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Climate Change Science, Impacts and Opportunities

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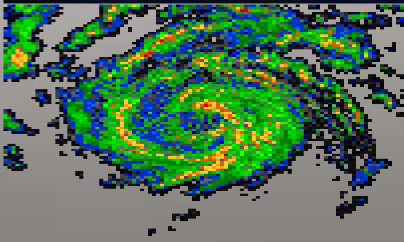
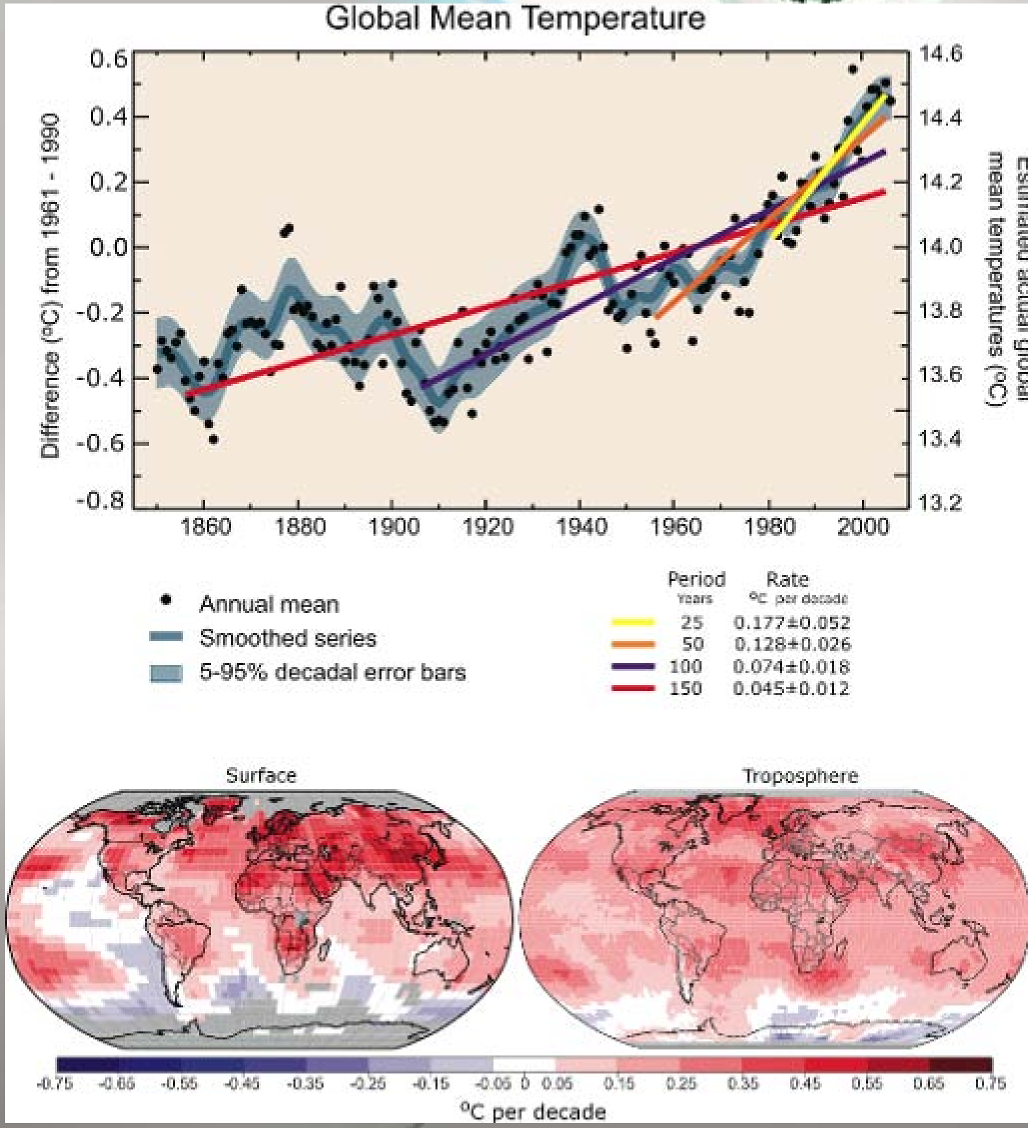
About Presentation

- Reading the signs of climate change – temperature rise, rainfall variation, sea level rise, extreme events and anomalies
- Impacts on sectors and South East Asia region
- Adaptation needs and challenges
- Delay in emission cuts and impacts
- Opportunities – integration and interlinking actions



Reading the signs - temperature

- Global mean temperature has increased 0.76°C during 1906-2005
- The average temperature in Southeast Asia has increased 0.1–0.3 C per decade over the last 50 years
- Increase in temperature varies by countries – highest change observed in Singapore



Source: IPCC, 2007

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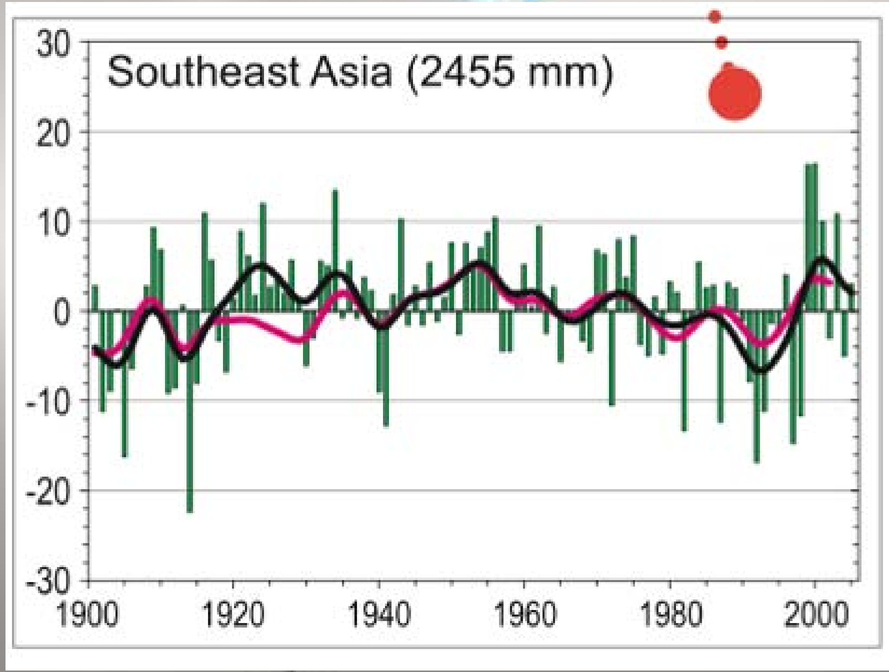
Reading the signs – precipitation

- Indonesia: decrease in annual rainfall during recent decades in some areas
- Philippines: increase in annual rainfall and in the number of rainy days
- Singapore decrease in annual rainfall in the past three decades
- Thailand decreasing annual rainfall for the last five decades
- Viet Nam: decrease in monthly rainfall in July-August and increase in September to November

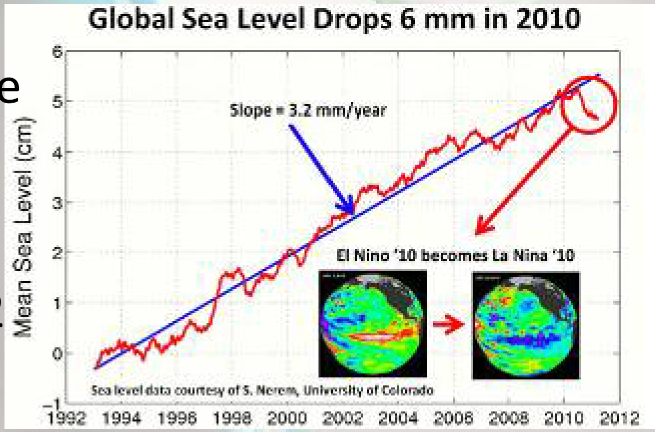
Precipitation in Southeast Asia trended downward from 1960 to 2000.



