



# Climate Change: Perspectives for the ASEAN region

**Prof. Fredolin Tangang**

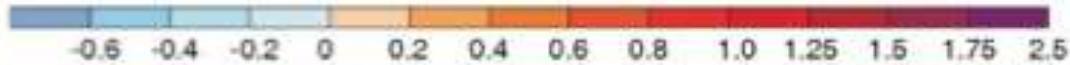
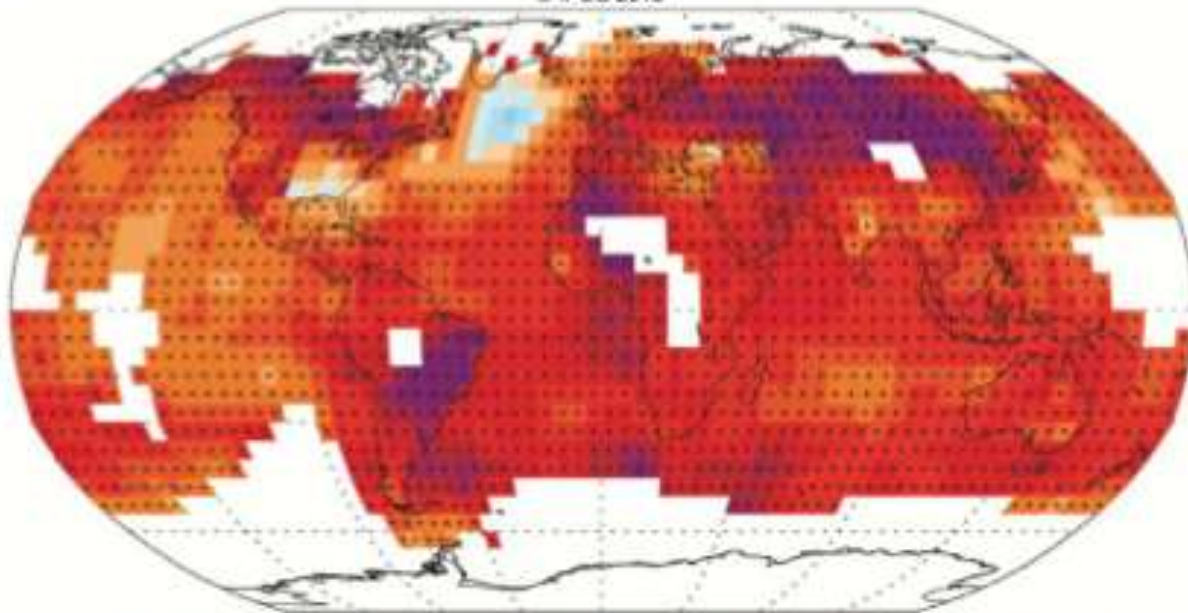
IPCC Working Group I Vice-Chair

# IPCC AR5 Assessment Reports



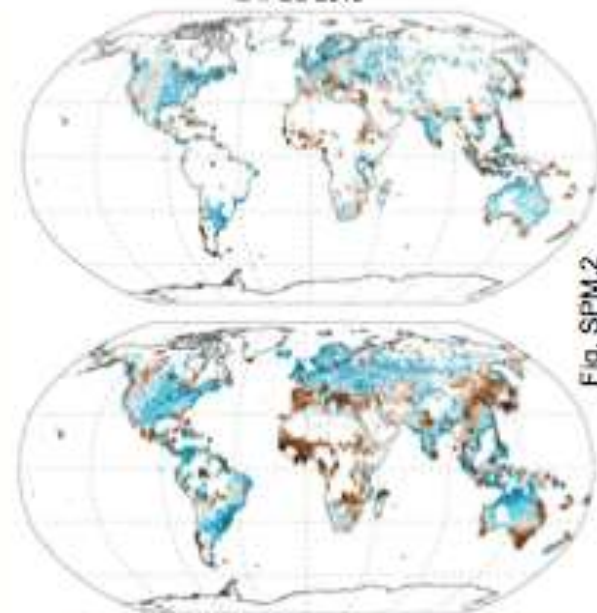


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Temperature Difference 1901 to 2012 based on trend (°C)

© IPCC 2013



Precipitation Trend (mm/yr per decade)

**Warming of the climate system  
is unequivocal**

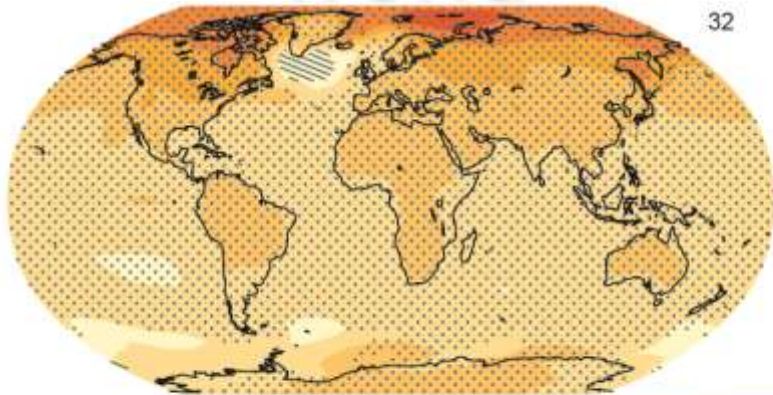
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INTERGOVERNMENTAL PANEL ON climate change



