S3 SLO1: IPCC assessment report 2 - 1995

Key role regarding the adoption of Kyoto Protocol – COP meet

Cont…

This Report responds to the invitation for IPCC '… to provide a Special Report in 2018 on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways' contained in the Decision of the 21st Conference of Parties of the United Nations Framework Convention on Climate Change to adopt the Paris Agreement

The IPCC accepted the invitation in April 2016, deciding to prepare this Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty. This Summary for Policymakers (SPM) presents the key findings of the Special Report, based on the assessment of the available scientific, technical and socio-economic literature relevant to global warming of 1.5°C and for the comparison between global warming of 1.5°C and 2°C above pre-industrial levels. The level of confidence associated with each key finding is reported using the IPCC calibrated language. The underlying scientific basis of each key finding is indicated by references provided to chapter elements. In the SPM, knowledge gaps are identified associated with the underlying chapters of the Report.

A.1. Human activities are estimated to have caused approximately 1.0°C of global warming above pre-industrial levels, with a *likely* range of 0.8°C to 1.2°C. Global warming is *likely* to reach 1.5°C between 2030 and 2052 if it continues to increase at the current rate.

A.1.1. Reflecting the long-term warming trend since pre-industrial times, observed global mean surface temperature (GMST) for the decade 2006–2015 was 0.87°C (*likely* between 0.75°C and 0.99°C higher than the average over the 1850–1900 period (*very high confidence*). Estimated anthropogenic global warming matches the level of observed warming to within ±20% (*likely* range). Estimated anthropogenic global warming is currently increasing at 0.2°C

(*likely* between 0.1°C and 0.3°C) per decade due to past and ongoing emissions (*high confidence*).

A.1.2. Warming greater than the global annual average is being experienced in many land regions and seasons, including two to three times higher in the Arctic. Warming is generally higher over land than over the ocean. (*High confidence*)

A.1.3. Trends in intensity and frequency of some climate and weather extremes have been detected over time spans during which about 0.5°C of global warming occurred (*medium confidence*). This assessment is based on several lines of evidence, including attribution studies for changes in extremes since 1950.

A.2. Warming from anthropogenic emissions from the pre-industrial period to the present will persist for centuries to millennia and will continue to cause further long-term changes in the climate system, such as sea level rise, with associated impacts (*high confidence*), but these emissions alone are *unlikely* to cause global warming of 1.5°C (*medium confidence*).

A.2.1. Anthropogenic emissions (including greenhouse gases, aerosols and their precursors) up to the present are *unlikely* to cause further warming of more than 0.5°C over the next two to three decades (*high confidence*) or on a century time scale (*medium confidence*).

