Asia Pacific Climate Change Adaptation Forum
1 October 2014, PWTC, Kuala Lumpur

ASIA-PACIFIC NETWORK FOR GLOBAL CHANGE RESEARCH

Integrating DRR, CCA and L+D: Issues and Challenges

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Climate Variability refers to variations in the mean state and other statistics (such as standard deviations, the occurrence of extremes, etc.) of the climate at all spatial and temporal scales beyond that of individual weather events [IPCC-SREX, 2012].

Climate Change **refers to** change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer [IPCC-SREX, 2012]. Climate change may be due to **natural variability** or as a result of **human activity**.

Climate Change **refers to** "a change of climate which is **attributed directly or indirectly to human activity** that alters the composition of the global atmosphere and which is **in addition to natural climate variability** observed over comparable time periods." (Article 1, UNFCCC)

Climate Change **refers to any change in climate over time that directly or indirectly affects humans and their activities as well as natural systems and its processes (National Policy on Climate Change, 2008)**

Exposure refers to the presence of people; livelihoods; environmental services and resources; infrastructure; or economic, social, or cultural assets in places that could be adversely affected.

Vulnerability refers to the propensity or predisposition to be adversely affected.

Resilience refers to the ability of a system and its component parts to anticipate, absorb, accommodate, or recover from the effects of a hazardous event in a timely and efficient manner, including through ensuring the preservation, restoration, or improvement of its essential basic structures and functions.

Susceptibility refers to the physical predisposition of human beings, infrastructure, and environment to be affected by a dangerous phenomenon due to lack of resistance and …….such systems once impacted will collapse or experience major harm and damage due to the influence of a hazard event.

Source: IPCC, 2012

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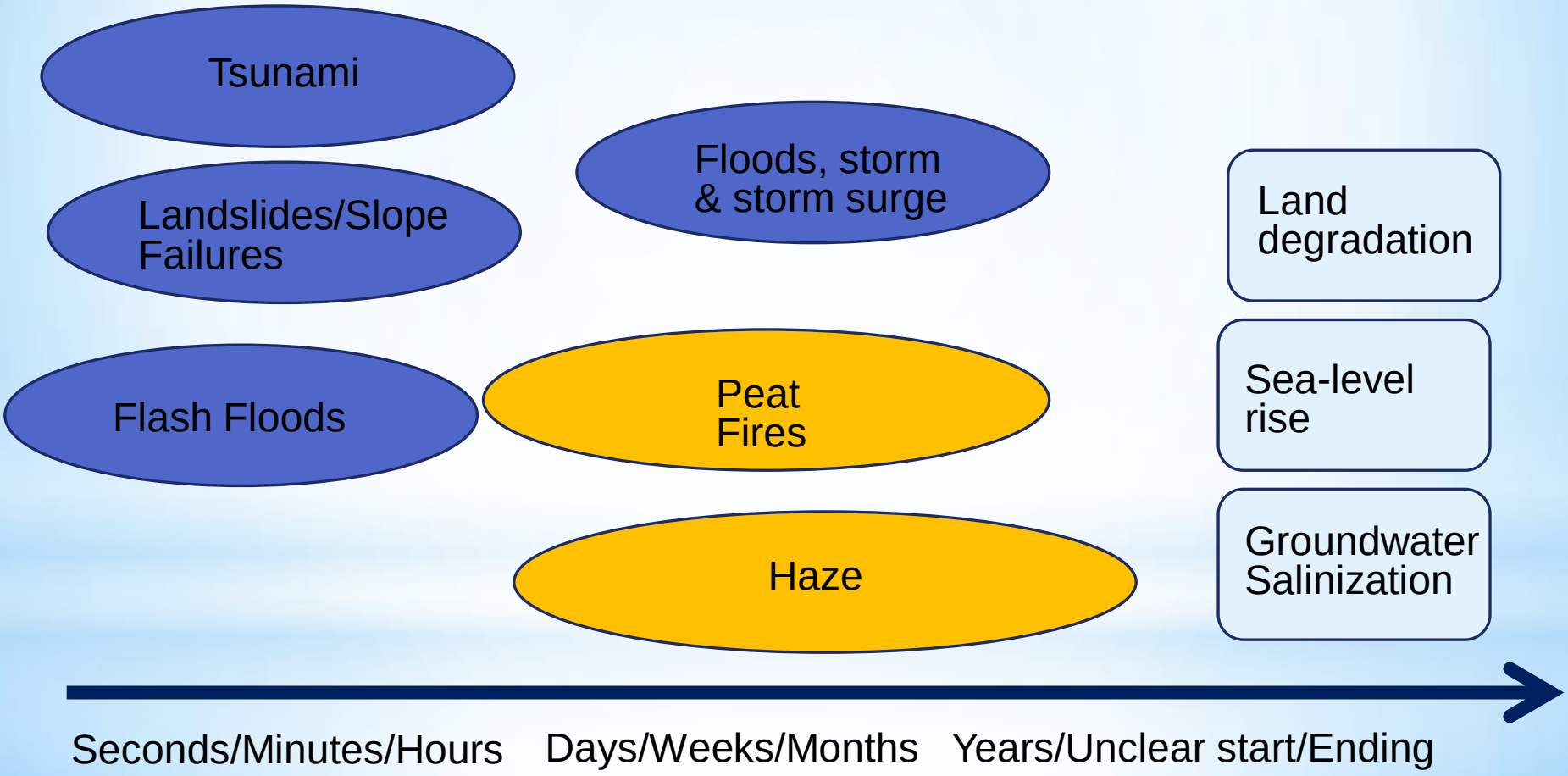
Attribution of Extreme Events

