Side Event to the 30th Meeting of the Parties to the Montreal Protocol on Substances that Deplete the Ozone Layer

IPCC Special Report on Global Warming of 1.5°C : Key Findings

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IPCC Vice-Chair

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Author in Chapters 3 and 4

Quito, Ecuador, 8th November, 2018

Overview of the IPCC and of the Special Report of Global Warming of 1.5°C

FAR SAR TAR AR4 AR5 SR15 MR AR6

IPCC – jointly established by **WMO and UNEP**

UNFCCC

Kyoto Protocol

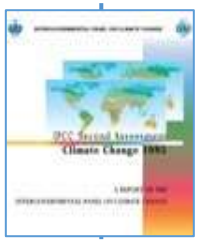
Adaptation

2 °C limit

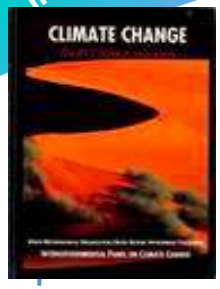
Paris Agreement

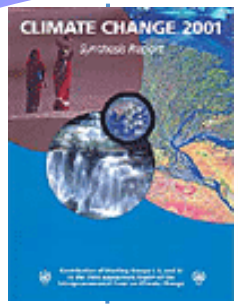
SROCC
SRCCL

UNFCCC Global Stocktake



Science of climate change (peer-reviewed literature)
Growing public awareness
Involvement of various actors





Nobel Peace Prize

1988 1995 2007 2018 2019 2023

1970s-1980s 1990 2001 2013/2014 2016-2022

The role of the IPCC is …

"… to assess on a comprehensive, objective, open and transparent basis the scientific, technical and socio-economic information relevant to understanding the scientific basis of risk of human-induced climate change, its potential impacts and options for adaptation and mitigation."

"IPCC reports should be neutral with respect to policy, although they may need to deal objectively with scientific, technical and socio-economic factors relevant to the application of particular policies."

Principles Governing IPCC Work, paragraph 2
Source: http://www.ipcc.ch/pdf/ipcc-principles/ipcc-principles.pdf

