Climate Extremes and Disaster Risk Reduction

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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

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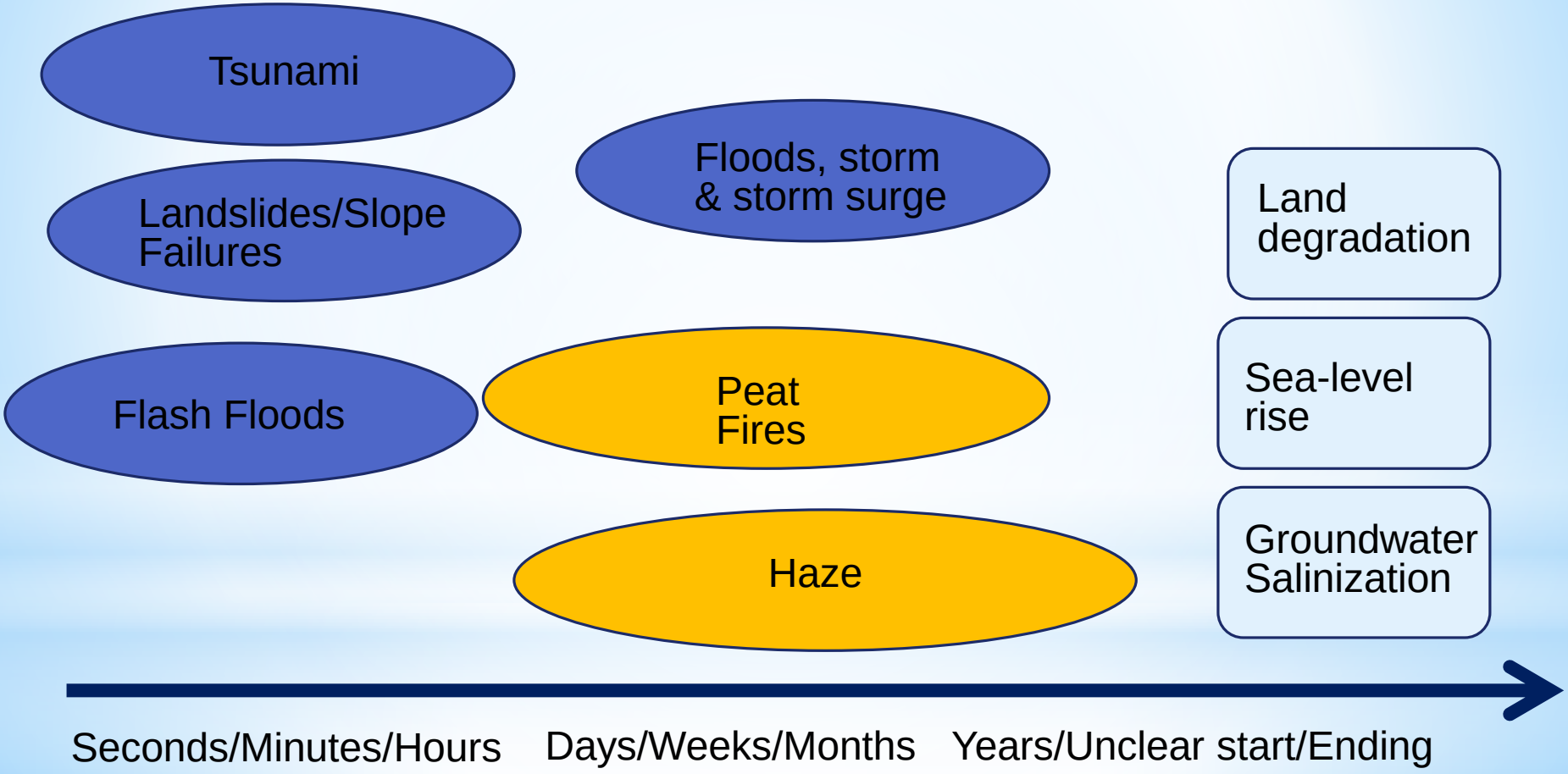
Fast & Slow Onset Events



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Asia

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Chapter 24, Asia: Coverage - 51 countries/regions

Source: IPCC, 2014

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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)

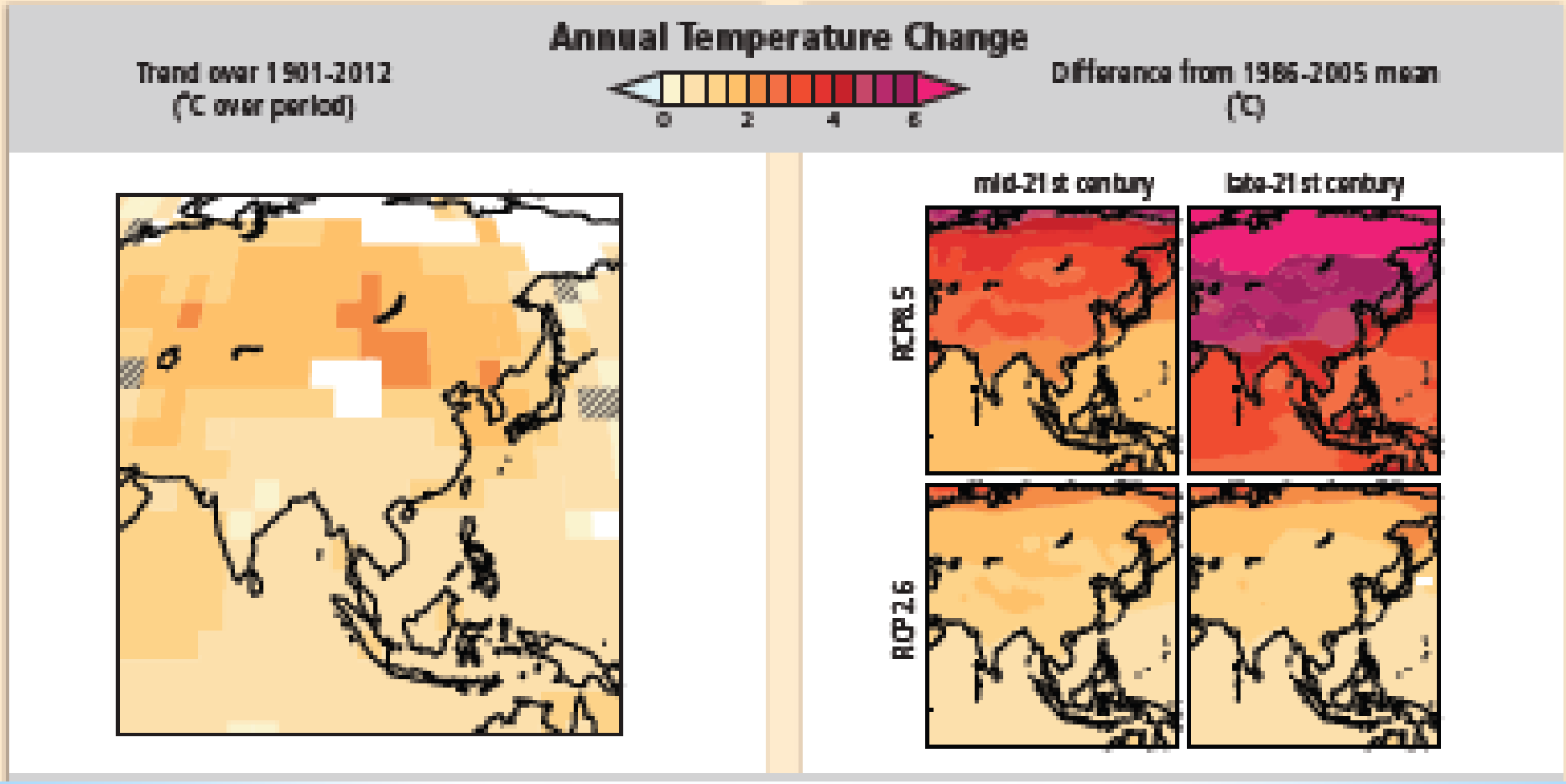
- Afghanistan
- Bangladesh
- Bhutan
- India
- Maldives
- Nepal
- Pakistan
- Sri Lanka

Southeast Asia (12)