There is evidence that some extremes have changed as a result of anthropogenic influences, including increases in atmospheric concentrations of greenhouse gases. It is *likely* that anthropogenic influences have led to **warming** of extreme daily minimum and maximum temperatures at the global scale. There is *medium confidence* that anthropogenic influences have contributed to intensification of extreme precipitation at the global scale. It is *likely* that there has been an anthropogenic influence on increasing **extreme coastal high water** due to an increase in mean sea level. The uncertainties in the historical tropical cyclone records, the incomplete understanding of the physical mechanisms linking tropical cyclone metrics to climate change, and the degree of tropical cyclone variability provide only *low confidence* for the attribution of any detectable changes in tropical cyclone activity to anthropogenic influences. **Attribution of single extreme events** to anthropogenic climate change is challenging. [3.2.2, 3.3.1, 3.3.2, 3.4.4, 3.5.3, Table 3-1]

Source: IPCC, 2012

Fast & Slow Onset Events



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Asia

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Chapter 24, Asia: Coverage - 51 countries/regions

Source: IPCC, 2013

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Central Asia (5)
- Kazakhstan
- Kyrgyzstan
- Tajikistan
- Turkmenistan
- Uzbekistan

North Asia (2)
- Mongolia
- Russia (East of Urals)

East Asia (7)
- China, Hong Kong Special Administrative Region (Hong Kong SAR)
- China, Macao Special Administrative Region
- Japan
- North Korea
- People's Republic of China (China)
- South Korea
- Taiwan Province of China (Taiwan POC)

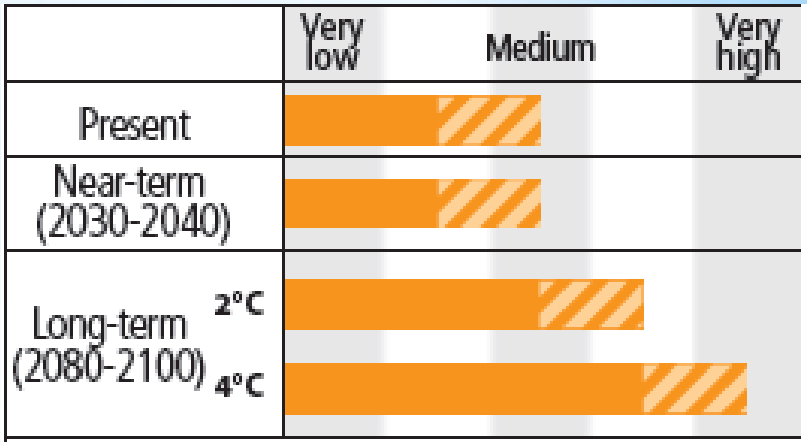
West Asia (17)
- Armenia
- Azerbaijan
- Bahrain
- Georgia
- Iran
- Iraq
- Israel
- Jordan
- Kuwait
- Lebanon
- Palestine
- Oman
- Qatar
- Saudi Arabia
- Syria
- United Arab Emirates
- Yemen