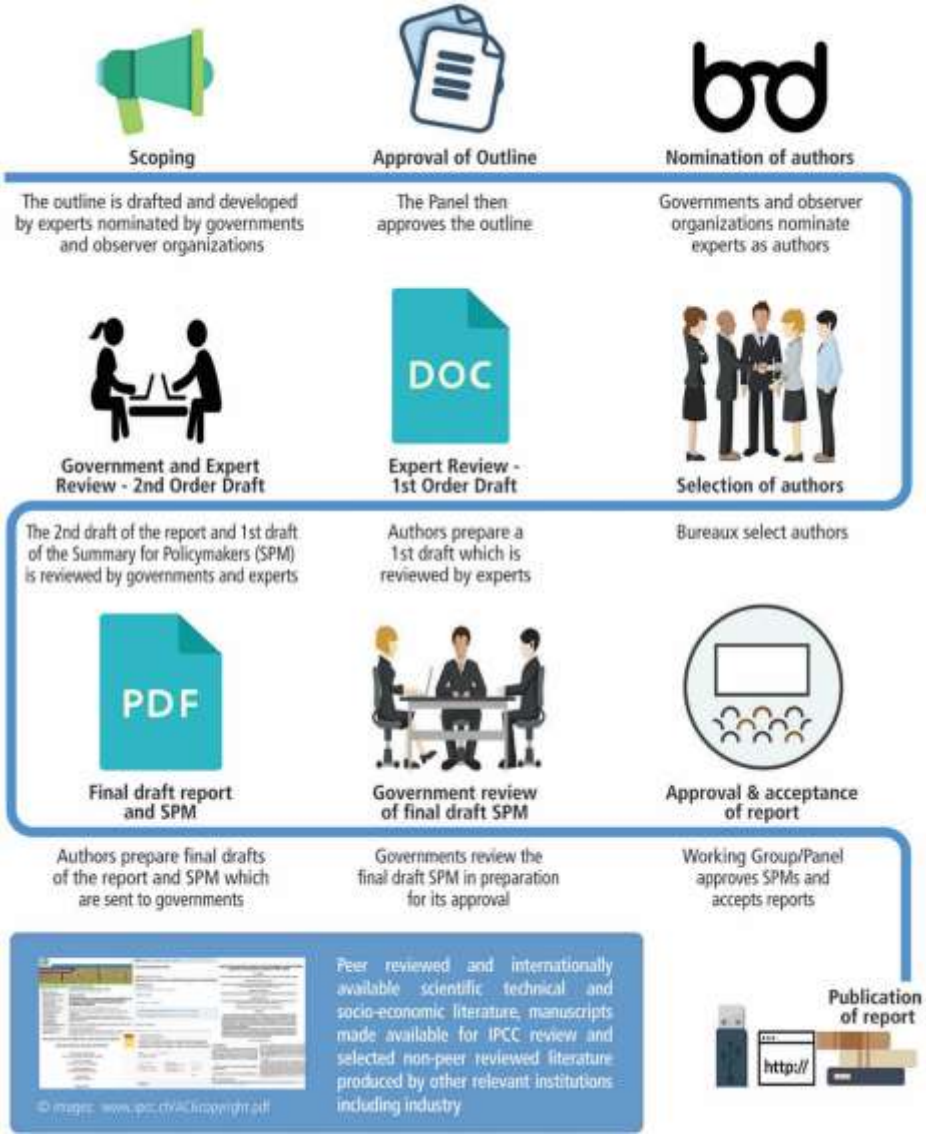
Science/Policy Interface

IPCC – jointly established by **WMO and UNEP**, action endorsed by the **UN General Assembly**

Intergovernmental Panel: 195 member States appointing National Focal Points

Hundreds of **scientists and experts from around the world** are involved in the preparation of IPCC reports

How the IPCC produces its reports?