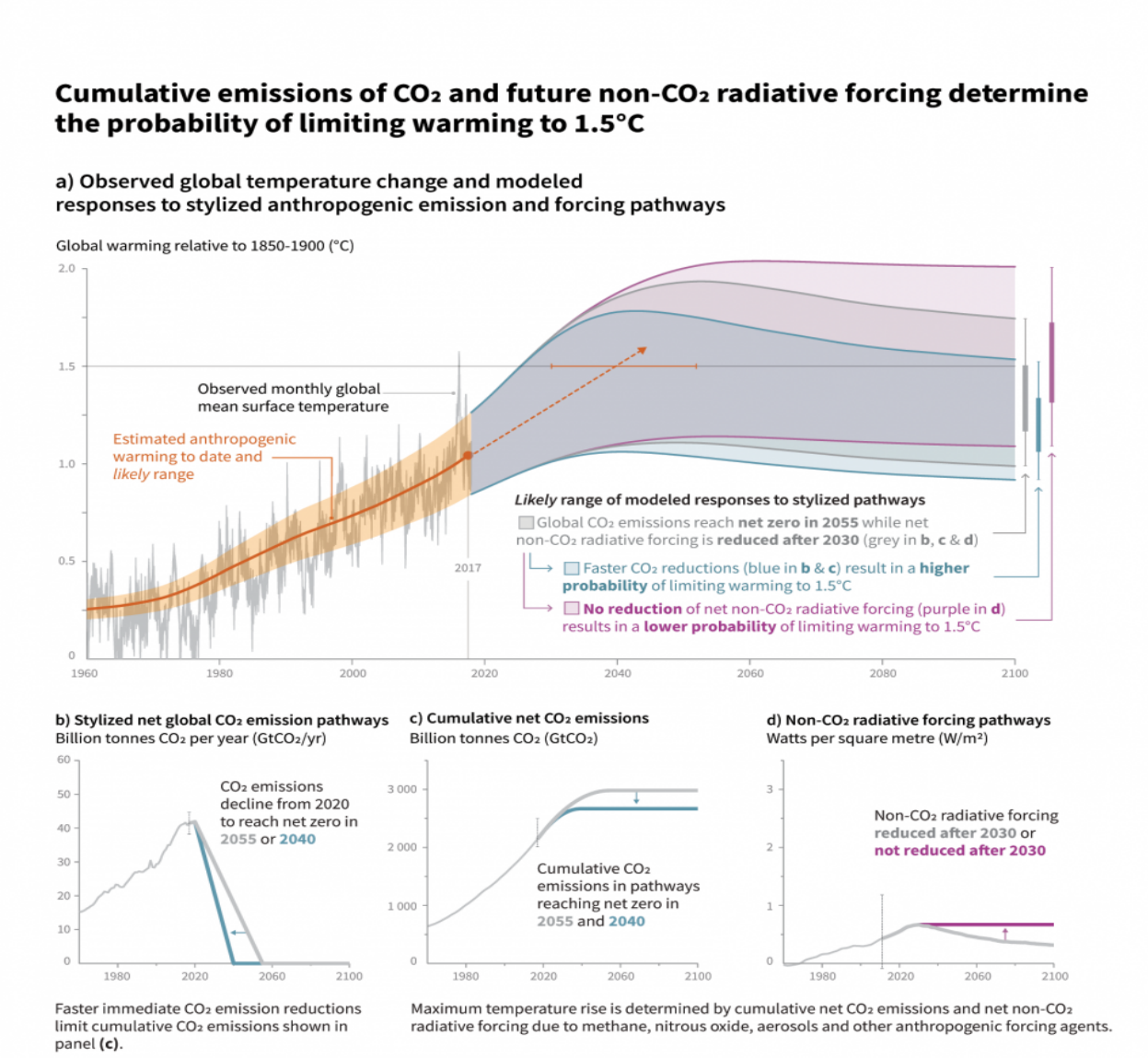
A.2.2. Reaching and sustaining net zero global anthropogenic CO_2 emissions and declining net non-CO_2 radiative forcing would halt anthropogenic global warming on multi-decadal time's cales (*high confidence*). The maximum temperature reached is then determined by cumulative net global anthropogenic CO_2 emissions up to the time of net zero CO_2 emissions (*high confidence*) and the level of non-CO_2 radiative forcing in the decades prior to the time that maximum temperatures are reached (*medium confidence*). On longer time scales, sustained net negative global anthropogenic CO_2 emissions and/or further reductions in non-CO_2 radiative forcing may still be required to prevent further warming due to Earth system feedbacks and to reverse ocean acidification (*medium confidence*) and will be required to minimize sea level rise (*high confidence*).

A.3. Climate-related risks for natural and human systems are higher for global warming of 1.5°C than at present, but lower than at 2°C (*high confidence*). These risks depend on the magnitude and rate of warming, geographic location, levels of development and vulnerability, and on the choices and implementation of adaptation and mitigation options (*high confidence*).

A.3.1. Impacts on natural and human systems from global warming have already been observed (*high confidence*). Many land and ocean ecosystems and some of the services they provide have already changed due to global warming (*high confidence*).

