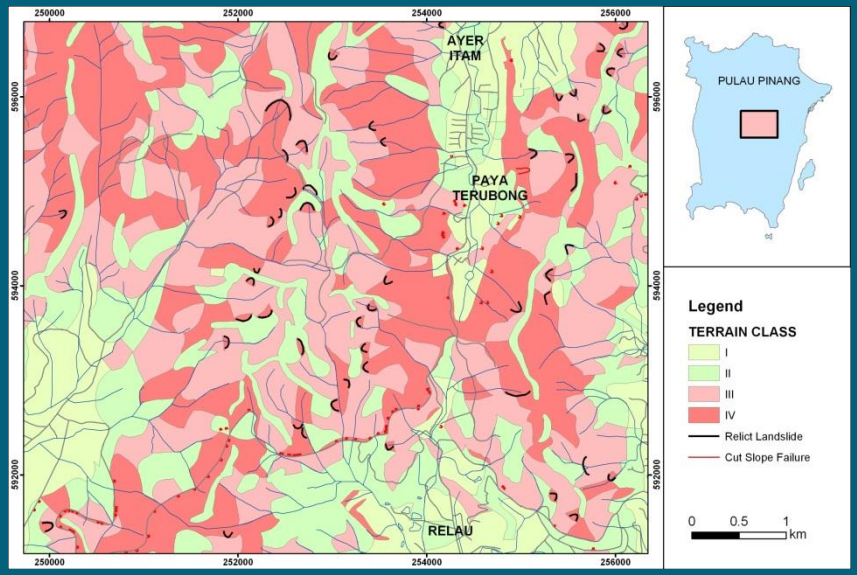
(i) Prediction based on historical records

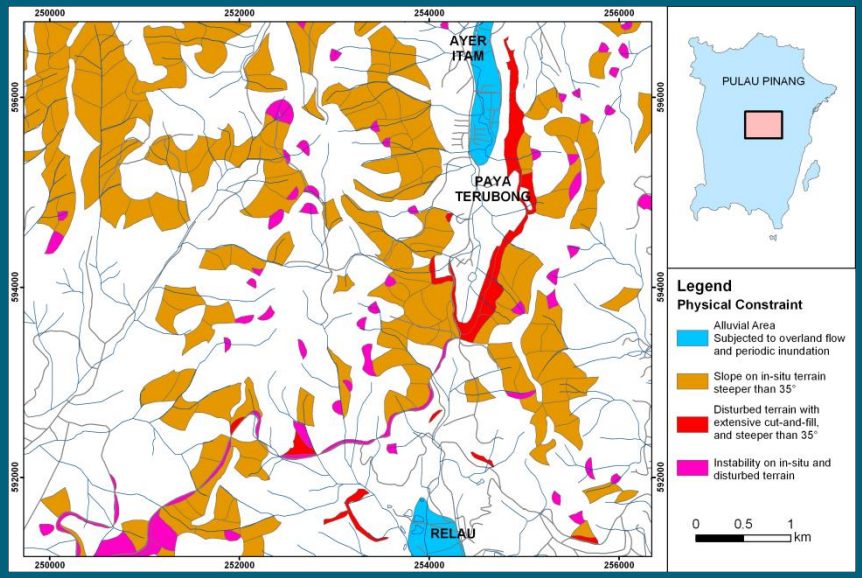
(ii) Changes in land use affects analysis

(iii) Changes in climate and extreme events affects analysis

(iv) Changes in sea-levels affects analysis in coastal areas

Managing Risks of Landslides





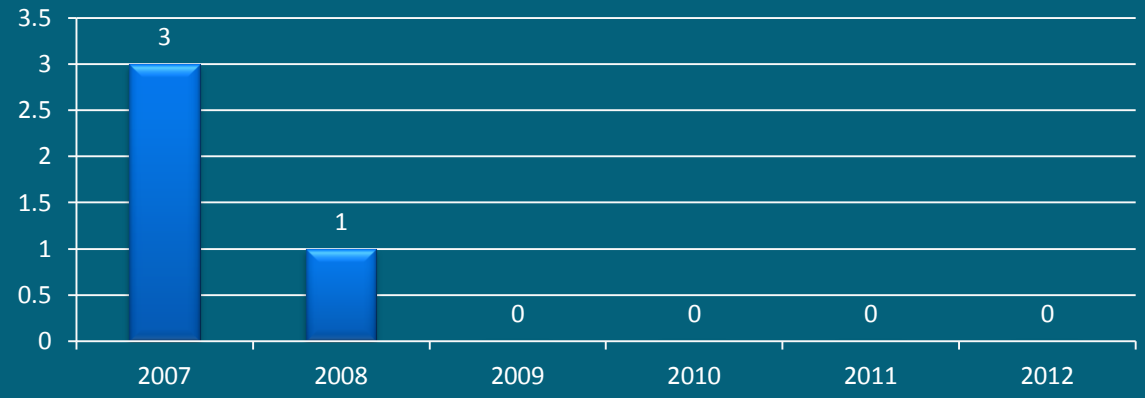
Risk Factors:

- Uninformed planning
- Development in unsuitable terrain
- Cleared areas/blocked drainage

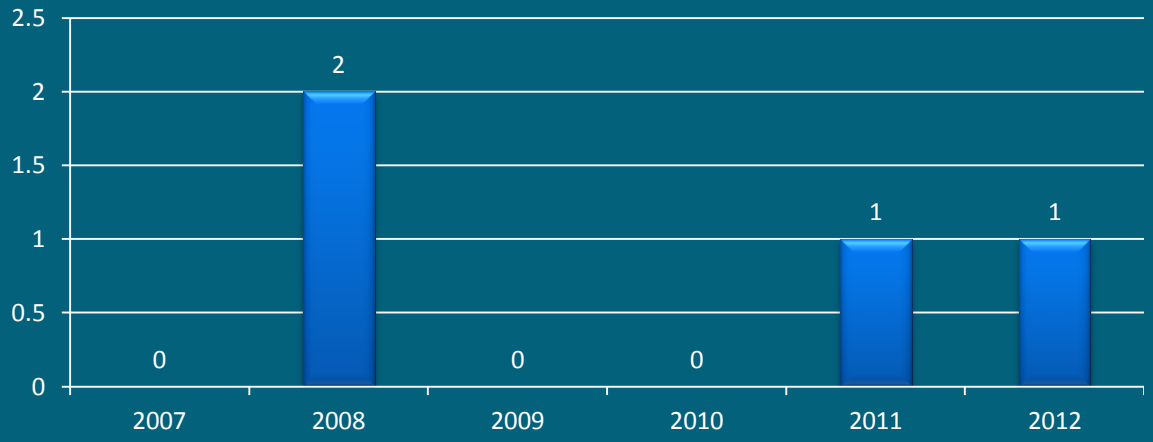
Adaptation Measures:

- Informed planning
- Regular slope inspection and maintenance
- Early warning systems
- Local community engagement
- Risk Pooling, etc.