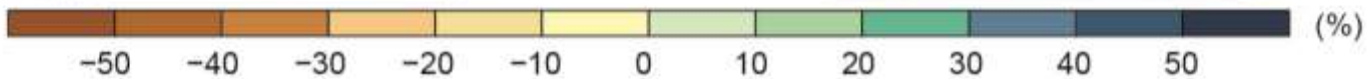
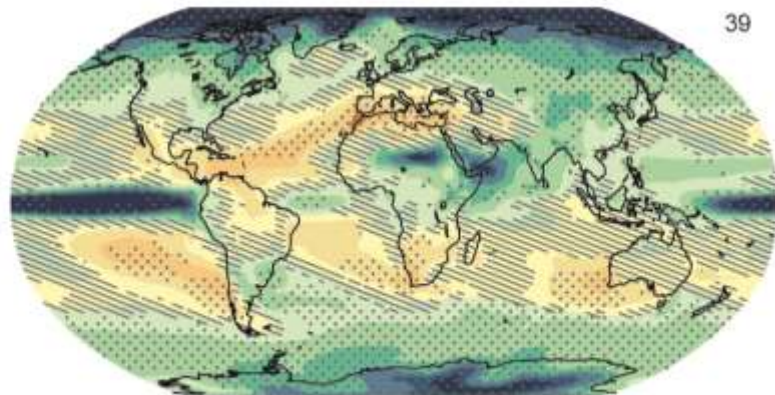
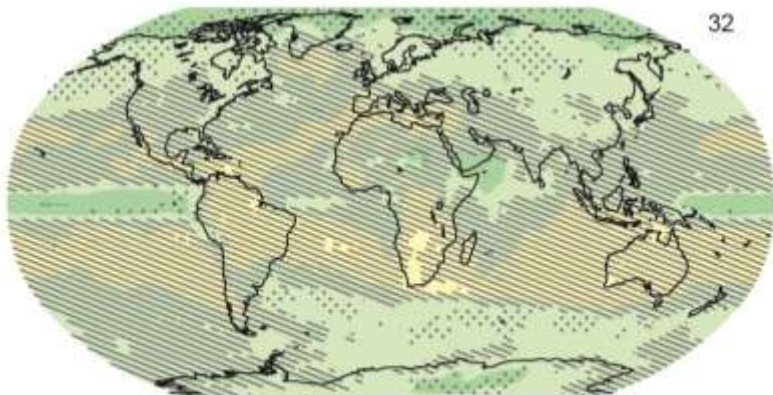
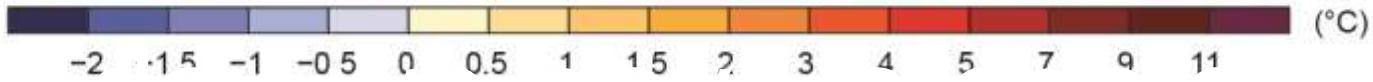
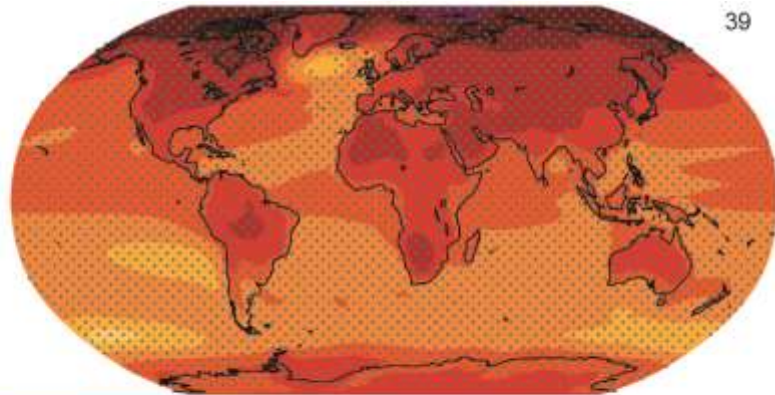
2° C