Special Report on Global Warming of 1.5°C

ipcc
INTERGOVERNMENTAL PANEL ON climate change
WMO UNEP

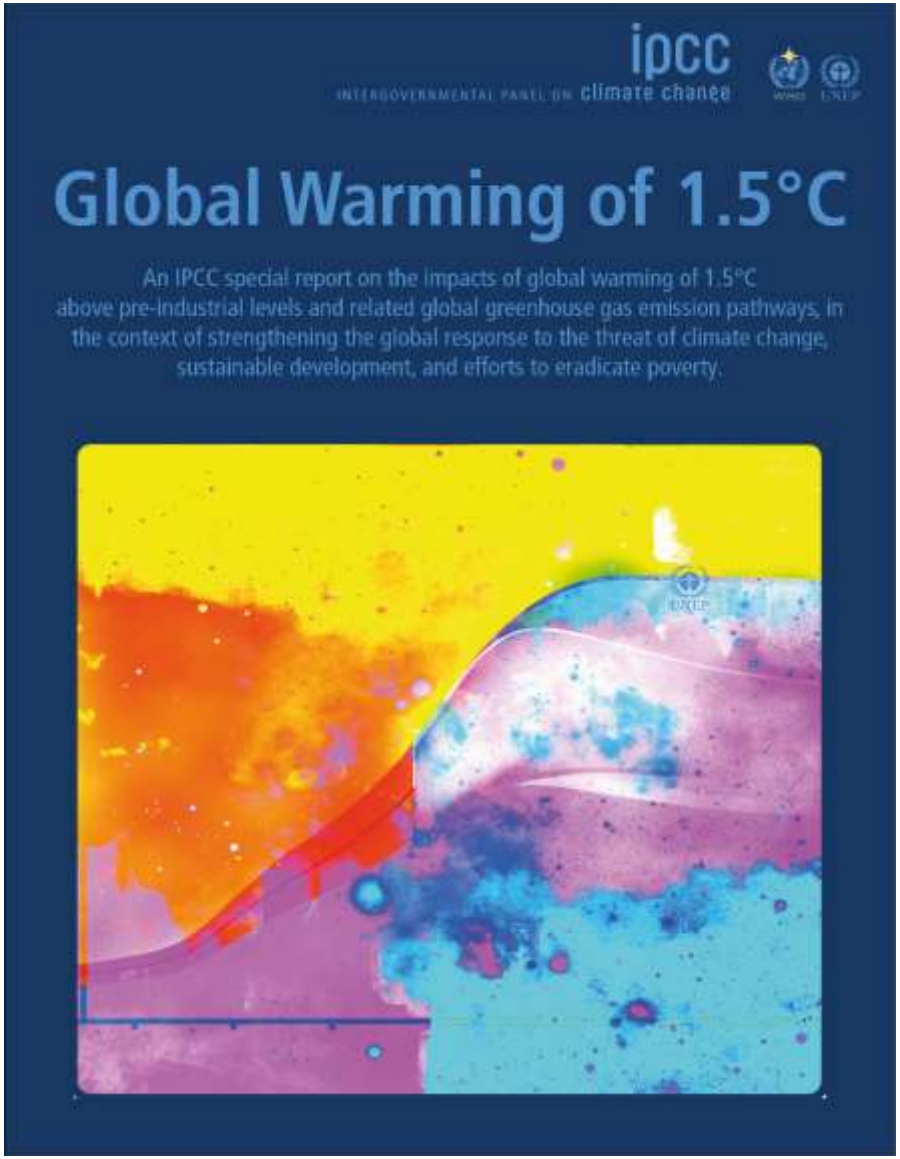
Introduction to the IPCC SR 1.5ºC

- **Report responds to the invitation from the UNFCCC to the IPCC …** "*to provide a Special Report in 2018 on the impacts of global warming of 1.5ºC above pre-industrial levels and related global greenhouse gas emission pathways*" **(Decision 1/CP.21, paragraph 21).**

- **IPCC accepts the invitation on April 2016**, and decides to prepare the Special Report on impacts and pathways, ***in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty.***

Global Warming of 1.5°C

An IPCC 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


ipcc
INTERGOVERNMENTAL PANEL ON climate change
Global Warming of 1.5°C
An IPCC 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.

The report in numbers

91 Authors from **40** Countries

133 Contributing authors

6000 Studies

1 113 Reviewers

42 001 Comments

Outline of the Special Report

Chapter 1 : Framing and scope

Chapter 2 : Mitigation pathways compatible with 1.5°C in the context of sustainable development

Chapter 3: Impacts of 1.5°C global warming on natural and human systems

Chapter 4 : Strengthening and implementing the global response

Chapter 5 : Sustainable development, poverty eradication and reducing inequalities

Relevance of the SR 1.5°C to the Montreal Protocol and the Kigali Amendment

Short-lived Climate Forcers – SLCF

- SLCF include shorter-lived GHGs:
  - Methane, some HFCs, particles (aerosols), their precursors and ozone precursors
  - SLCFs are strongly mitigated in 1.5°C pathways as is the case for 2°C pathways

- Reducing non-CO_2 emissions is part of most mitigation pathways consistent with 1.5°C

- Temperature change from SLCFs disappears within decades after emissions of SLCFs are ceased
  - Long-term warming is mainly driven by CO_2 emissions