Source: IPCC, 2007

Reading the signs – sea level rise

- Sea level has risen at the rate 1.8 mm/year since 1961 and 3.1 mm/year since 1993.
- IPCC estimated sea levels may rise 18cm - 59cm in the coming century.
- One study now estimates sea level rise of between 0.8 and 1.5 meters, while another suggests a rise of 2 meters in the coming century from outflows of ice from Greenland alone.
- The Greenland ice sheet, which could raise sea levels by 6m if it melted away, is currently losing more than 100 cubic km a year-faster than can be explained by natural melting.
- In SEA, sea levels have risen 1–3 millimeters per year and projected to rise by 70 cm by 2100
- Cambodia: Sea level rise of 0.18-0.56 m by the 2090s



Reading the signs – sea level rise

Sources of Sea Level Rise	Rate of sea level rise (mm per year)	
	1961-2003	1993-2003
Thermal Expansion	0.42 0.12	1.6 0.5
Glaciers and ice caps	0.50 0.18	0.77 0.22
Greenland and Ice Sheet	0.05 0.12	0.21 0.07
Antarctic Ice Sheet	0.14 0.41	0.21 0.35
Sum of individual climate contributions to sea level rise	1.1 0.5	2.8 0.7
Observed total sea level rise	1.8 0.5	3.1 0.7
Difference (observed minus sum of estimated climate contribution)	0.7 0.7	0.3 1.0

Source: IPCC, 2007

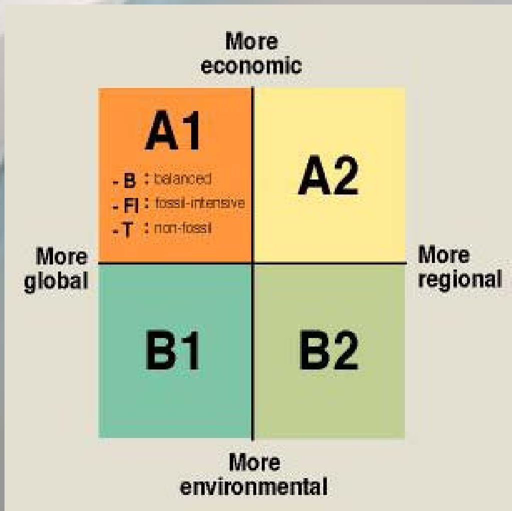
Reading the signs – extreme events

Extreme Events	Key Trends
Heat waves	Increase in hot days and warm nights and decrease in cold days and nights between 1961 and 1998
Intense rains and floods	Increased occurrence of extreme rains causing flash floods in Viet Nam; landslides and floods in 1990 and 2004 in the Philippines, and floods in Cambodia in 2000
Droughts	Droughts normally associated with El Niño years in Indonesia, Lao PDR, Myanmar, Philippines, and Viet Nam; droughts in 1997 and 1998 causing massive crop failures and water shortages as well as forest fires in various parts of Indonesia, Lao PDR, and Philippines
Typhoons	On average, 20 cyclones cross the Philippine area of responsibility with about eight or nine making landfall each year; an average increase of 4.2 in the frequency of cyclones entering the Philippine area of responsibility during the period 1990—2003

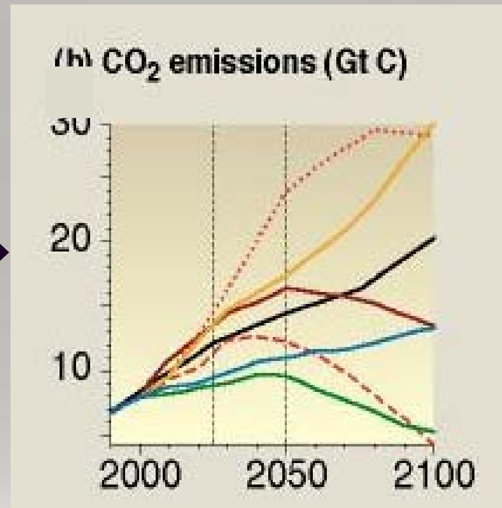
Source: IPCC, 2007

Reading the signs – future storyline

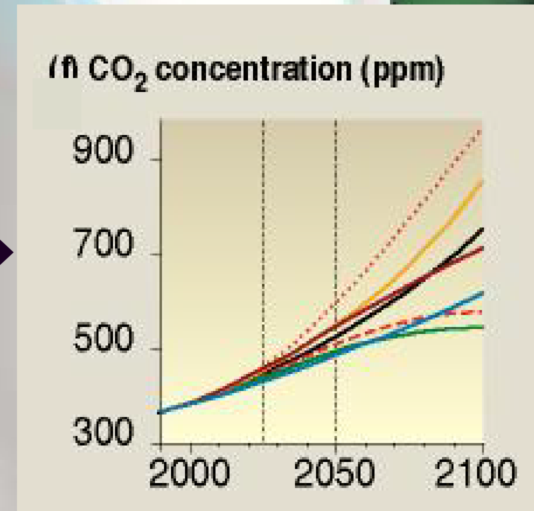
Socio-economic scenarios



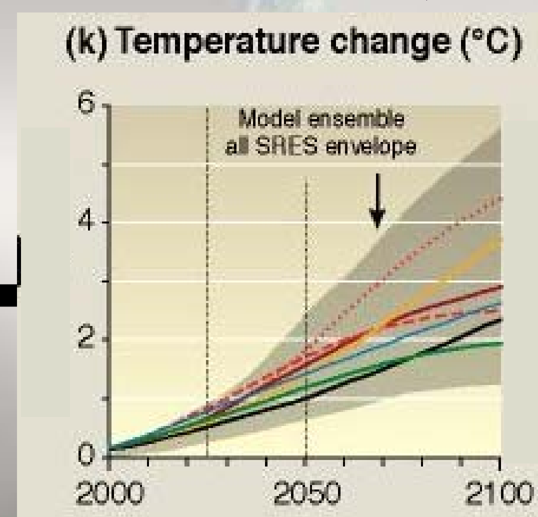
Emissions



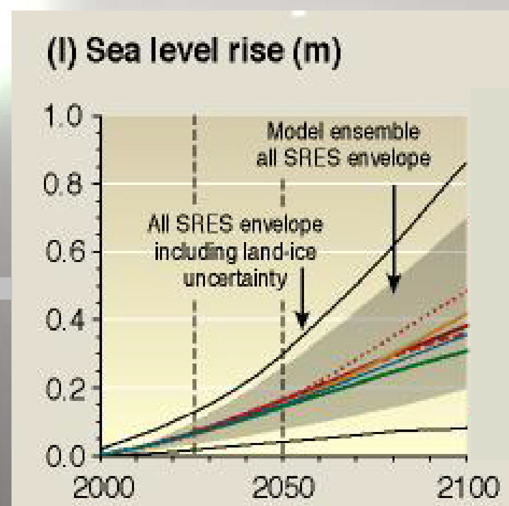
Concentrations



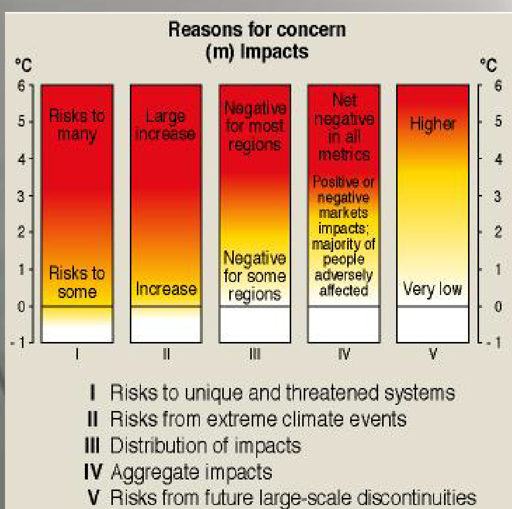
Temperature change



Sea level rise



Reasons for concern



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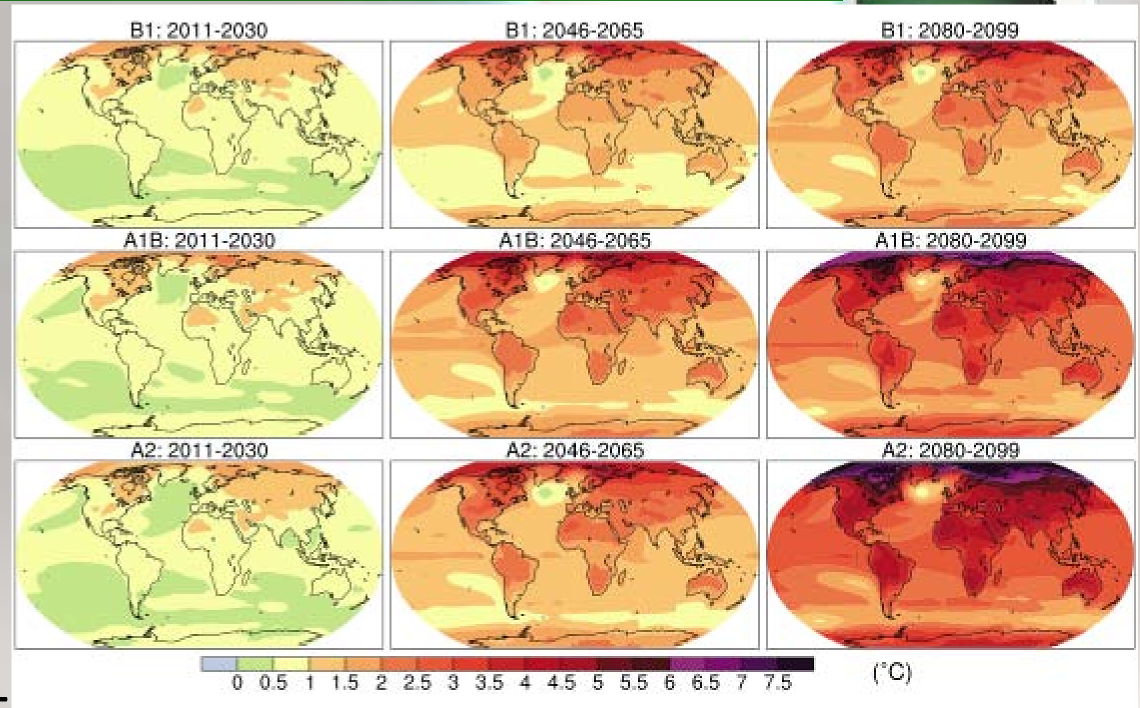
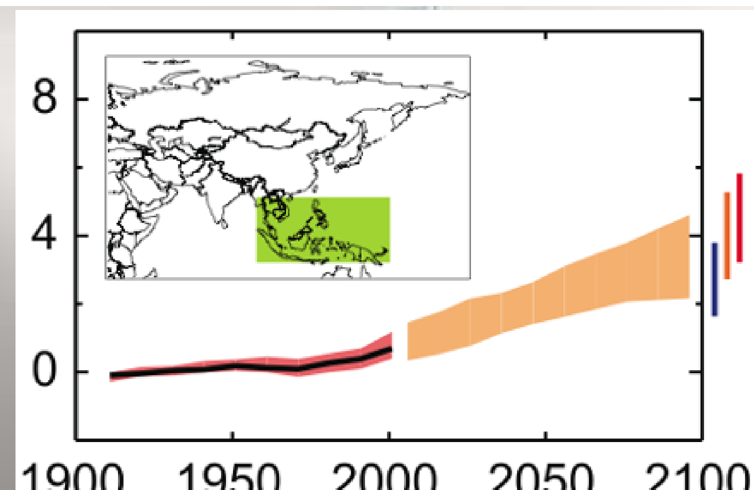
Source: IPCC, 2007