A.3.2. Future climate-related risks depend on the rate, peak and duration of warming. In the aggregate, they are larger if global warming exceeds 1.5°C before returning to that level by 2100 than if global warming gradually stabilizes at 1.5°C, especially if the peak temperature is high (e.g., about 2°C) (*high confidence*). Some impacts may be long-lasting or irreversible, such as the loss of some ecosystems (*high confidence*).

A.3.3. Adaptation and mitigation are already occurring (*high confidence*). Future climate-related risks would be reduced by the upscaling and acceleration of far-reaching, multilevel and cross-sectoral climate mitigation and by both incremental and transformational adaptation (*high confidence*).



S3 SLO2: IPCC assessment report 3 - 2001

The Third Assessment Report of Working Group I of the Intergovernmental Panel on Climate Change (IPCC) builds upon past assessments and incorporates new results from the past five years of research on climate change. The global average surface temperature has increased over the 20th century by about 0.6°C. •The global average surface temperature (the average of near surface air temperature over land, and sea surface temperature) has increased since 1861. Over the 20th century the increase has been 0.6 ± 0.2°C5,6 This value is about 0.15°C larger than that

estimated by the SAR for the period up to 1994, owing to the **relatively high temperatures** of the additional years (1995 to 2000) and improved methods of processing the data. These numbers take into account various adjustments, including urban heat island effects.

- The record shows a great deal of variability; for example, most of the warming occurred during the 20th century, during two periods, 1910 to 1945 and 1976 to 2000.
- Globally, it is very likely that the 1990s was the **warmest decade** and 1998 the warmest year in the instrumental record, since 1861
- New analyses of proxy data for the Northern Hemisphere indicate that the increase in temperature in the 20th century is likely to have been the largest of any century during the past 1,000 years. It is also likely that, in the Northern Hemisphere, the 1990s was the warmest decade and 1998 the warmest year. Because less data are available, less is known about annual averages prior to 1,000 years before present and for conditions prevailing in most of the Southern Hemisphere prior to 1861.
- On average, between 1950 and 1993, **night-time daily minimum air temperatures** over land increased by about 0.2°C per decade. This is about **twice the rate of increase** in daytime daily maximum air temperatures (0.1°C per decade). This has lengthened the freeze-free season in many mid- and high latitude regions. The increase in sea surface temperature over this period is about half that of the mean land surface air temperature. Some important aspects of climate appear not to have changed.
- A few are a soft he globe have not warmed in recent decades, mainly over some parts of the **Southern Hemisphere oceans** and parts of Antarctica.
- No significant trends of Antarctic sea-ice extent are apparent since 1978, the period of reliable satellite measurements.
- Changes globally in tropical and extra-tropical storm intensity and frequency are dominated by inter-decadal to multi-decadal variations, with no significant trends evident over the 20th century. Conflicting analyses make it difficult to draw definitive **conclusions about changes in storm activity, especially in the extra-tropics**.
- **No systematic** changes in the frequency of **tornadoes, thunder days, or hail events** are evident in the limited areas analysed.

S4 SLO1: IPCC assessment report 4 -2007

Greater attention to integrate the climate change with substantial development polices
Relation between mitigation and adaptation

FOURTH ASSESMENT OF IPCC- 2007

IPCC stands for Intergovernmental Panel on Climate Change. It is a group of scientists chosen by governments and other large groups from around the world who study the way that **humans are making the Earth heat up unnaturally**. The group was established in 1988 by the World Meteorological Organization and the United Nations Environment Programme, two organizations of the United Nations. The report is the largest and most detailed summary of the climate change situation ever undertaken, produced by thousands of authors, editors, and reviewers from dozens of countries, citing over 6,000 peer-reviewed scientific studies. The report was released in four principal sections:

- Contribution of Working Group I: Climate Change 2007: The Physical Science Basis
- Contribution of Working Group II: Climate Change 2007: Impacts, Adaptation and Vulnerability
- Contribution of Working Group III: Climate Change 2007: Mitigation of Climate Change
- Contribution of Working Groups I, II, and III: The Synthesis Report (SYR)

WORKING GROUP I: The physical science basis:-

The first working group states (WGI) was published in March 2007. It includes a Summary for Policymakers (SPM), which was published in February 2007, and a Frequently Asked Questions section. It assessed current scientific knowledge of "the natural and human drivers of climate change" as well as observed changes in climate. It looked at the ability of science to attribute changes to different causes, and made projections of future climate change. It was produced by 676 authors from 40 countries, then reviewed by over 625 expert reviewers. More than 6,000 peer-reviewed publications were cited. Before being approved, the summary was reviewed line

by line by representatives of 113 governments during the 10th session of WGI, in January to February 2007. The key observations of this report were

- Changes in the atmosphere
- Warming of the planet
- Ice, snow, permaforest, rain and oceans.
- Hurricanes

This report also stated the factors responsible for climate change and thy term it as radiative forcing. It shows the individual contribution of the various gases.

- Total radiative forcing from the sum of all human activities is about +1.6 watts/m²
- Radiative forcing from an increase of solar intensity since 1750 is about +0.12 watts/m²
- Radiative forcing from carbon dioxide, methane, and nitrous oxide combined is very likely (>90%) increasing more quickly during the current era (1750–present) than at any other time in the last 10,000 years.

Climate sensitivity had also been discussed. Climate sensitivity is defined as the amount of global average surface warming following a doubling of carbon dioxide concentrations. It is likely to be in the range of 2 to 4.5 °C, with a best estimate of about 3 °C.

WORKING GROUP II:- Impacts, adaptation and vulnerability:-

It was released on April 6, 2007. WGII states that "evidence from all continents and most oceans shows that many natural systems are being affected by regional climate changes, particularly temperature increases. With a high confidence WGII asserts that climate change has resulted in Increasing ground instability in permafrost regions. Increasing rock avalanches in mountain regions. With a very high confidence WGII asserts that climate change is affecting terrestrial biological systems in that Spring events such as the unfolding of leaves, laying of eggs, and migration are happening earlier.

Fresh water

Heavy precipitation events are very likely to become more common and will increase flood risk. Water supplies stored in glaciers and snow cover will be reduced over the course of the century.

Ecosystems

Carbon removal by terrestrial ecosystems is likely to peak before mid-century and then weaken or reverse. This would amplify climate change.

It is projected with very high confidence that coasts will be exposed to increasing risks such as coastal erosion due to climate change and sea-level rise.

WORKING GROUP III:- Mitigation of Climate change:-

Working Group III's was published on 4 May 2007 at the 26th session of the IPCC. The full WG III report was published online in September, 2007. The IPCC convened in Bangkok on April 30 to start discussions on the draft Summary, with the participation of over 400 scientists and experts from about 120 countries. Despite this, the figures from the original proposal were incorporated into the Summary for Policymakers. The Summary concludes that stabilization of greenhouse gas concentrations is possible at a reasonable cost, with stabilization between 445ppm and 535ppm costing less than 3% of global GDP.

WORKING GROUP IV:- The synthesis report:-

A draft version of the Synthesis Report, said to be subject to final copyedit, was published on 16 November 2007. In fact, this Conference was postponed to December to allow the IPCC Synthesis Report to come out first. The six topics addressed in the Synthesis Report are:

- Observed changes in climate and its effects (WGI and WGII).
- Causes of change (WGI and WGIII).
- Climate change and its impacts in the near and long term under different scenarios (WGI and WGIII).
- Adaptation and mitigation options and responses, and the inter-relationship with sustainable development, at global and regional levels (WGII and WGIII).
- The long-term perspective: scientific and socio-economic aspects relevant to adaptation and mitigation, consistent with the objectives and provisions of the Convention [sic], and in the context of sustainable development (WGI and WGIII).
- Robust findings, key uncertainties (WGI, WGII and WGIII).

