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

Fredolin Tangang
Fmr. IPCC Working Group I Vice-Chair
Professor, Universiti Kebangsaan Malaysia
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
IPCC Assessment Process

Key « Rules » for IPCC Work

- **COMPREHENSIVE** – all the latest relevant scientific, technical and socio-economic literature published worldwide is assessed
- **BALANCED** – differing 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
IPCC Assessment Reports

- FAR 1990
- SAR 1995
- TAR 2001
- AR4 2007
- AR5 WGI 2013
- AR5 WGII 2014
- AR5 WGIII 2014
- Synthesis Report 2014
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

Trend $\sim 1.0^\circ C$ per century
Greenhouse Effect

The natural greenhouse effect increases surface temperatures by about 30°C.

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$^{-2}$)
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)
The atmospheric concentrations of carbon dioxide ($\text{CO}_2$), methane ($\text{CH}_4$), and nitrous oxide ($\text{N}_2\text{O}$) have increased to levels unprecedented in at least the last 800,000 years.
GHG Historical Record in Ice Cores

Ice Cores

IPCC (2007)
GHG emissions growth between 2000 and 2010 has been larger than in the previous three decades.
Sources of emissions

Energy production remains the primary driver of GHG emissions

- **35%** Energy Sector
- **24%** Agriculture, forests and other land uses
- **21%** Industry
- **14%** Transport
- **6.4%** Building Sector

**2010 GHG emissions**

AR5 WGIII SPM
Radiative Forcing due to GHG Emissions
Humans are changing the climate

Human Influence is Clear
Humans are changing the climate

Climate Models Responses to Various Forcings

Natural + Anthropogenic

Natural

CO2 forcing only

Human Influence is Clear
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.
Impacts are already underway

- Tropics to the poles
- On all continents and in the ocean
- Affecting rich and poor countries
Projecting Future Climate Requires GHG Concentration Pathway

For future climate projections, climate models require Emission Scenarios. Models in AR5 use Representative Concentration Pathway (RCP)
The temperature increase during the last 100 years is only about 0.8°C.
Projected Sea Level Rise by end of 21st Century

0.4-0.6 m projected SLR around Southeast Asia region

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

AR5 WGI SPM
Potential Impacts of Climate Change

- Food and water shortages
- Increased poverty
- Increased displacement of people
- Coastal flooding
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
Stabilization of atmospheric concentrations requires moving away from the baseline – regardless of the mitigation goal.
The window for action is rapidly closing

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

Total Carbon Budget: 790 GtC

Amount Used 1870-2011: 515 GtC

Amount Remaining: 275 GtC
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
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
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
The Choices We Make Will Create Different Outcomes

With substantial mitigation

Without additional mitigation

Change in average surface temperature (1986–2005 to 2081–2100)
Can PARIS 2015 be a great success?
Framing the RISK

Global, Regional, National, Local

CLIMATE
Natural Variability
Climate Change

Hazards
Exposure
Vulnerability

EMISSIONS and Land-use Change

SOCIOECONOMIC PROCESSES
- Socioeconomic Pathways
- Adaptation and Mitigation Actions
- Governance

Sustainable Development
Attribution of observed impacts to Climate Change

Lack of attribution studies in the Southeast Asia region
The amount of information supporting conclusion regarding observed and projected impacts

<table>
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<th>Sector</th>
<th>Topics/issues</th>
<th>North Asia</th>
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</table>

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

Table 24.2 IPCC AR5 WGII
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
<table>
<thead>
<tr>
<th>Country</th>
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<th>Institution &amp; Country developed the GCM</th>
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CORDEX Southeast Asia related workshops here at Manila Observatory and Ateneo de Manila University
IPCC Fifth Assessment Report

WG1, WGII, WGIII, Synthesis Report

(http://www.ipcc.ch)