South Asia (8)
- Afghanistan
- Bangladesh
- Bhutan
- India
- Maldives
- Nepal
- Pakistan
- Sri Lanka

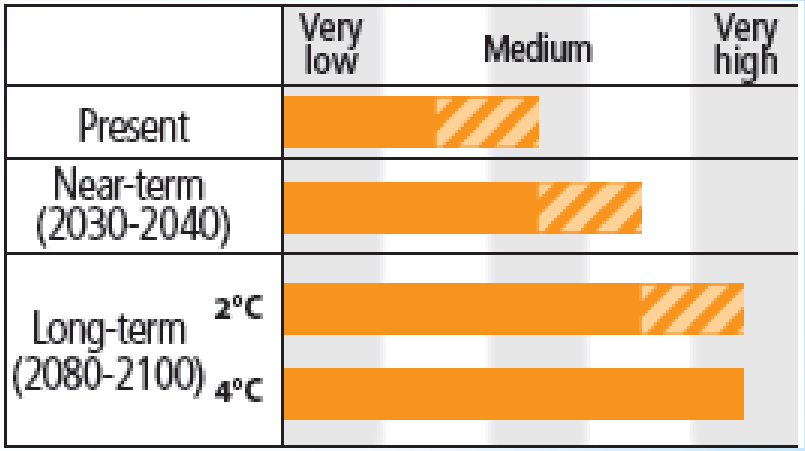
Southeast Asia (12)
- Brunei
- Indonesia
- Lao People's Democratic
- Malaysia
- Myanmar
- Papua New Guinea
- The Philippines
- Republic Cambodia
- Singapore
- Thailand
- Timor-Leste
- Vietnam

Key Risks in Asia

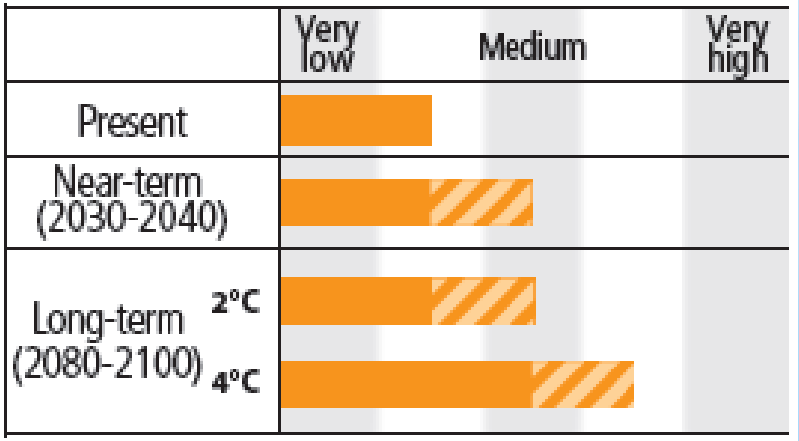
Increased coastal, riverine and urban flooding leading to widespread damage to infrastructure and settlements in Asia (medium confidence)



Increased risk of heat-related mortality (high confidence)



Increased risk of drought-related water and food shortage causing malnutrition (high confidence)