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

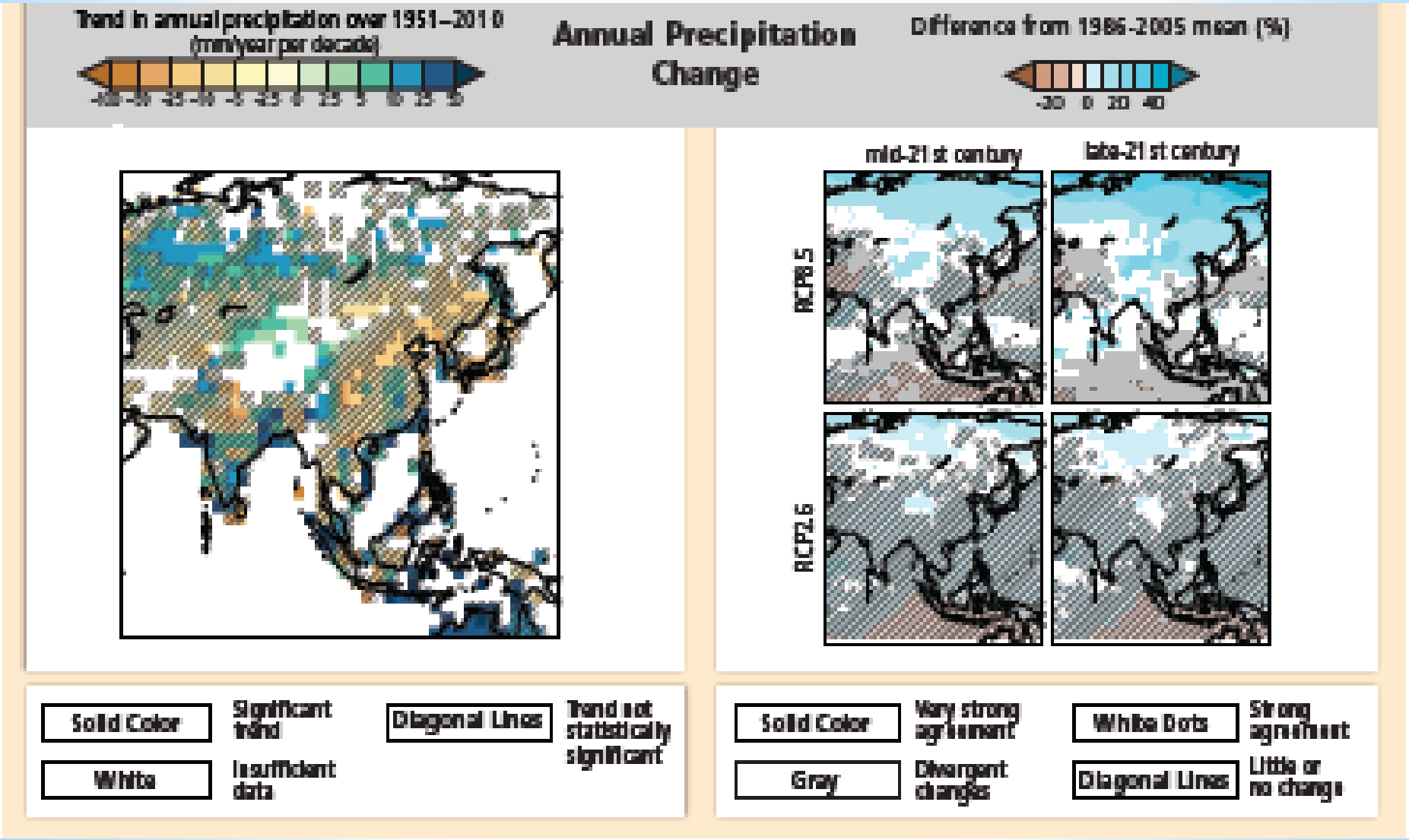
Chapter 24, Asia: Observed and projected changes in annual average temperature in Asia

Source: IPCC, 2014



Chapter 24, Asia: Observed and projected changes in annual average precipitation in Asia

Source: IPCC, 2014



Observations of Past Events

Source: IPCC, 2013

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Climate Phenomenon	Asia	Southeast Asia
Heat Waves	It is likely that the frequency of heat waves has increased in large parts of Asia.	No Specific Observations
Drought	There is medium confidence that more megadroughts occurred in monsoon Asia and wetter conditions prevailed in arid Central Asia monsoon region during the Little Ice Age (1450–1850) compared to the Medieval Climate Anomaly (950–1250).	No Specific Observations
Floods	With high confidence, past floods larger than recorded since the 20th century occurred during the past five centuries in eastern Asia. There is medium confidence that in the Near East and India modern large floods are comparable or surpass historical floods in magnitude and/or frequency.	No Specific Observations

Future Projections

Source: IPCC, 2013

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Climate Phenomenon	Asia	Southeast Asia
Precipitation	Future increase in precipitation extremes related to the monsoon is very likely in East Asia, South Asia and Southeast Asia.	Future increase in precipitation extremes related to the monsoon is very likely in Southeast Asia.
	Indian monsoon rainfall is projected to increase. For the East Asian summer monsoon, both monsoon circulation and rainfall are projected to increase.	There is low confidence in projections of future changes in the Madden-Julian Oscillation due to the poor skill in model simulations of this intraseasonal phenomenon and the sensitivity to ocean warming patterns. Future projections of regional climate extremes in Southeast Asia are therefore of low confidence.
		Reduced precipitation in Indonesia in Jul-Oct due to pattern of Indian Ocean warming (RCP 4.5 or higher end scenarios)
El Niño-Southern Oscillation	Natural modulations of the variance and spatial pattern of El Niño-Southern Oscillation are so large that confidence in any projected change for the 21st century remains low. Confidence is low in changes in climate impacts for most of Asia.	Low Confidence in any projected change for the 21st century.

Sea Level Rise (IPCC 2013)

Source: IPCC, 2013

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- Projected climate change (based on RCPs) **in AR5 is similar to AR4** in both patterns and magnitude, after accounting for scenario differences.
- Projections of global mean sea level rise **has increased in confidence** since the AR4 because of the improved physical understanding of the components of sea level, the improved agreement of process-based models with observations, and the inclusion of ice-sheet dynamical changes.
- Global mean sea level **will continue to rise during the 21st century**. Under all RCP scenarios the rate of sea level rise will *very likely* exceed that observed during 1971–2010 due to increased ocean warming and increased loss of mass from glaciers and ice sheets.

Sea Level Rise (IPCC 2013)

Source: IPCC, 2013

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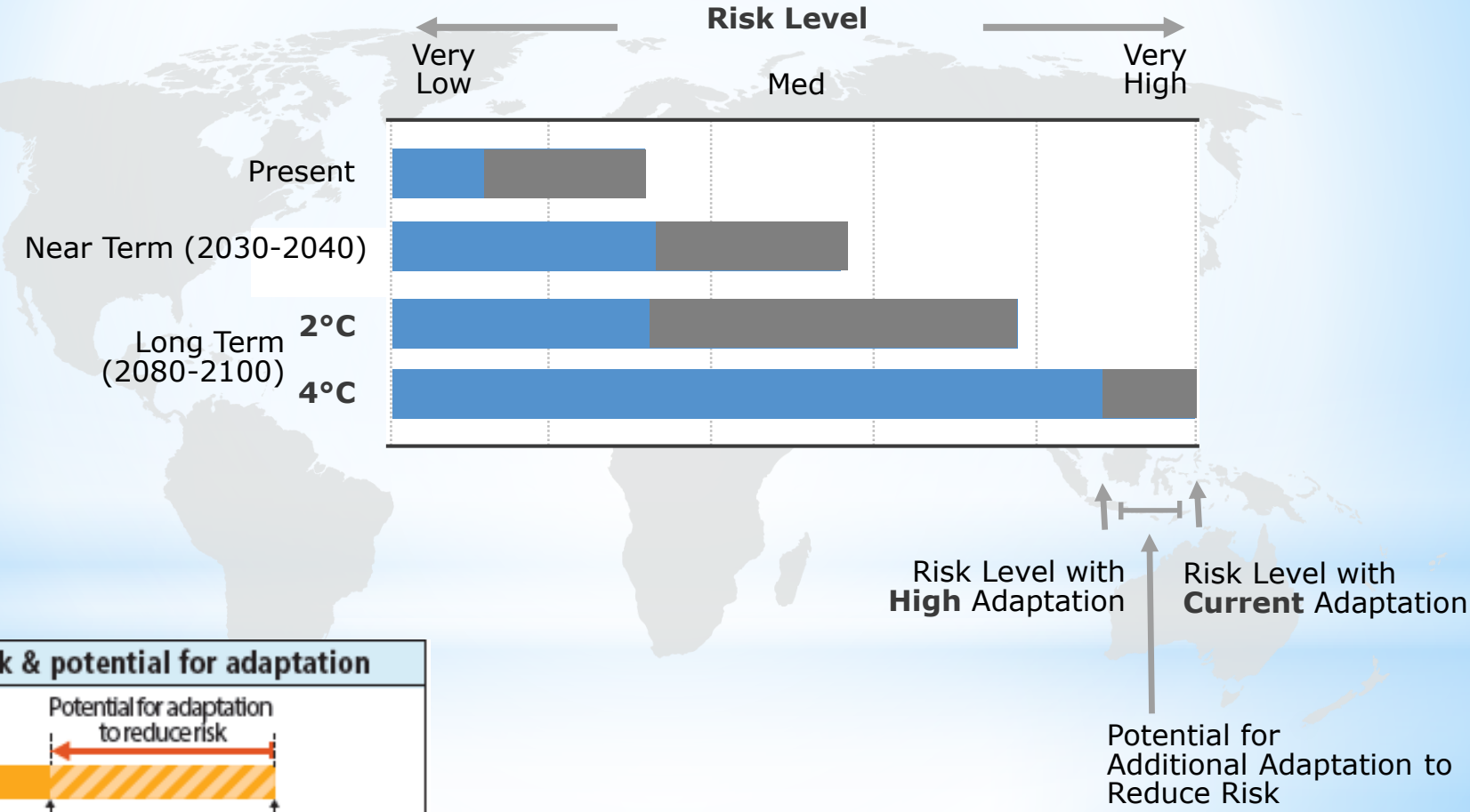
Global mean sea level rise for 2081–2100 relative to 1986–2005 will *likely* be in the following ranges:

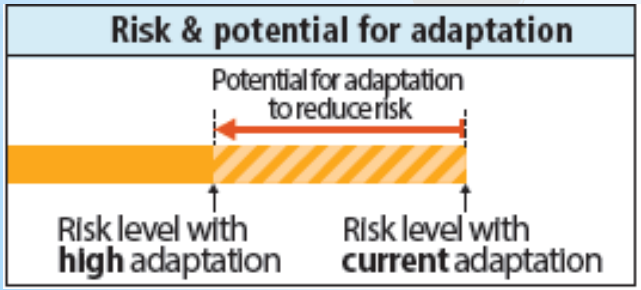
- 0.26 to 0.55 m (RCP2.6)
- 0.32 to 0.63 m (RCP4.5)
- 0.33 to 0.63 m (RCP6.0)
- 0.45 to 0.82 m (RCP8.5) – medium confidence

Sea level rise will **not be uniform**. By the end of the 21st century, it is *very likely* that sea level will rise in more than about 95% of the ocean area.

About 70% of the coastlines worldwide are projected to experience sea level change **within 20% of the global mean sea level change**.

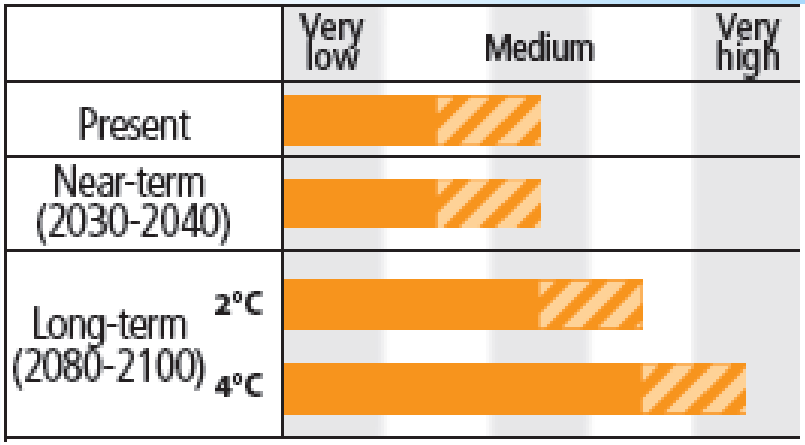
Assessing risk



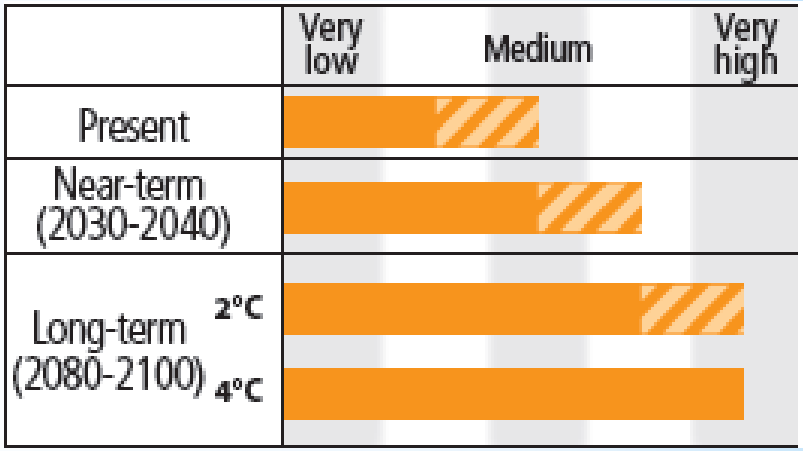


Key Risks in Asia

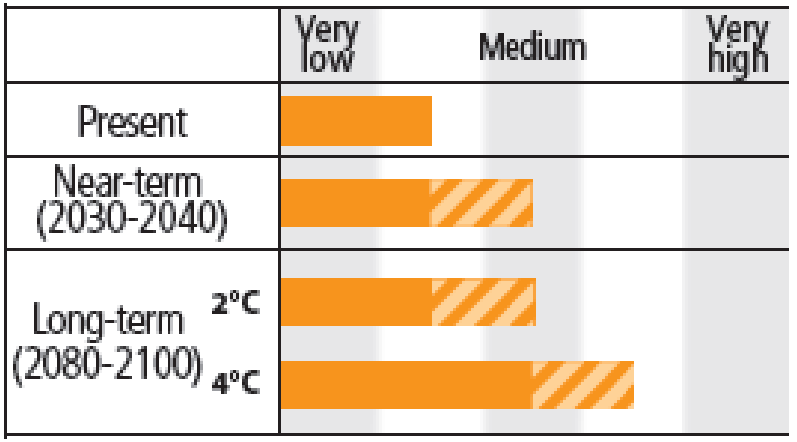
Increased coastal, riverine and urban flooding leading to widespread damage to infrastructure and settlements in Asia (medium confidence)



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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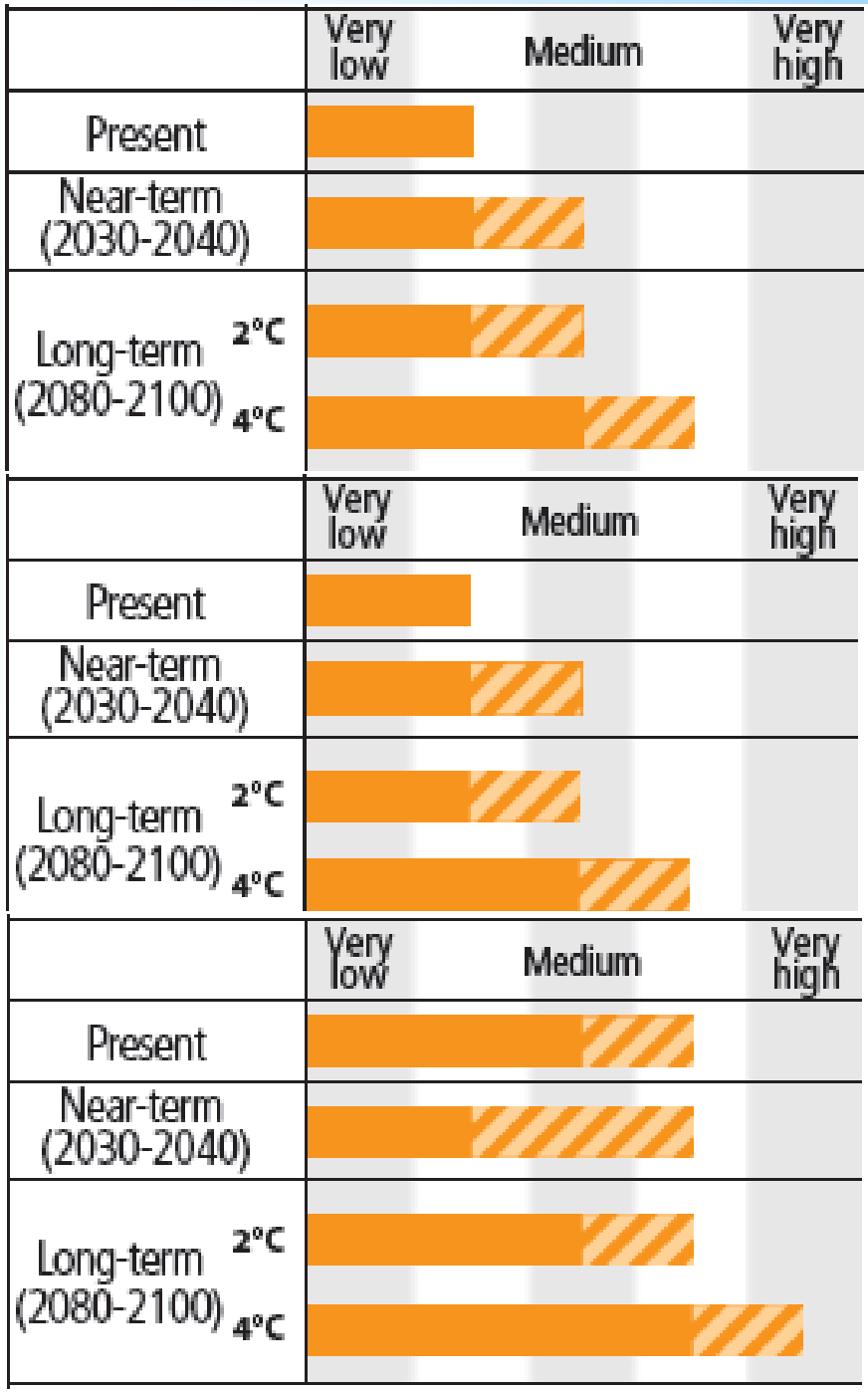
Key Risks in Asia