S4 SLO2: IPCC assessment report 5

IPCC FIFTH Assessment Report – 2014

The Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) finds, beyond reasonable doubt, that the Earth's climate is warming.1 Since the 1950s, the rate of global warming has been unprecedented compared to previous decades and millennia.2 The Fifth Assessment Report presents a long list of changes that scientists have observed around the world. Since the mid-19th century, the average increase in the temperature of the Earth's surface has been 0.85 degrees Centigrade (°C).3 Globally, sea levels have risen faster than at any time during the previous two millennia – and the effects are felt in South Asia.4 Changing patterns of rainfall or melting snow and ice are altering freshwater systems, affecting the quantity and quality of water available in many regions, including South Asia.5 Climate change will have widespread impacts on South Asian society and South Asians' interaction with the natural environment.6 The IPCC finds with 95% scientific certainty (Box 1) that increasing concentrations of greenhouse gases in the atmosphere due to human activities have been the dominant cause of the observed warming since the mid-20th century.7 Current science provides the clearest evidence yet that human activity is changing our climate.8 The impacts of climate change will influence flooding of settlements and infrastructure, heat-related deaths, and food and water shortages in South Asia.9 The following pages explore these risks in more depth. Given the interdependence among countries in today's world, the impacts of climate change on resources or commodities in one place will have far-reaching effects on prices, supply chains, trade, investment and political relations in other places. Climate change will progressively.

The IPCC assigns a degree of certainty to each key finding based on the type, amount, quality and consistency of evidence (e.g., data, theory, models, expert judgment), and the degree of agreement among scientists. The terms to describe evidence are: limited, medium or robust; and to describe agreement: low, medium or high. When the Fifth Assessment Report talks about 'confidence' in a finding, the level of confidence derives from a synthesis of the evidence that exists and the degree of scientific agreement on what the evidence means. The levels of

confidence IPCC assigns are: very low, low, medium, high and very high. IPCC describes the likelihood or certainty of an outcome having occurred or occurring in the future in terms of percentages: Virtually certain 99% or more Extremely likely 95% or more Very likely 90% or more Likely 66% or more More likely than not more than 50% About as likely as not 33–66% Unlikely 33% or less Very unlikely 10% or less Extremely unlikely 5% or less Exceptionally unlikely 1% or less On this scale, the world's leading climate scientists consider it extremely likely that human activities have been the dominant cause of observed warming. Scientists consider 95% confidence as the 'gold standard', the standard at which theories are accepted as valid. For example, the theory of evolution, the theory on the age of the Earth and the Big Bang theory all meet this standard of scientific confidence.

The draft outlines had been prepared following a scientific scoping meeting in May held in Addis Ababa, Ethiopia. At the meeting in Montreal, representatives of the IPCC's 195 member governments discussed this draft and agreed on a final outline.

The IPCC includes three working groups: Working Group I assesses the physical science basis of climate change; Working Group II is responsible for impacts, adaptation and vulnerability; and Working Group III assesses the mitigation of climate change. It also includes a Task Force on National Greenhouse Gas Inventories that focuses on developing internationally agreed methodologies for calculating and reporting greenhouse gas emissions.

The outline of the Synthesis Report, the final instalment of AR6, will be agreed in 2019. The Synthesis Report will integrate the three working group contributions and the Special Reports produced during the AR6 cycle. It will be finalized in April 2022.

The agreed outlines, subject to final copy edits, are available now on the IPCC website. The full agenda and documents can be found **here**.

Among other business in Montreal the IPCC also considered options for strengthening the financial stability of the IPCC and for aligning its work with the global stocktake cycles of the United Nations Framework Convention on Climate Change. WMO scientific products, including

its annual statement on the status of the global climate and its Greenhouse Gas Bulletin contribute to the global stocktake between the full IPCC assessment reports.