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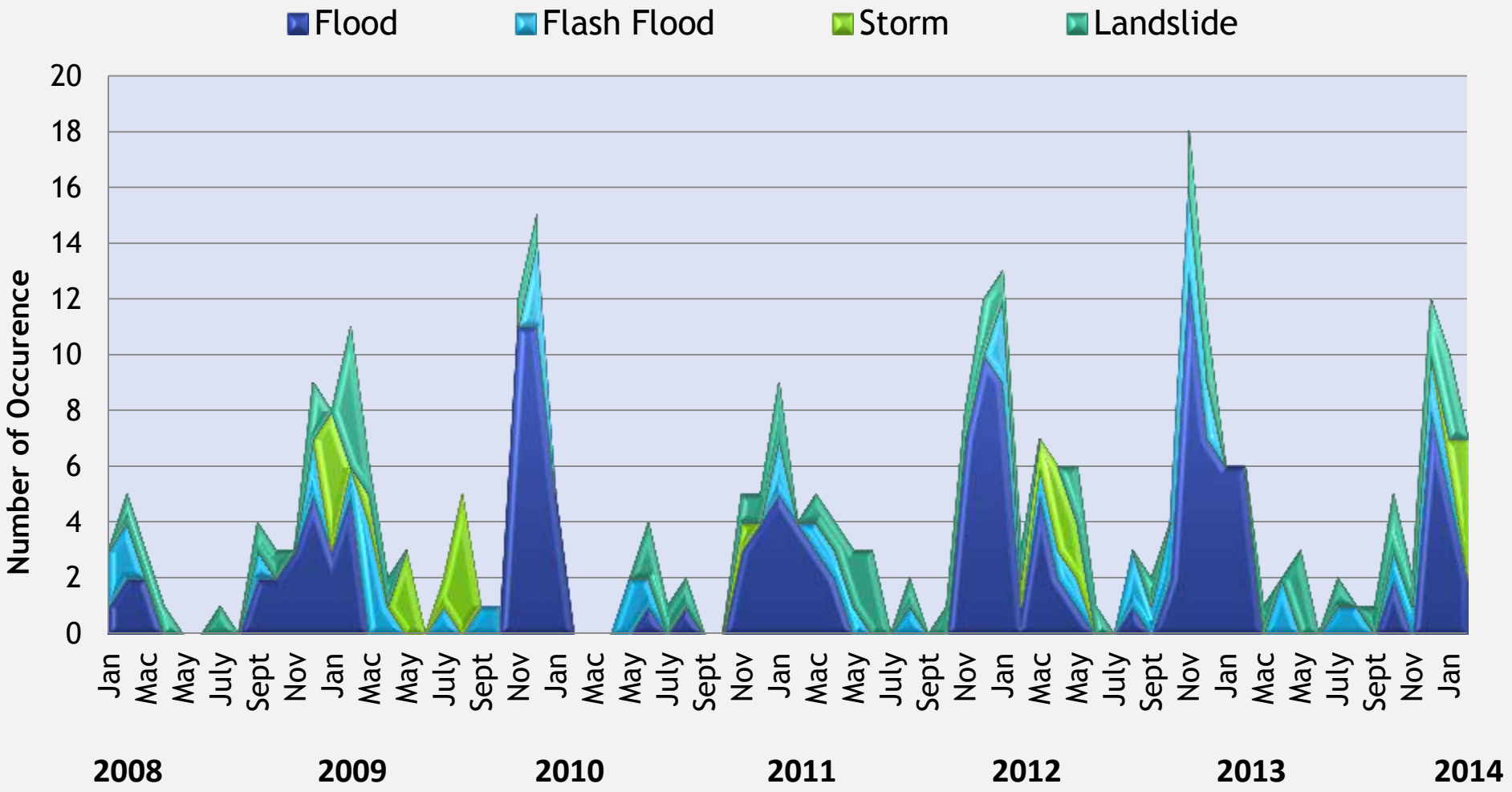
Frequency of Disasters in Malaysia