Reading the signs – projection of temperature

- Global mean temperature projected to be increased by 1.8 to 5.4 C by 2100
- The mean surface air temperature in SEA would increase between 0.75–0.87 C by 2039, 1.32–2.01 C by 2069, and 1.96–3.77 C by 2100 (IPCC, 2007)

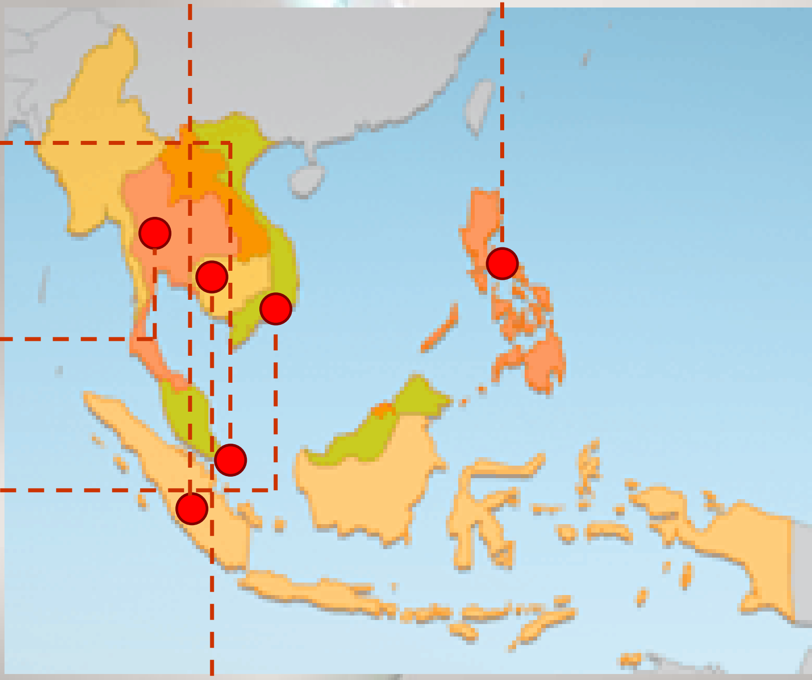




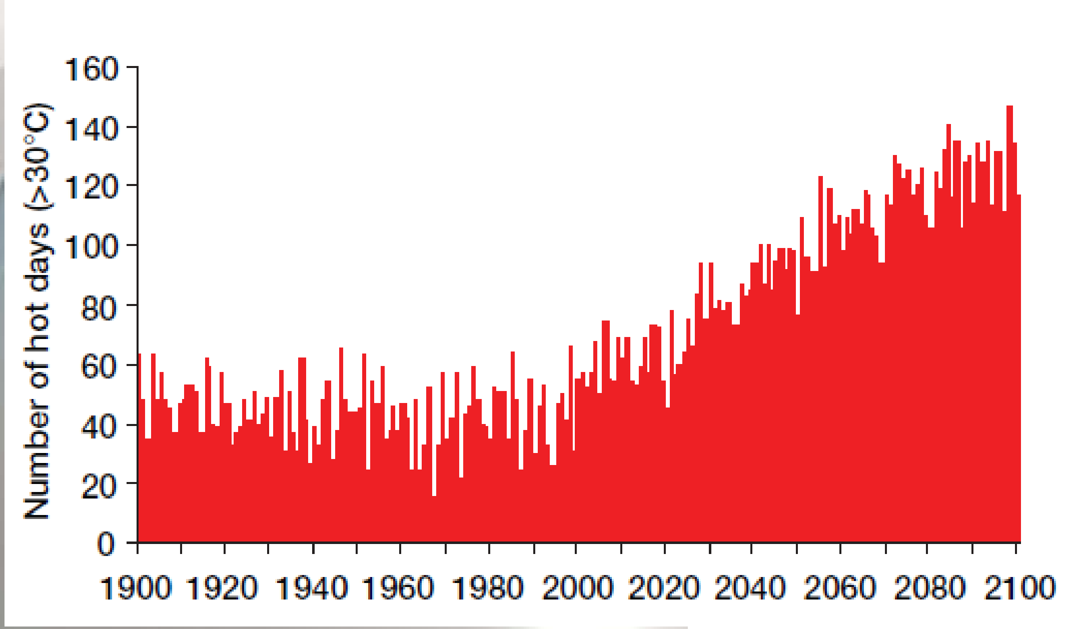
Source: IPCC, 2007

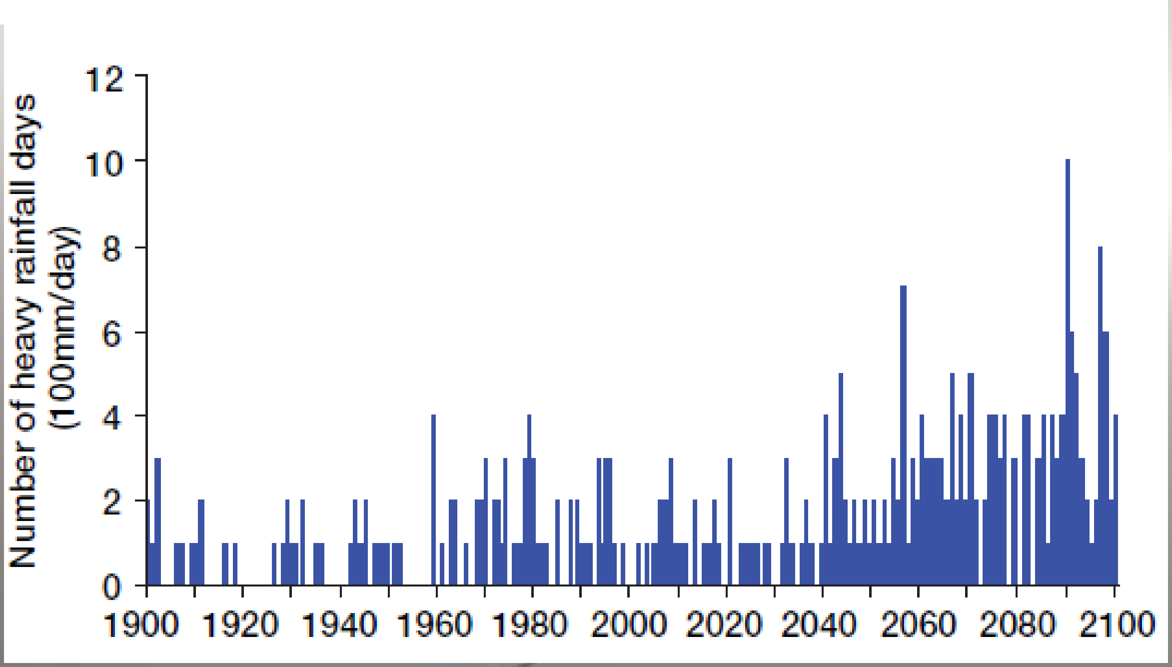
Reading the signs – projection of temperature