Increased risk of flood-related deaths, injuries, infectious diseases and mental disorders (medium confidence)

Increased risk of water and vector-borne diseases (medium confidence)

Exacerbated poverty, inequalities and new vulnerabilities (high confidence)



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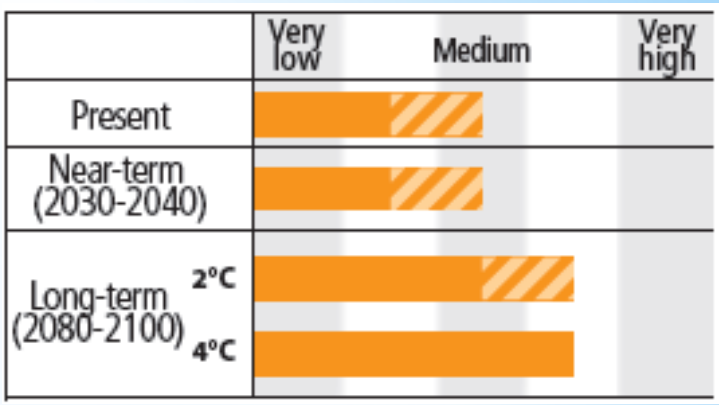
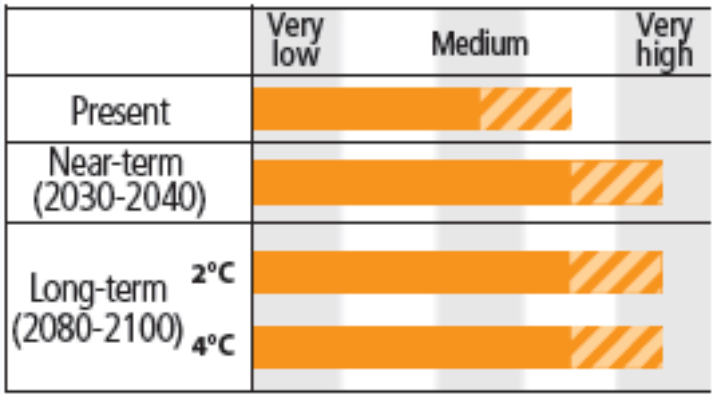
Key Risks in Asia

Increased risk of crop failure and lower crop production could lead to food insecurity in Asia (medium confidence)

Water shortage in arid areas of Asia (medium confidence)





KEY CONCLUSIONS: IPCC-WG2 Chapter 24, Asia

- Water scarcity is expected to be a major challenge for most of the region due to increased water demand and lack of good management (*medium confidence*)
- There is *low confidence* in future precipitation projections at a sub-regional scale and thus in future freshwater availability in most parts of Asia.
- Integrated water management strategies could help adapt to climate change, including developing water saving technologies, increasing water productivity, and water reuse.

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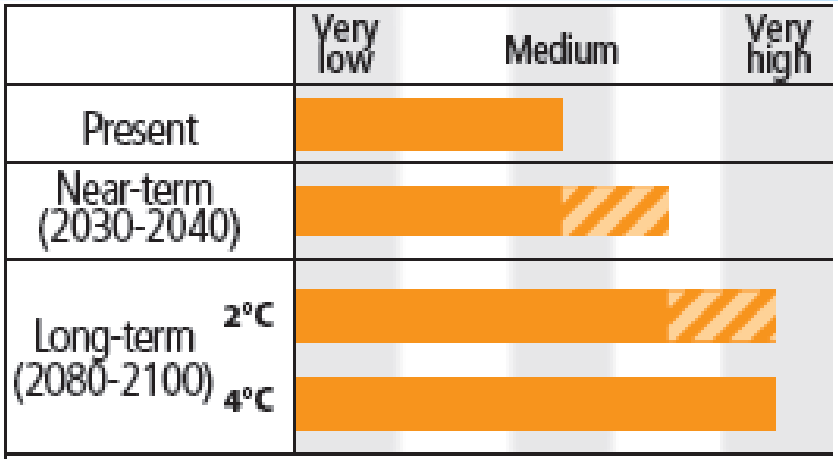
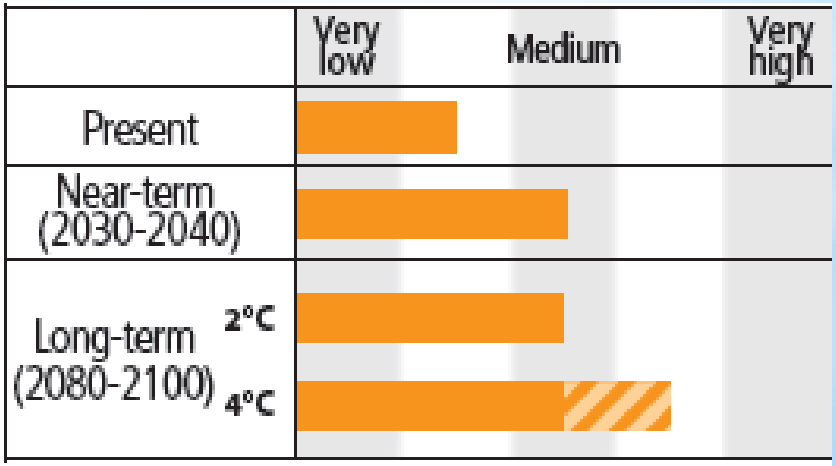
Key Risks in Asia

Coral reef decline in Asia (high confidence)



Mountain-top extinctions in Asia (high confidence)



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Chapter 24, Asia: Coverage of Information