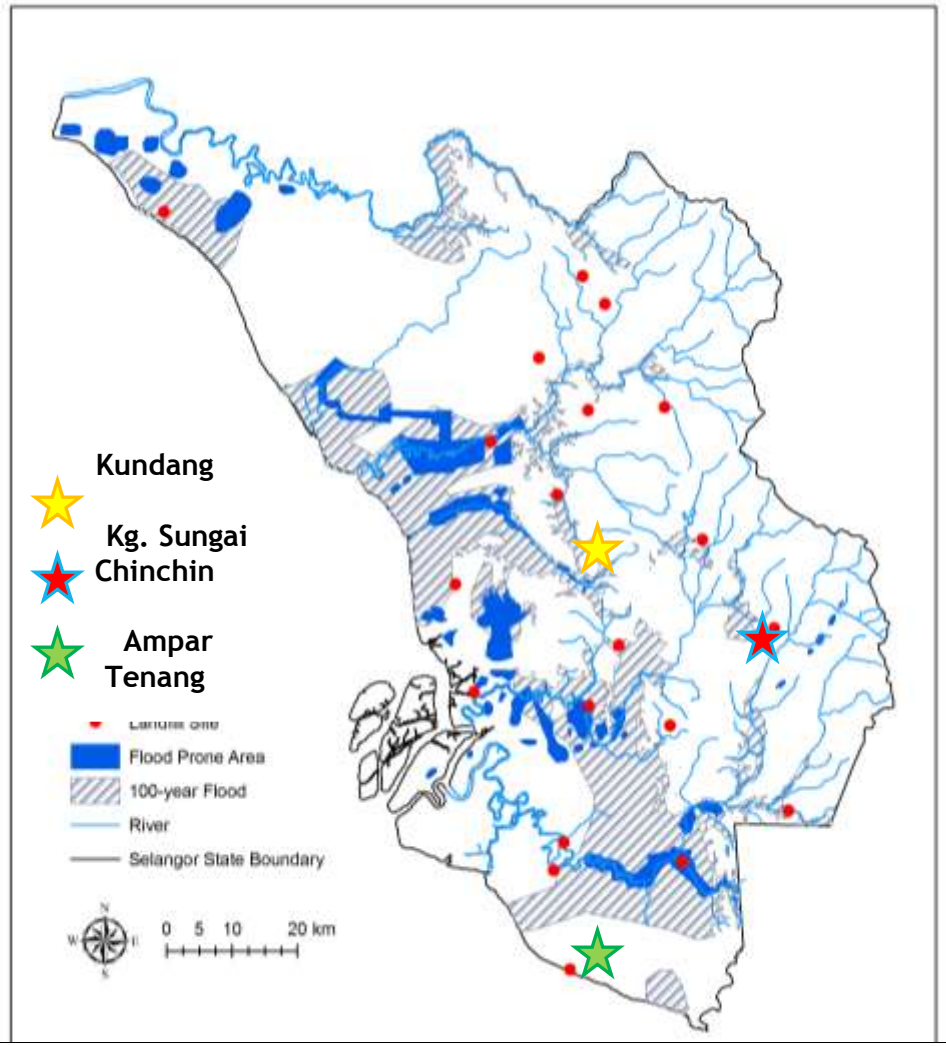
Disasters data complied by SEADPRI from newspaper resources

* Flood Prone Areas in Malaysia

Source: Drainage and Irrigation Department of Malaysia

Cascading Risks

Emerging Hazards



Flood prone area and 100-year flood map with identified active and closed landfill sites in Selangor. (Sources: Flood map adapted from RFN-2 Report 2009, landfill sites from NAHRIM and NRE 2010) Source: Nurul, Lim and Pereira 2013

Landfill Sites Exposed to Flooding:

- Number of sites located within flood prone area: **4**
- Number of sites located within 100-year flood: **9**
- Number of sites potentially exposed to impacts from sea level rise: **3**

Kg. Sungai Chinchin

Floodplain – Issues

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

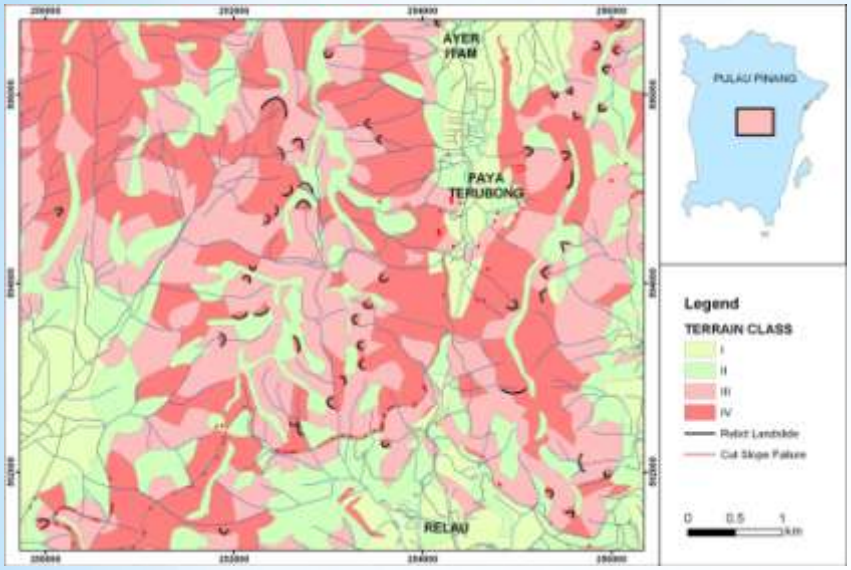
(i) Prediction based on historical records