- Indonesia: increase 2.1ºC and 3.4ºC by 2100 under the B2 and A2 scenarios, respectively.
- Philippines: increase of 1.2–3.9ºC by 2080, using all the IPCC emission scenarios.
- Singapore: similar to the projected global mean temperature rise of 2.5ºC with a range of 1.7–4.4ºC.
- Thailand: increase 2–4ºC by the end of this century
- Viet Nam: increase in temperature of 2–4ºC by 2100
- Cambodia: increase in mean annual temperatures of 0.3-0.6 C by 2025, 0.7-2.7 C by the 2060s and of 1.4-4.3 C by the 2090s



Reading the signs – projection of anomalies





Reading the signs - global average surface warming and sea level rise

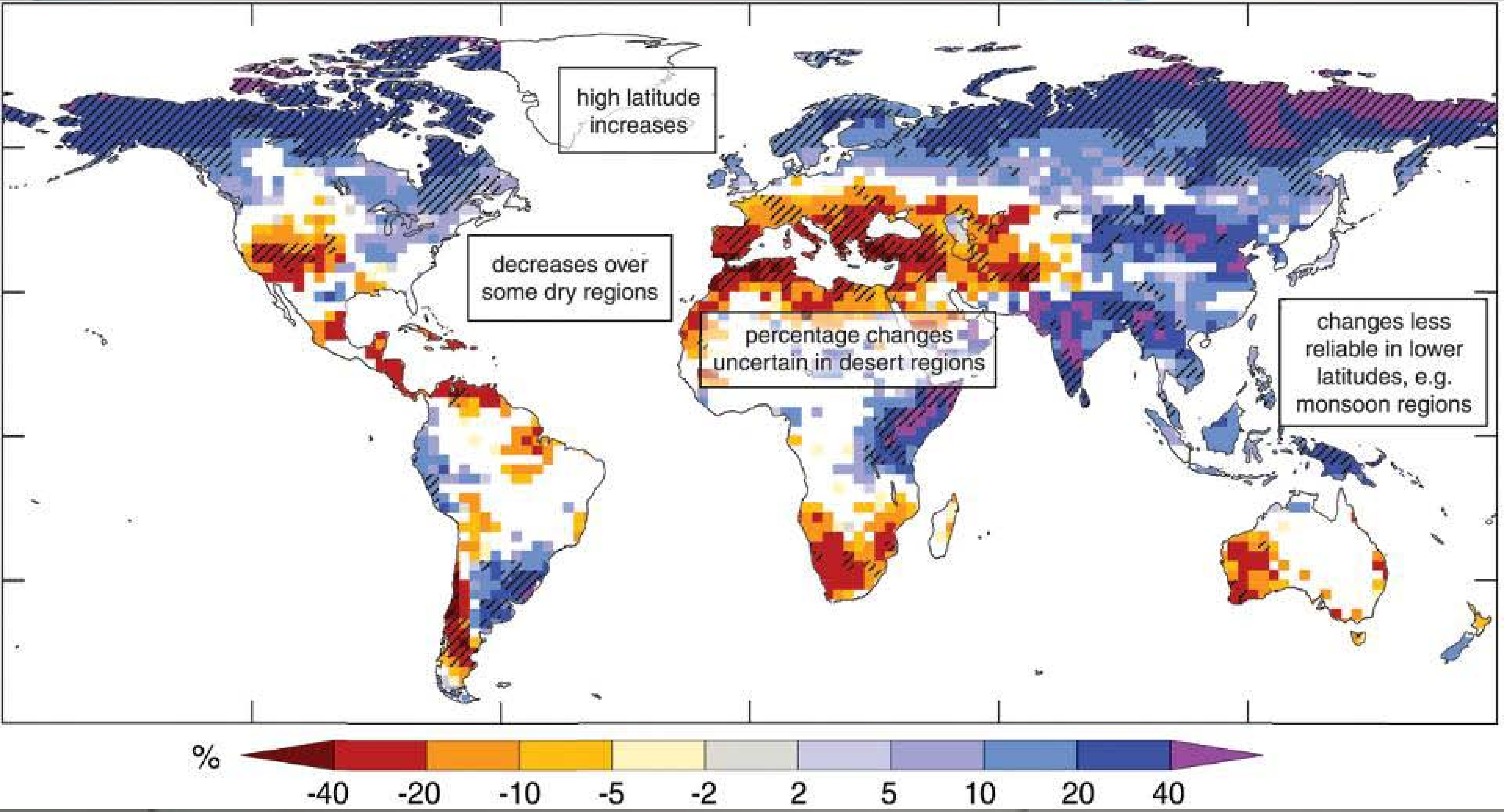
Thermal Expansion	Temperature Change (°C at 2090-2099 relative to 1980-1999)		Sea Level Rise (m at 2090-2099 relative to 1980-1999)
Case	Best estimate	Likely range	Model-based range excluding future rapid dynamical changes in ice flow
B1 Scenario	1.8	1.1 – 2.9	0.18 – 0.38
A1T Scenario	2.4	1.4 – 3.8	0.20 – 0.45
B2 Scenario	2.4	1.4 – 3.8	0.20 – 0.43
A1B Scenario	2.8	1.7 – 4.4	0.21 – 0.48
A2 Scenario	3.4	2.0 – 5.4	0.23 – 0.51
A1FI Scenario	4.0	2.4 – 6.4	0.26 – 0.59

Source: IPCC, 2007

Key impacts stem from reduced water availability.

Projected changes (%) in run-off, 21st century.

White areas are where less than two-thirds of models agree, hatched are where 90% of models agree (IPCC SYR)



Source: IPCC, 2007

Impacts by sector (IPCC WGII TS 2007)