Source: IPCC, 2014

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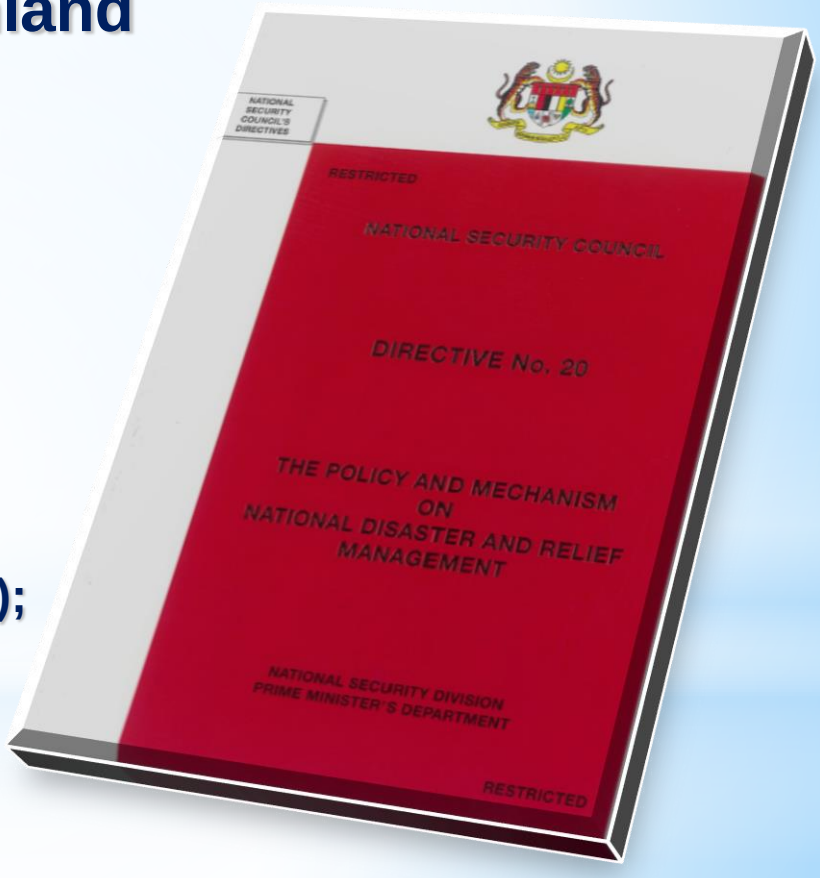
Sector	Topics/issues	North Asia		East Asia		Southeast Asia		South Asia		Central Asia		West Asia	
	O = Observed impacts, P = Projected Impacts	O	P	O	P	O	P	O	P	O	P	O	P
Freshwater resources	Major river runoff	/	x	/	/	/	/	/	x	x	x	x	x
	Water supply	x	x	x	x	x	x	x	x	x	x	x	x
Terrestrial and inland water systems	Phenology and growth rates	/	/	/	/	x	x	x	x	x	x	x	x
	Distributions of species and biomes	/	/	/	/	x	x	x	/	x	x	x	x
	Permafrost	/	/	/	/	/	x	/	/	/	/	/	x
	Inland waters	x	x	/	x	x	x	x	x	x	x	x	x
Coastal systems and low-lying areas	Coral reefs	NR	NR	/	/	/	/	/	/	NR	NR	/	/
	Other coastal ecosystems	x	x	/	/	x	x	x	x	NR	NR	x	x
	Arctic coast erosion	/	/	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Food production systems and food security	Rice yield	x	x	/	/	x	/	x	/	x	x	X	/
	Wheat yield	x	x	x	x	x	x	x	/	x	x	/	/
	Corn yield	x	x	x	/	x	x	x	x	x	x	x	x
	Other crops (e.g., barley, potato)	x	x	/	/	x	x	x	x	x	X	/	/
	Vegetables	x	x	/	x	x	x	x	x	x	x	x	x
	Fruits	x	x	/	x	x	x	x	x	x	x	x	x
	Livestock	x	x	/	x	x	x	x	x	x	x	x	x
	Fisheries and aquaculture production	x	/	x	/	x	/	x	x	x	x	x	x
	Farming area	x	/	x	/	x	x	x	/	x	/	x	x
	Water demand for irrigation	x	/	x	/	x	x	x	/	x	x	x	x
	Pest and disease occurrence	x	x	x	x	x	x	x	/	x	x	x	x
Human settlements, industry, and infrastructure	Floodplains	x	x	/	/	/	/	/	/	x	x	x	x
	Coastal areas	x	x	/	/	/	/	/	/	NR	NR	x	x
	Population and assets	x	x	/	/	/	/	/	/	x	x	x	x
	Industry and infrastructure	x	x	/	/	/	/	/	/	x	x	x	x
Human health, security, livelihoods, and poverty	Health effects of floods	x	x	x	x	x	x	/	x	x	x	x	x
	Health effects of heat	x	x	/	x	x	x	x	x	x	x	x	x
	Health effects of drought	x	x	x	x	x	x	x	x	x	x	x	x
	Water-borne diseases	x	x	x	x	/	x	/	x	x	x	x	x
	Vector-borne diseases	x	x	x	x	/	x	/	x	x	x	x	x
	Livelihoods and poverty	x	x	/	x	x	x	/	x	x	x	x	x
	Economic valuation	x	x	x	x	/	/	/	/	x	x	x	x

* Disaster Management Framework

* Experience the collapse of Highland Towers in 1993;
* NSC Directive No. 20 came into force in 11 May 1997;
* Reviewed on 30 Mac 2012;
* Needs to manage:
  * Total Disaster Risk Management (TDRM);
  * increase in complexity;
  * engage private, NGO and community;
  * take into account AADMER & other international arrangements.



* Aims of Directive No. 20

Outlines:

Policy and Mechanism on Disaster and Relief Management on Land

Based on:

Levels of Government Administration

By:

Establishing a holistic management mechanism at the stage of pre, during & post disaster; and

determining roles & responsibilities of various Government Agencies, statutory bodies, the private sector and voluntary bodies in disaster management in disaster management.

* Disaster Management Framework

MAKING DISASTER RISK REDUCTION A PRIORITY

- Legal framework and policy
- Mainstreaming Disaster Risk Reduction into the Development Policy, Planning and Implementation

IDENTIFYING, ASSESSING AND MONITORING RISK AND ENHANCING EARLY WARNING

- Risk Mapping
- Early Warning and Disseminations

BUILDING A CULTURE OF RESILIENCE TO DISASTERS THROUGH AWARENESS, EDUCATION AND TRAINING

- Public Awareness Program

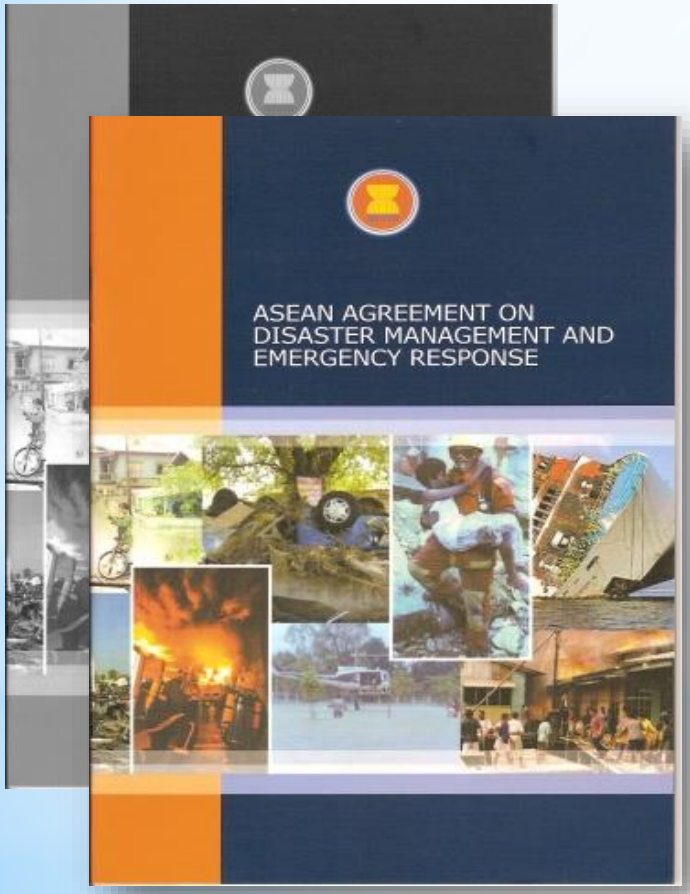
REDUCING RISK IN KEY SECTORS

- Environmental Management and Climate Change Adaptation

STRENGTHENING DISASTER PREPAREDNESS FOR EFFECTIVE RESPONSE

- Capacity Building and Assets Enhancement

* ASEAN AGREEMENT ON DISASTER MANAGEMENT AND DISASTER RESPONSE (AADMER)



ASEAN Agreement on Disaster Management and Emergency Response

Signed in July 2005, ratified by all ten (10) ASEAN Member Countries, entered into force on 24 December 2009

Objective: Reduce disaster losses in ASEAN region, and jointly respond to disaster emergencies

A legal framework for all ASEAN Member States and serves as a **common platform** in responding to disasters within ASEAN

ASEAN Coordinating Centre for Humanitarian Assistance on disaster management (AHA Centre) as the operational coordination body and engine of AADMER

* Financial Aspects

* Central and State Governments through their respective agencies are responsible to allocate funds for the purpose of Disaster management and Disaster Risk Reduction;
* Donation drives for a specific disaster may channel financial contribution to the National Disaster Relief Trust Fund (NDRTF).
* RMK-11 – special allocation for DRR adminsitered by the National Security Council

NATIONAL PLATFORM AND ACTION PLAN FOR DISASTER RISK REDUCTION (MyDRR)

- **The National Security Council (MKN) of the Prime Minister's Department is entrusted with the responsibility of ensuring the effectiveness of the disaster management mechanisms in the country as mandated by MKN Directive 20.**

- **MKN is formalising existing arrangements for DRR and expanding the array of stakeholders through establishment of the National Platform on DRR, which was announced in 2013.**

- **The National Action Plan for DRR (MyDRR) is now undergoing stakeholder consultation. Formal workshops have been held with government agencies, non-government organisations and the private sector.**

NATIONAL ACTION PLAN FOR DISASTER RISK REDUCTION (MyDRR)

GOAL

Towards Sustainable Development and Resilient Communities though Disaster Risk Reduction