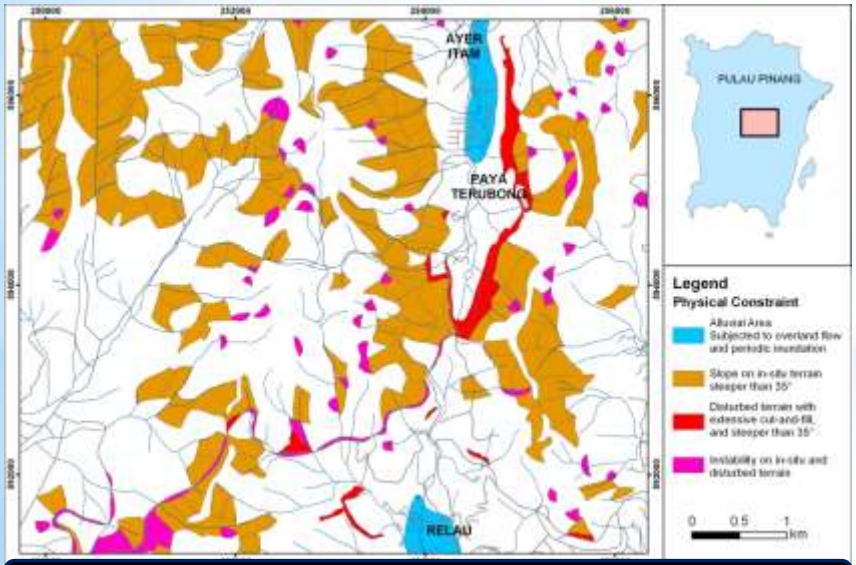
(ii) Changes in land use affects analysis

(iii) Changes in climate and extreme events affects analysis

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

Areas Susceptible to Landslides/Floods





Source: Ng, 2011 based on data from JMG

Risk Factors:

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

Adaptation Measures:

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

	Type of Flood	Cause of flood	Affected area
1.	Flash flood	Heavy rainfall event, dam or levee failure	Destroy structures, down trees and wash out roads
2.	River flood	Overflow the river banks, heavy rainfall, snowmelt and ice jams	Extensive damage to residents living near rivers and streams
3.	Coastal flood	Hurricanes, tropical storms, tsunamis, extremely high tides and strong onshore winds.	Extensive damage to industry, agricultural, residents living near coastal area.
4.	Urban flood	Flash flooding, river flooding and coastal flooding	High economic damages to businesses and homes
5.	Areal floods	Heavy rainfall and dangerous inundation of low lying areas	Agricultural losses and breeding ground for insects and disease.

Table: Last 20 years damage and losses by flood events in Malaysia

Flood Event (Year)	Place	Damage (USD million at 1996 prices)	Deaths	No. of Victims Evacuated
1991	Other Peninsular Malaysia	NA	11	NA
1992	Peninsular Malaysia	NA	12	NA
1993	Peninsular	NA	22	17,000
1993	Sabah State	72.57	5	5,000
1995	Shah Alam/Kelang Valley	1.76	1	8,970
1995	Klang Selangor	NA	3	0
1995	Other Peninsular Malaysia	NA	4	14,900
June, 1996	Sahab	>100 houses destroyed	1	9,000
29.8.1996	Pos Dipang, Perak	97.8	44	Hundreds
December, 1996	Sabah	NA	241	23,000
30.12.1998	Kuala Lumpur	NA	5	0
5-9.1.1999	Penampang, Sabah	NA	6	4,481
11.1.1999	Sandakan Sabah	NA	3	0
23.11.2000	Kg. La	NA	6	0
Dec. 2001	Kelantan, Pahang, Terengganu	Crop loss & property damage in millions USD; USD 0.65 million texts destroyed	6	>10,000
27.12.2001	Gunung Pulai, Johor	Mudslide swept away 4 houses 5	4	families
31.12.2001	Benut Marang, Terengganu	Crop loss & property damage	4	Thousands
Dec 2006 – Jan 2007	Johor State Kelantan State	USD 489 million Property Damage USD 17.28 Damage to Infrastructures	18	110,000
2008	Johor State	65 (Relief Costs)	28	34,000
November 2010	Kedah & Perlis States	Alor Setar Airport closed, railway line flooded, USD 8.48 million padi crop damage	4	50,000