Floods in Penang, Jan 2007 – Oct 2012

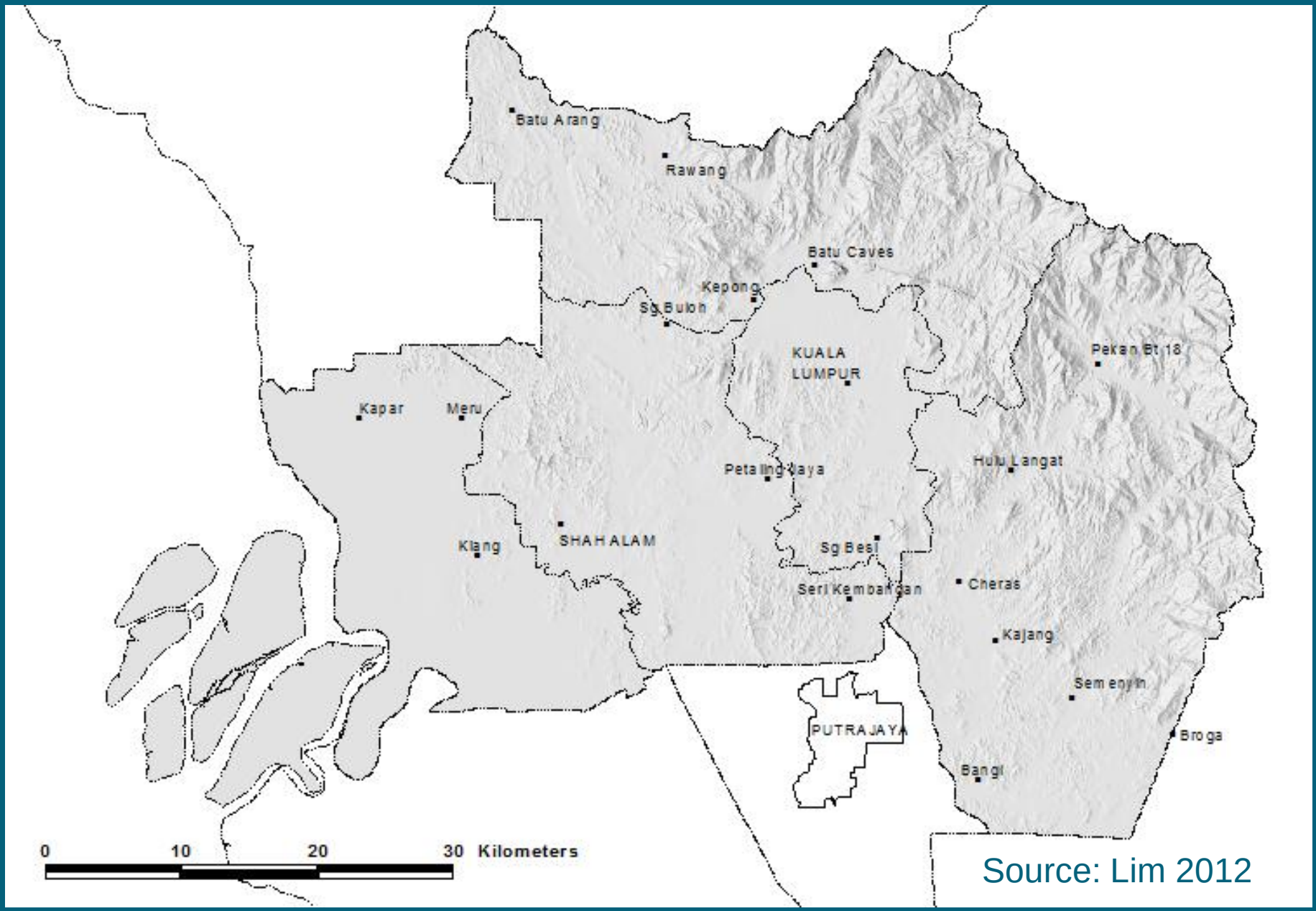


Flash Floods in Penang, Jan 2007 – Oct 2012



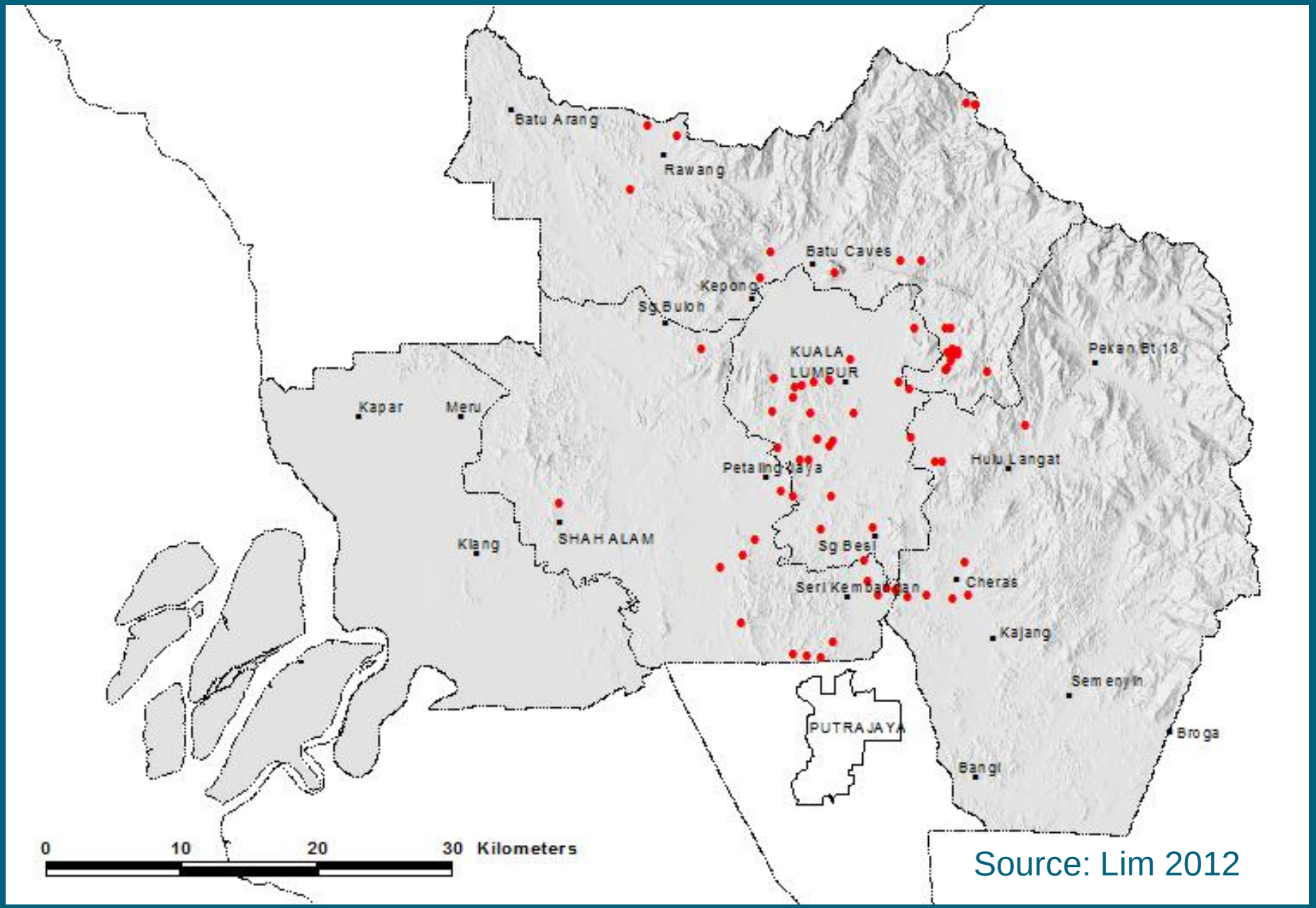
Source*: Bernama News *(http://blis2.bernama.com/mainHomeBypass.do)