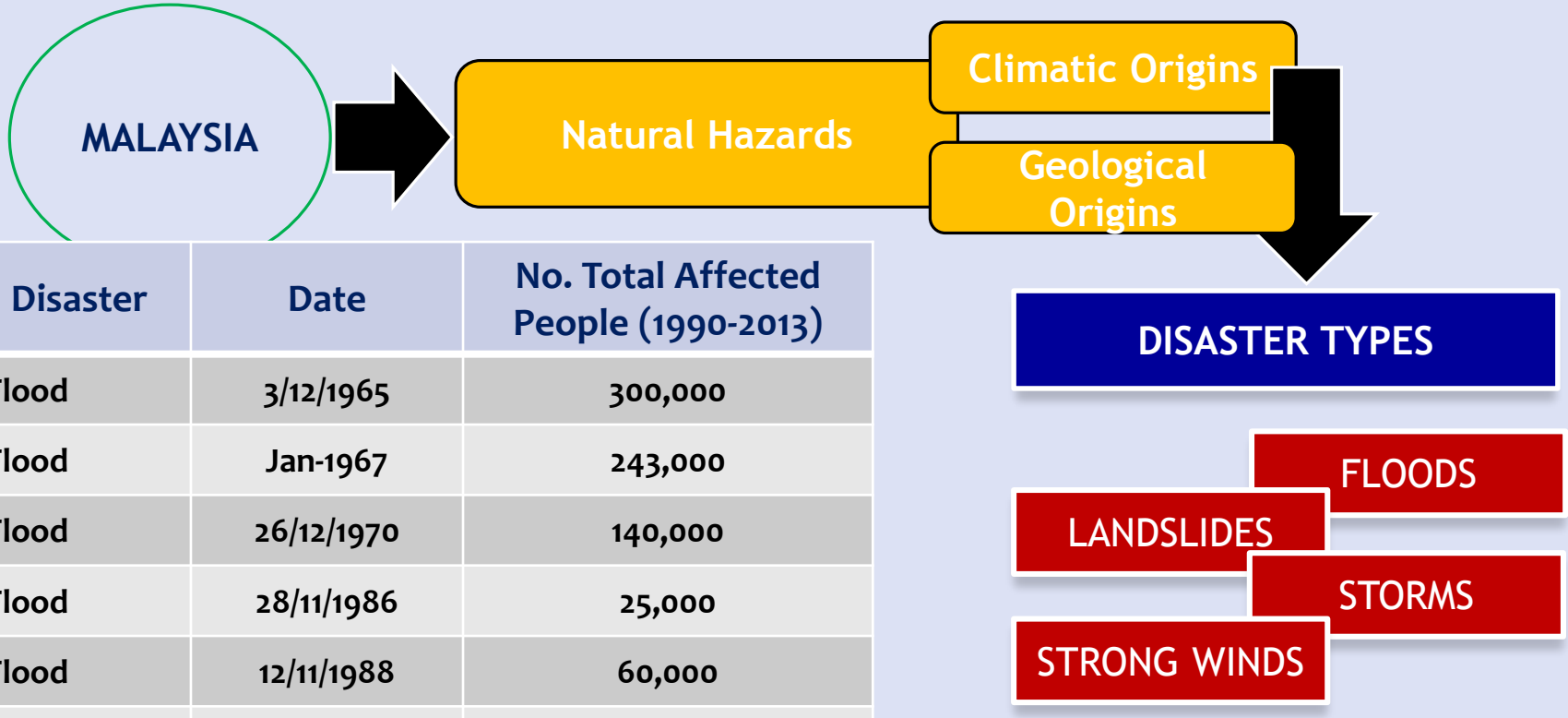
OBJECTIVES

- **Mainstreaming DRR in national development;**
- **Enhancing capacity for holistic and effective disaster management at all levels;**
- **Strengthening monitoring systems, early warning and information dissemination on disasters; and**
- **Developing a culture of resilience to current and emerging hazards and disasters at the community level.**

MyDRR – KEY ACTION AREAS

- Formulation and implementation of laws related to disaster management;
- Integration of risk reduction measures in the development agenda at all levels;
- Assessment of hazards and risks
- Infrastructure for disaster mitigation and early warning systems;
- Disaster preparedness at all levels;
- Disaster response mechanisms;
- Disaster Recovery and Reconstruction

NATURAL HAZARDS IN MALAYSIA

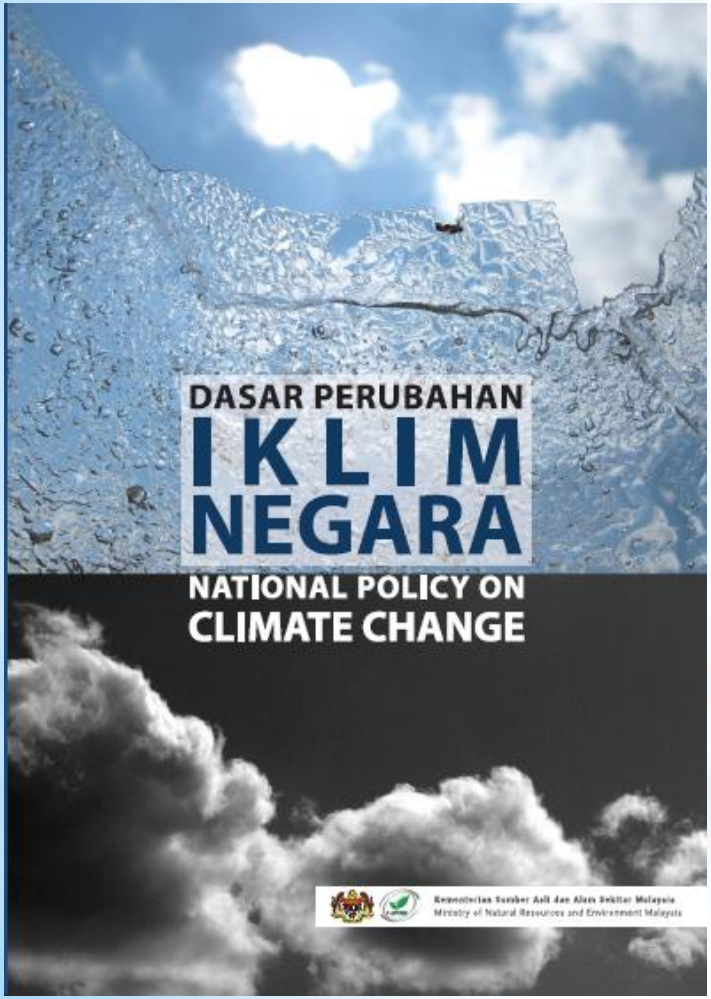


Disaster	Date	No. Total Affected People (1990-2013)
Flood	3/12/1965	300,000
Flood	Jan-1967	243,000
Flood	26/12/1970	140,000
Flood	28/11/1986	25,000
Flood	12/11/1988	60,000
Flood	6/11/1988	40,000
Flood	23/11/2005	30,000
Flood	19/12/2006	100,000
Flood	11/1/2007	137,533
Flood	7/12/2007	29,000

Natural hazards in Malaysia are influenced by climatic factors

Source: http://www.emdat.be/result-country-profile

* National Policy on Climate Change (2009)



Climate-resilient development – development that takes into account measures to address climate change and extreme weather in line with national priorities.

Broadened definition enables the National Policy on Climate Change to serve as an instrument to harmonise and integrate to the extent possible and in line with national priorities, measures on climate change adaptation, mitigation and disaster risk reduction

5 Principles, 10 Strategic Thrusts & 43 Key Actions

KEY ACTIONS RELATED TO DRR IN THE NATIONAL POLICY ON CLIMATE CHANGE (2009)

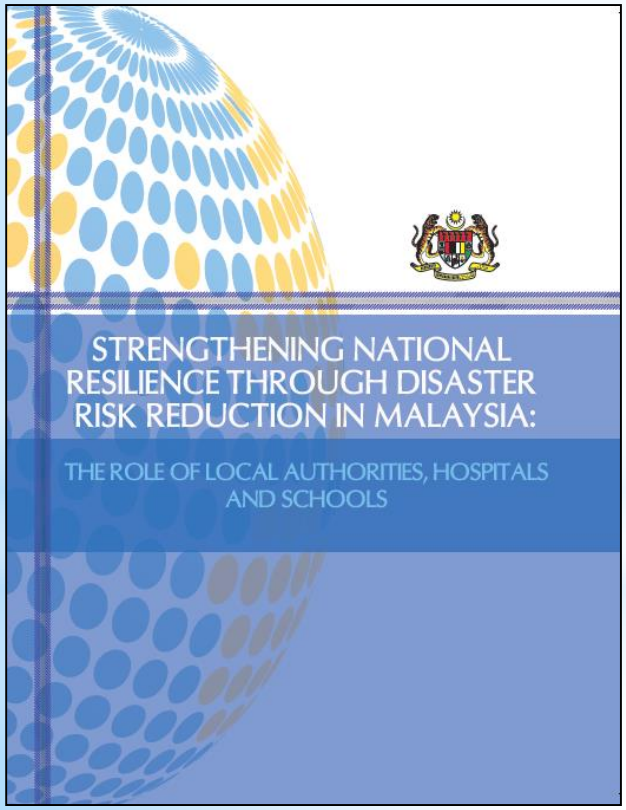
RATIONALE: Climate change and extreme weather have intensified the occurrence of natural disasters, amongst others sea-level rise, floods, landslides, coastal and land erosion, drought, forest fires and haze, which have impacted human safety and health, threatened the fabric of the nation's economy and caused changes to natural and built landscapes.