Sources: Drainage and Irrigation Department Malaysia, Malaysian National Security Council and Chan, 2012.

Date	Place	Damage and Losses
December, 2011	Sungai Jelok, Kajang	RM2.4 million in damages with 61 businesses recording losses of between RM1,000 and RM250,000 each.

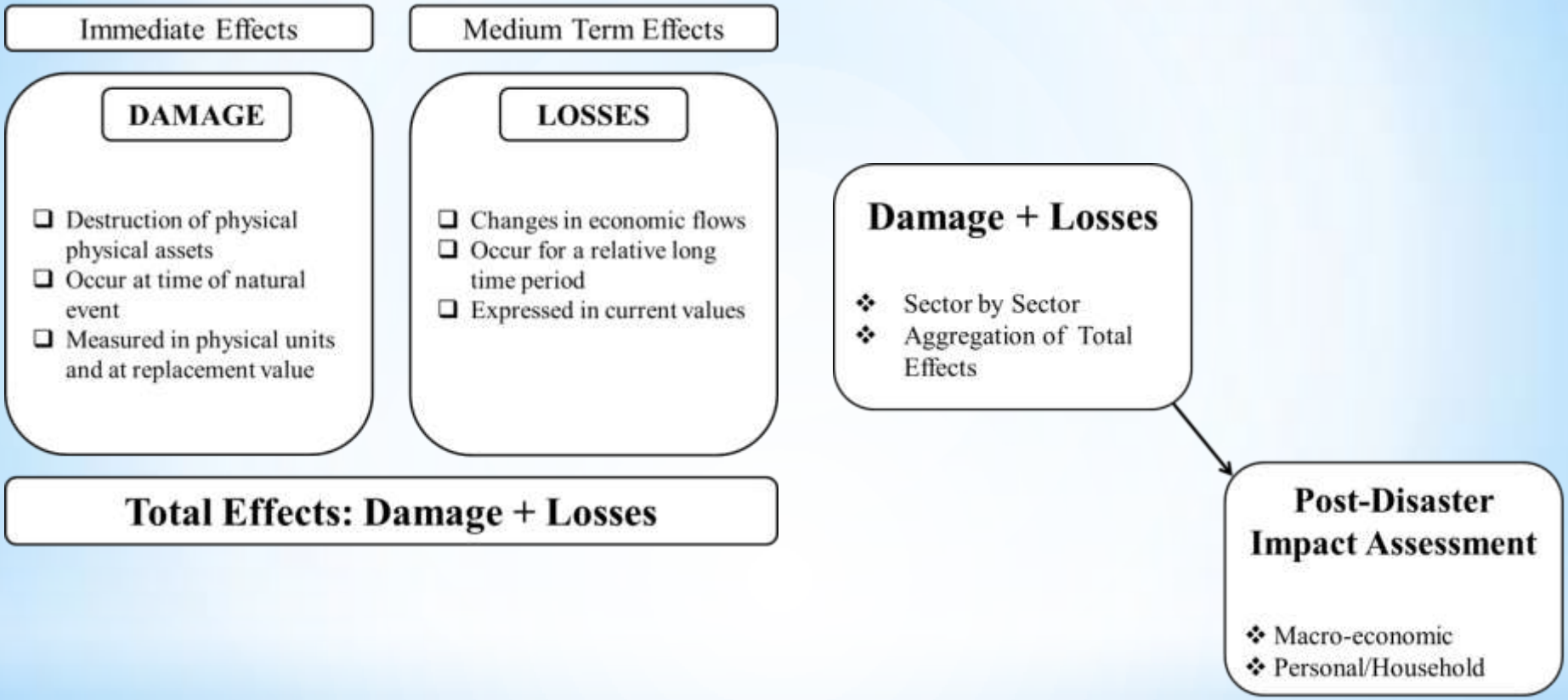
Date	Place	Damage and Losses
September, 2012	Serdang and Kajang	• About 100 vehicles were left stranded and 350 houses were in a metre of floodwaters. • 600 students and teachers from two schools were trapped.