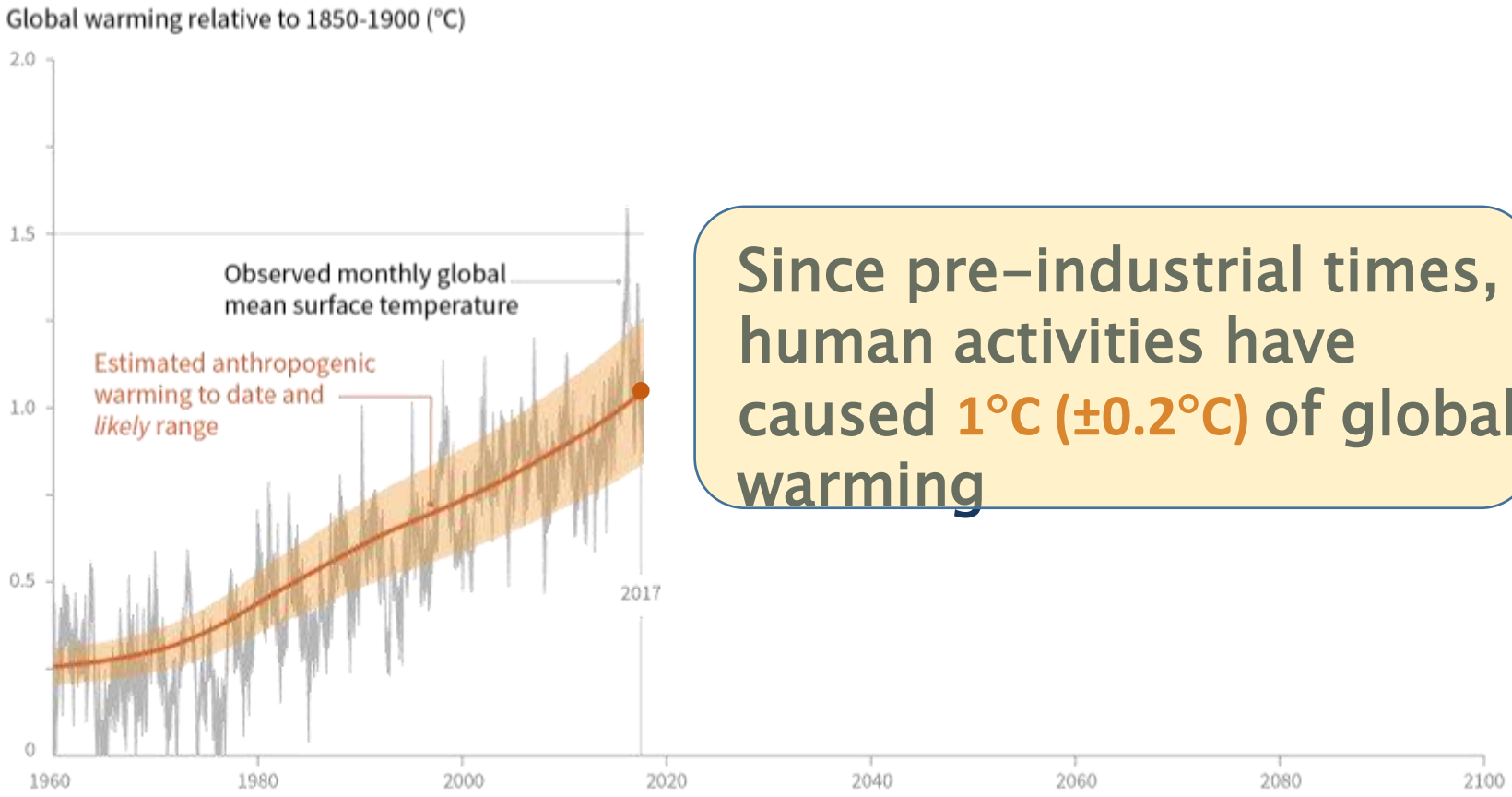
Hidrofluorcarbons – HFCs

- **HFCs represent a small proportion of the global annual GHG emissions**
  - annual global emissions : 0.35 Gt CO_2–eq
- ***Main anthropogenic sources*** : air conditioning, refrigeration, construction material
- **HFC mitigation options**
  - alternatives with reduced warming effects
  - ideally combined with improved energy efficiency
- **Cost for most HFC mitigation potential**
  - below USD_{2010} 60 tCO_2-eq