- Conduct systematic reviews and harmonise existing legislation, policies and plans, taking into account and proposing relevant balanced adaptation and mitigation measures to address DRR [KA1 - ST1]
- Incorporate measures, including mobilising financing and technical assistance for DRR [KA13 - ST4]
- Integrate measures into policies, plans, programmes and projects in DRR [KA25 - ST6]
- Establish and implement a national R&D agenda on climate change taking into account vulnerability due to extreme weather events and natural disasters [KA28 - ST7]
- Strengthen national data repository through periodic national inventory by establishing a database/inventory on natural disasters and extreme weather events [KA29 - ST7]

*DRR & CCA Linkage

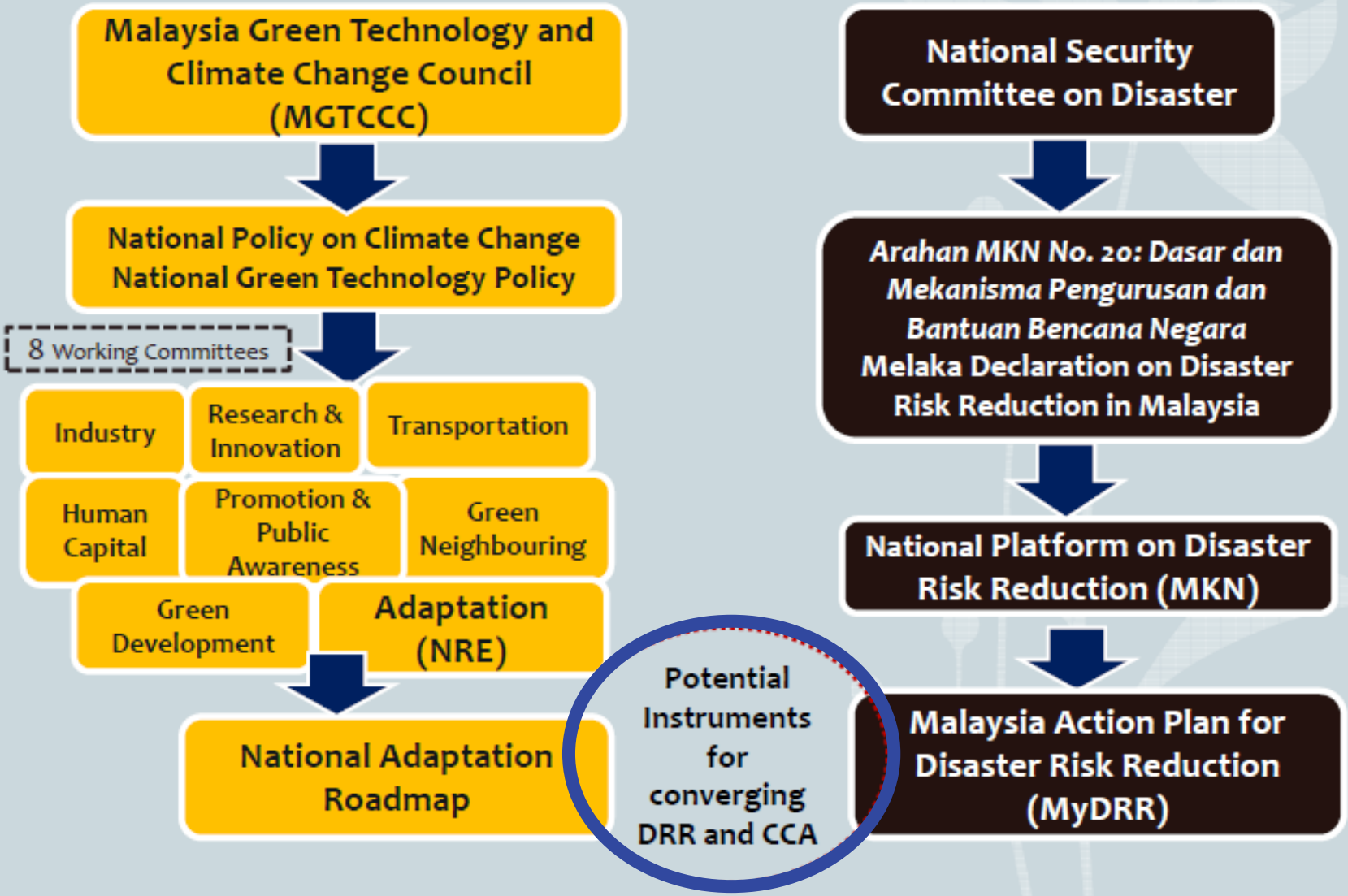
Melaka Declaration on Disaster Risk Reduction in Malaysia 2011

Melaka, 18–19 February 2011



- Recognising the changing nature of disaster risk in the country due to climate variability and change
- To promote the use of technology in support of early warning, multi-hazards risk assessment, and climate modelling and downscaling.
- To strengthen local capacity to integrate climate and disaster risk into local development planning

INSTITUTIONAL ARRANGEMENT



MyDRR & NPCC: Converging Aspirations

NPCC

Balanced adaptation and mitigation for climate resilient development

MyDRR + NPCC

Managing disaster risk related to climate variability and climate extremes, and preparing for risks related to climate change

MyDRR

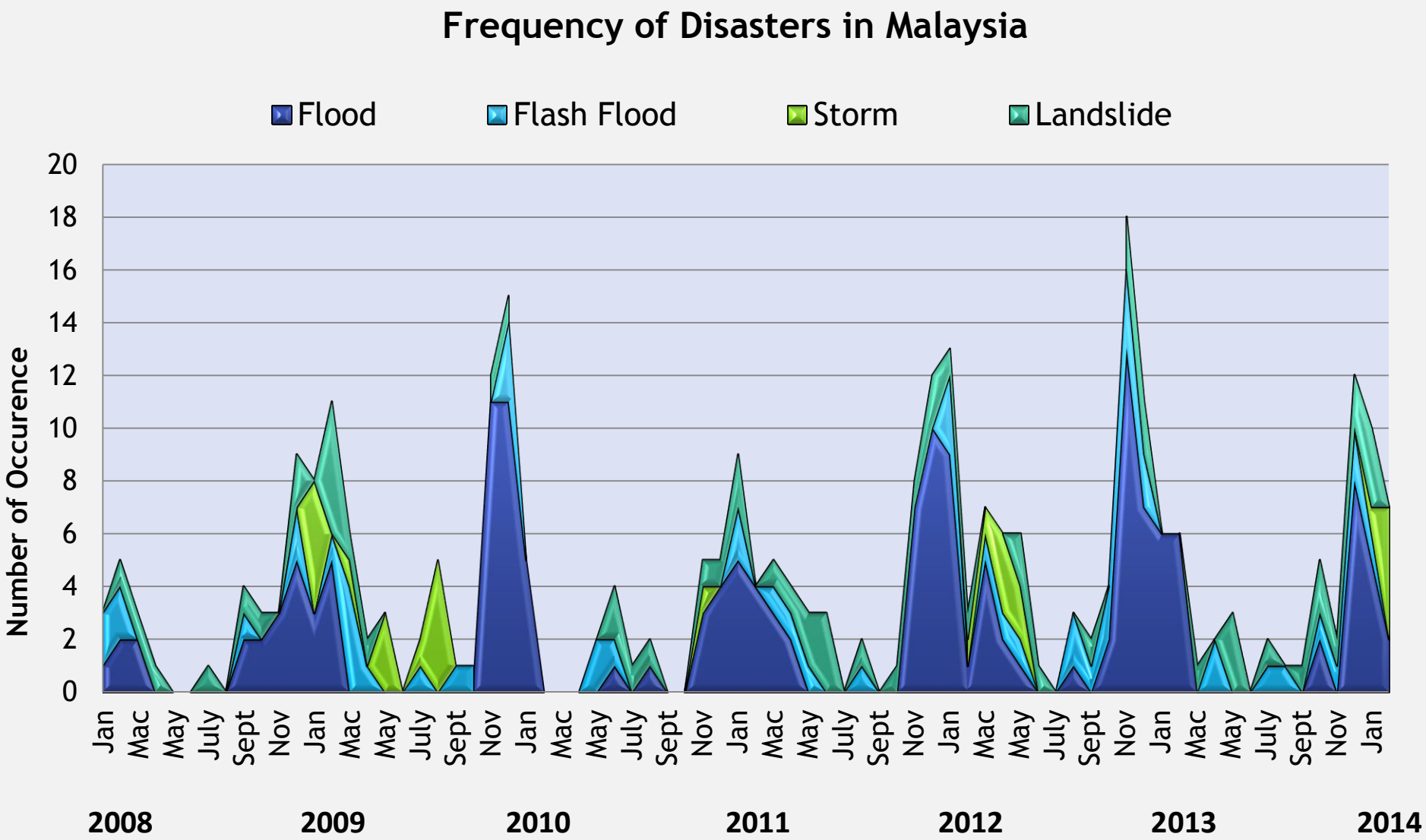
Managing risks due to all types of hazards: climatic, geological, biological and technological