The Impacts of Flooding

* **Communication:** Floodwater can seriously disrupt public and personal **transport** by cutting off **roads and railway lines**, as well as communication links when **telephone lines** are damaged.
* **Health:** Floods disrupt normal **drainage systems** in cities, and sewage spills are common, which represents a serious health hazard, along with standing water and wet materials in the home. Bacteria, mould and viruses, cause **disease, trigger allergic reactions**, and continue to damage materials long after a flood.
* **Agricultural:** Floods can distribute large amounts of **water and suspended sediment** over vast areas, restocking valuable **soil nutrients** to agricultural lands. In contrast, soil can be eroded by large amounts of fast flowing water, **ruining crops**, **destroying agricultural land / buildings and drowning farm animals**.
* **Personal property:** Severe floods not only ruin homes / businesses and destroy personal property, but the water left behind causes further damage to property and contents.
* **Environment:** The environment and wildlife is also at risk when damage when damage to businesses causes the accidental release of toxic materials like paints, pesticides, gasoline etc.

No.	Method	Country	Disaster type	Reference
1.	Victorian rapid appraisal method (RAM) and the natural hazard loss estimation methodology (HAZUS)	Australia	Any type of disaster	Emergency Management Australia, 2002
2.	Costing Model (CM) and Event Impact Rapid Assessment and Disaster Scaling (EIRADS) calculator	Philippines	Any type of disaster	Raza, T. & Peralta, J.F. 2013,
3.	Calculation of direct and indirect losses	United States of America	Drought, Hurricane, floods and earthquake	National Academy Press, Washington, D.C. 1999
4.	The Economic Commission for Latin America and the Caribbean (ECLAC) Methodology	Jamaica	FLOOD RAINS AND LANDSLIDES	Economic Commission for Latin America and The Caribbean. 7 December 2001.
5.	The index of damaged area (IDA), direct damage assessment, indirect damage assessment and intangible damage assessment.	Italy	Landslide	Petrucci, O., 2013.
6.	Damage and Loss Assessment Methodology (DaLA)	Bangladesh	Cyclone	GFDRR, 2008
7.	Damage and Loss Assessment Methodology (DaLA)	Indonesia, Venezuela and Yemen	Tsunami and Flood	GFDRR and World Bank, 2007

Definition of Disaster Effects



Assessment Process

Damage and Loss Assessment (DaLA)

Damage and Loss Assessment (DaLA) Methodology

- Step 1: Define a pre-disaster baseline
- Step 2: Develop a post-disaster situation
- Step 3: Estimate damage and losses on a sector-by-sector fashion
- Step 4: Estimate overall amount of disaster effects
- Step 5: Estimate macro-economic impact
- Step 6: Estimate impact on personal/household employment/income

Sectors	Sub-sectors
Infrastructure	• Water Supply and Sanitation • Transport • Energy • Telecommunication
Production	• Industry • Agriculture, Livestock and Fishery • Trade • Tourism
Social	• Education • Housing • Health • Cultural heritage
Cross-Cutting	• Environment • Gender

Concluding Remarks: Challenges

- Recognition of cascading hazards and slow onset hazards - persistent, insidious and long-term;
- Detection and attribution related to extreme events;
- Identification of susceptible areas and spatial distribution of exposed and vulnerable communities therein;
- Data for assessment of loss and damage;
- Early warning and response systems
- New models for risk sharing / social protection schemes
- Legal implications and future security challenges

ACKNOWLEDGEMENT

APN & PROJECT PARTNERS: IGES, IMHEN, RUPP & MCCW

*THANK YOU!