Temperature trends: Warming has occurred, at a country scale, across most of South Asia over the 20th century and into the 2000s (Figure 1). There were more temperature extremes (high confidence).14 Records indicate that it is likely that the numbers of cold days and nights have decreased and the numbers of warm days and nights have increased across most of Asia since about 1950. Heat wave frequency has increased since the middle of the 20th century in large parts of Asia.15 Rainfall trends: Most areas of the Asian region lack sufficient observational records to draw conclusions about trends in annual rainfall over the past century. Rainfall trends, including extremes, are characterised by strong variability, with both increasing and decreasing trends observed in different parts of Asia (Figure 2).16 Observations also show that there have been more extreme rainfall events and fewer weak rainfall events in the central Indian region.17 Sea level rise: Globally, the rate of sea level rise since the 1850s has been larger than the average rate during the previous 2,000 years (high confidence). Sea level rise can vary between regions, though. Shifting surface winds, the expansion of warming ocean water, and the addition of melting ice can alter ocean currents which, in turn, lead to changes in sea level that vary from place to place. Past and present variations in the distribution of land ice affect the shape and gravitational field of the Earth, which also cause regional fluctuations in sea level. Additional variations are caused by sediment and tectonics. Changes of sea level in the Indian Ocean have emerged since the 1960s, driven by changing wind patterns.

Observed effects of climate change: Even today, climaterelated risks threaten lives, food security, health and wellbeing across many parts of South Asia. There are clear signs that the impacts of climate change are already being felt.21 The Asia region as a whole experienced the most weatherand climate-related disasters in the world between 2000 and 2008 and suffered the second highest proportion (almost 30%) of total global economic losses.22 The risk of deaths due to flooding is highly concentrated in Asia. At the same time as sea levels are rising, most Asian deltas are sinking as a result of groundwater extraction, floodplain engineering and trapping of sediments by dams.23 Severe floods in Mumbai in 2005 have been attributed to both climatic and non-climatic factors, suggesting an interaction between climate change and other stressors.24 Extreme rainfall and flooding is causing illnesses, deaths and mass displacement. In

2008, the embankments of the Kosi River, a tributary of the Ganges, broke, displacing over 60,000 people in Nepal and 3.5 million in India, and disrupting transport and power across large areas.25 Climate change is impacting on human health in several ways. Contaminated urban flood waters have caused exposure to disease and toxic compounds, for example, in India and Pakistan.26 The incidence of many diseases increases at higher temperatures: the pathogens and parasites that cause disease multiply faster. Dengue and Japanese encephalitis outbreaks in South Asia have been associated with temperature and rainfall. Malaria prevalence in India and Nepal has been linked to rainfall patterns.

Special issue

The IPCC accepted the invitation in April 2016, deciding to prepare this Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty.

- **Understanding the global warming of 1.5°C**

Human activities are estimated to have caused approximately 1.0°C of global warming.

Warming from anthropogenic emissions from the pre-industrial period to the present will persist for centuries to millennia and will continue to cause further long-term changes in the climate system, such as sea level rise, with associated impacts, but these emissions alone are *unlikely* to cause global warming of 1.5°C.

Climate-related risks for natural and human systems are higher for global warming of 1.5°C than at present, but lower than at 2°C. These risks depend on the magnitude and rate of warming, geographic location, levels of development and vulnerability, and on the choices and implementation of adaptation and mitigation options.

- **Projected climate change**

Temperature extremes on land are projected to warm more than GMST (high confidence): extreme hot days in mid-latitudes warm by up to about 3°C at global warming of 1.5°C and about 4°C at 2°C, and extreme cold nights in high latitudes warm by up to about 4.5°C at 1.5°C and about 6°C at 2°C. The number of hot days is projected to increase in most land regions, with highest increases in the tropics.