Klang Valley – Planning Boundary



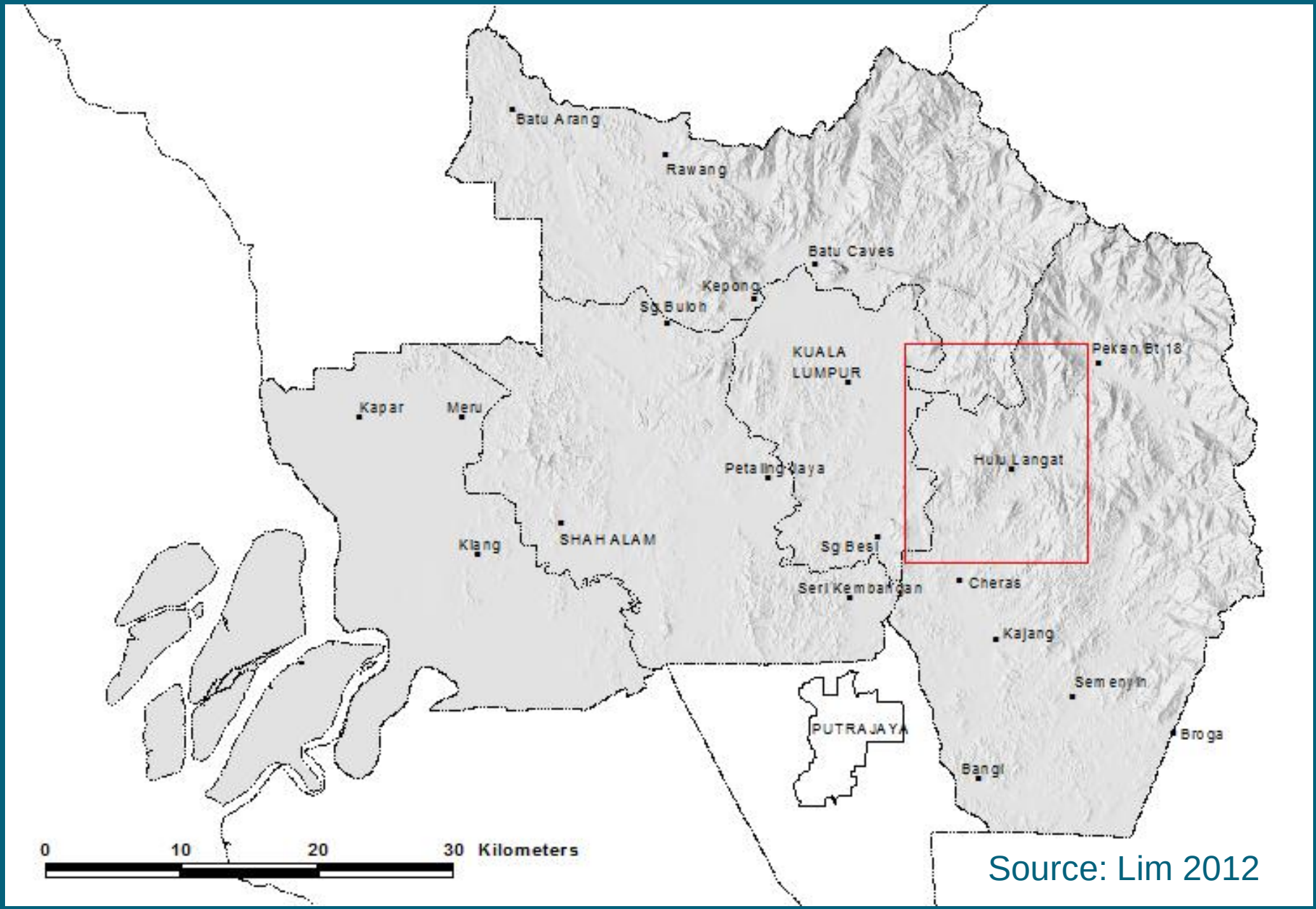
Source: Lim 2012

Landslides, 1970 - 2011



Source: Lim 2012

Terrain Mapping in Hulu Langat



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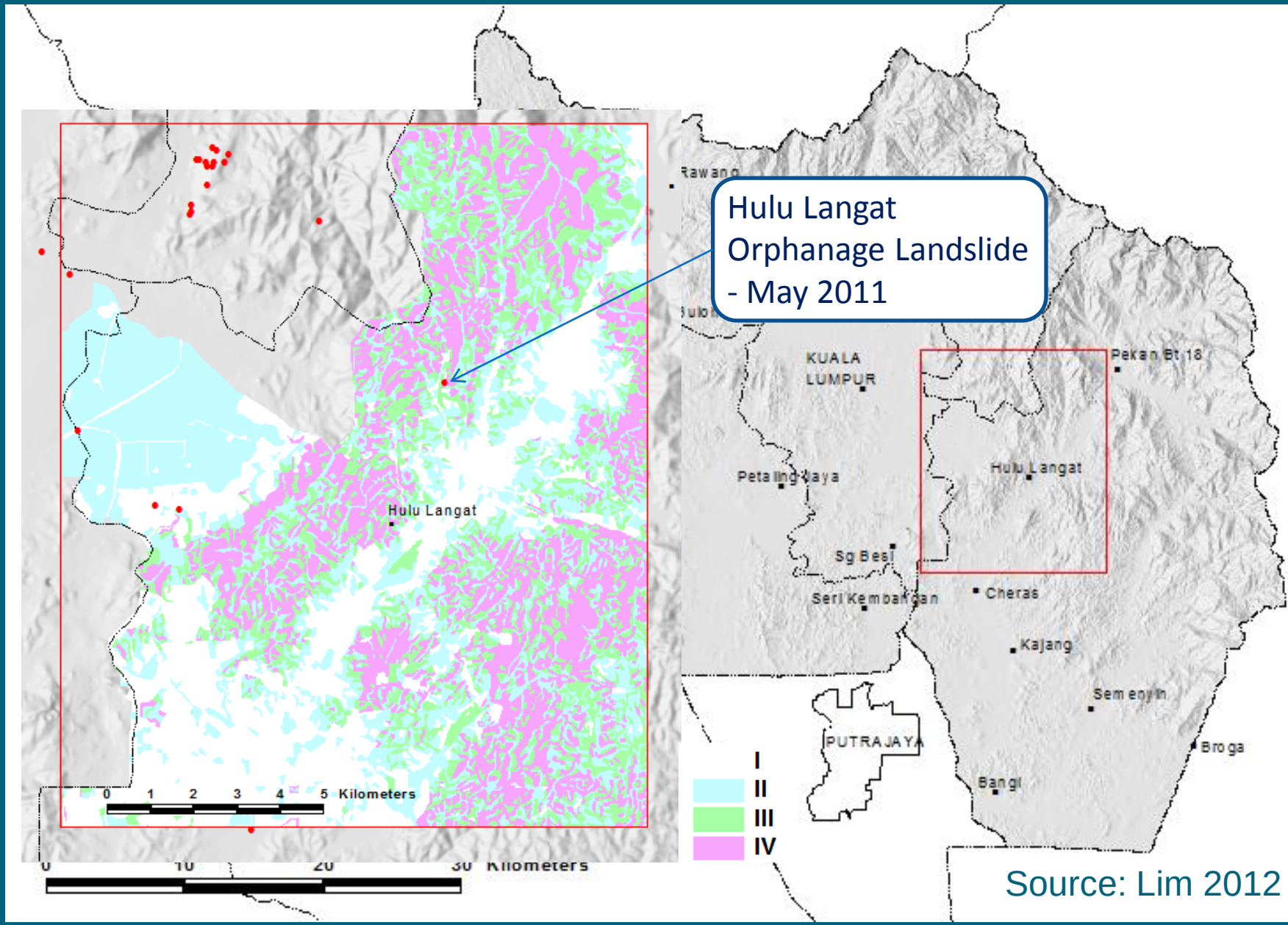

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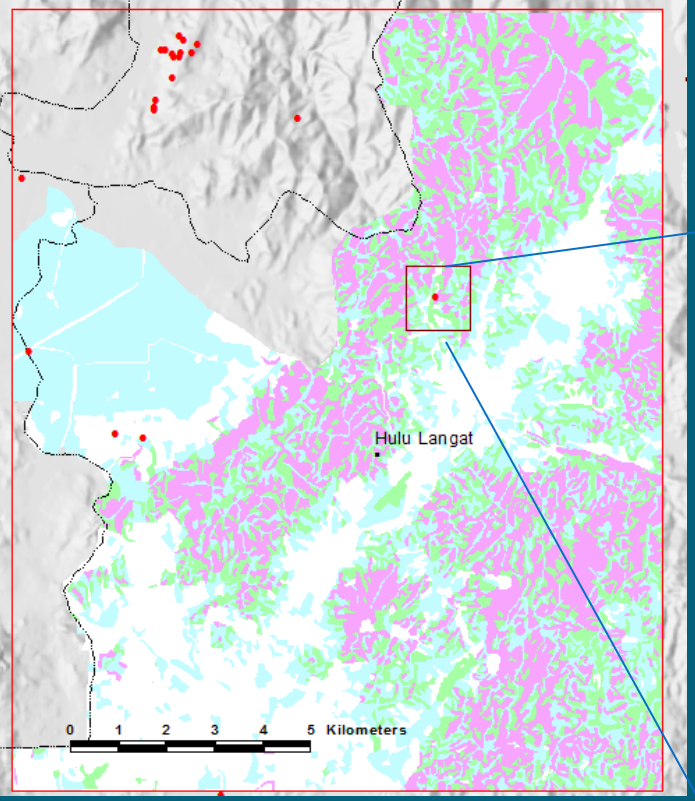
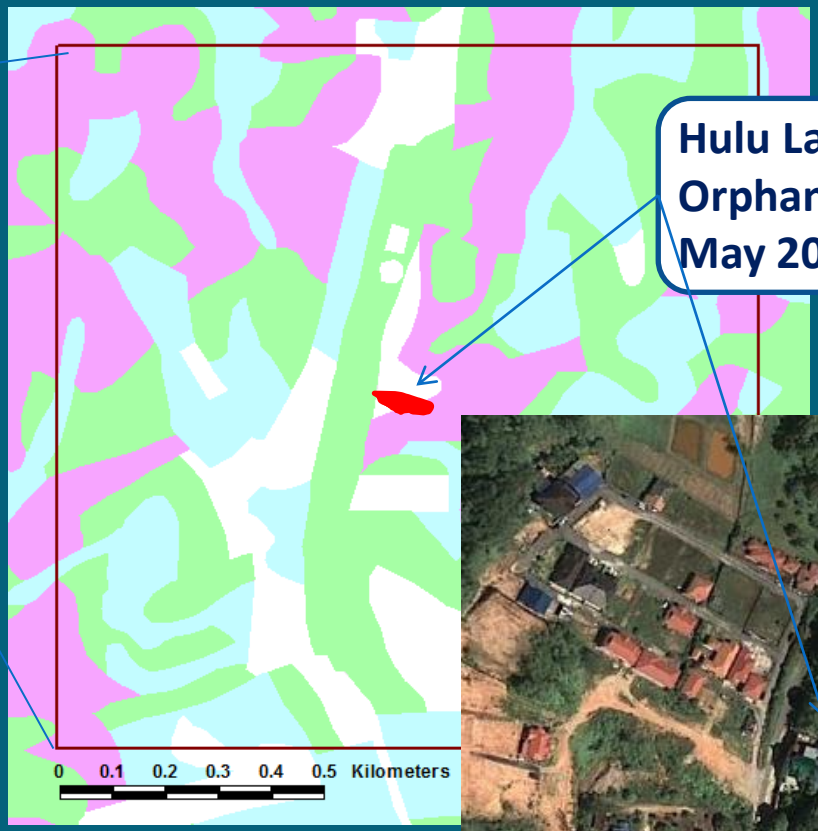
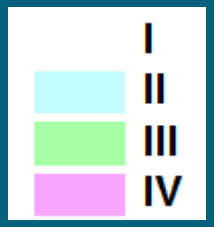




