Climate Change: Key findings of the IPCC Fifth Assessment Report (AR5)

Fredolin Tangang

Fmr. IPCC Working Group I Vice-Chair
Professor, Universiti Kebangsaaan Malaysia

IPCC AR5 Synthesis Report

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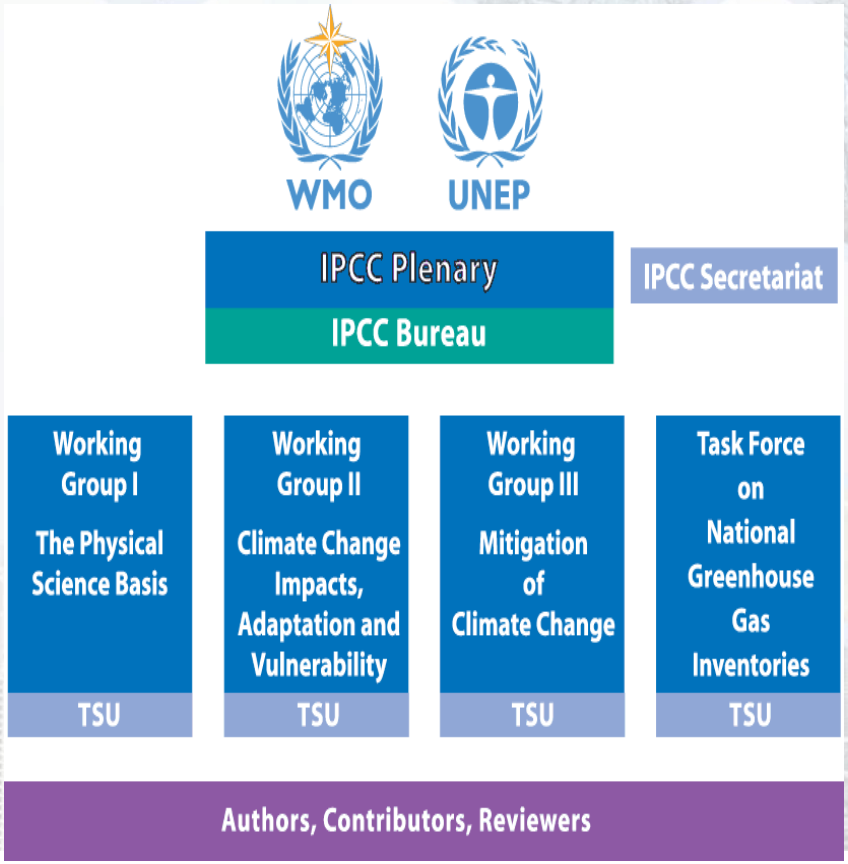
The 4th Annual Meeting of the Low Carbon Asia Research Network (LoCARNet) Johor Bahru, Malaysia, 11-13 October 2015

Why IPCC?

- **Prior to the establishment of IPCC, growing number of literatures indicate the Earth's climate system is warming due to increasing GHG concentration in atmosphere**
- **Independent, objective, fair and transparent assessment of the state of global climate system is required**
- **For this reason, United Nations General Assembly (UNGA) 42 proposed the establishment of IPCC and in 1988 IPCC was established under WMO and UNEP**
- **The IPCC provides such assessment and this becomes the source of information particularly to policy makers and UNFCCC on 1. Causes of climate change, 2. Potential impacts on built and natural systems and socio-economic, 3. Possible response options.**

Inter-governmental Panel on Climate Change (IPCC)



- IPCC plenary comprises of all countries in the world
- IPCC Bureau comprises of 30 elected members; IPCC elects its bureau members once in a 6-7 years cycle
- 3 working groups & a Task Force on NGGI
- Authors, Contributors, Reviewers, Review Editors

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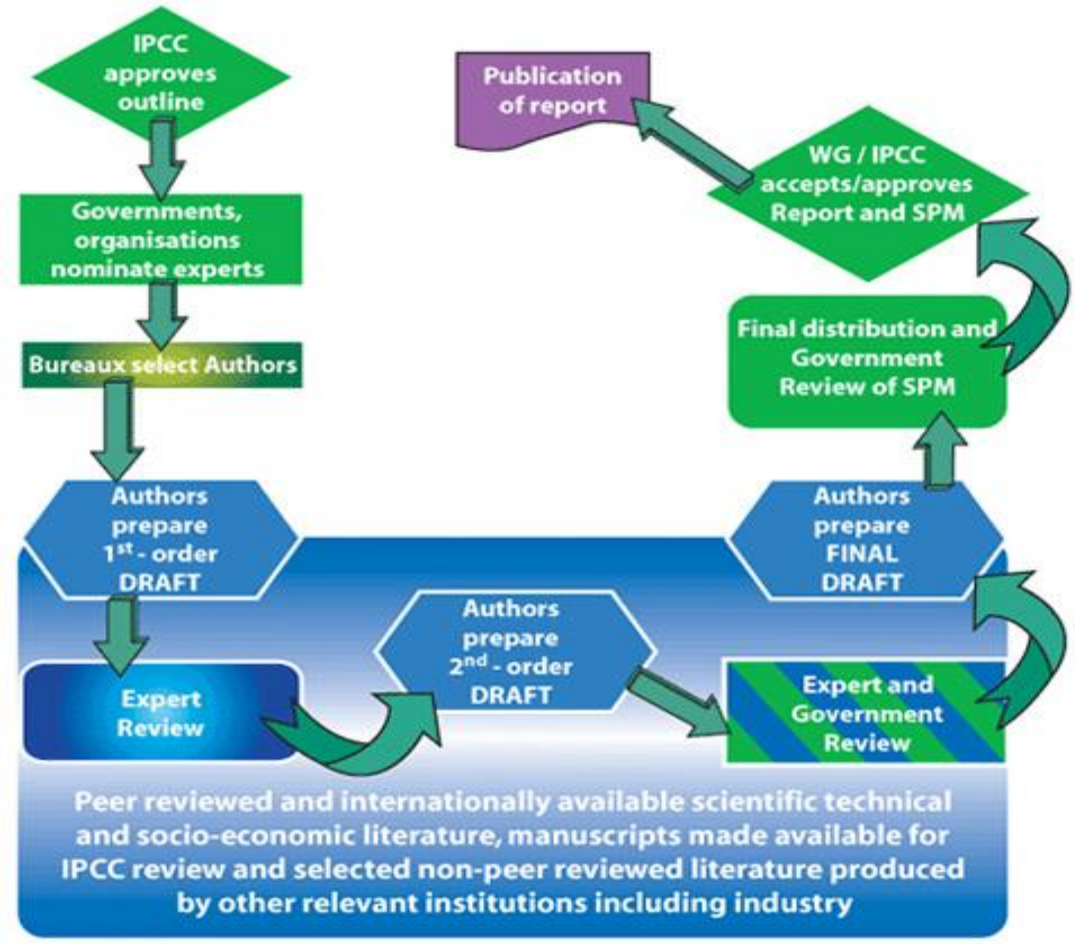
IPCC Assessment Process



Key « Rules » for IPCC Work

- COMPREHENSIVE – all the latest relevant scientific, technical and socio-economic literature published wordwide is assessed
- BALANCED – differring views are reflected in the reports
- OPEN – selection of authors from all countries and relevant discipline, wide review process by experts and governments
- TRANSPARENT – strict clear procedures

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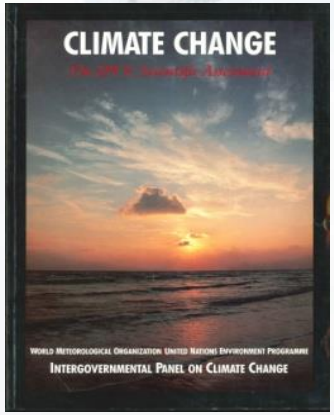
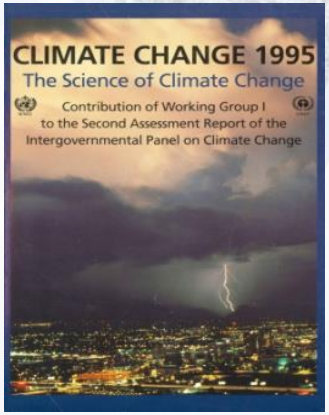
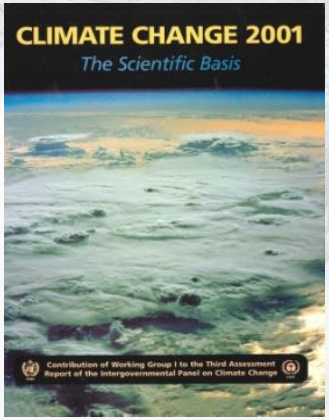
IPCC Assessment Reports