world



4.5° C

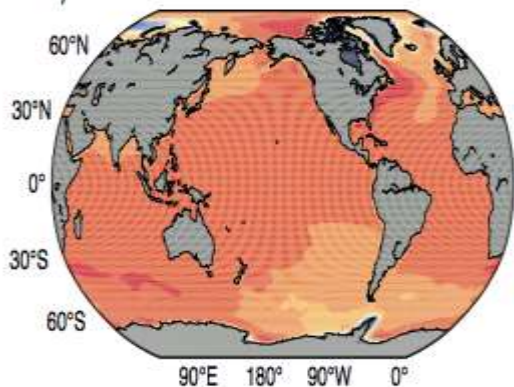
world



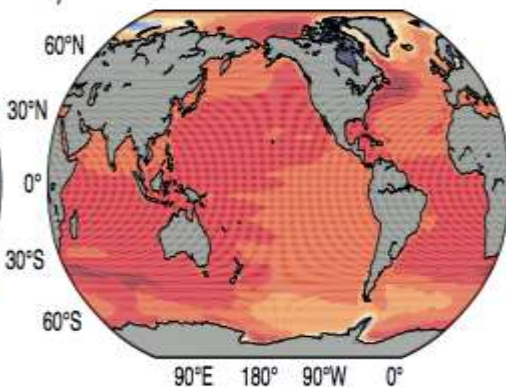


# Projected Sea Level Rise by end of 21<sup>st</sup> Century

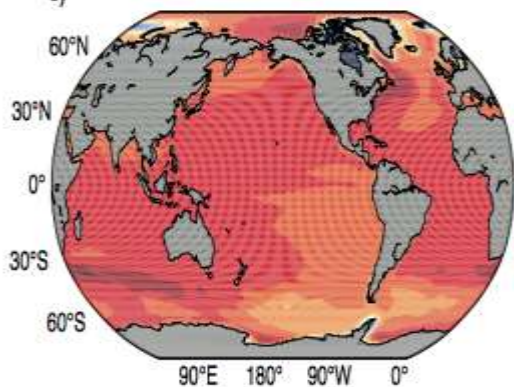
a) RCP2.6



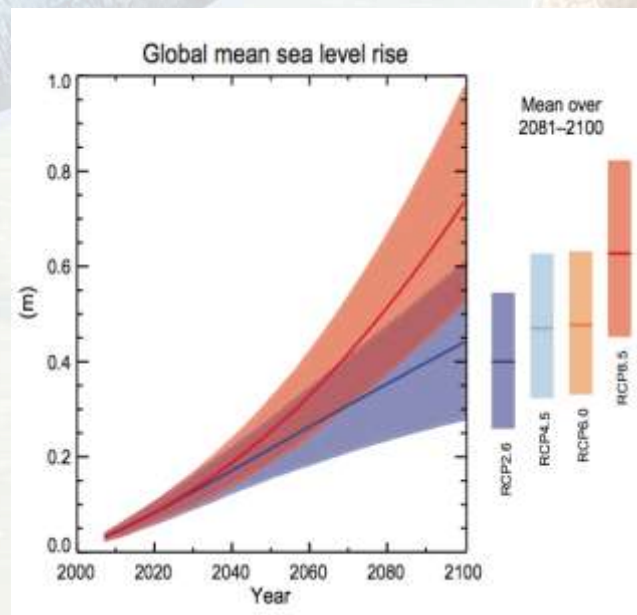
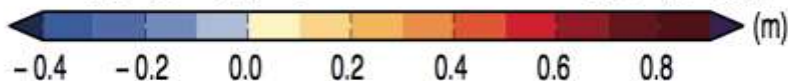
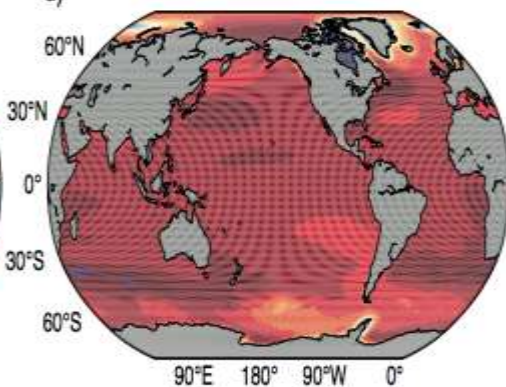
b) RCP4.5



c) RCP6.0

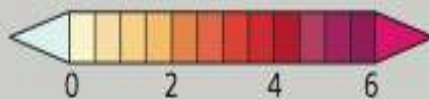


d) RCP8.5

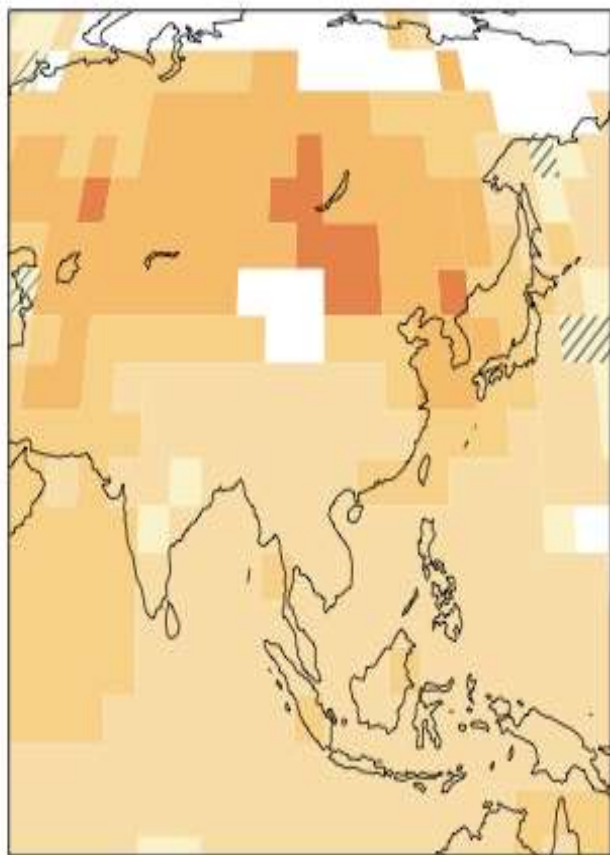


# Annual Temperature Change

Trend over 1901–2012  
(°C over period)