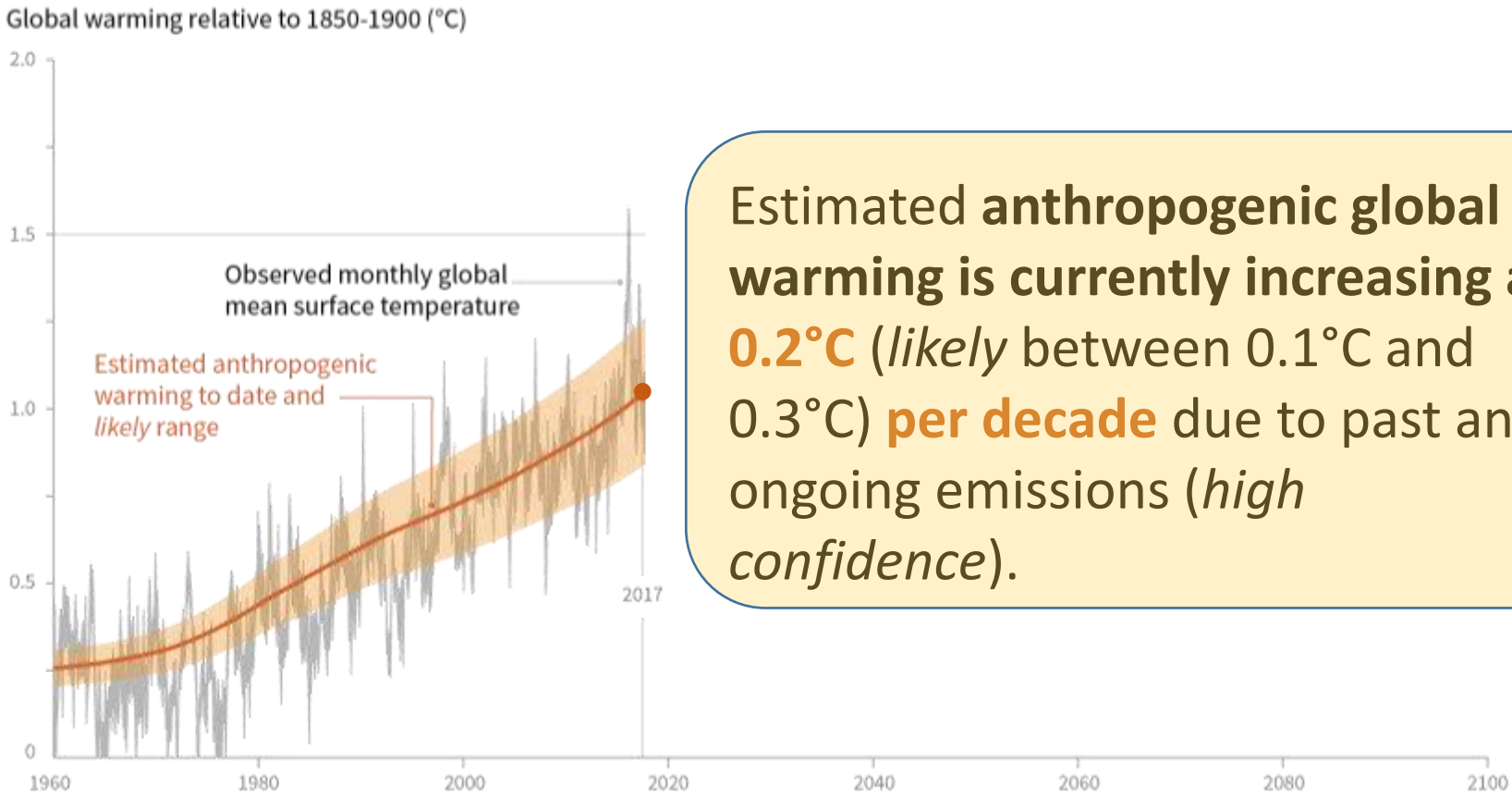
Fluorinated Gases in 1.5°C-consistent Pathways

- **F-gases reduced by 75 – 80% relative to 2010 levels in 2050**
- **Projected reductions by 2050 of F-gases are deeper than published estimates of what a full implementation of the Montreal Protocol's Kigali Amendment would achieve.**
  - Roughly ½ of F-gas emissions in 2050 compared to 2010
- **Potential F-gas emissions reductions of more than 90% have been estimated**
  - application of commercially available technologies (tested and implemented to a limited extent)