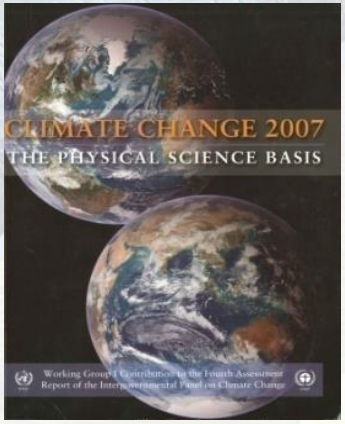
FAR 1990



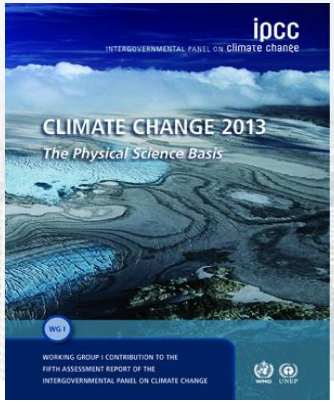
SAR 1995



TAR 2001

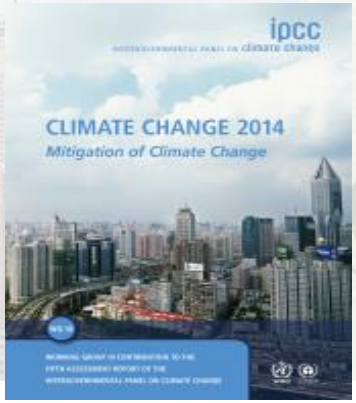


AR4 2007

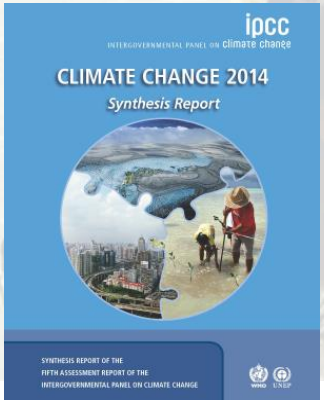


AR5 WGI 2013

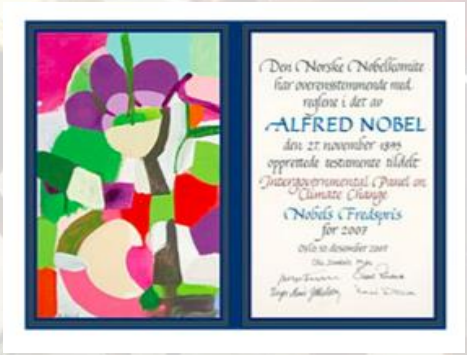
AR5 WGII 2014



AR5 WGIII 2014



Synthesis Report 2014



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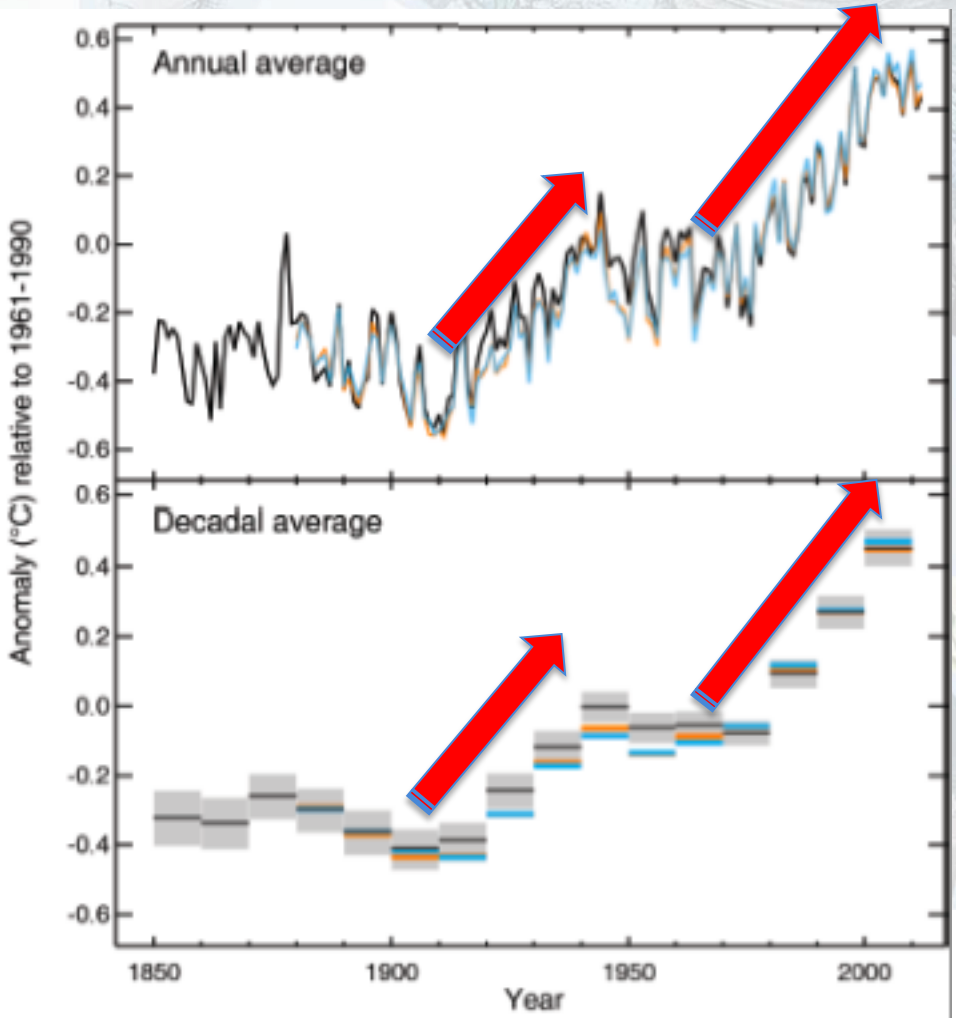
Observed Mean Global Temperature

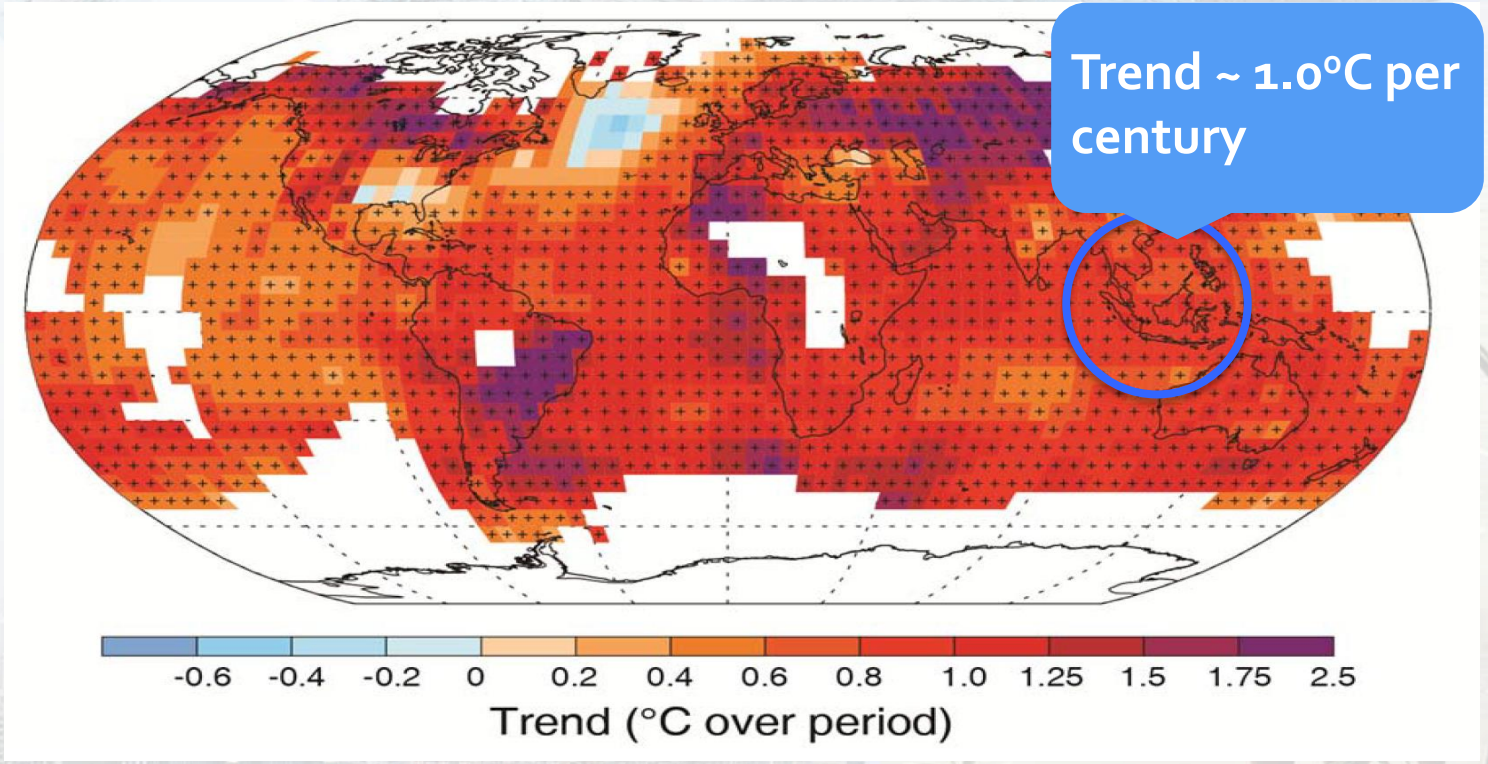


The globally averaged surface temperature data as calculated by a linear trend, show a warming of 0.85 [0.65 to 1.06] ° C over 1880 - 2012

Each of the last three decades has been successively warmer at the Earth's surface than any preceding decade since 1850.

In the Northern Hemisphere, 1983–2012 was *likely* the warmest 30-year period of the last 1400 years (*medium confidence*)

Trend of Surface Temperature Increase



Warming of the climate system is unequivocal

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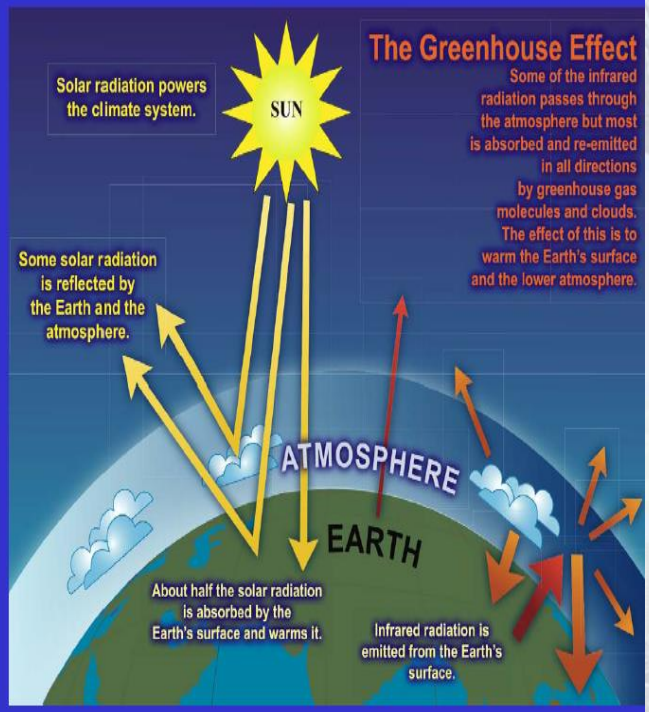
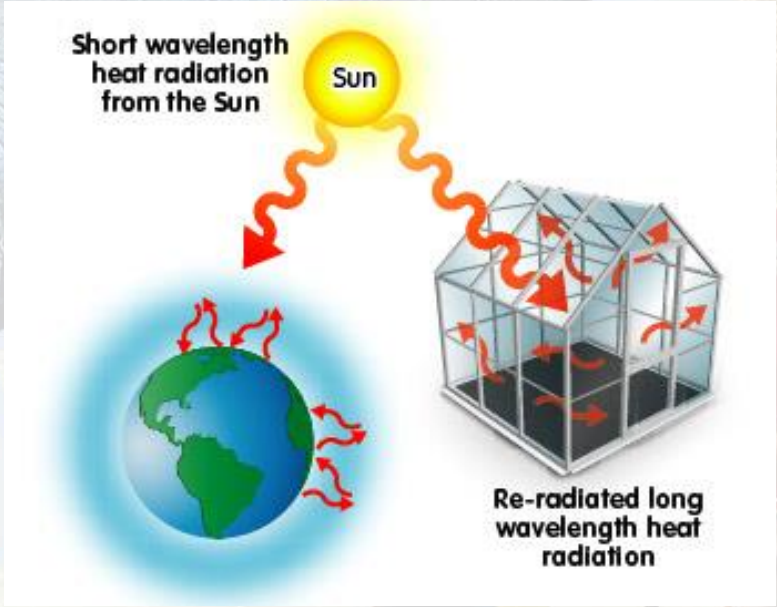
Greenhouse Effect

The greenhouse effect

The natural greenhouse effect increases surface temperatures by about 30ºC.

Increasing greenhouse gas concentrations tends to increase surface temperatures.