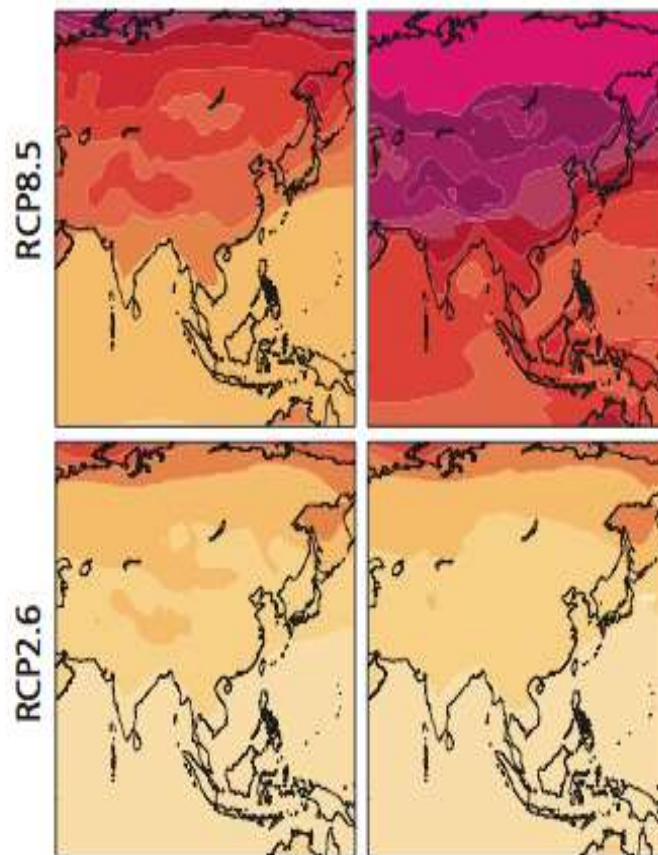


Difference from 1986–2005 mean  
(°C)



mid 21st century

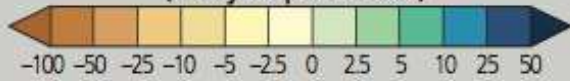
late 21st century



**Fig.24-2a (IPCC AR5 WGII)**

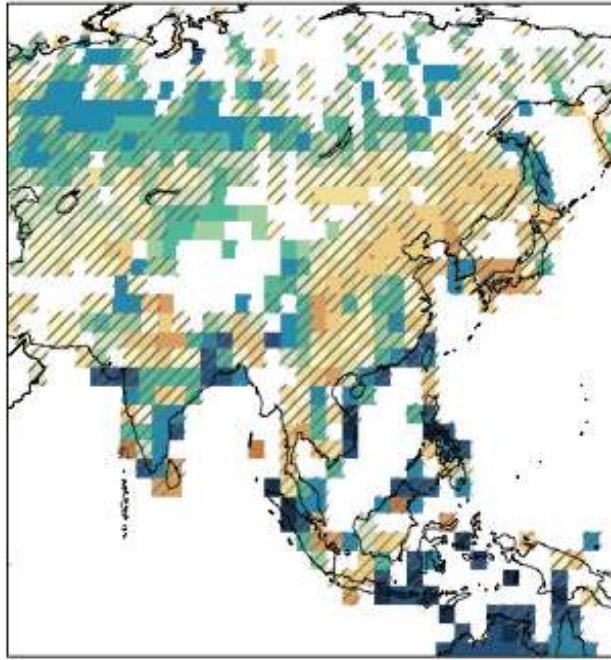
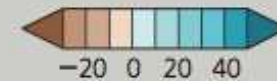


Trend in annual precipitation over 1951–2010  
(mm/year per decade)



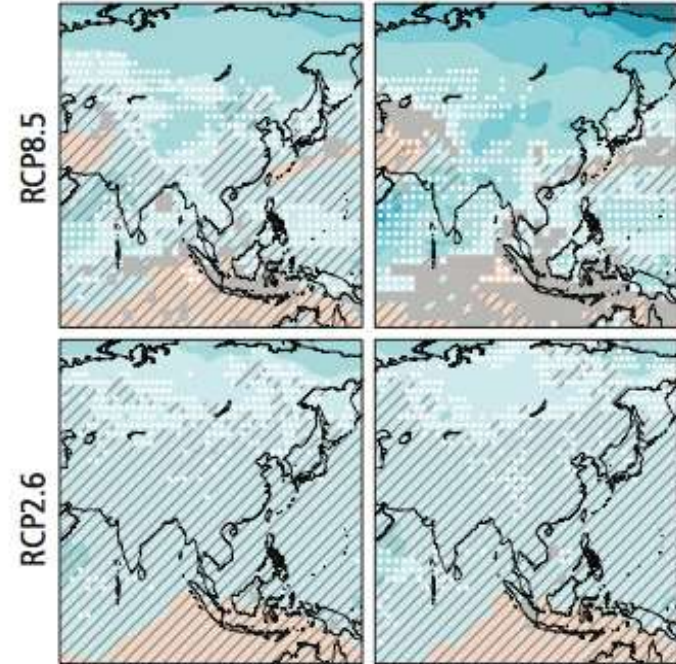
## Annual Precipitation Change

Difference from 1986–2005 mean (%)



mid 21st century

late 21st century



Solid Color

Significant trend

Diagonal Lines

Trend not statistically significant

White

Insufficient data

Solid Color

Very strong agreement

White Dots

Strong agreement

Gray

Divergent changes

Diagonal Lines

Little or no change

Fig.24-2b (IPCC AR5 WGII)