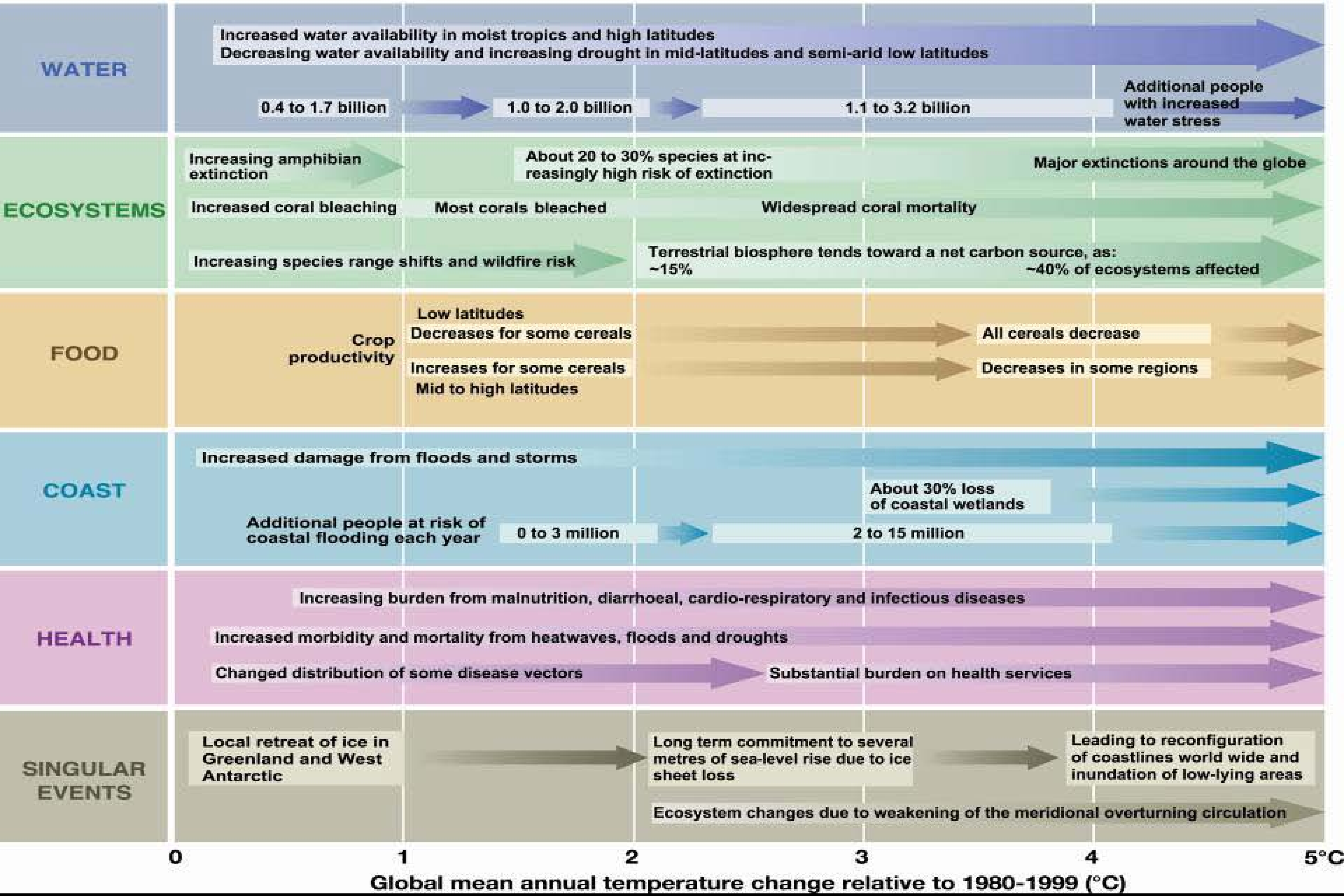


Table 3.1 Highlights of possible climate impacts discussed in this chapter

Temp rise (°C)	Water	Food	Health	Land	Environment	Abrupt and Large-Scale Impacts
1°C	Small glaciers in the Andes disappear completely, threatening water supplies for 50 million people	Modest increases in cereal yields in temperate regions	At least 300,000 people each year die from climate-related diseases (predominantly diarrhoea, malaria, and malnutrition) Reduction in winter mortality in higher latitudes (Northern Europe, USA)	Permafrost thawing damages buildings and roads in parts of Canada and Russia	At least 10% of land species facing extinction (according to one estimate) 80% bleaching of coral reefs, including Great Barrier Reef	Atlantic Thermohaline Circulation starts to weaken
2°C	Potentially 20 - 30% decrease in water availability in some vulnerable regions, e.g. Southern Africa and Mediterranean	Sharp declines in crop yield in tropical regions (5 - 10% in Africa)	40 – 60 million more people exposed to malaria in Africa	Up to 10 million more people affected by coastal flooding each year	15 – 40% of species facing extinction (according to one estimate) High risk of extinction of Arctic species, including polar bear and caribou	Potential for Greenland ice sheet to begin melting irreversibly, accelerating sea level rise and committing world to an eventual 7 m sea level rise
3°C	In Southern Europe, serious droughts occur once every 10 years 1 - 4 billion more people suffer water shortages, while 1 – 5 billion gain water, which may increase flood risk	150 - 550 additional millions at risk of hunger (if carbon fertilisation weak) Agricultural yields in higher latitudes likely to peak	1 – 3 million more people die from malnutrition (if carbon fertilisation weak)	1 – 170 million more people affected by coastal flooding each year	20 – 50% of species facing extinction (according to one estimate), including 25 – 60% mammals, 30 – 40% birds and 15 – 70% butterflies in South Africa Collapse of Amazon rainforest (according to some models)	Rising risk of abrupt changes to atmospheric circulations, e.g. the monsoon Rising risk of collapse of West Antarctic Ice Sheet Rising risk of collapse of Atlantic Thermohaline Circulation
4°C	Potentially 30 – 50% decrease in water availability in Southern Africa and Mediterranean	Agricultural yields decline by 15 – 35% in Africa, and entire regions out of production (e.g. parts of Australia)	Up to 80 million more people exposed to malaria in Africa	7 – 300 million more people affected by coastal flooding each year	Loss of around half Arctic tundra Around half of all the world's nature reserves cannot fulfill objectives	
5°C	Possible disappearance of large glaciers in Himalayas, affecting one-quarter of China's population and hundreds of millions in India	Continued increase in ocean acidity seriously disrupting marine ecosystems and possibly fish stocks		Sea level rise threatens small islands, low-lying coastal areas (Florida) and major world cities such as New York, London, and Tokyo		
More than 5°C	The latest science suggests that the Earth's average temperature will rise by even more than 5 or 6°C if emissions continue to grow and positive feedbacks amplify the warming effect of greenhouse gases (e.g. release of carbon dioxide from soils or methane from permafrost). This level of global temperature rise would be equivalent to the amount of warming that occurred between the last age and today – and is likely to lead to major disruption and large-scale movement of population. Such "socially contingent" effects could be catastrophic, but are currently very hard to capture with current models as temperatures would be so far outside human experience.					

Note: This table shows illustrative impacts at different degrees of warming. Some of the uncertainty is captured in the ranges shown, but there will be additional uncertainties about the exact size of impacts (more detail in Box 3.2). Temperatures represent increases relative to pre-industrial levels. At each temperature, the impacts are expressed for a 1°C band around the central temperature, e.g. 1°C represents the range 0.5 – 1.5°C etc. Numbers of people affected at different temperatures assume population and GDP scenarios for the 2080s from the Intergovernmental Panel on Climate Change (IPCC). Figures generally assume adaptation at the level of an individual or firm, but not economy-wide adaptations due to policy intervention (covered in Part V).

Reading the future signs – impacts

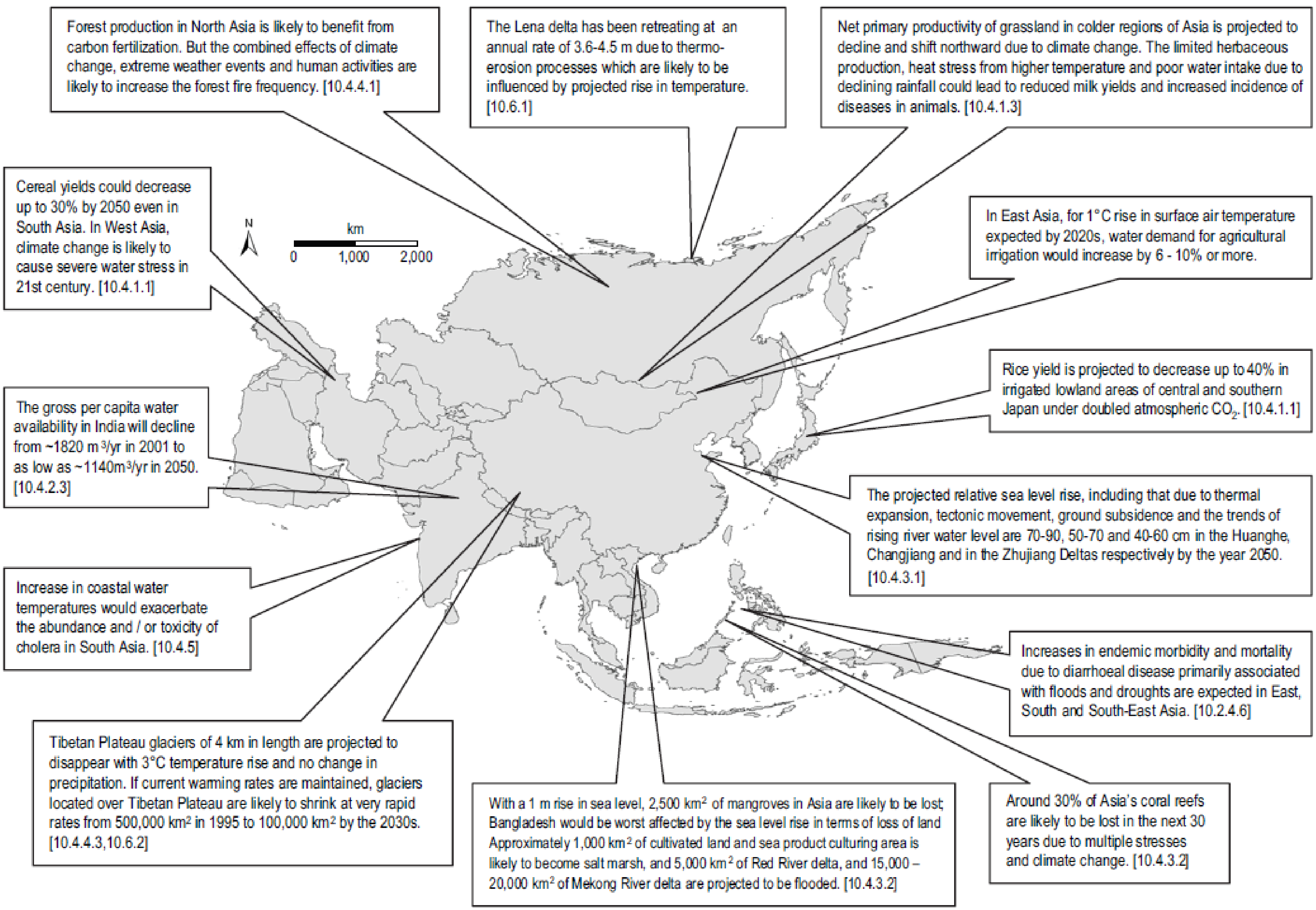


Figure 10.4. *Hotspots of key future climate impacts and vulnerabilities in Asia.*

Observed impacts – water resources

Climate Change	Observed Impact
Increasing temperature	– Increased evapotranspiration in rivers, dams, and other water reservoirs leading to decreased water availability for human consumption, agricultural irrigation, and hydropower generation
Variability in precipitation (including El Niño Southern Oscillation)	– Decreased river flows and water level in many dams and water reservoirs, particularly during El Niño years, leading to decreased water availability; increased populations under water stress – Increased stream flow particularly during La Niña years leading to increased water availability in some parts of the region – Increased runoff, soil erosion, and flooding, which affected the quality of surface water and groundwater
Sea level rise	– Advancing saltwater intrusion into aquifer and groundwater resources leading to decreased freshwater availability
Sources: Boer and Dewi (2008), Cuong (2008), Ho (2008), Jesdapipat (2008), Perez (2008).	