Radiative Forcing: Change in energy flux caused by natural or anthropogenic drivers of climate change (in Wm^{-2})

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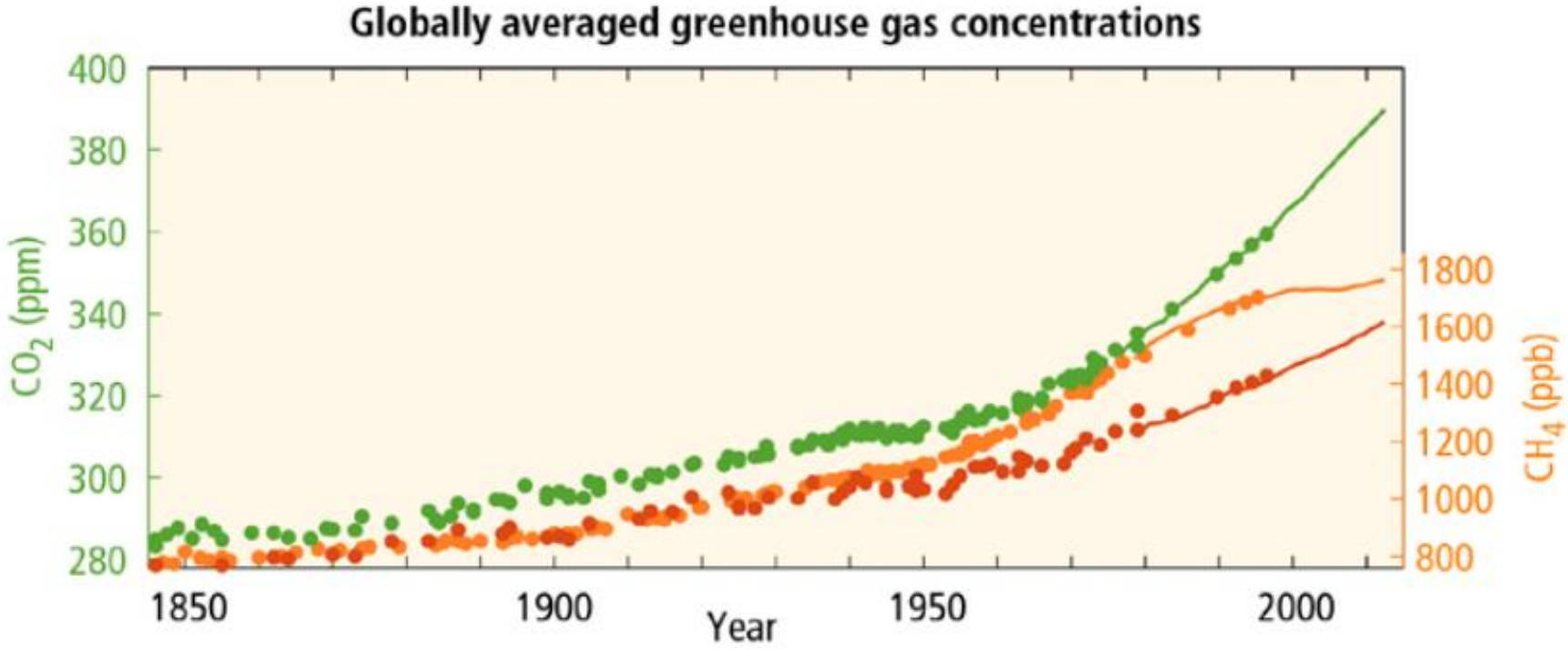
The Father of Greenhouse Effect

Svante Arrhenius

(1859-1927, Nobel Prize Winner for Chemistry 1903; The first Swedish Nobel Prize Winner)

- **Published a paper in early 1900 highlighting the greenhouse effect**
- **The first person to predict that emission of CO_2 from burning of fossil fuels would cause global warming**
- **Predicted doubling of CO_2 would result 5-6°C increase in global mean temperature (IPCC projection was 2-4.5°C)**
- **Predicted it would take 3000 years to double the CO_2 concentration (IPCC estimated this would be achieved within this century)**

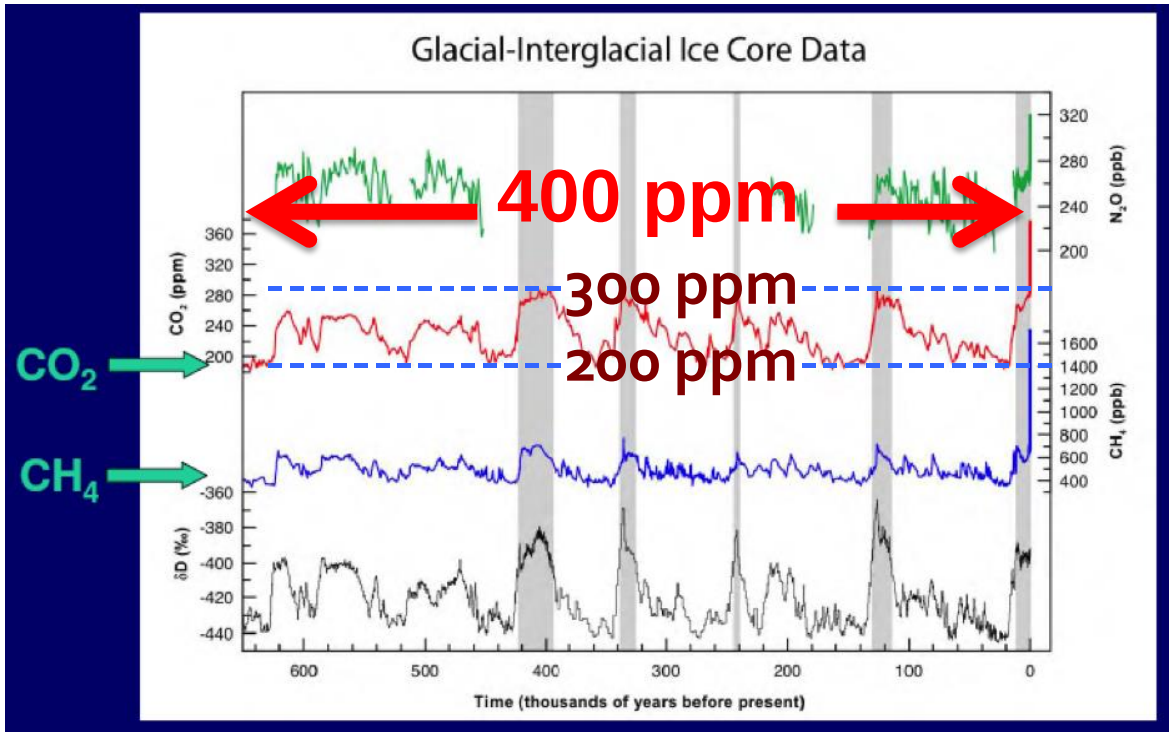
Historical GHG Emission



The atmospheric concentrations of carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) have increased to levels unprecedented in at least the last 800,000 years.

GHG Historical Record in Ice Cores

Ice Cores



IPCC (2007)

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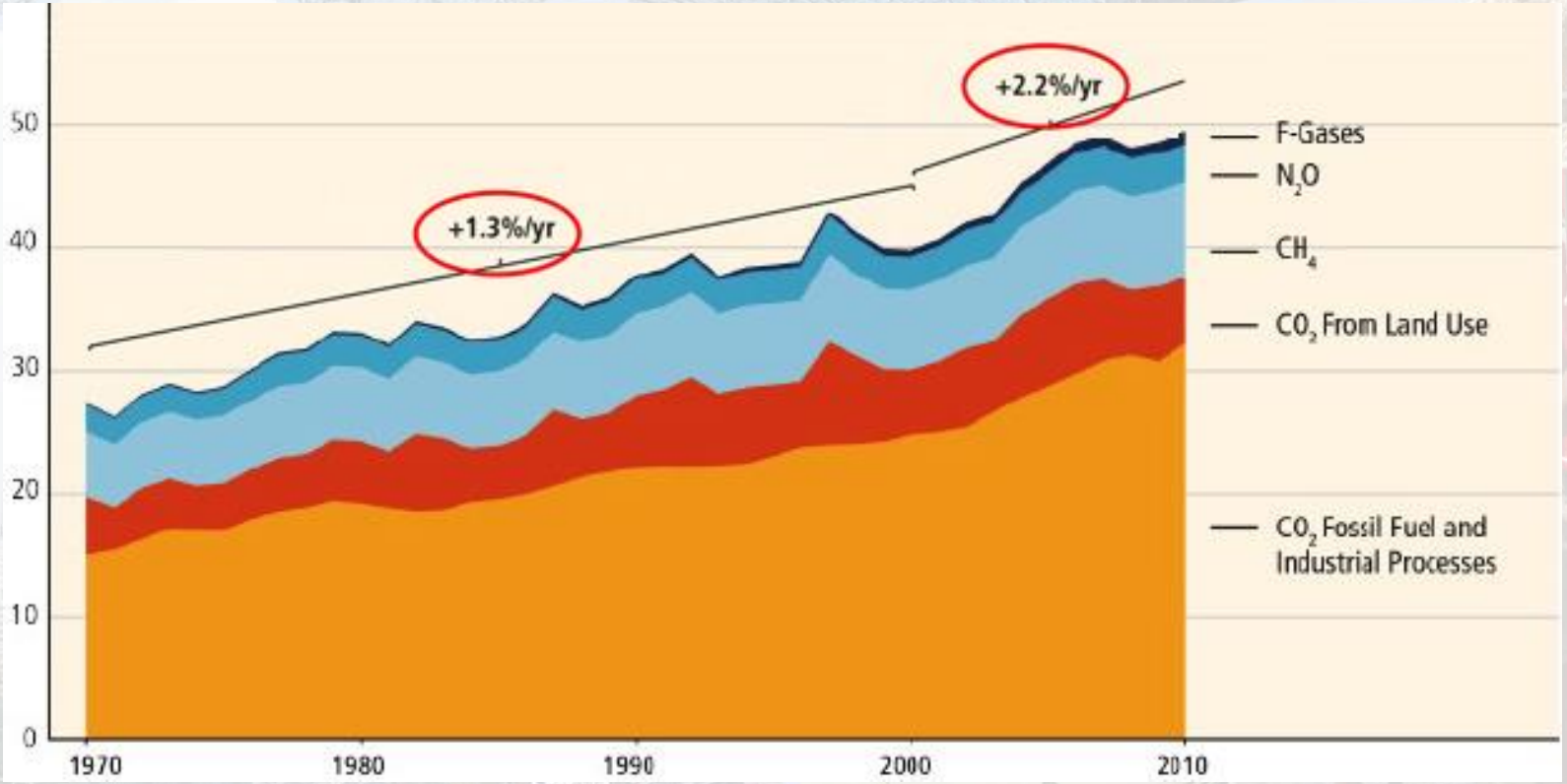
GHG emissions growth between 2000 and 2010 has been larger than in the previous three decades