Integrating DRR, CCA and L+D

SEADPRI-UKM, IGES, IMHEN, RUPP & MCCW

APN

ASIA-PACIFIC NETWORK FOR
GLOBAL CHANGE RESEARCH

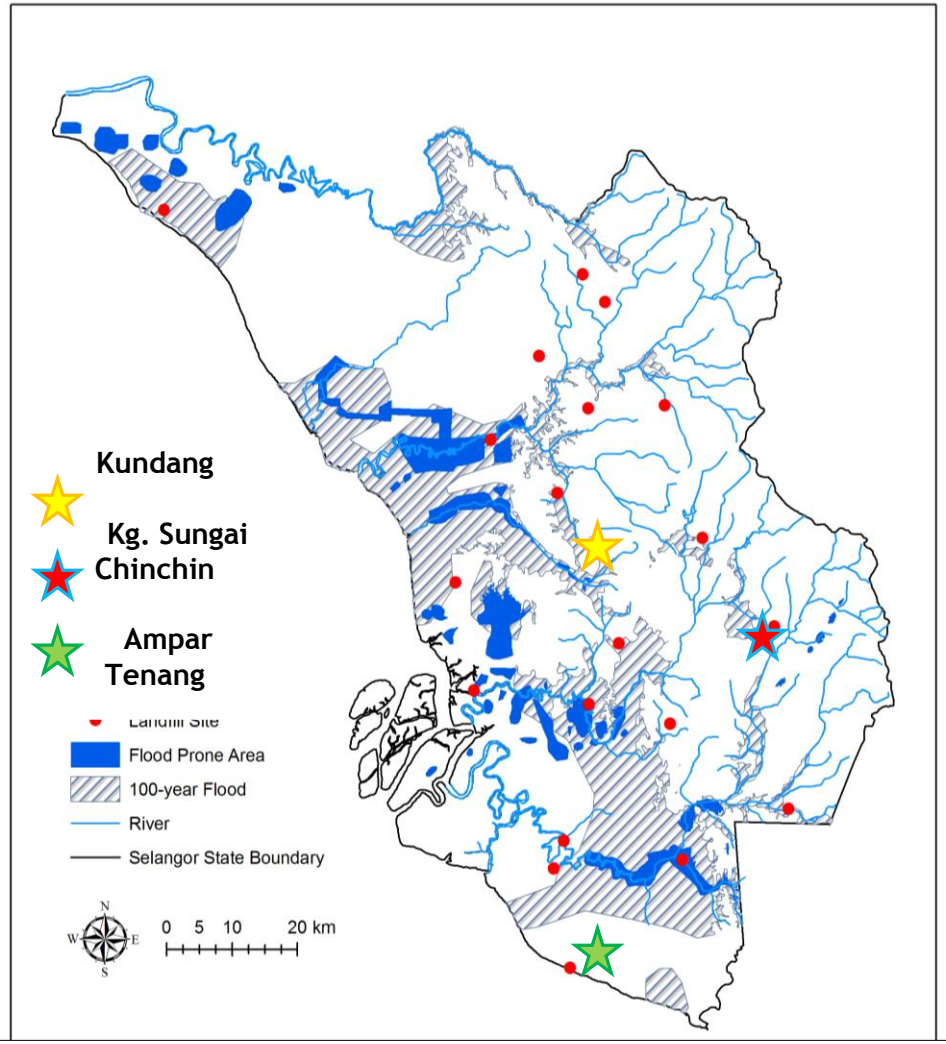


Disaster data compiled by SEADPRI-UKM from multiple sources

* Flood Prone Areas in Malaysia

Source: Drainage and Irrigation Department of Malaysia

Cascading Risks



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**

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

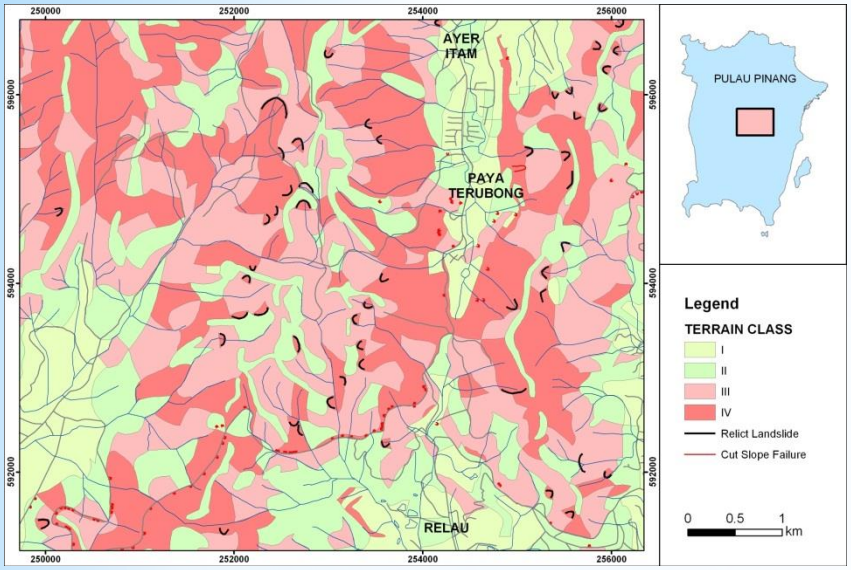
(i) Prediction based on historical records

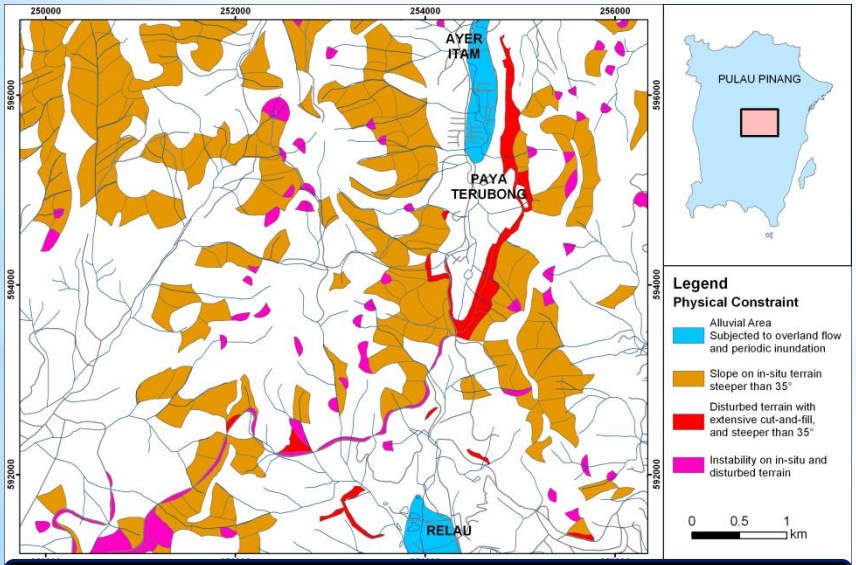
(ii) Changes in land use affects analysis

(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

Immediate Effects

DAMAGE

- Destruction of physical physical assets
- Occur at time of natural event
- Measured in physical units and at replacement value

Medium Term Effects

LOSSES

- Changes in economic flows
- Occur for a relative long time period
- Expressed in current values

Total Effects: Damage + Losses

Damage + Losses

- Sector by Sector
- Aggregation of Total Effects

Post-Disaster Impact Assessment

- Macro-economic
- Personal/Household

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

Challenges in L+D Assessment

- 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

Concluding Remarks

- DRR is central to adapt to climate extremes
- MKN has the mandate and the experience to address current and emerging risks due to climate extremes
- DRR and CCA are closely linked and need to be addressed together to ensure sustainable development
- Investing in enhanced capacity for disaster risk reduction, disaster preparedness and building resilience at all levels is a “no regret option” for climate change adaptation.

Thank You!