Observed impacts – agriculture

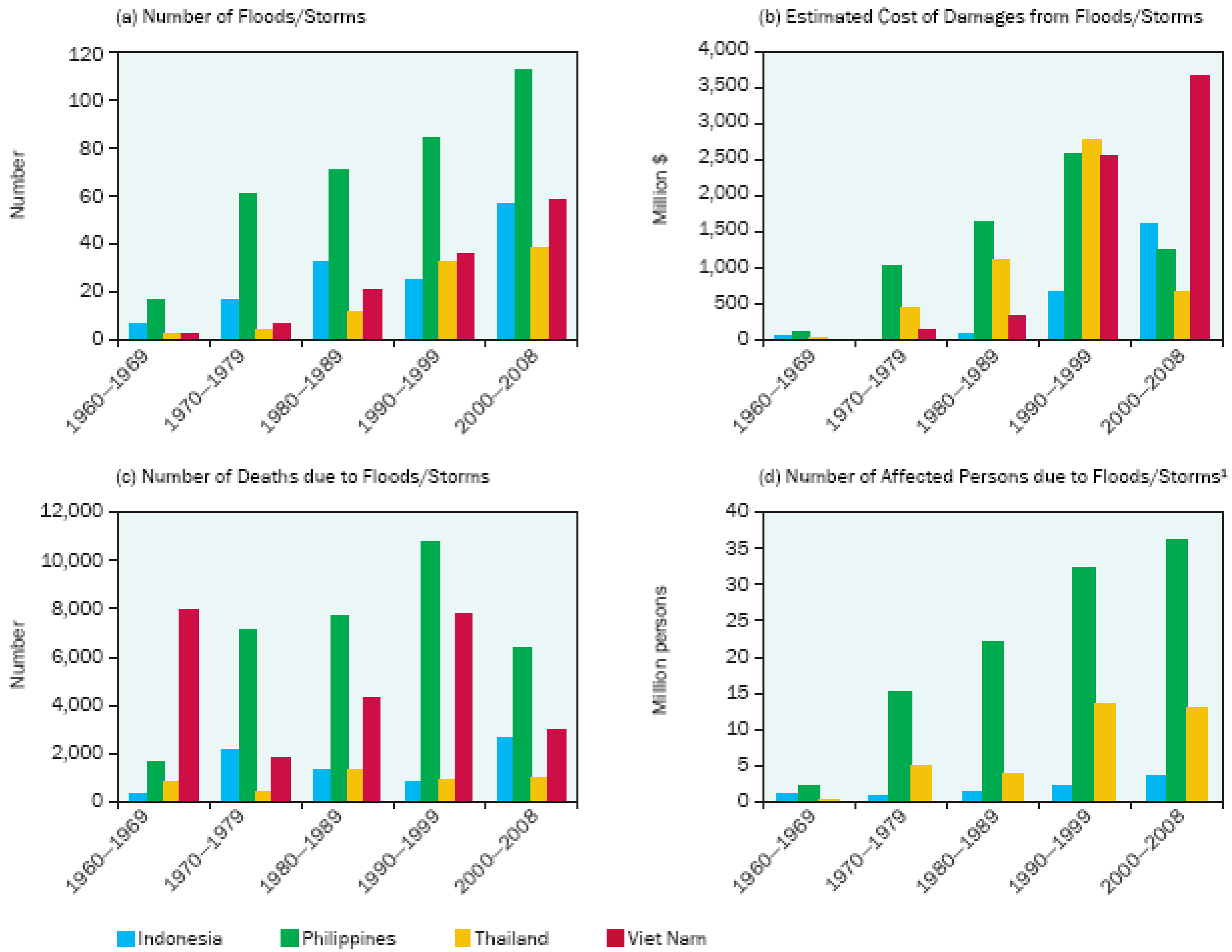
Climate change	Observed impacts
Increasing temperature	– Decreased crop yields due to heat stress – Increased livestock deaths due to heat stress – Increased outbreak of insect pests and diseases
Variability in precipitation (including El Niño Southern Oscillation)	– Increased frequency of drought, floods, and tropical cyclones (associated with strong winds), causing damage to crops – Change in precipitation pattern affected current cropping pattern; crop growing season and sowing period changed – Increased runoff and soil erosion caused decline in soil fertility and consequently crop yields
Sea level rise	– Loss of arable lands due to advancing sea level – Salinization of irrigation water affected crop growth and yield
Sources: Boer and Dewi (2008), Cuong (2008), Ho (2008), Jesdapipat (2008), Perez (2008).	

Observed impacts – health sector

Climate Change	Indonesia	Philippines	Singapore	Thailand	Viet Nam
Increasing temperature and variability in precipitation	Significant increase in dengue cases in La Niña years; illness and deaths due to heat stress	Increased dengue outbreak; illness and deaths due to heat stress	increasing cases of dengue; spreading to areas not previously found	Impacts of dengue fever significant and increasing	Increased number of dengue cases
Sea level rise	Spread of water-borne infectious diseases	Spread of water-borne infectious diseases		Spread of water-borne infectious diseases	Spread of water-borne infectious diseases

Sources: Boer and Dewi (2008), Cuong (2008), Ho (2008), Jesdapipat (2008) Perez (2008).

Impacts – cost of damage



Note: 1 Data not available in Viet Nam for the number of affected persons due to floods/storms.
Sources: CRED (2008), CCFSC (2005).

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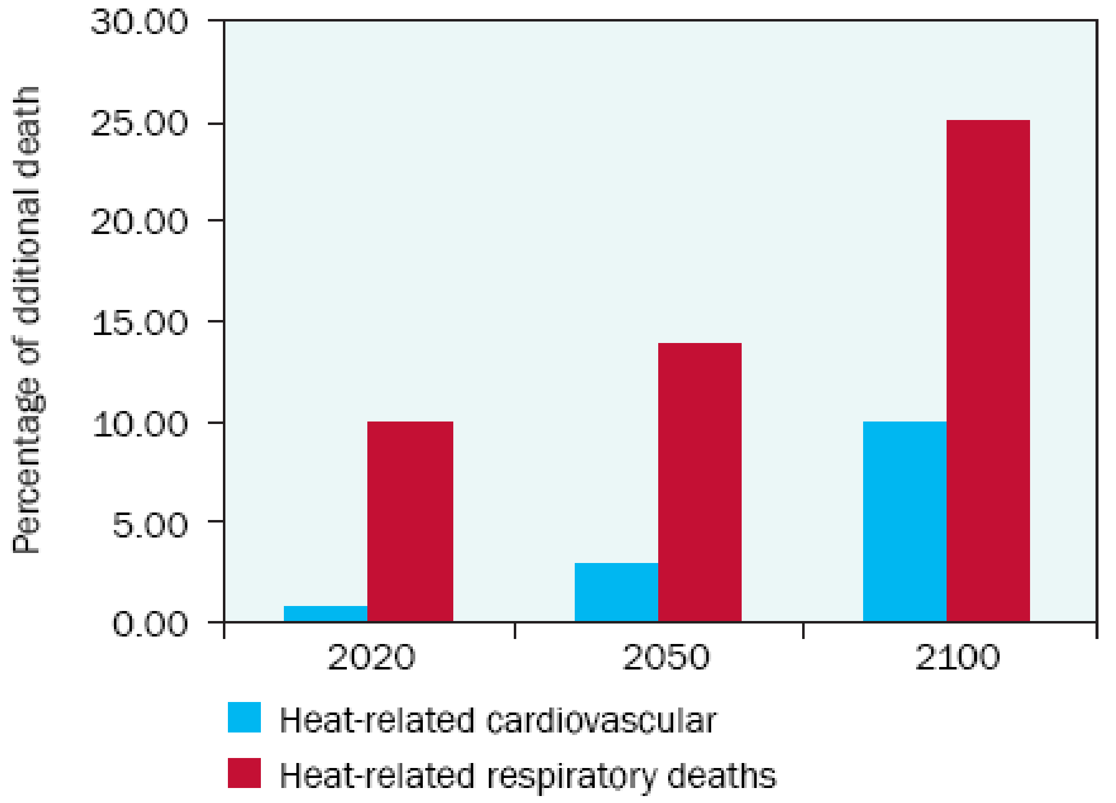
Future impacts – projection of death



Source: ADB study team.