AR5 SYR SPM.2; AR5 WGIII SPM

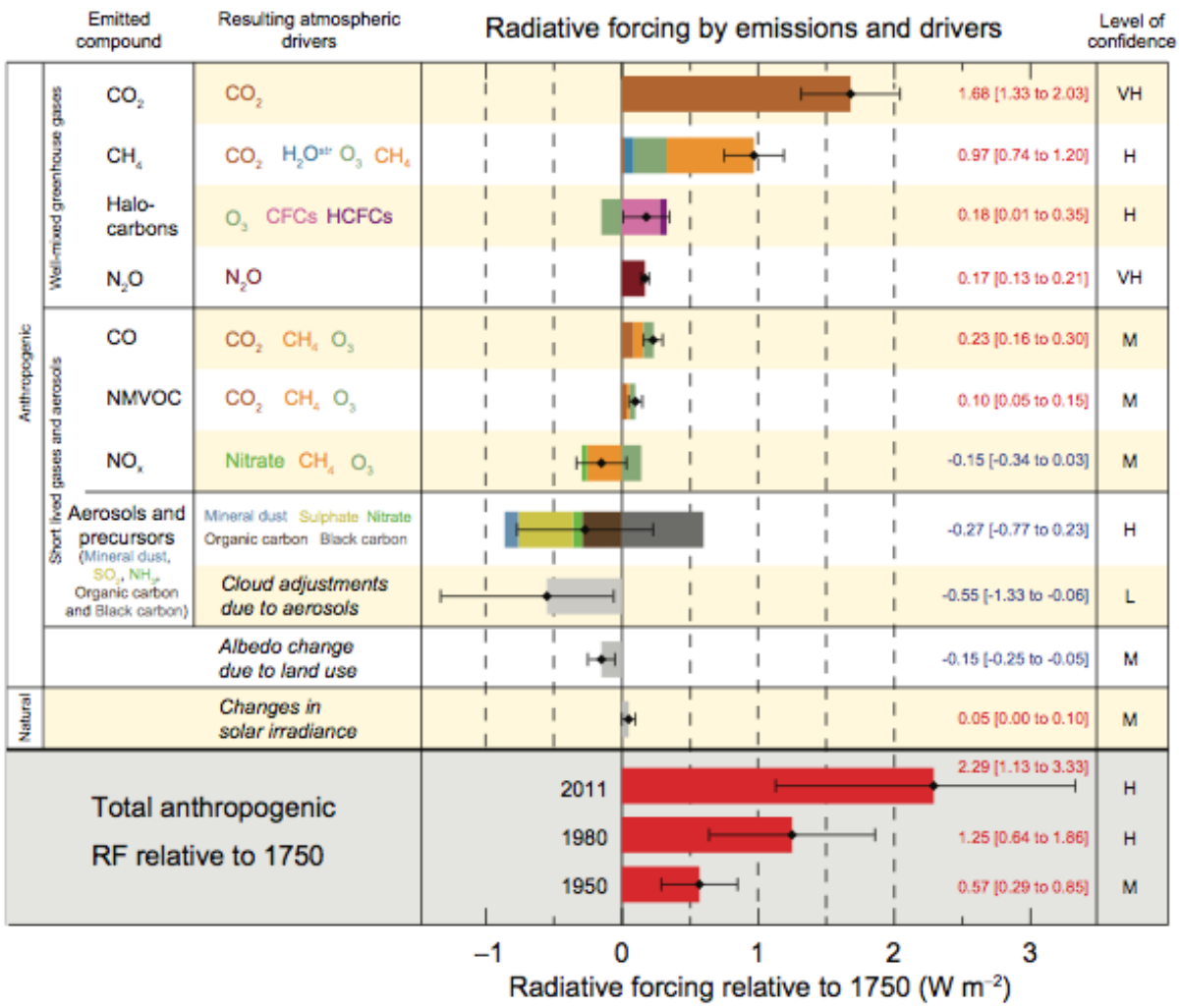
Sources of emissions

Energy production remains the primary driver of GHG emissions

2010 GHG emissions

AR5 WGIII SPM

Radiative Forcing due to GHG Emissions



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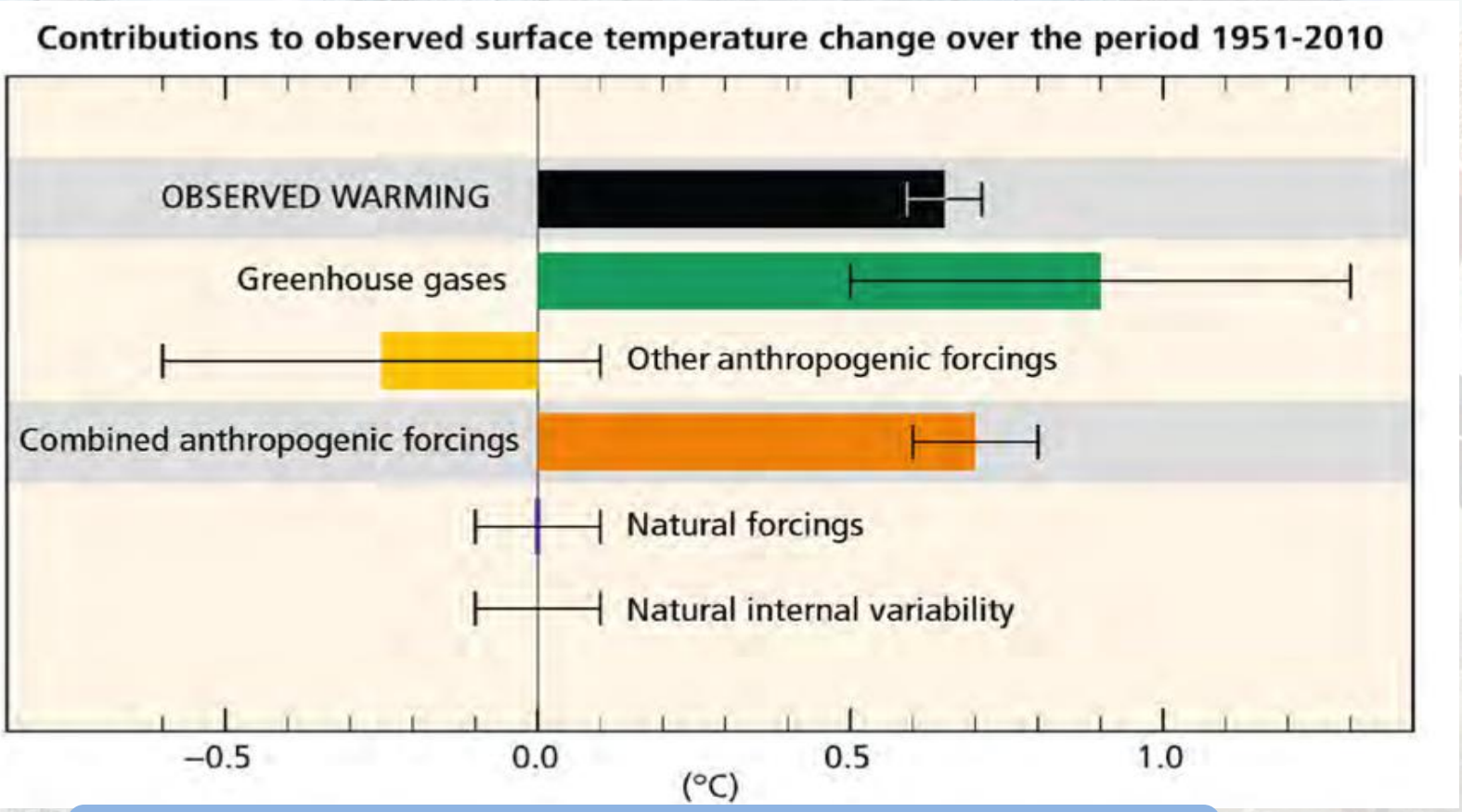
Humans are changing the climate