Hulu Langat Orphanage Landslide - May 2011

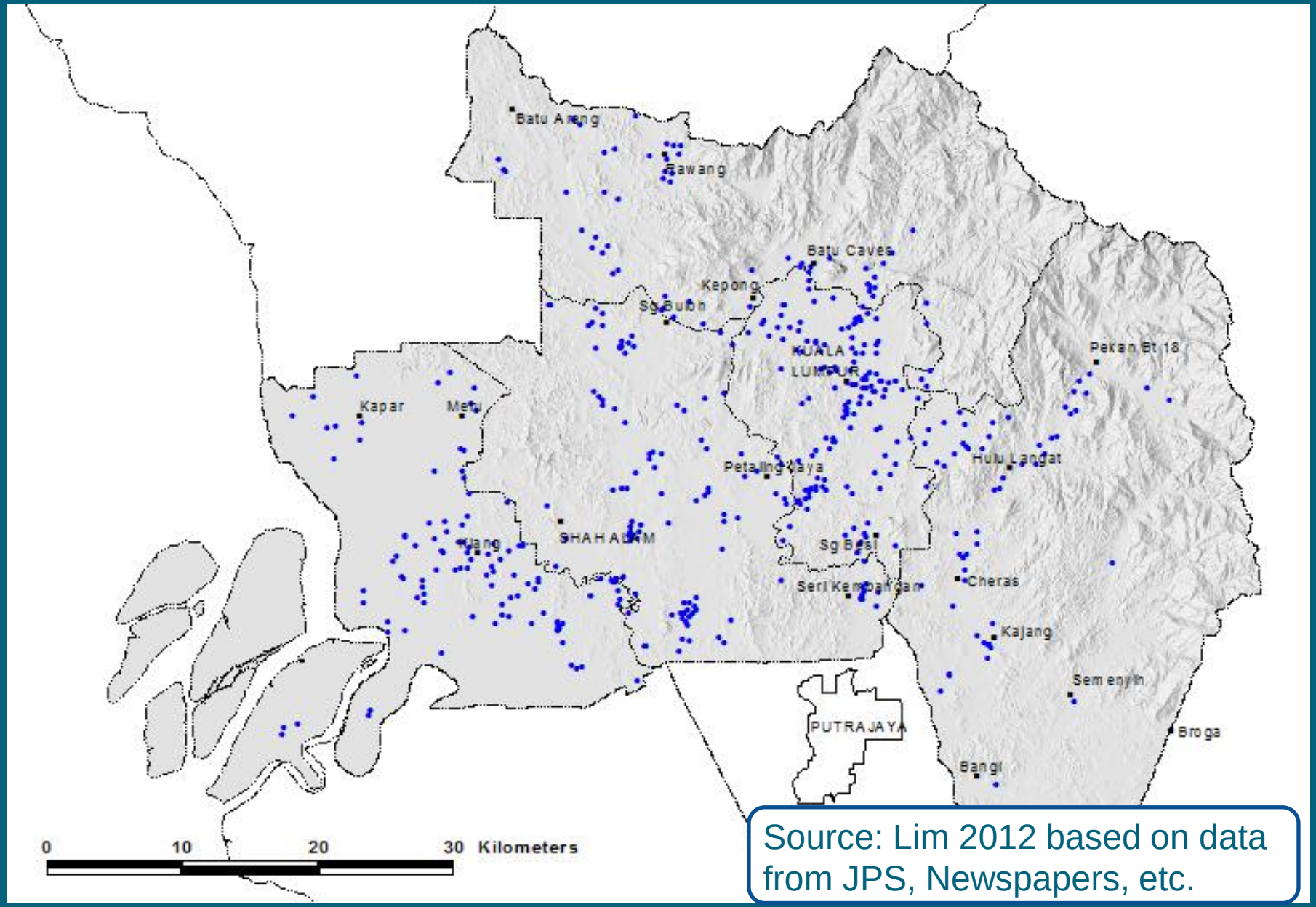
Image: Google Earth

Terrain Class



Source: Lim 2012

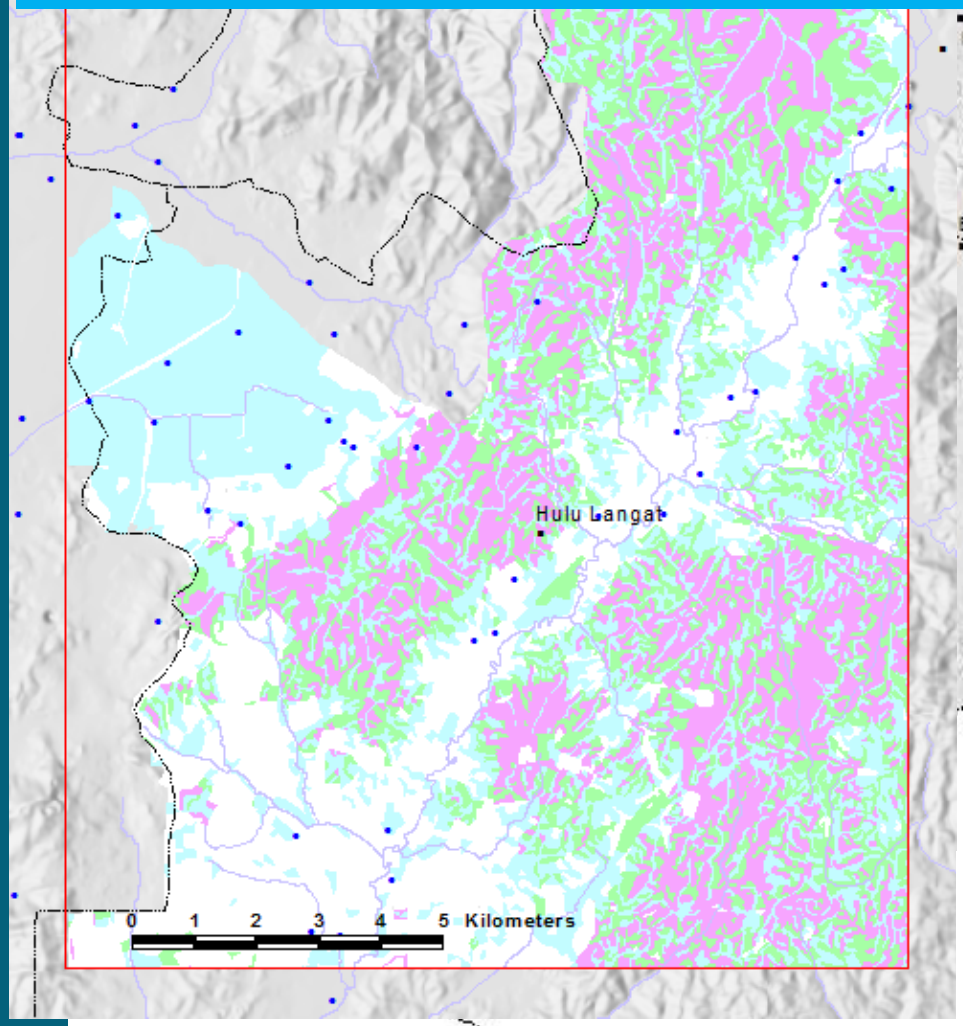
Floods & Flash Floods,1975-2000

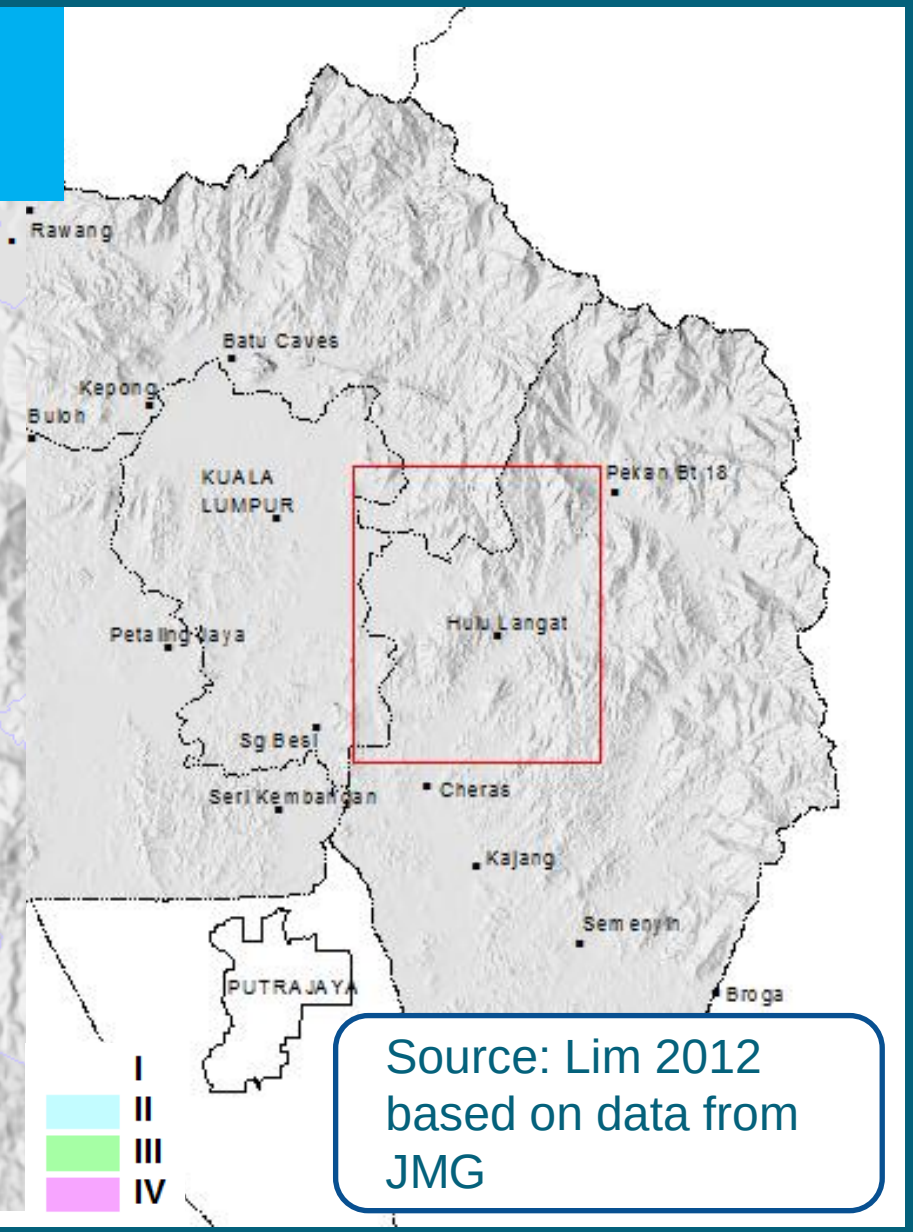


Source: Lim 2012 based on data from JPS, Newspapers, etc.