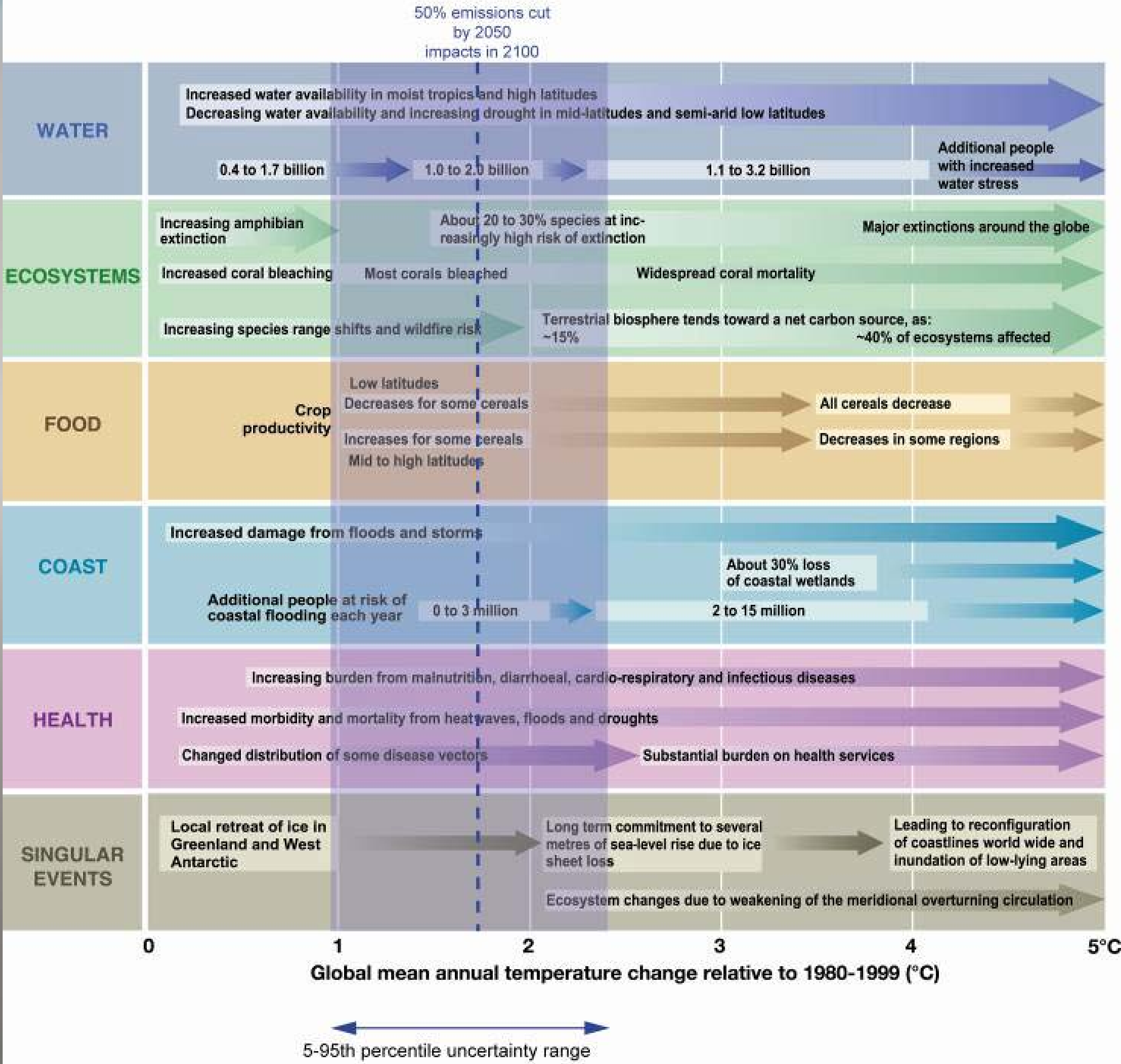
Adaptation options

- Water resources: scale up water conservation and management, integrated water management, flood early warning system, irrigation improvement, etc;
- Agriculture: better climate information, research and development on heat-resistant crop varieties, early warning systems, and efficient irrigation systems; and explore innovative risk-sharing instruments;
- Forestry: Enhance early warning systems and awareness-raising programs to prepare for more frequent forest fires;
- Coastal and marine resources: integrated coastal zone management plans, including mangrove conservation and planting;
- Health: early warning systems for disease outbreaks, health surveillance, awareness-raising campaigns, and infectious disease control programs;
- Infrastructure: introduce “climate proofing” in transport-related investments and infrastructure - starting with public buildings.

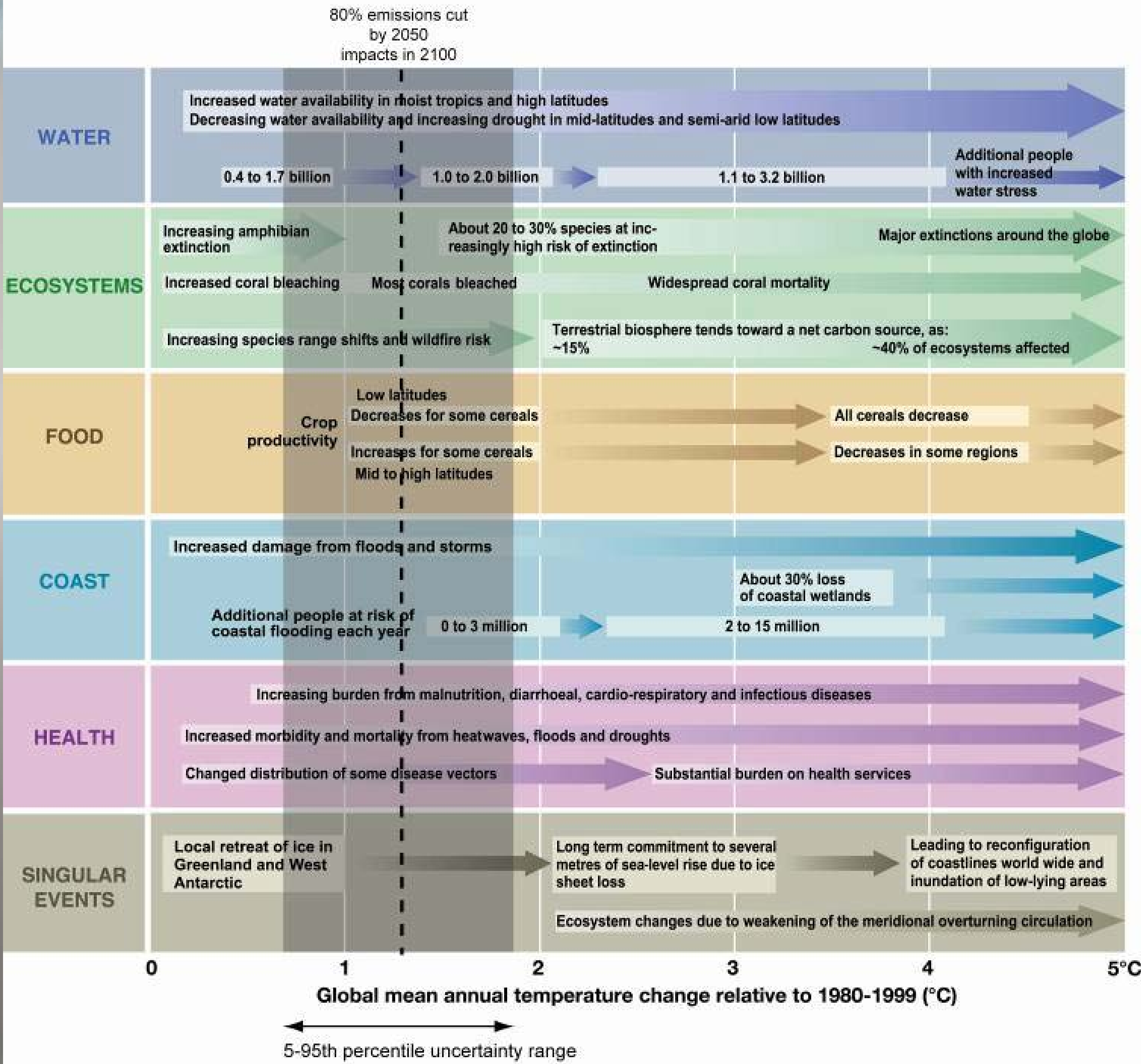
Challenges for adaptation

- Insufficient information and knowledge on the impacts of climate change and responses of natural systems to climate change;
- Limited studies on the interconnections between adaptation and mitigation options, costs and benefits of adaptation, and trade-offs between various courses of actions;
- The absence of information on adaptation costs and benefits makes it difficult to undertake the best adaptation option;
- The above limiting factors are most constraining in developing countries where systems for monitoring and research on climate and responses of natural and human systems to climate are usually lacking;
- More relevant information will be needed for action
  - crop yield benefits linked to changes in planting dates for various regions
  - cost of coastal protection investment in Vietnam and Cambodia

Impacts under 50% emissions cut by 2050 [3% per year] [Parry et al., Nature Reports Climate Change, June 2008]