## Some key findings in observed climates relevant to Southeast Asia region

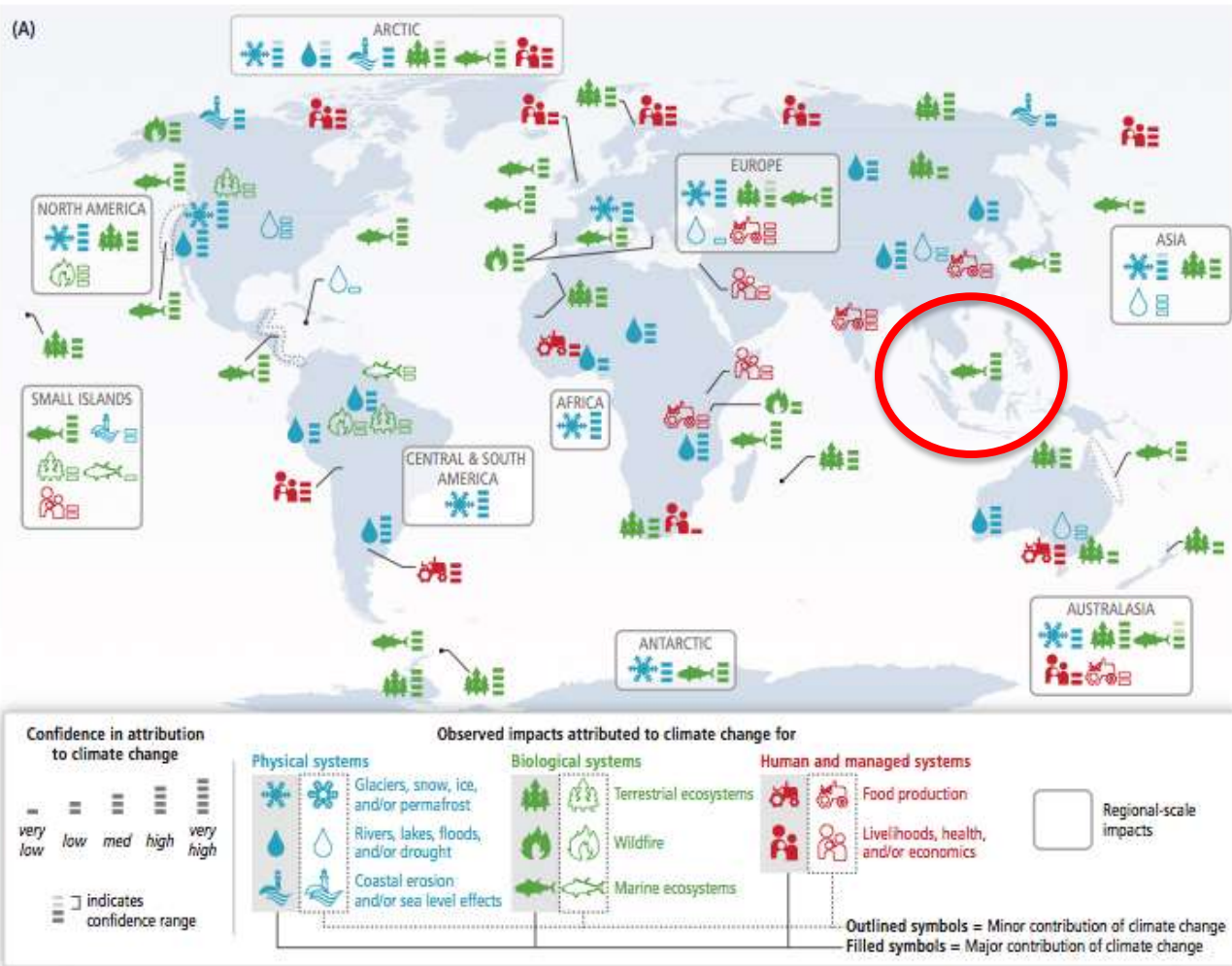
- Across Southeast Asia, temperature has been increasing at a rate of 0.14° C to 0.20° C per decade since the 1960s. Number of hot days and warm nights have increased while cooler weather has declined.
- Observed annual total wet-day rainfall has increased by 22 mm per decade, while rainfall from extreme rain days has increased by 10 mm per decade
- An increasing frequency of extreme events has been reported in the northern parts of Southeast Asia, decreasing trends in such events are reported in Myanmar.
- In Malay Peninsular during the southwest monsoon season, total rainfall and the frequency of wet days decreased, but rainfall intensity increased in much of the region. During the northeast monsoon, total rainfall, the frequency of extreme rainfall events, and rainfall intensity all increased over the peninsula.
- No significant trends in tropical cyclones making landfall was found
- Over the period 1993–2010, large rates of sea level rise in the western tropical Pacific were reported, corresponding to an increase in the strength of the trade winds in the central and eastern tropical Pacific