Understanding Global Warming of 1.5°C

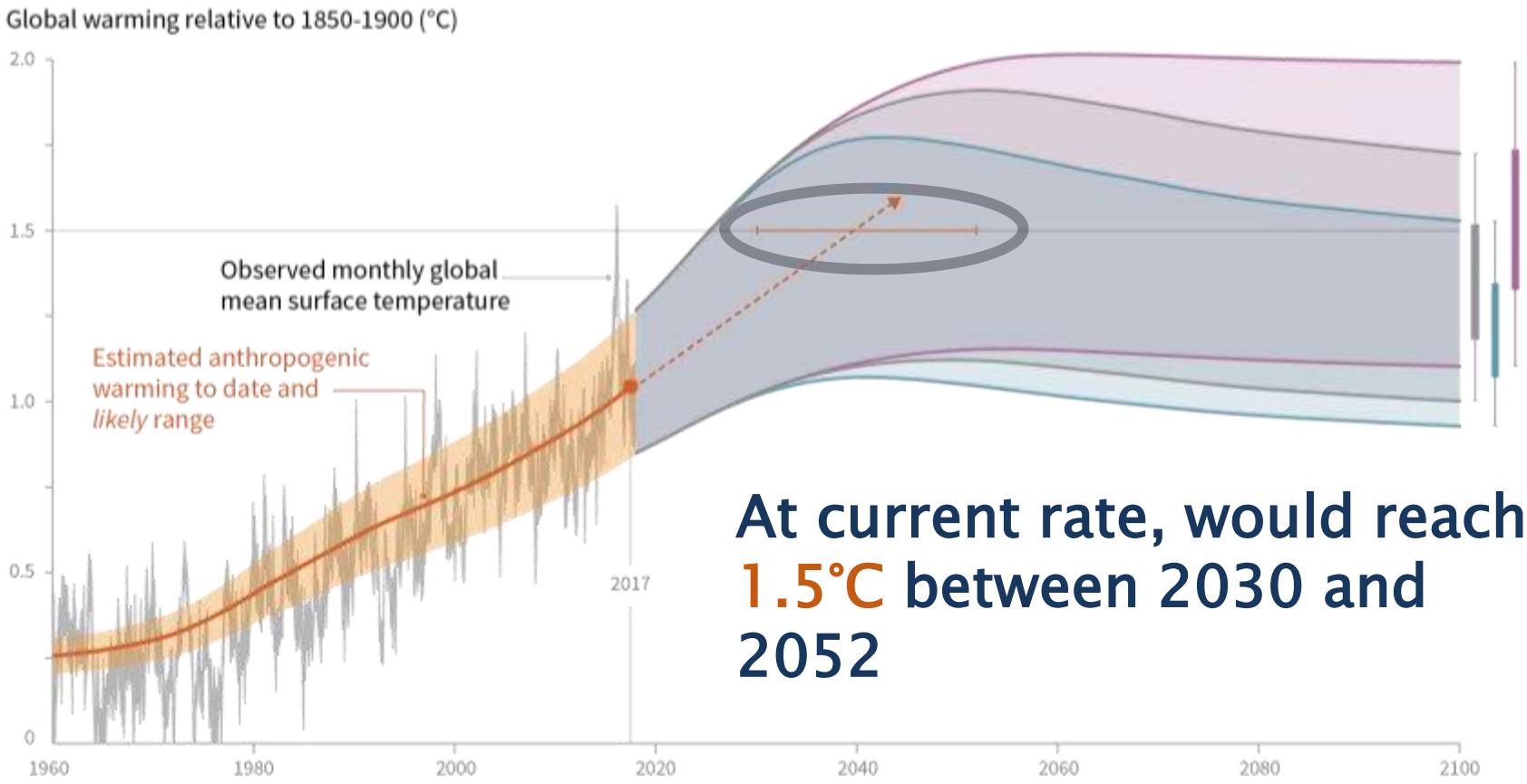


Since pre-industrial times, human activities have caused 1°C (±0.2°C) of global warming