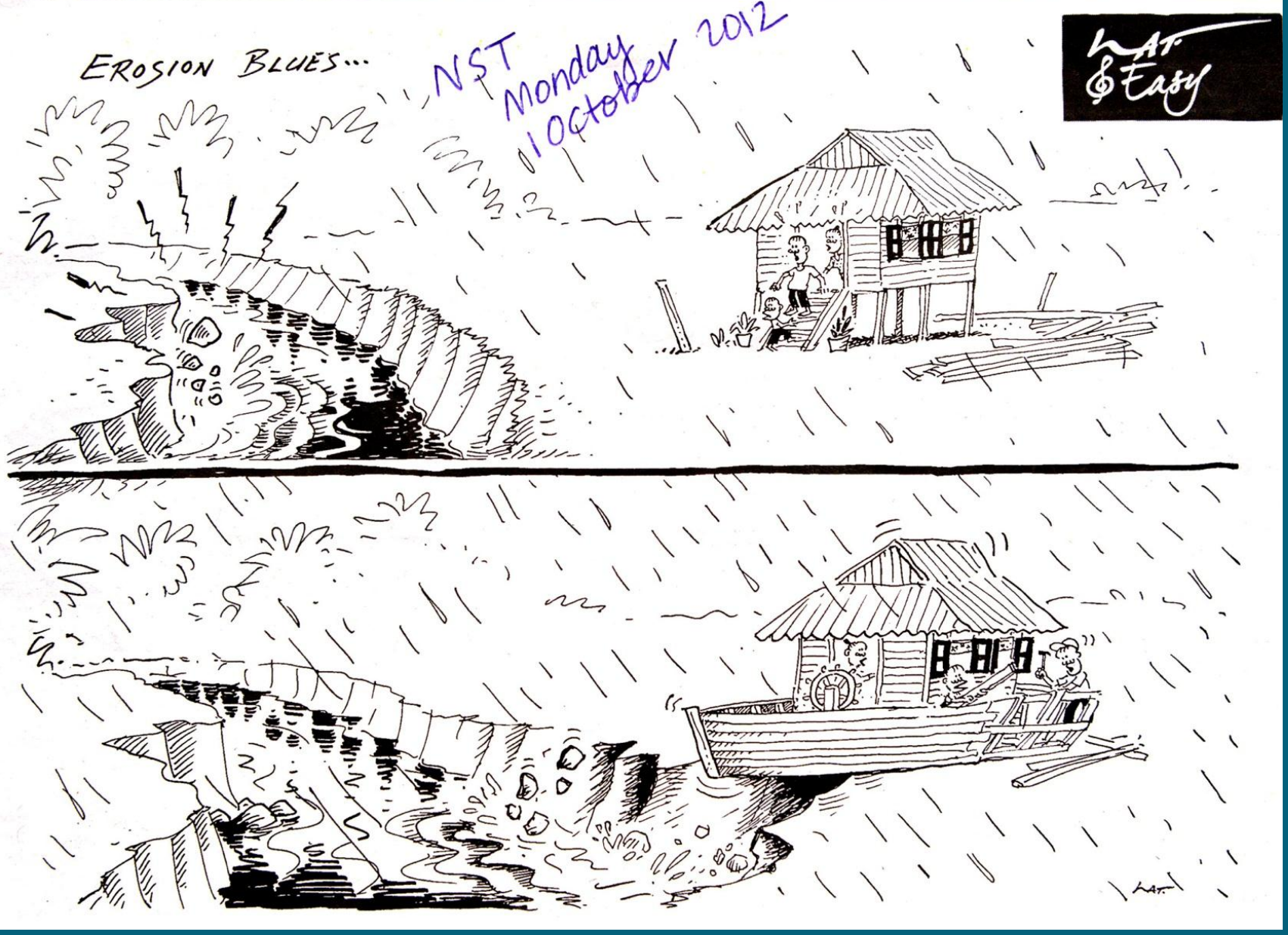
Terrain Mapping in Hulu Langat

Terrain Mapping (Alluvial Floodplains) >>>
Extent of Future Flood Susceptibility >>>
Requires R&D





Source: Lim 2012 based on data from JMG


EROSION BLUES...
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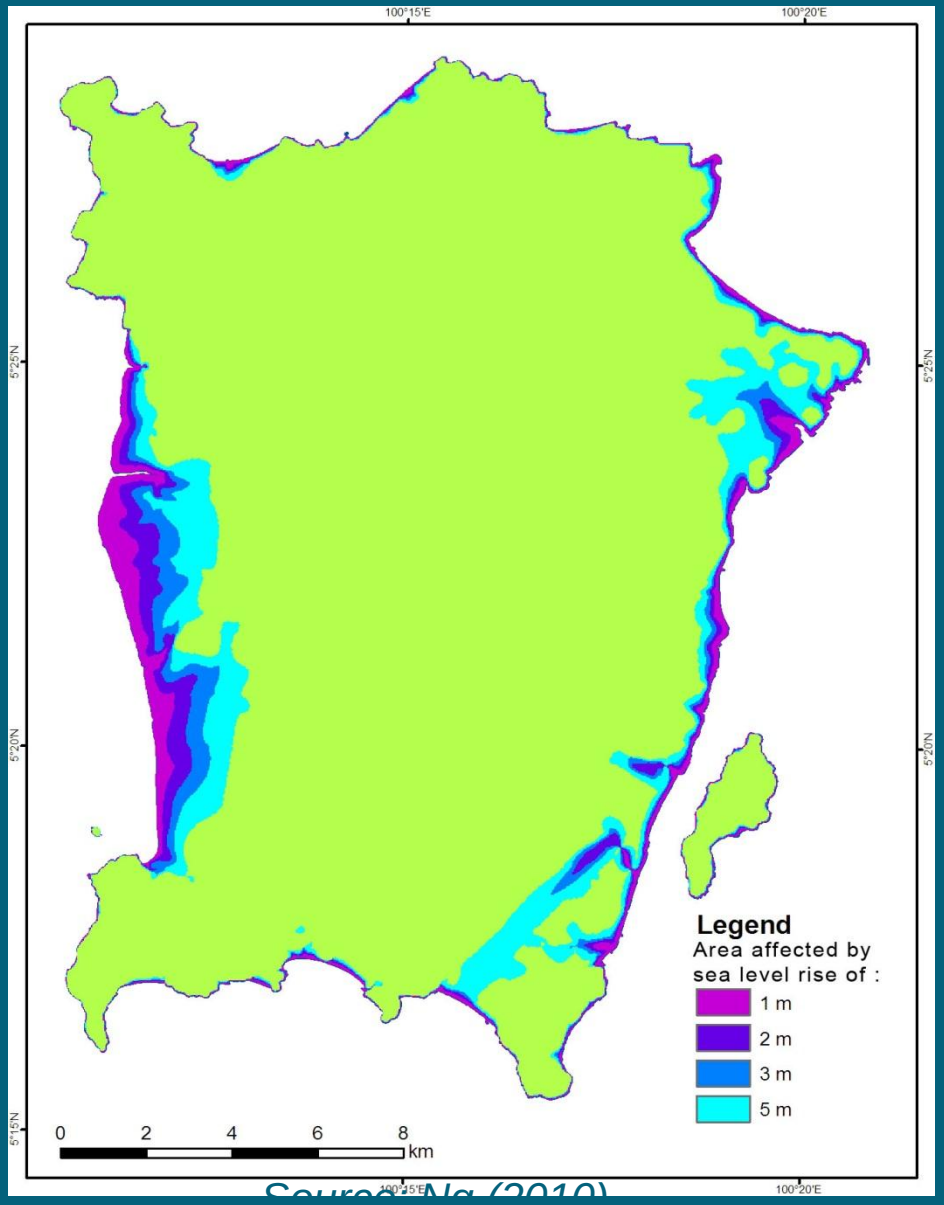
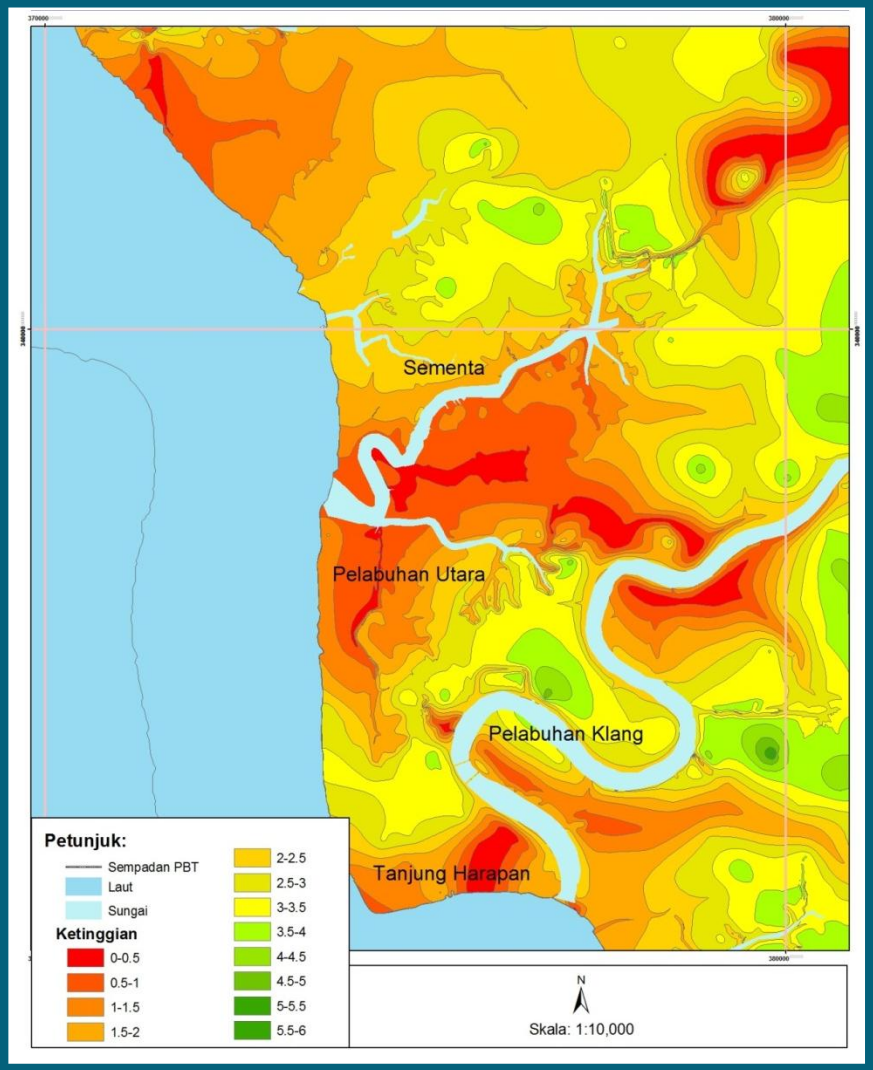
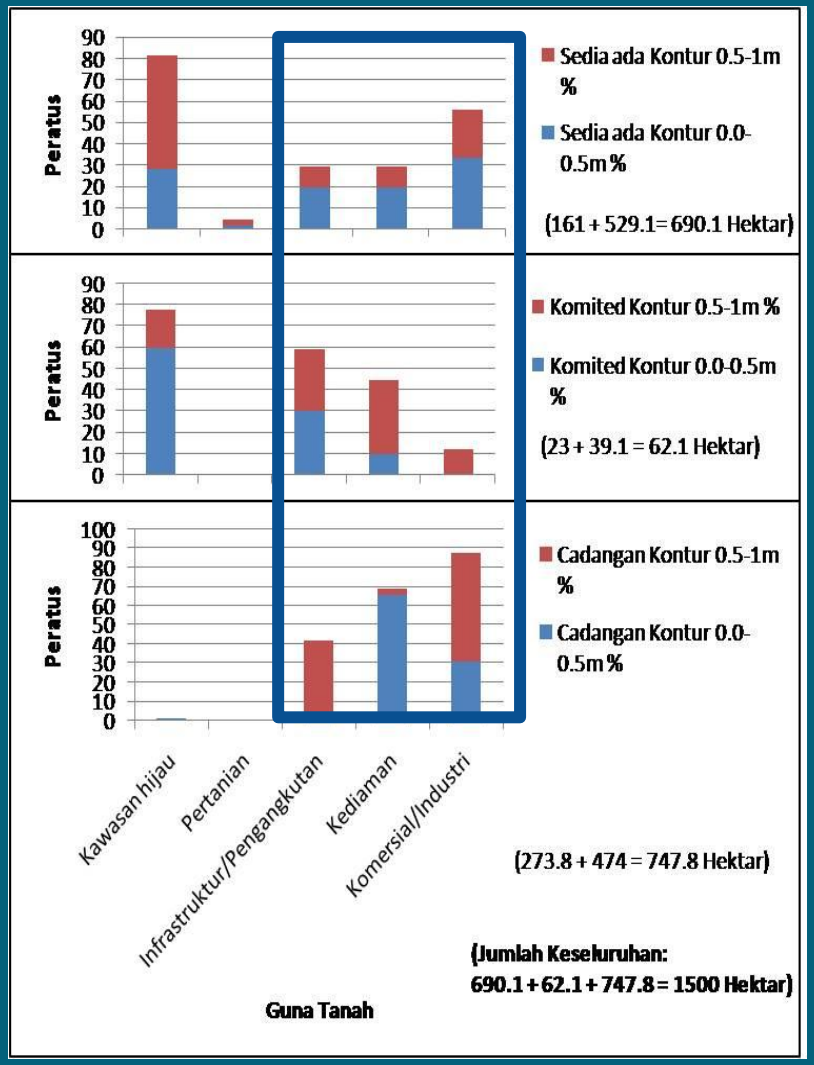
Areas Potentially Affected by Sea-Level Rise in Penang Island