## Some key findings on projected future climates relevant to Southeast Asia region

- Under RCP8.5, for the Southeast Asia region the projected ensemble-mean changes in mean annual temperature are greater than 3° C
- Models appeared to have low agreement in changes in projected annual precipitation by mid and the end of the 21<sup>st</sup> century
- Future increases in precipitation extremes related to the monsoon are *very likely* in Southeast Asia
- The future influence of climate change on tropical cyclones is *likely* to vary by region, but there is *low confidence* in region-specific projections of frequency and intensity.
- However, better process understanding and model agreement in specific regions indicate that precipitation will *likely* be more extreme near the centers of tropical cyclones making landfall
- The ocean in subtropical and tropical regions will warm in all RCP scenarios and will show the strongest warming signal at the surface
- Sea level is also projected to increase at the end of the 21<sup>st</sup> century

# Attribution of observed impacts to Climate Change



Lack of attribution studies in the Southeast Asia region



### Climate-related drivers of impacts











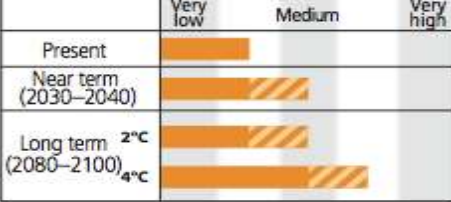


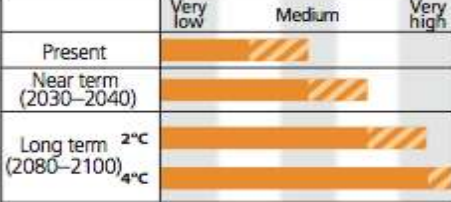



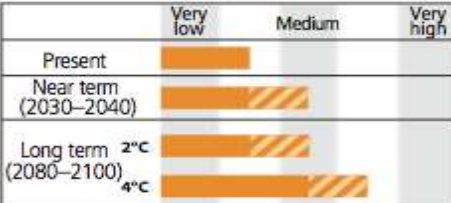




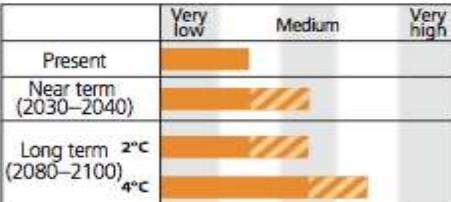


### Level of risk & potential for adaptation



Key risk	Adaptation issues & prospects	Climatic drivers	Timeframe	Risk & potential for adaptation
<p>Increased risk of crop failure and lower crop production could lead to food insecurity in Asia (<i>medium confidence</i>)</p> <p>[24.4.4]</p>	<p>Autonomous adaptation of farmers on-going in many parts of Asia.</p>		<p>Present</p> <p>Near term (2030–2040)</p> <p>Long term (2080–2100) 2°C 4°C</p>	<p>Very low Medium Very high</p>
<p>Water shortage in arid areas of Asia (<i>medium confidence</i>)</p> <p>[24.4.1.3, 24.4.1.4]</p>	<p>Limited capacity for water resource adaptation; options include developing water saving technology, changing drought-resilient crops, building more water reservoirs.</p>		<p>Present</p> <p>Near term (2030–2040)</p> <p>Long term (2080–2100) 2°C 4°C</p>	<p>Very low Medium Very high</p>
<p>Increased riverine, coastal, and urban flooding leading to widespread damage to infrastructure, livelihoods, and settlements in Asia (<i>medium confidence</i>)</p> <p>[24.4]</p>	<ul style="list-style-type: none"> <li>• Exposure reduction via structural and non-structural measures, effective land-use planning, and selective relocation</li> <li>• Reduction in the vulnerability of lifeline infrastructure and services (e.g., water, energy, waste management, food, biomass, mobility, local ecosystems, telecommunications)</li> <li>• Construction of monitoring and early warning systems; Measures to identify exposed areas, assist vulnerable areas and households, and diversify livelihoods</li> <li>• Economic diversification</li> </ul>		<p>Present</p> <p>Near term (2030–2040)</p> <p>Long-term (2080–2100) 2°C 4°C</p>	<p>Very low Medium Very high</p>