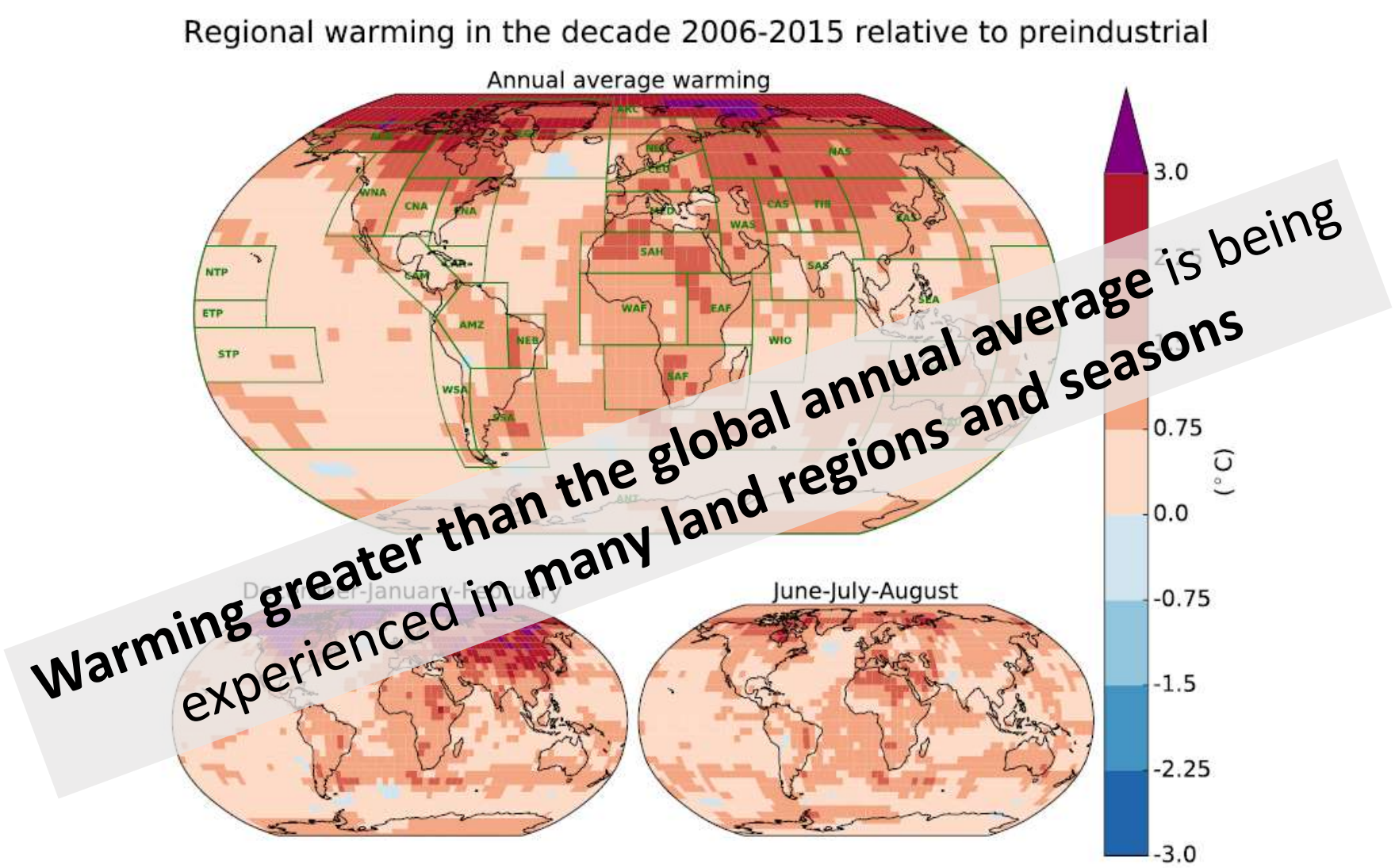
Estimated **anthropogenic global warming is currently increasing at 0.2°C** (*likely* between 0.1°C and 0.3°C) **per decade** due to past and ongoing emissions (*high confidence*).

Already seeing consequences for people, nature and livelihoods



At current rate, would reach 1.5°C between 2030 and 2052

Past emissions alone do not commit the world to 1.5°C


Regional warming in the decade 2006-2015 relative to preindustrial
Annual average warming
June-July-August
3.0
0.75
0.0
-0.75
-1.5
-2.25
-3.0
(°C)
Warming greater than the global annual average is being experienced in many land regions and seasons

Projected Climate Change, Potential Impacts and Associated Risks

Impacts of global warming at 1.5°C compared to 2°C

TEMPERATURE

Robust differences in regional climate characteristics including increases in mean temperature in most land and ocean regions and in hot extremes in most inhabited regions at 2°C