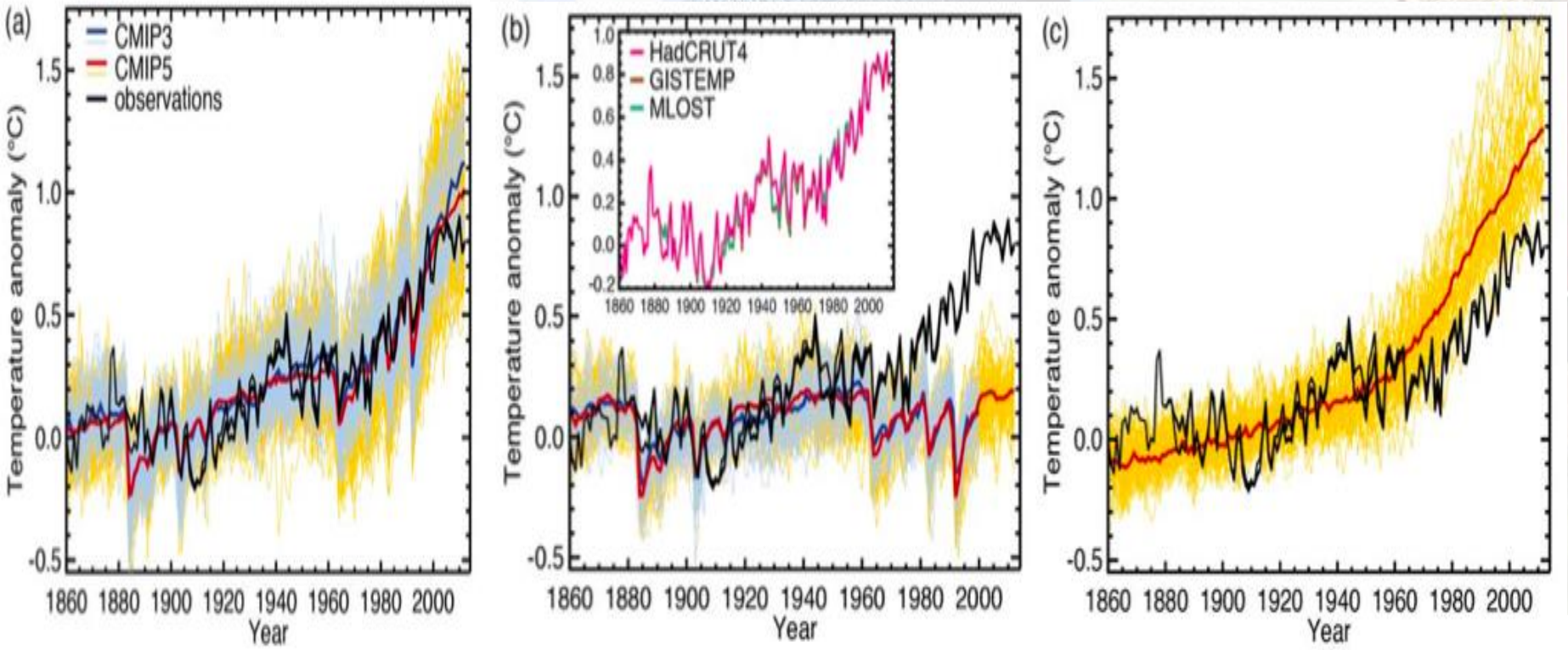
AR5 SYR SPM.3

Human Influence is Clear

Humans are changing the climate

Climate Models Responses to Various Forcings

Natural + Anthropogenic | Natural | CO_2 forcing only



Human Influence is Clear

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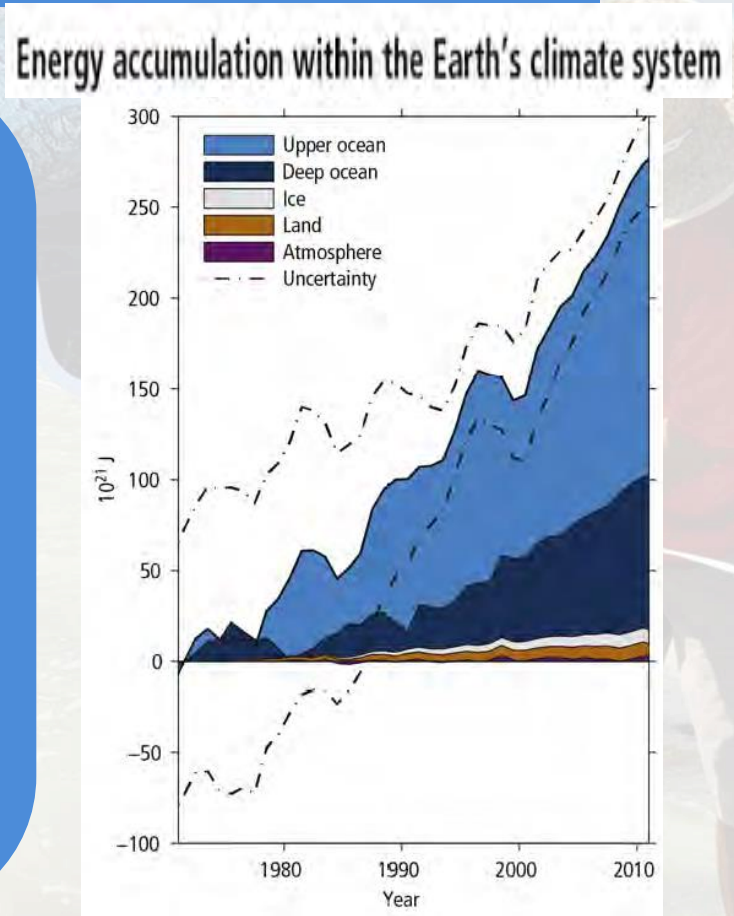
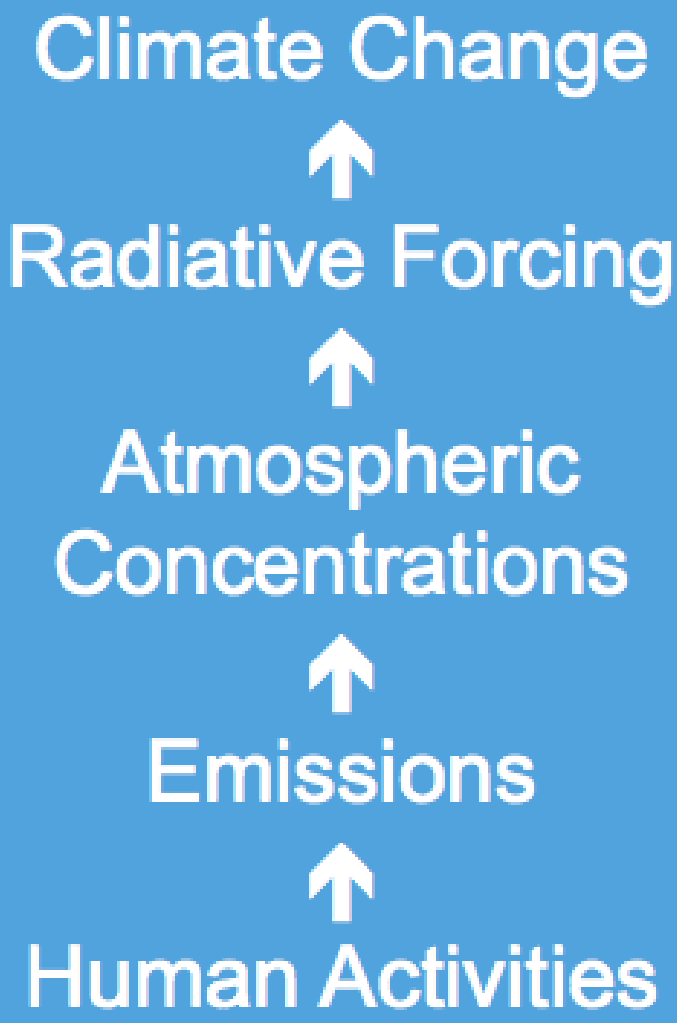
Earth is in Radiative Imbalance

Earth has been in radiative imbalance, with more energy from the sun entering than exiting the top of the atmosphere, since at least circa 1970. It is *virtually certain* that Earth has gained substantial energy from 1971–2010. More than 90% of this extra heat is absorbed by the ocean (*high confidence*)




Climate Change
Radiative Forcing
Atmospheric Concentrations
Emissions
Human Activities

Some of the changes in extreme weather and climate events observed since about 1950 have been linked to human influence



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Impacts are already underway

- Tropics to the poles
- On all continents and in the ocean
- Affecting rich and poor countries




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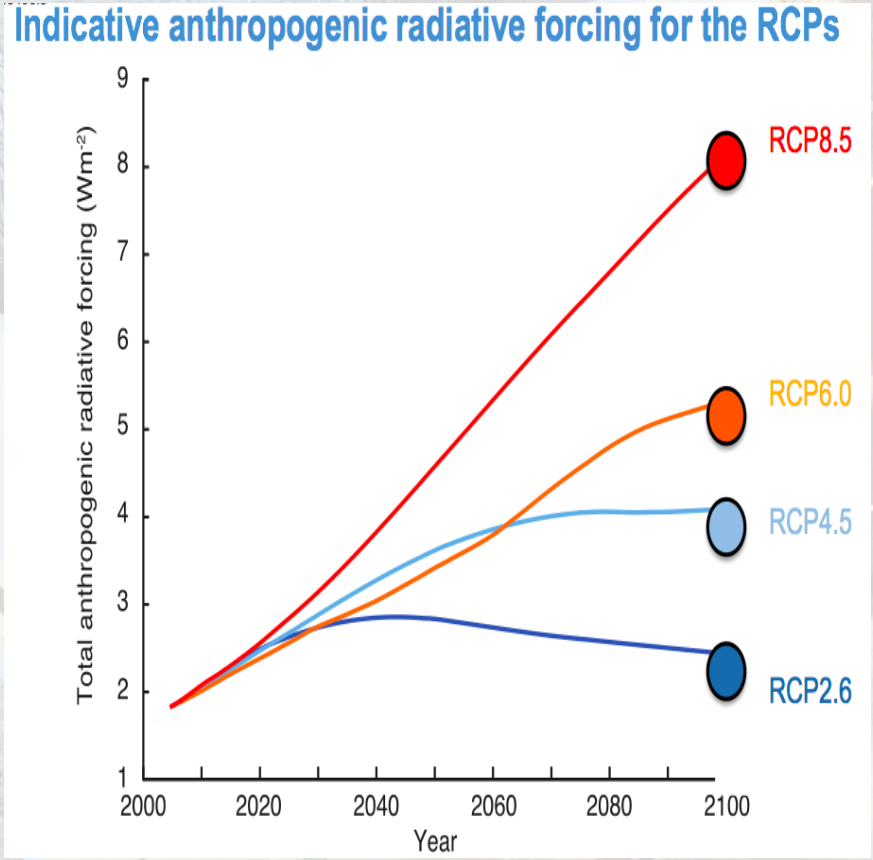
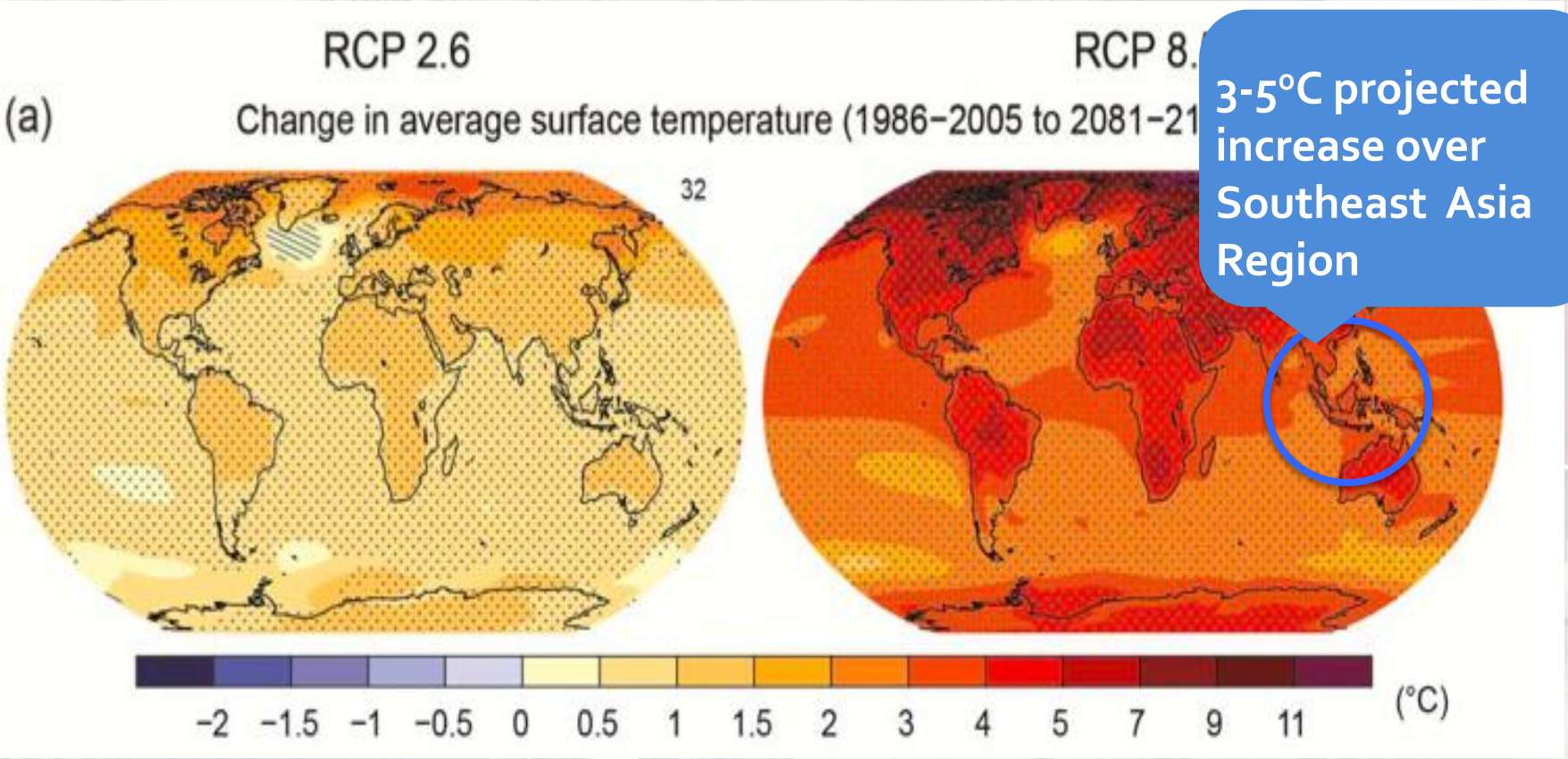
Projecting Future Climate Requires GHG Concentration Pathway

For future climate projections, climate models require Emission Scenarios. Models in AR5 use Representative Concentration Pathway (RCP)



Projected Mean Surface Temperature by end of 21st Century



3-5°C projected increase over Southeast Asia Region

The temperature increase during the last 100 years is only about 0.8°C.