**Table 24.1 IPCC AR5 WGII**

Climate-related drivers of impacts							Level of risk & potential for adaptation
 Warming trend	 Extreme temperature	 Extreme precipitation	 Drying trend	 Damaging cyclone	 Sea level	 Ocean acidification	 <p>Potential for additional adaptation to reduce risk</p> <p>Risk level with <b>high</b> adaptation</p> <p>Risk level with <b>current</b> adaptation</p>
Key risk	Adaptation issues & prospects			Climatic drivers	Timeframe	Risk & potential for adaptation	
<p>Increased risk of flood-related deaths, injuries, infectious diseases and mental disorders (<i>medium confidence</i>)</p> <p>[24.4.6.2, 24.4.6.3, 24.4.6.5]</p>	<p>Disaster preparedness including early-warning systems and local coping strategies.</p>			 	<p>Present</p> <p>Near term (2030–2040)</p> <p>Long term (2080–2100)</p> <p>2°C</p> <p>4°C</p>		
<p>Increased risk of heat-related mortality (<i>high confidence</i>)</p> <p>[24.4]</p>	<ul style="list-style-type: none"> <li>Heat health warning systems</li> <li>Urban planning to reduce heat islands; Improvement of the built environment; Development of sustainable cities</li> <li>New work practices to avoid heat stress among outdoor workers</li> </ul>			 	<p>Present</p> <p>Near term (2030–2040)</p> <p>Long term (2080–2100)</p> <p>2°C</p> <p>4°C</p>		
<p>Increased risk of drought-related water and food shortage causing malnutrition (<i>high confidence</i>)</p> <p>[24.4]</p>	<ul style="list-style-type: none"> <li>Disaster preparedness including early-warning systems and local coping strategies</li> <li>Adaptive/integrated water resource management</li> <li>Water infrastructure and reservoir development</li> <li>Diversification of water sources including water re-use</li> <li>More efficient use of water (e.g., improved agricultural practices, irrigation management, and resilient agriculture)</li> </ul>			  	<p>Present</p> <p>Near term (2030–2040)</p> <p>Long term (2080–2100)</p> <p>2°C</p> <p>4°C</p>		
<p>Increased risk of water and vector-borne diseases (<i>medium confidence</i>)</p> <p>[24.4.6.2, 24.4.6.3, 24.4.6.5]</p>	<p>Early-warning systems, vector control programs, water management and sanitation programs.</p>			   	<p>Present</p> <p>Near term (2030–2040)</p> <p>Long term (2080–2100)</p> <p>2°C</p> <p>4°C</p>		

**Table 24.1 IPCC AR5 WGII**



Climate-related drivers of impacts							Level of risk & potential for adaptation			
Warming trend	Extreme temperature	Extreme precipitation	Drying trend	Damaging cyclone	Sea level	Ocean acidification	Potential for additional adaptation to reduce risk Risk level with <b>high</b> adaptation      Risk level with <b>current</b> adaptation			
Key risk	Adaptation issues & prospects			Climatic drivers		Timeframe	Risk & potential for adaptation			
Exacerbated poverty, inequalities and new vulnerabilities ( <i>high confidence</i> ) [24.4.5, 24.4.6]	Insufficient emphasis and limited understanding on urban poverty, interaction between livelihoods, poverty and climate change.						Very low	Medium	Very high	
							Present	[Risk level with high adaptation] [Risk level with current adaptation]		
							Near term (2030–2040)	[Risk level with high adaptation] [Risk level with current adaptation]		
							Long term (2080–2100)	2°C	[Risk level with high adaptation] [Risk level with current adaptation]	
4°C	[Risk level with high adaptation] [Risk level with current adaptation]									
Coral reef decline in Asia ( <i>high confidence</i> ) [24.4.3.3, 24.4.3.5, CC-CR, CC-OA]	The limited adaptation options include minimizing additional stresses in marine protected areas sited where sea surface temperatures are expected to change least and reef resilience is expected to be highest.						Very low	Medium	Very high	
							Present	[Risk level with high adaptation] [Risk level with current adaptation]		
							Near term (2030–2040)	[Risk level with high adaptation] [Risk level with current adaptation]		
							Long term (2080–2100)	2°C	[Risk level with high adaptation] [Risk level with current adaptation]	
4°C	[Risk level with high adaptation] [Risk level with current adaptation]									
Mountain-top extinctions in Asia ( <i>high confidence</i> ) [24.4.2.4, 24.4.2.5]	Adaptation options are limited. Reducing non-climate impacts and maximizing habitat connectivity will reduce risks to some extent, while assisted migration may be practical for some species.						Very low	Medium	Very high	
							Present	[Risk level with high adaptation] [Risk level with current adaptation]		
							Near term (2030–2040)	[Risk level with high adaptation] [Risk level with current adaptation]		
							Long term (2080–2100)	2°C	[Risk level with high adaptation] [Risk level with current adaptation]	
4°C	[Risk level with high adaptation] [Risk level with current adaptation]									

**Table 24.1 IPCC AR5 WGII**

## Case study: Lower Mekong River Basin (LMB)

- Covers ~606,000 km<sup>2</sup> across the countries of Thailand, Laos, Cambodia, and Vietnam. More than 60 million people depend on LM food & natural resources, in particular agriculture and fisheries, for their well-being.
- Thailand and Vietnam produced 51% of the world's rice exports in 2008, mostly in the LMB.
- In the past 30 to 50 years LMB experienced an increase in temperature, an increase in rainfall in the wet season and decreases in the dry season, intensified flood and drought events, and sea level rise
- Agricultural output has been noticeably impacted by intensified floods and droughts. These caused almost 90% of rice production losses in Cambodia during 1996– 2001
- Vietnam and Cambodia are two of the countries most vulnerable to climate impacts on fisheries
- Projected future changes in LMB: increased temperature and annual precipitation; increased depth and duration of flood in the Mekong Delta and Cambodia floodplain; prolonged agricultural drought in the south and the east of the basin; and sea level rise and salinity intrusion in the Mekong delta.
- No transboundary adaptation planning