Source: Ng (2010)

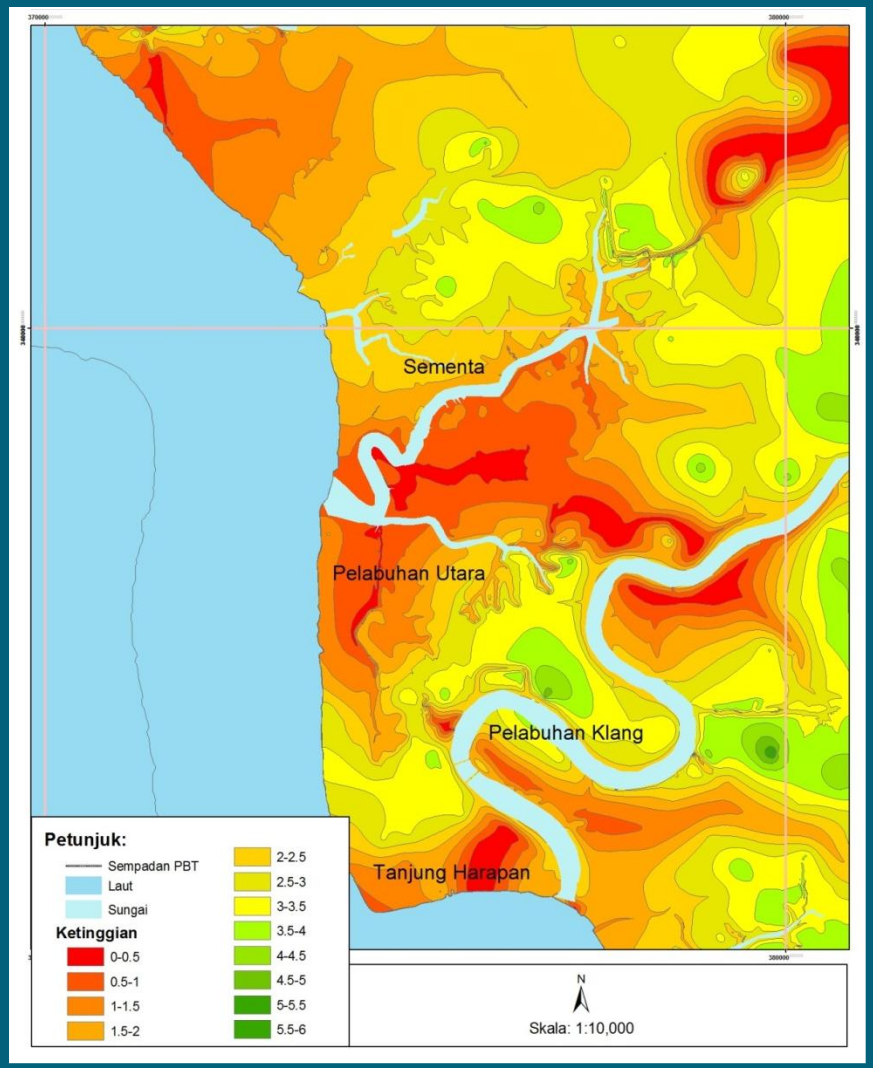
Areas Potentially Affected by Sea-Level Rise in Port Klang