By 2100, global mean sea level rise is projected to be around 0.1 metre lower with global warming of 1.5°C compared to 2°C. Sea level will continue to rise well beyond 2100, and the magnitude and rate of this rise depend on future emission pathways. A slower rate of sea level rise enables greater opportunities for adaptation in the human and ecological systems of small islands, low-lying coastal areas and deltas.

On land, impacts on biodiversity and ecosystems, including species loss and extinction, are projected to be lower at 1.5°C of global warming compared to 2°C. Limiting global warming to 1.5°C compared to 2°C is projected to lower the impacts on terrestrial, freshwater and coastal ecosystems and to retain more of their services to humans.

Limiting global warming to 1.5°C compared to 2°C is projected to reduce increases in ocean temperature as well as associated increases in ocean acidity and decreases in ocean oxygen levels (high confidence). Consequently, limiting global warming to 1.5°C is projected to reduce risks to marine biodiversity, fisheries, and ecosystems, and their functions and services to humans, as illustrated by recent changes to Arctic sea ice and warm-water coral reef ecosystems.

Climate-related risks to health, livelihoods, food security, water supply, human security, and economic growth are projected to increase with global warming of 1.5°C and increase further with 2°C.

- **Strengthening the Global Response in the Context of Sustainable Development and Efforts to Eradicate Poverty**

The avoided climate change impacts on sustainable development, eradication of poverty and reducing inequalities would be greater if global warming were limited to 1.5°C rather than 2°C, if mitigation and adaptation synergies are maximized while trade-offs are minimized.

Adaptation options specific to national contexts, if carefully selected together with enabling conditions, will have benefits for sustainable development and poverty reduction with global warming of 1.5°C, although trade-offs are possible.

Limiting the risks from global warming of 1.5°C in the context of sustainable development and poverty eradication implies system transitions that can be enabled by an increase of adaptation and mitigation investments, policy instruments, the acceleration of technological innovation and behaviour changes.

Sustainable development supports, and often enables, the fundamental societal and systems transitions and transformations that help limit global warming to 1.5°C. Such changes facilitate the pursuit of climate-resilient development pathways that achieve ambitious mitigation and adaptation in conjunction with poverty eradication and efforts to reduce inequalities.

- **Contributors**

Researchers from 40 countries, representing 91 authors and editors contributed to the report, which includes over 6,000 scientific references

- **Reactions from different countries**

Australia

Prime Minister Scott Morrison emphasised that the report was not specifically for Australia but for the whole world.

Canada

Canadian Environment Minister Catherine McKenna acknowledged that the SR15 report would say Canada is not "on track" for 1.5 °C. Canada will not be implementing new plans but it will continue to move forward on a "national price on carbon, eliminating coal-fired power plants, making homes and businesses more energy-efficient, and investing in clean technologies and renewable energy.

India

The Centre for Science and Environment said the repercussions for developing countries such as India, would be "catastrophic" at 2 °C warming and that the impact even at 1.5 °C described in SR15 is much greater than anticipated. Crop yields would decline and poverty would increase.

New Zealand

The Minister for Climate Change James Shaw said that the Report "has laid out a strong case for countries to make every effort to limit temperature rise to 1.5° Celsius above pre-industrial levels. ... The good news is that the IPCC's report is broadly in line with this Government's direction on climate change and it's highly relevant to the work we are doing with the Zero Carbon Bill."

United States

President Donald Trump said that he had received the report, but wanted to learn more about those who "drew it" before offering conclusions. In an interview with ABC's "This Week" the director of the National Economic Council, Larry Kudlow, stated, "personally, I think the UN study is way too difficult," and that the authors "overestimate" the likelihood for environmental disasters. Since the publication Trump stated in an interview on 60 Minutes that he didn't know that climate change is manmade and that "it'll change back again", the scientists who say it's worse than ever have "a very big political agenda" and that "we have scientists that disagree with [manmade climate change]."

IPCC Sixth Assessment Report – 2018 – sub2019…..