# The amount of information supporting conclusion regarding observed and projected impacts

Sector	Topics/issues	North Asia		East Asia		Southeast Asia		South Asia		Central Asia		West Asia	
		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
Coastal systems and low-lying areas	Coral reefs	/	/	/	/	/	/	/	/	/	/	/	/
	Other coastal ecosystems	/	/	/	/	/	/	/	/	/	/	/	x
	Arctic coast erosion	/	/	/	/	/	/	/	/	/	/	/	NR
Food production systems and food security	Rice yield	/	/	/	/	/	/	/	/	/	/	/	/
	Wheat yield	/	/	/	/	/	/	/	/	/	/	/	/
	Corn yield	/	/	/	/	/	/	/	/	/	/	/	x
	Other crops (e.g., barley, potato)	/	/	/	/	/	/	/	/	/	/	/	/
	Vegetables	/	/	/	/	/	/	/	/	/	/	/	x
	Fruits	/	/	/	/	/	/	/	/	/	/	/	x
	Livestock	/	/	/	/	/	/	/	/	/	/	/	x
	Fisheries and aquaculture production	/	/	/	/	/	/	/	/	/	/	/	x
	Farming area	/	/	/	/	/	/	/	/	/	/	/	x
	Water demand for irrigation	/	/	/	/	/	/	/	/	/	/	/	x
Pest and disease occurrence	/	/	/	/	/	/	/	/	/	/	/	x	
Human settlements, industry, and infrastructure	Floodplains	/	/	/	/	/	/	/	/	/	/	/	x
	Coastal areas	/	/	/	/	/	/	/	/	/	/	/	x
	Population and assets	/	/	/	/	/	/	/	/	/	/	/	x
	Industry and infrastructure	/	/	/	/	/	/	/	/	/	/	/	x
Human health, security, livelihoods, and poverty	Health effects of floods	/	/	/	/	/	/	/	/	/	/	/	x
	Health effects of heat	/	/	/	/	/	/	/	/	/	/	/	x
	Health effects of drought	/	/	/	/	/	/	/	/	/	/	/	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

**/ -- Relatively abundant / sufficient information but knowledge gaps exist;**

**x -- limited knowledge / critical knowledge gaps, difficult to draw conclusion**

Table 24.2 IPCC AR5 WGII

# The amount of information supporting conclusion regarding observed and projected impacts

Sector	Topics/issues	North Asia		East Asia		Southeast Asia		South Asia		Central Asia		West Asia	
		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)												/
	Vegetables												x
	Fruits												x
	Livestock												x
	Fisheries and aquaculture production												x
	Farming area												x
	Water demand for irrigation												x
Human settlements, industry, and infrastructure	Pest and disease occurrence												x
	Floodplains												x
	Coastal areas												x
Human health, security, livelihoods, and poverty	Population and assets	x	x	/	/	/	/	/	/	x	x	x	x
	Industry and infrastructure	x	x	/	/	/	/	/	/	x	x	x	x
	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	

Critically lack of studies on impacts of climate change in Southeast Asia region

Table 24.2 IPCC AR5 WGII

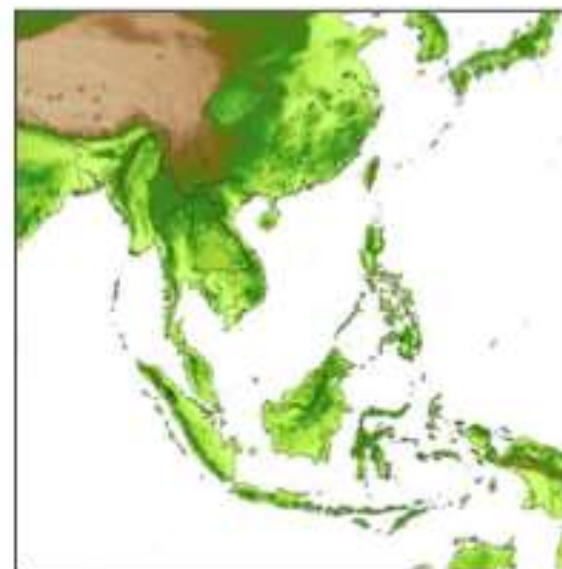


# SEACLID

*CORDEX-Southeast Asia*

## The Southeast Asia Regional Climate Downscaling (SEACLID) / CORDEX Southeast Asia Project

- *3 years project ( Nov 2013 – Oct 2016) involving 17 institutions from 13 countries (7 from Southeast Asia – Thailand, Malaysia, Indonesia, Vietnam, Philippines, Cambodia and Lao PDR; 6 from outside – UK, Australia, Hong Kong SAR, South Korea, Sweden & Germany)*
- *To generate multi-models, multi-scenarios high-resolution regional climate change projections for Southeast Asia & make them freely available through ESGF*
- *Enhancing understanding of science of regional climate change*
- *Capacity building*



<http://www.ukm.edu.my/seaclid-cordex>



# Summary

- Observed records showed consistent increases in mean surface temperature across Southeast Asia but less coherent in rainfall changes
- Projected increase in future mean temperature but models have low agreement in future rainfall change; Extreme precipitation is projected to increase
- Key risks in various sectors have been identified. The greater the warming implies the greater the risks. In most sectors, adaptation could reduce the risk
- Large knowledge gaps on how climate change impact various sectors in Southeast Asia region





# IPCC Fifth Assessment Report

WG1, WGII, WGIII, Synthesis  
Report

(<http://www.ipcc.ch>)

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INTERGOVERNMENTAL PANEL ON climate change