Source: Rasyidah et al., 2012 based on data from JPBD Selangor

Managing Risks of Sea-level Rise



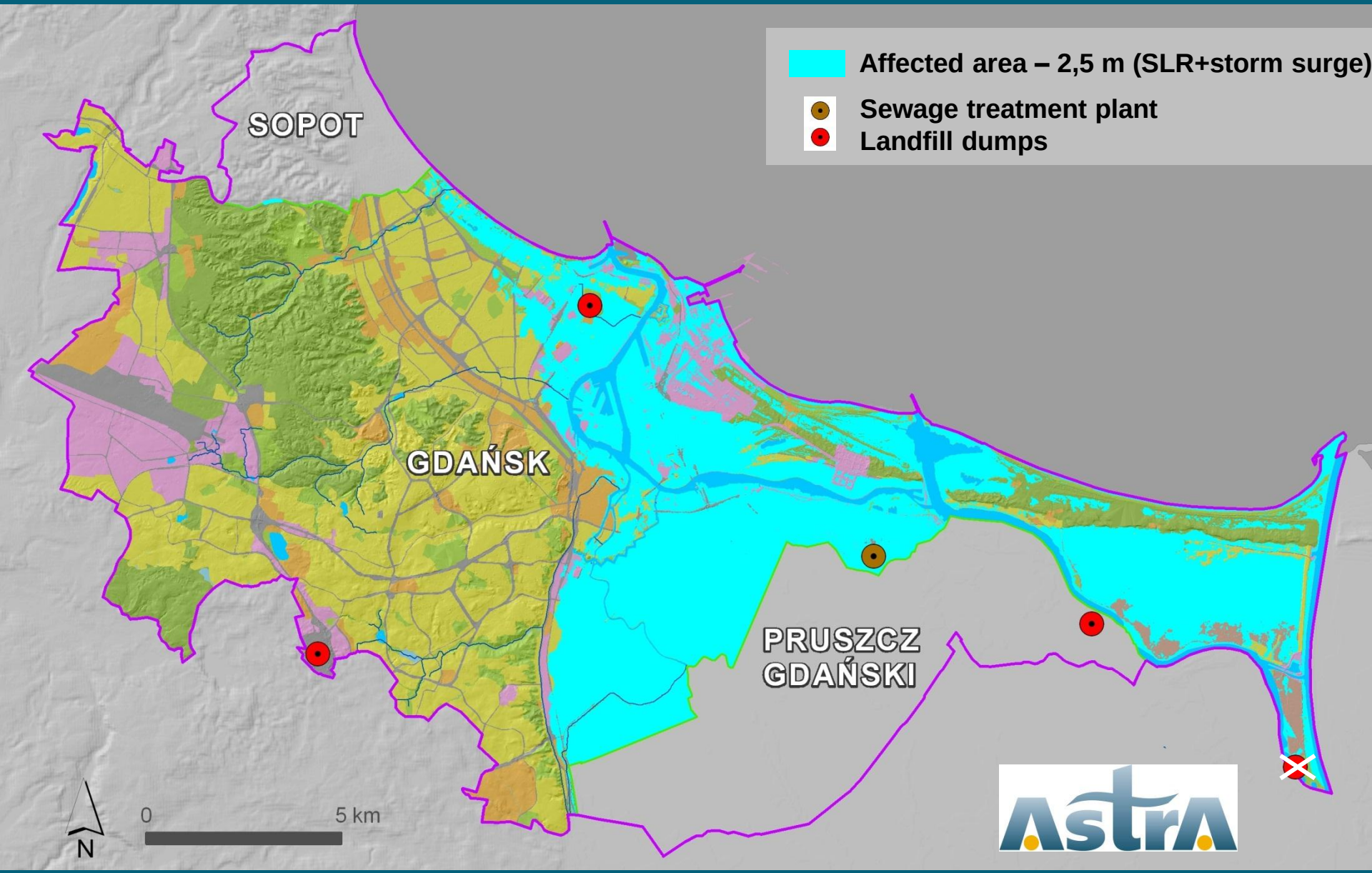
Risk Factors:

- Shore erosion
- Saltwater intrusion
- Coastal floods
- Coastal populations
- Tourism economies

Adaptation Measures:

- Informed planning
- Early warning systems
- Maintenance of drainage
- Risk pooling
- Relocation
- Etc.

Areas potentially affected by sea level rise– 2,5 m (SEAREG: 1m SLR+ 1,5m storm surge)



* excluding water

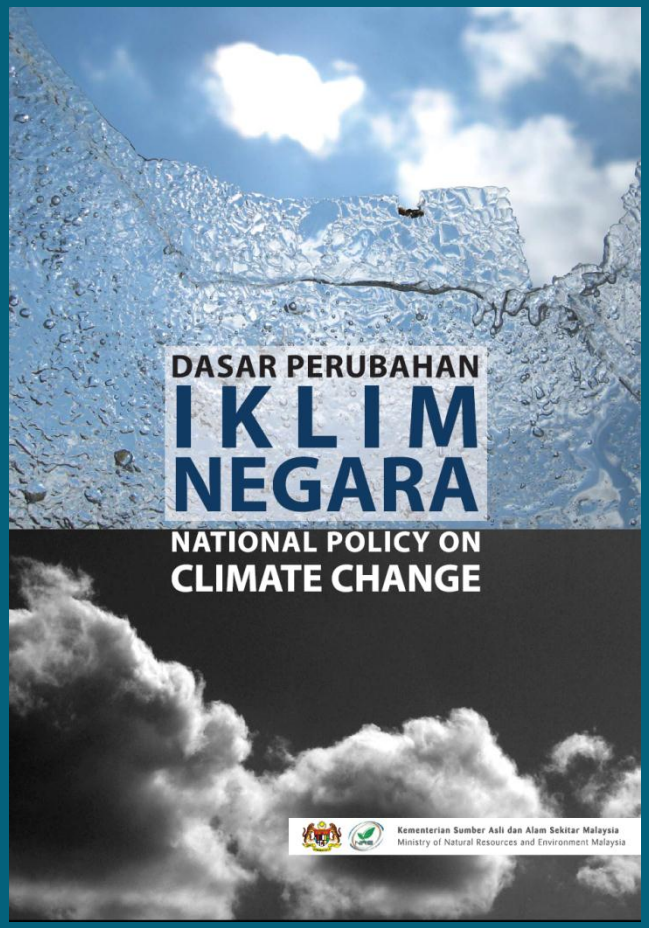
Outline:

1. Hazards and Disasters
2. Highlights from IPCC-SREX
3. Definitions: Conceptual to Operational
4. **Policy Context**
5. Concluding Remarks

National Policy on Climate Change

Contents:

- **Preamble**
- **Policy Statement**
- **Rationale**
- **Objectives (3)**
- **Principles (5)**
- **Strategic Thrusts (10)**
- **Key Actions (44)**
- **Glossary**



Climate Change Projection - Malaysia (Source: NAHRIM, 2008)

Source: NAHRIM (2008)

Possible climatic change in Peninsular Malaysia by 2041-2050:

Temperature rise 2^0C

More extreme hydrological conditions

Higher maximum rainfall; Lower minimum rainfall.

Higher high riverflow; Lower low riverflow.

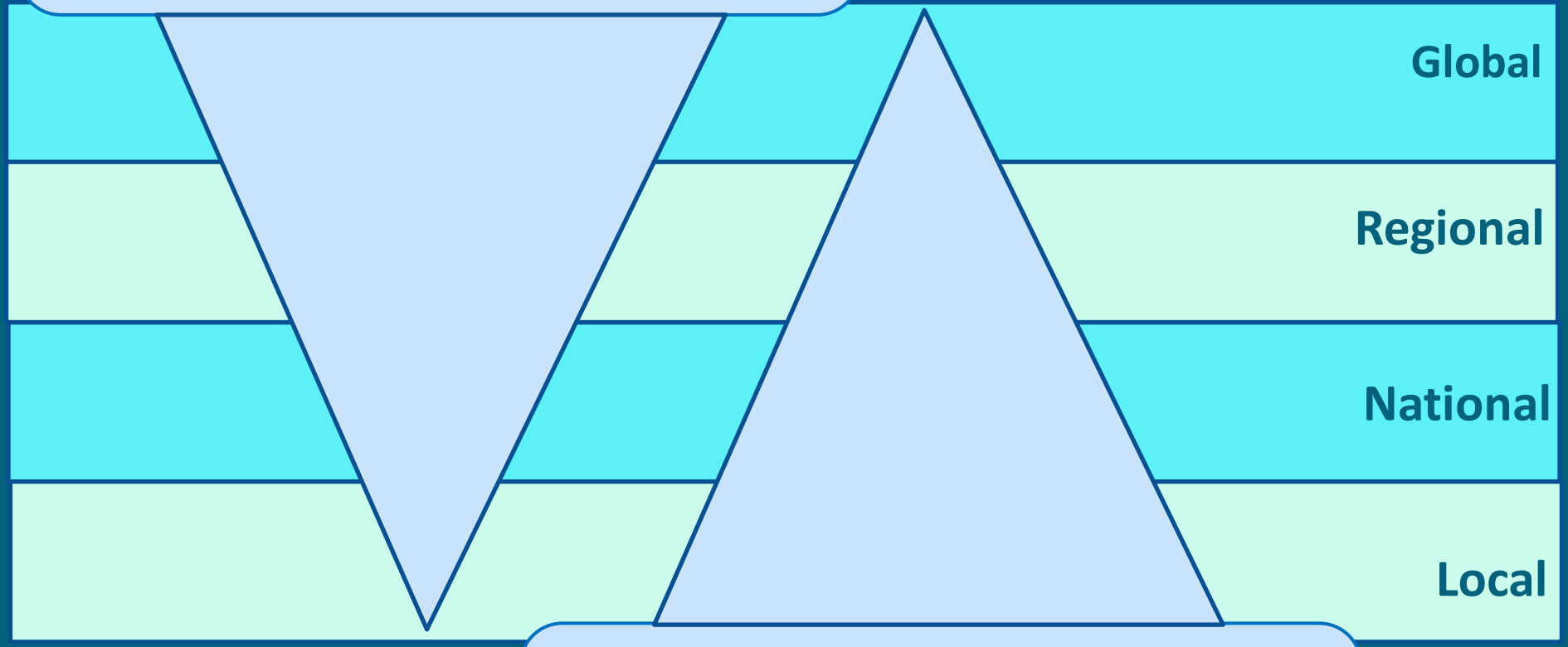
Potential implications:

- Water balance → Water sufficiency
- Crops yields → Food security
- Plantation → Economic loss
- Infrastructure → Repairs & reconstruction

Adaptation based on wise resource management;
Mitigation to enhance adaptation & sustainable development