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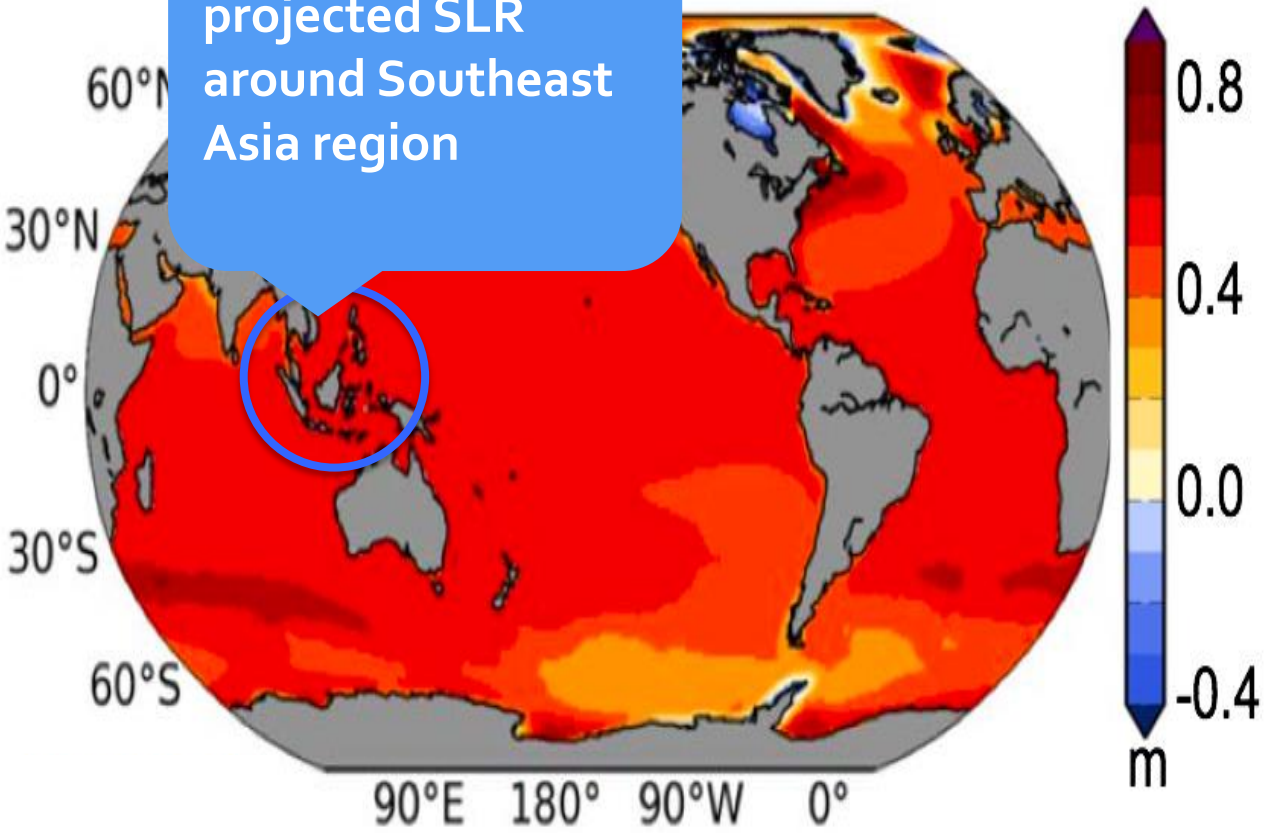
Projected Sea Level Rise by end of 21st Century



It is *very likely* that sea level will rise in more than about 95% of the ocean area.

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Projected climate changes

Continued emissions of greenhouse gases will cause further warming and changes in the climate system

Oceans will continue to warm during the 21st century

Global mean sea level will continue to rise during the 21st century

It is very likely that the Arctic sea ice cover will continue to shrink and thin as global mean surface temperature rises

Global glacier volume will further decrease

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Potential Impacts of Climate Change

Food and water shortages

Increased displacement of people

Increased poverty

Coastal flooding

AR5 WGII SPM

Limiting Temperature Increase to 2˚C

Measures exist to achieve the substantial emissions reductions required to limit likely warming to 2˚ C

A combination of adaptation and substantial, sustained reductions in greenhouse gas emissions can limit climate change risks

Implementing reductions in greenhouse gas emissions poses substantial technological, economic, social, and institutional challenges

But delaying mitigation will substantially increase the challenges associated with limiting warming to 2˚ C

AR5 WGI SPM, AR5 WGII SPM,AR5 WGIII SPM

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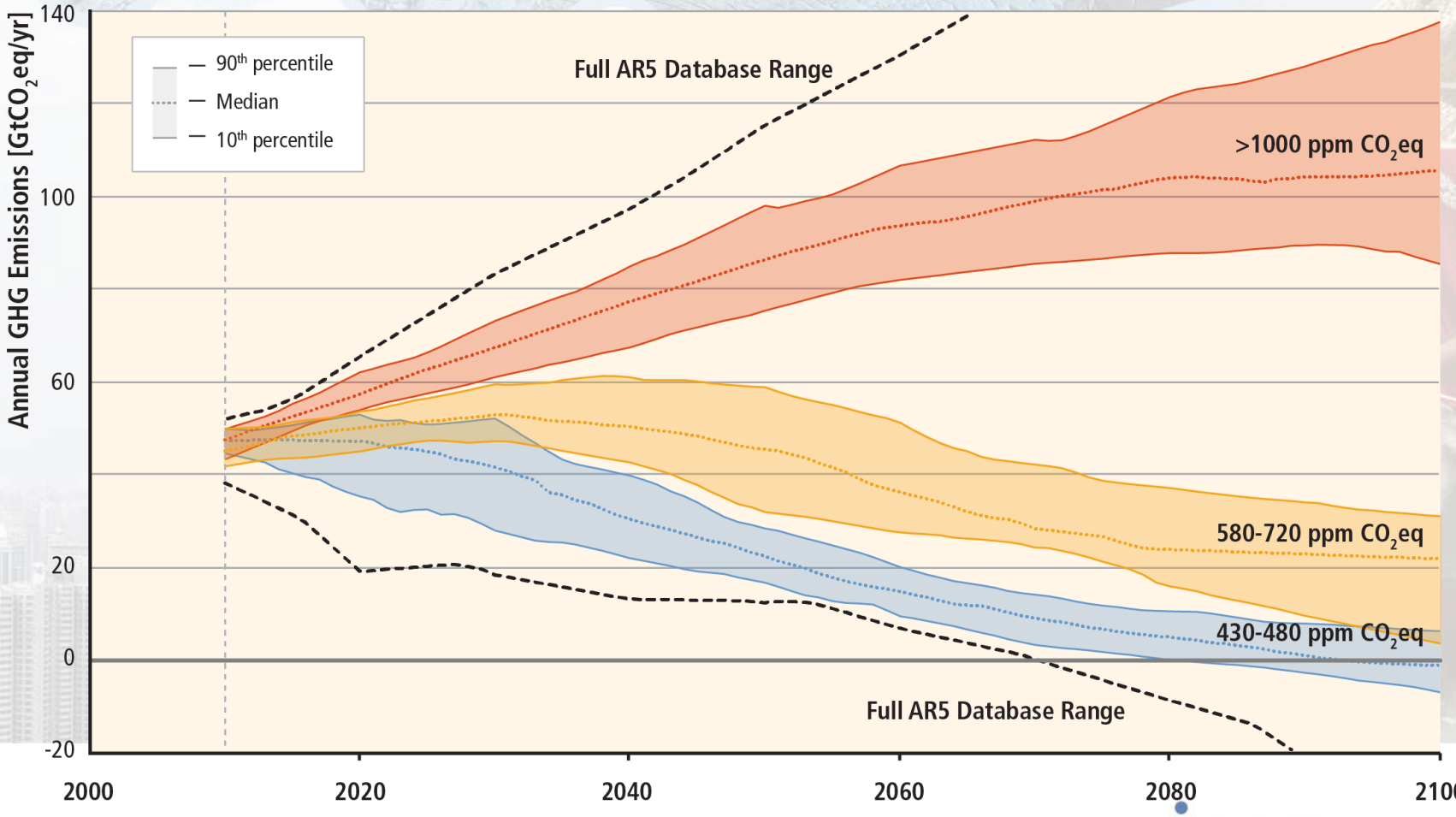
Stabilization of atmospheric concentrations requires moving away from the baseline – regardless of the mitigation goal.



Based on Figure 6.7

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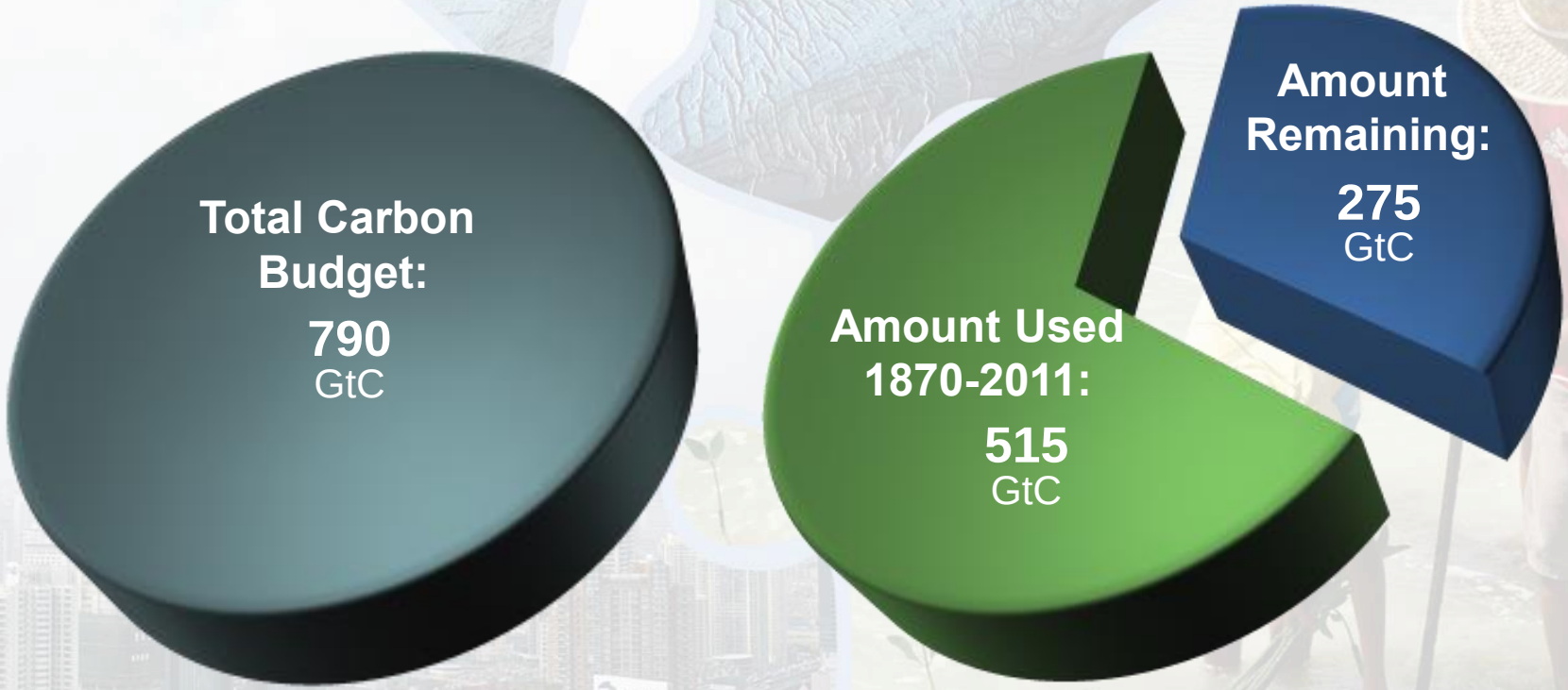
The window for action is rapidly closing

65% of our carbon budget compatible with a 2° C goal already used



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Mitigation Measures

More efficient use of energy

Greater use of low-carbon and no-carbon energy

- Many of these technologies exist today

Improved carbon sinks

- Reduced deforestation and improved forest management and planting of new forests
- Bio-energy with carbon capture and storage