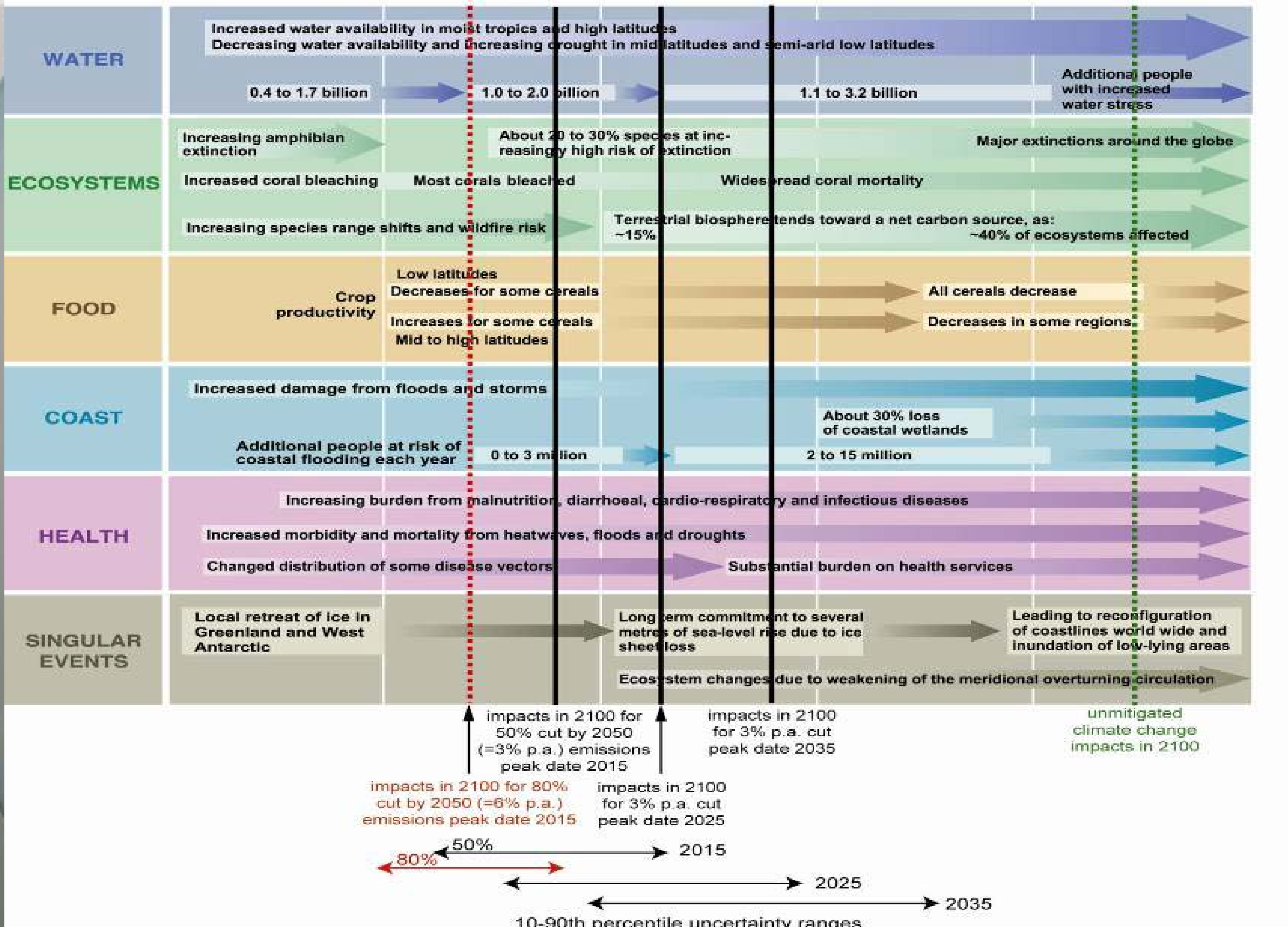


Impacts under 80% emissions cut by 2050 [6% per year] [Parry, et al..,2008



Impacts under 80% and 50% and delayed emissions cuts

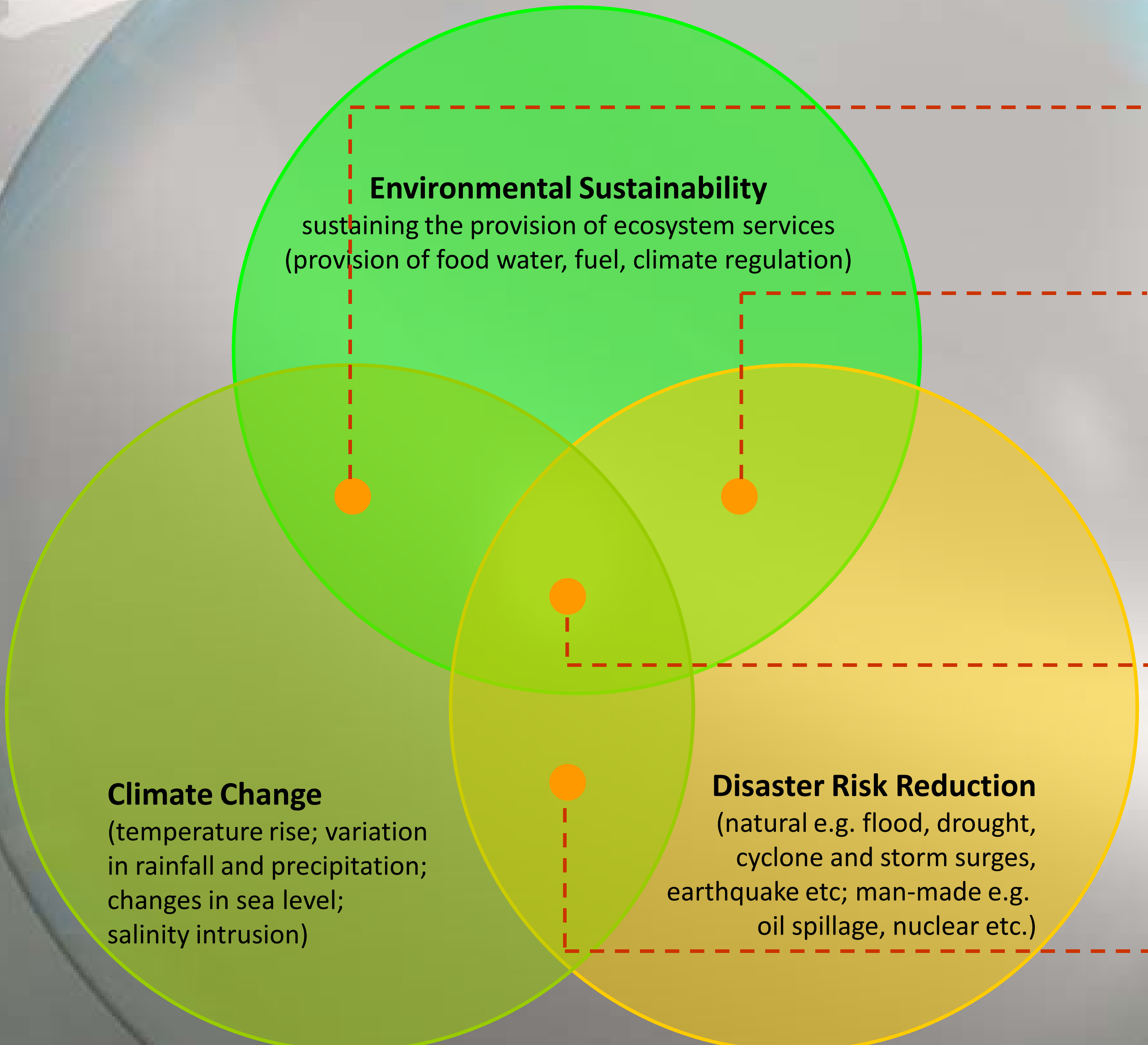
[Parry, Lowe, Hansen: December, 2008



Opportunities

- Politically high in the agenda and recognition of implication on development – allow engagement of policy and decision makers;
- New institutional setup to coordinate climate change – mandate, policy and strategy are key
- Provisions for finance, technology, and capacity building – funding window under UNFCCC (existing and new), technology mechanism, capacity building
- Development is in progress and integrating climate change will support sustainable development – integration of multi-sector and multiple issues are opportunities

Multiple sector and issues: responses inter-linkage



- Ecosystem based adaptation (coastal, mountain, dry land, river basin);
- Reduction of emission from deforestation and forest degradation;
- Management of marine ecosystem (blue carbon)

- Multi-hazard and risk mapping;
- Local level capacity building for disaster preparedness and environmental management

- Improvement of systematic observation and monitoring;
- Improve local level plan, design and implementation;
- Information and communication;
- Integrated coastal zone management;
- Integrated watershed management;
- Conservation, protection and management of ecosystems and services.

- Improvement of early warning systems;
- Improvement of modeling and forecasting of short-term and long-term phenomenon;
- Development of drought, flood, salinity resilient crop variety

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Act Now – delay will increase cost

- Science is clear that a certain degree of adverse impacts can not be avoided even with stringent mitigation measures;
- Many beneficial measures to enhance resilience to cope with climate variability and weather extremes are already exist and much can be learned from experiences and knowledge;
- Integration of adaptation measures into development will help both addressing climate change and development

THANK YOU !

For more information:
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