Issues of Scale

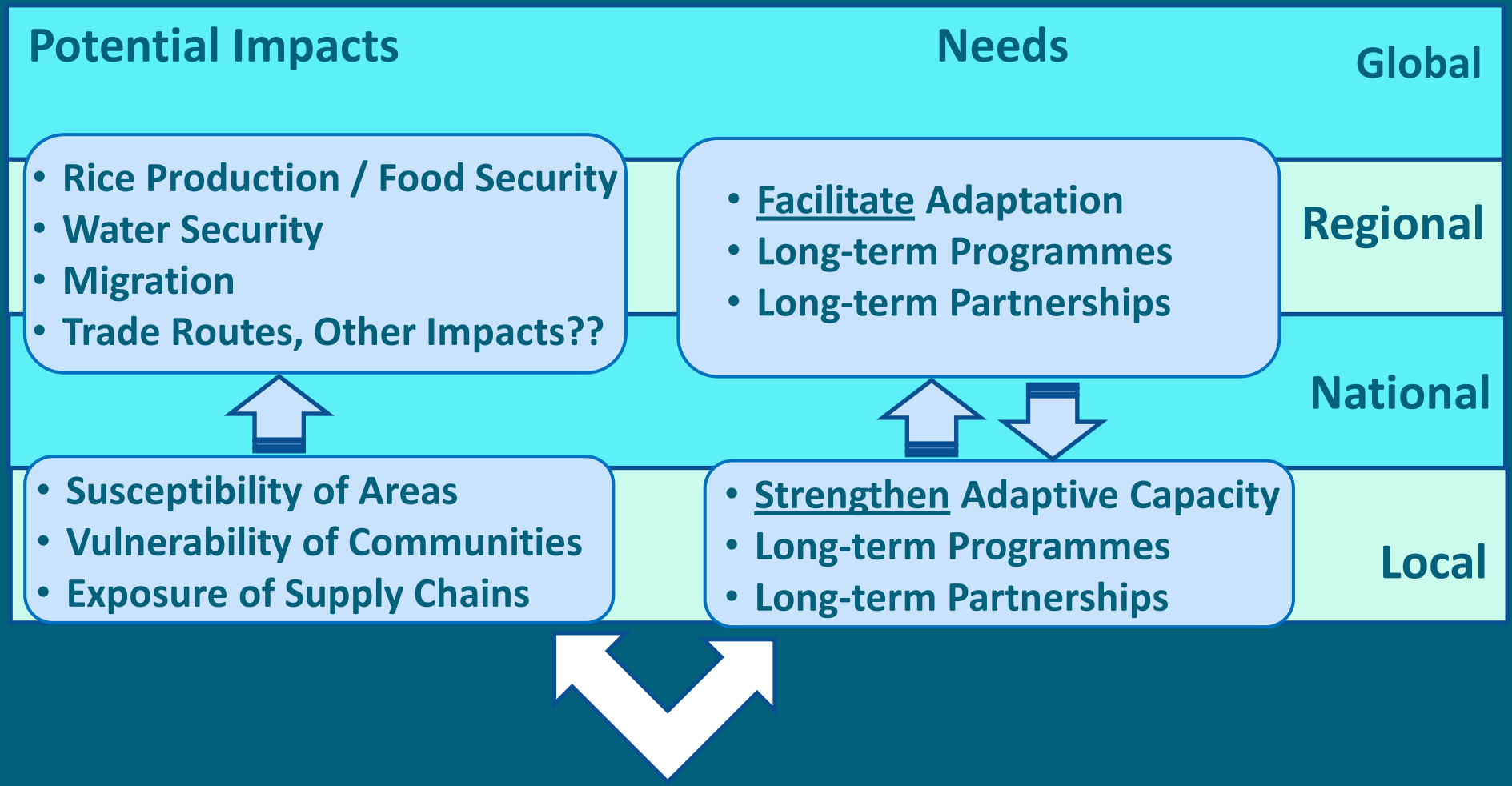
- Climate Projection (accuracy of models)
- Time Scale (relevance)
- Participation of National Focal Points (extent)
- International Funds (mobilization)
- Capacity (high)



- Impacts , Vulnerability , Exposure (place specific)
- Participation of Scientists (multidisciplinary)
- Adaptation Actions (quantity & quality)
- Bottom-up Adaptation /DRR (effectiveness)

Source: Pereira et al. 2012

Scale, Potential Impacts and Needs



Depends on National Circumstances, Local Conditions and State of Science

Source: Pereira et al. 2012

Major Challenges

R&D CHALLENGES

Method development

Information availability

Entry points for adaptation

IMPLEMENTATION

Scale of information and governance

Balance between top-down and bottom-up approaches

Balance between sector-based & macro-based approaches

Linking adaptation to growth agendas

Pro-poor adaptation

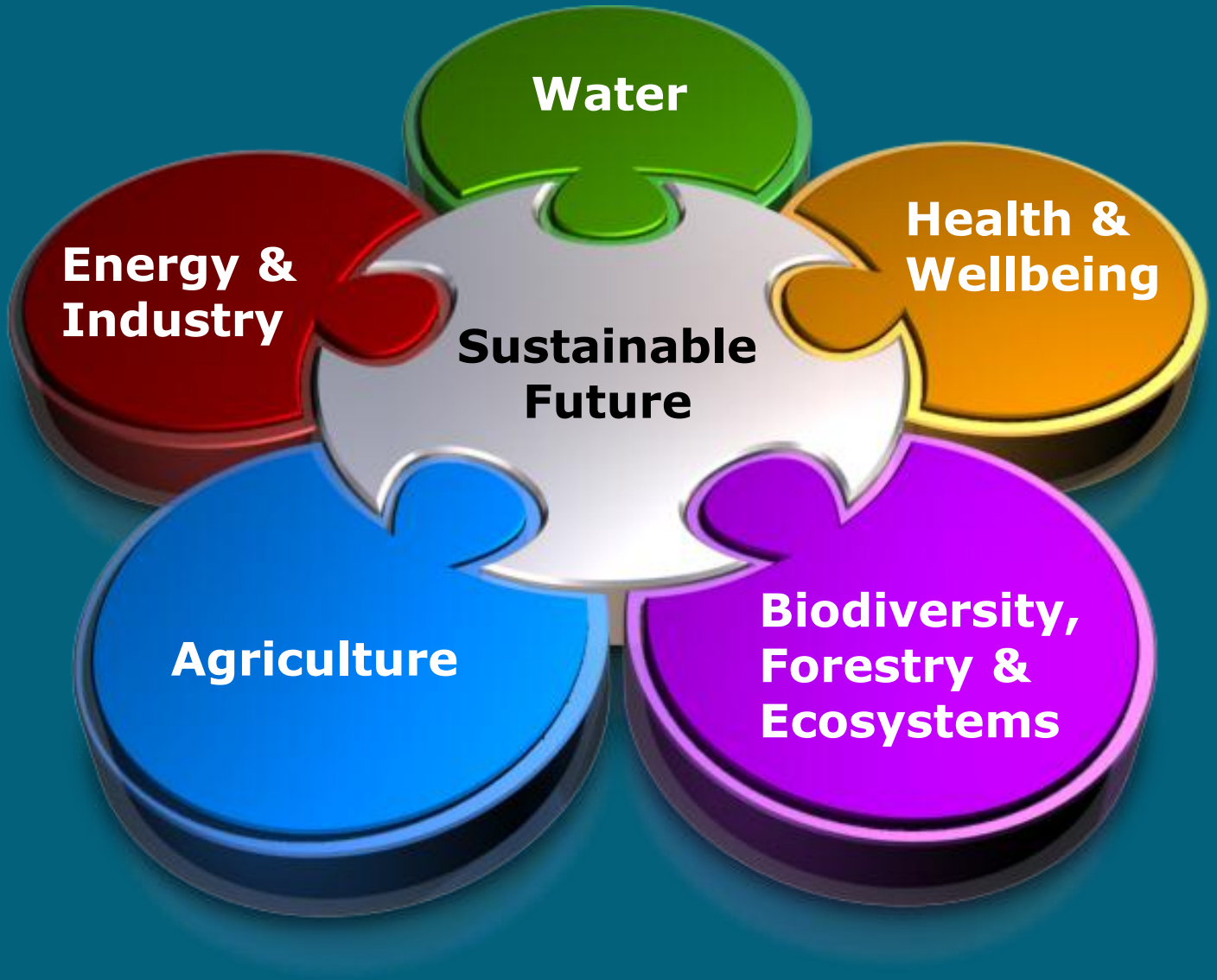
Transforming livelihoods and coping mechanisms

Climate justice and rights

CONCLUDING REMARKS

- Climate change is unequivocal; science has addressed the dispute on drivers of climate change
- Adaptation should be balanced with mitigation
- Adaptation should be an iterative process combining both the top-down and bottom-up approaches
- Bottom-up adaptation should be the first option where science is lagging; strong links required between DRR & CCA stakeholders
- Action-oriented R&D required to develop assessment protocols (S/V/E), identify adaptation measures and produce tools that support decision-making at appropriate scales.
- Priority: Mainstreaming DRR/CCA and building adaptive capacity

Adaptation is Critical for All Sectors



National Key Economic Areas (NKEA)

- There are 12 National Key Economic Areas (NKEAs) at the core of the Economic Transformation Programme (ETP).
- The NKEAs are expected to help Malaysia achieve high-income status in 2020.
- Climate change should not undermine national aspirations of the ETP
- Emphasis should be on promoting climate-resilient development for sustainability


Agriculture


Oil, Gas & Energy


Greater KL


Communications, Contents, Infrastructure


Healthcare

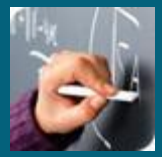

Tourism


Business Services


Palm Oil


Wholesale & Retail


Electronics & Electrical


Education


Financial Services

Sustainable Development Goals…

- Both the environment and the community are given adequate emphasis
- A wide range of social, economic and environmental needs are satisfied
- Equitable access to resources
- Fairness in distribution of societal risk
- Needs of both present and future generations are met

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THANK YOU!

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