Lifestyle and behavioural changes

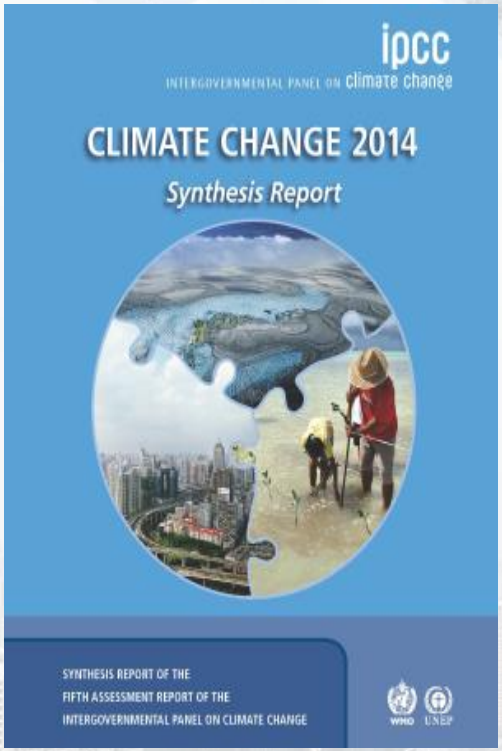
AR5 WGIII SPM

Ambitious Mitigation Is Affordable

- Economic growth reduced by ~ 0.06%
  (BAU growth 1.6 - 3%)
- This translates into delayed and not forgone growth
- Estimated cost does not account for the benefits of reduced climate change
- Unmitigated climate change would create increasing risks to economic growth

AR5 WGI SPM, AR5 WGII SPM

Key Messages



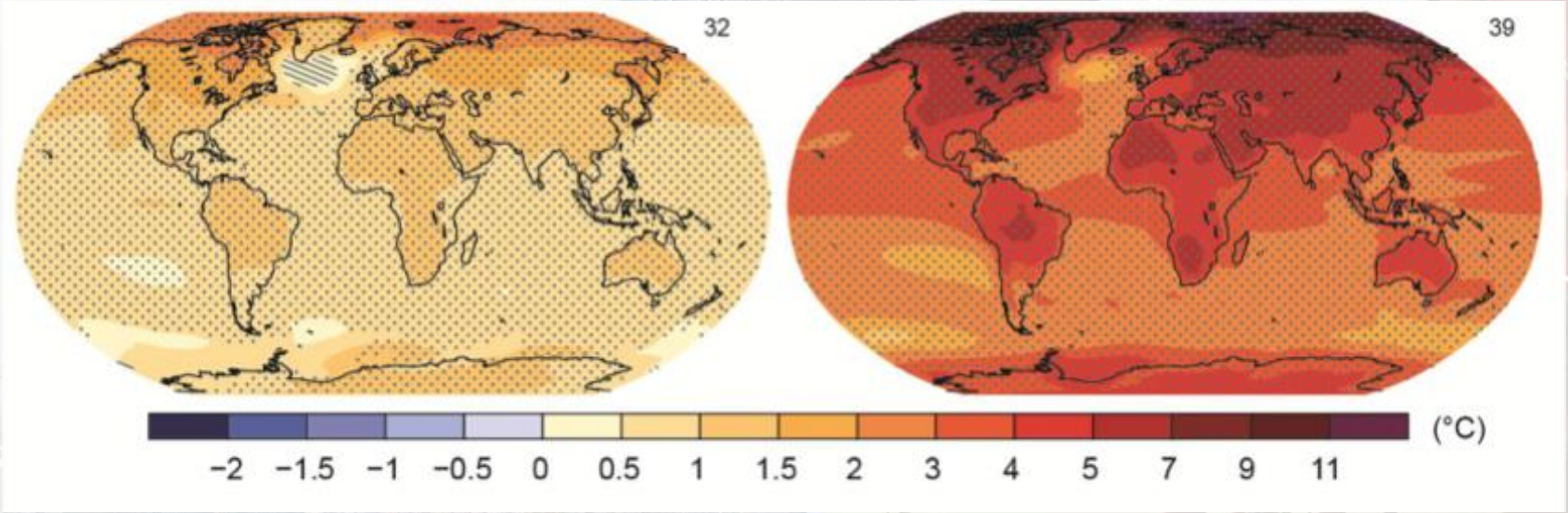
- ➜ **Human influence on the climate system is clear**
- ➜ **The more we disrupt our climate, the more we risk severe, pervasive and irreversible impacts**
- ➜ **We have the means to limit climate change and build a more prosperous, sustainable future**

AR5 WGI SPM, AR5 WGII SPM, AR5 WGIII SPM

The Choices We Make Will Create Different Outcomes

With substantial mitigation

Without additional mitigation



Change in average surface temperature (1986–2005 to 2081–2100)

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PARIS 2015 UN Climate Change Conference

Can PARIS2015 be a great success?

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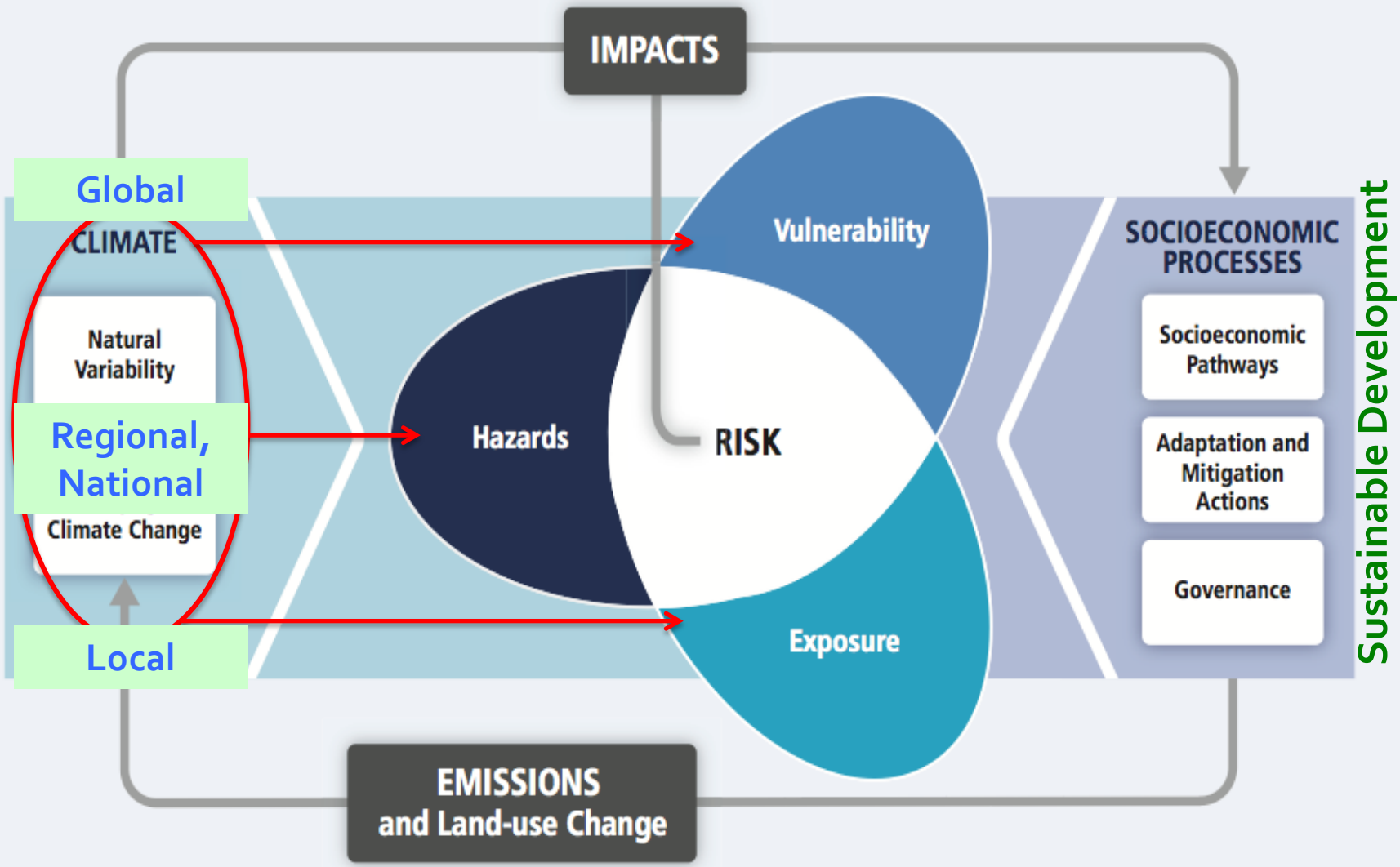
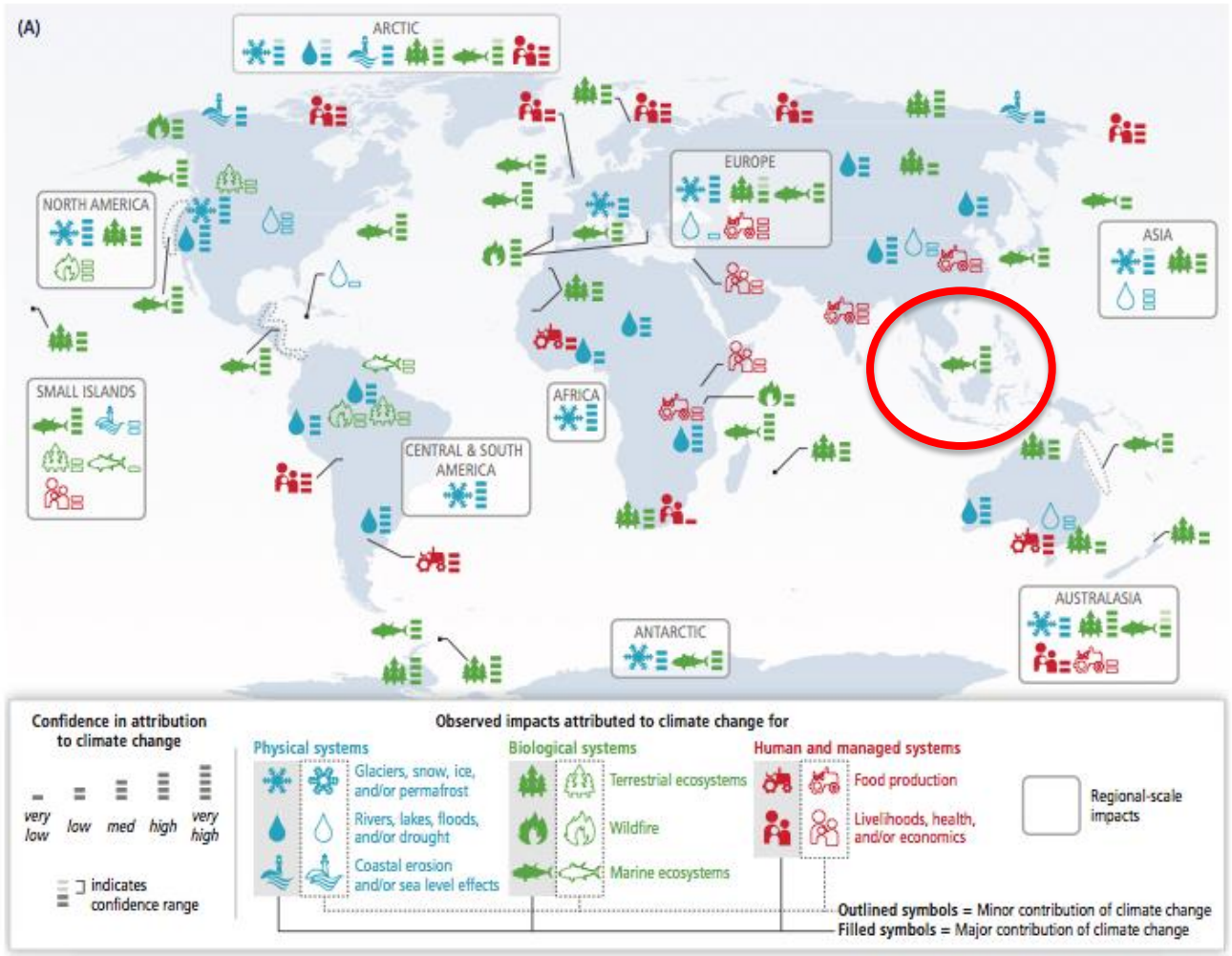
Framing the RISK



Attribution of observed impacts to Climate Change



Lack of attribution studies in the Southeast Asia region

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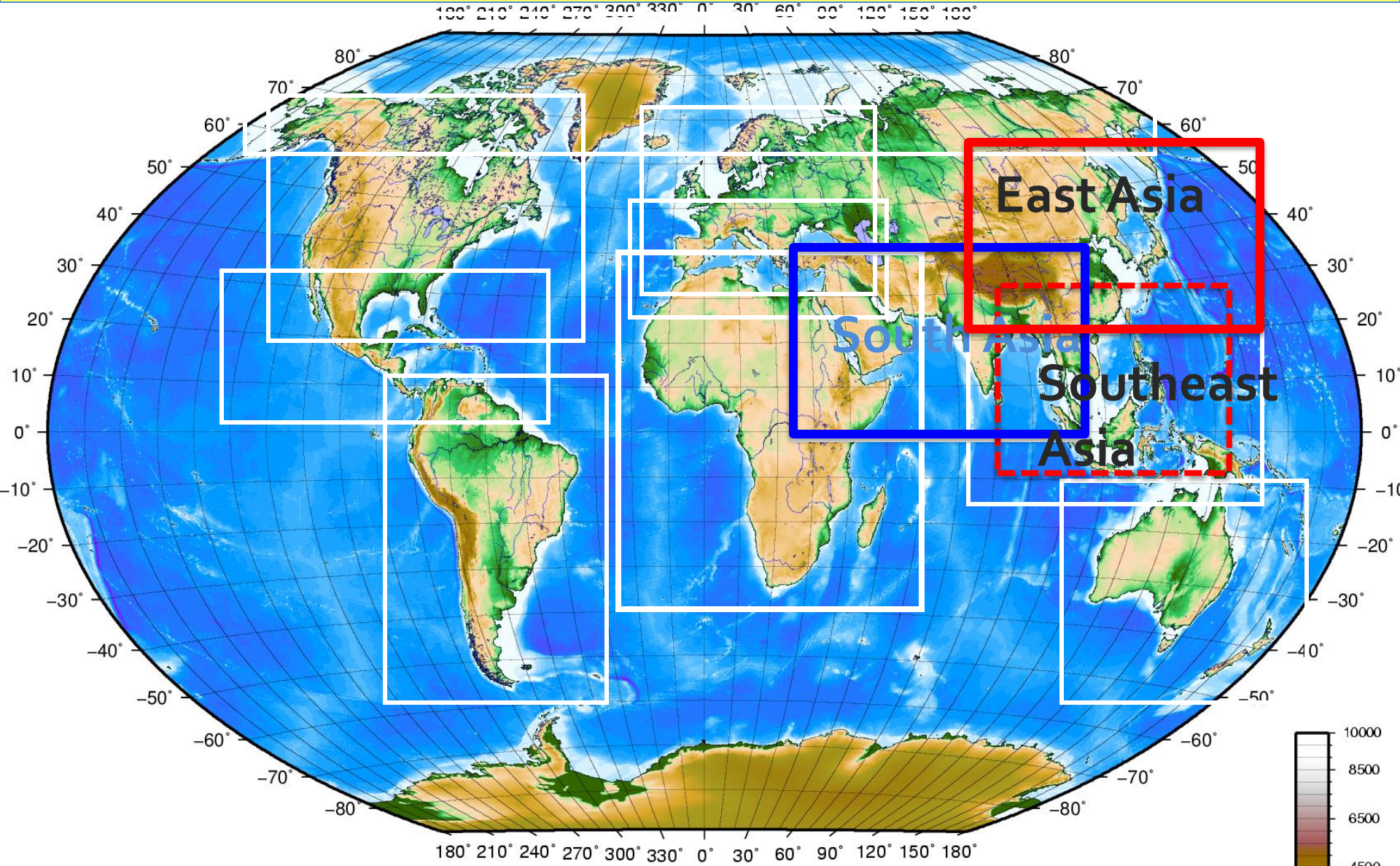
The amount of information supporting conclusion regarding observed and projected impacts

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

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

Table 24.2 IPCC AR5 WGII

CORDEX domains

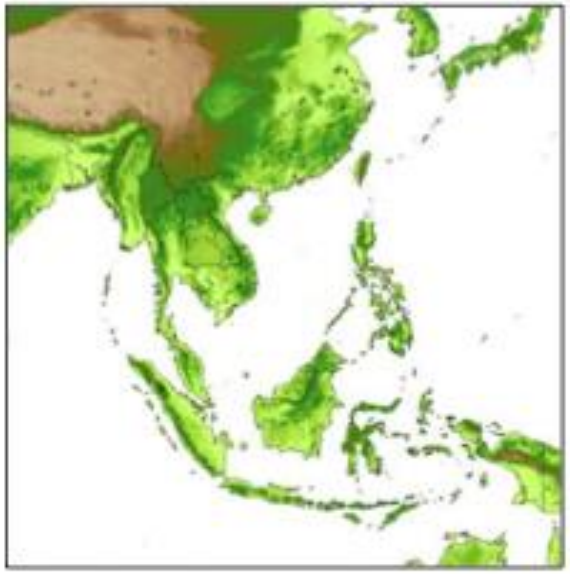


SEACLID

CORDEX-Southeast Asia

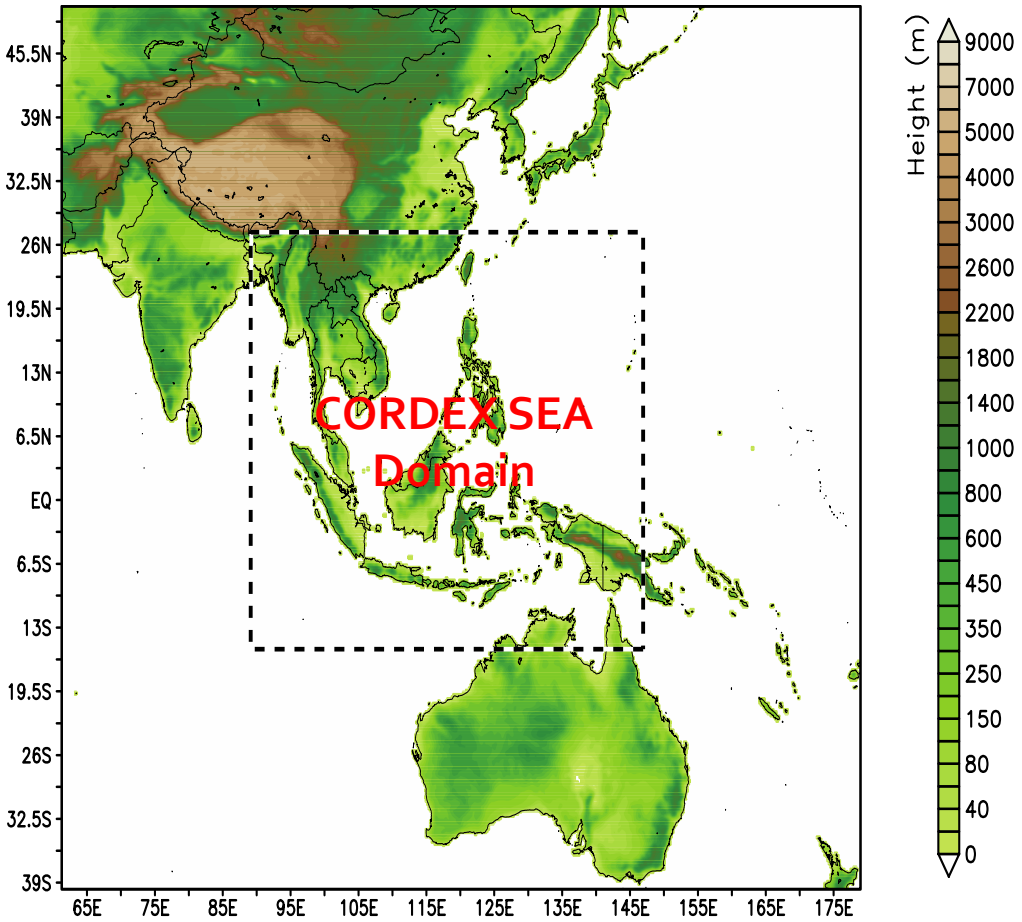
The Southeast Asia Regional Climate Downscaling (SEACLID) / CORDEX Southeast Asia Project

- *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)

Southeast Asia region



- Domain: ~15.14° S – 27.26° N, ~89.26° E – 146.96° E
- Resolution: 25 km × 25 km

Second Phase of CORDEX (2016-2019) will focus on much higher resolution (<5 km) to target certain application or sectors

Country	GCM	Institution & Country developed the GCM	RCP	RCM
Vietnam	CNRM-CM5	Centre national de Recherches Meteorologiques, France	RCP8.5, 4.5	RegCM4
Philippines	HadGEM2	Hadley Centre, UK	RCP8.5, 4.5	RegCM4
Thailand	MPI-ESM-MR	Max Planck Institute for Meteorology, Germany	RCP8.5, 4.5	RegCM4
Thailand	EC-Earth	EC-Earth consortium	RCP8.5, 4.5	RegCM4
Indonesia	CSIRO MK3.6	CSIRO, Australia	RCP8.5, 4.5	RegCM4
Malaysia	CanESM2	Canadian Centre for Climate Modeling and Analysis, Canada	RCP8.5, 4.5	RegCM4
Malaysia	IPSL-CM5A-LR	Institute Pierre-Simon Laplace, France	RCP8.5, 4.5	RegCM4
Malaysia	GFDL-ESM2M	GFDL, USA	RCP8.5, 4.5	RegCM4
Australia	CNRM-CM5	Centre national de Recherches Meteorologiques, France	RCP8.5	CCAM
Australia	CCSM4	NCAR, USA	RCP8.5	CCAM
Australia	ACCESS1.3	CSIRO, Australia	RCP8.5	CCAM
Hong Kong SAR	CCSM4 or CESM	NCAR, USA	RCP8.5, 4.5	WRF
United Kingdom	HadGEM2-ES	Hadley Centre, UKMO	RCP8.5, 4.5	PRECIS
South Korea	HadGEM2-AO	Hadley Centre, UKMO	RCP8.5, 4.5	WRF
Sweden	CNRM-CM5	Centre national de Recherches Meteorologiques, France	RCP8.5, 4.5	RCA3
Sweden	HadGEM2-ES	Centre national de Recherches Meteorologiques, France	RCP8.5,4.5	RCA3
Germany	MPI-ESM-LR	Max Planck Institute for Meteorology, Germany	RCP8.5, 4.5	ROM

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1st RegCM Workshop for Southeast Asia

IPCC Fifth Assessment Report

WG1, WGII, WGIII, Synthesis Report (http://www.ipcc.ch)

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