PRECIPITATION

Limiting global warming to 1.5°C reduces the risk of heavy precipitation in several regions and the probability of drought and precipitation deficits in some regions

Impacts of global warming at 1.5°C compared to 2°C

FLOODS

The fraction of the global land area affected by flood hazards is projected to be larger at 2°C compared to 1.5°C of global warming

SEA LEVEL

By 2100, global mean sea level rise would be around 10 cm lower with global warming of 1.5°C compared to 2°C. This would mean up to 10 million fewer people exposed the risk of rising seas

Impacts of global warming at 1.5°C compared to 2°C

- Lower impact on biodiversity and species
- Smaller reductions in yields of maize, rice, wheat
- Global population exposed to increased water shortages is up to 50% less

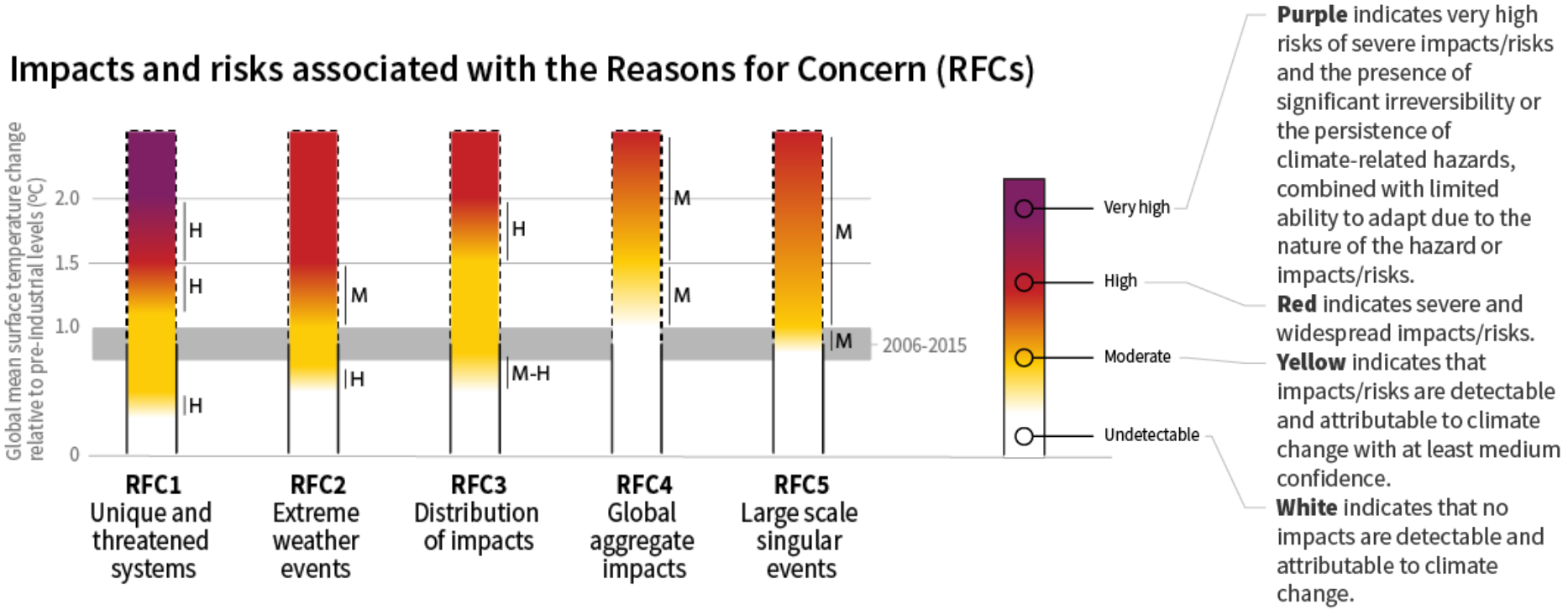
Andre Seale / Aurora Photos

Impacts of global warming at 1.5°C compared to 2°C

- Lower risk to fisheries and the livelihoods that depend on them
- Up to several hundred million fewer people exposed to climate-related risk and susceptible to poverty by 2050

Natalie Behring / Aurora Photos

Five Reasons For Concern (RFCs) illustrate the impacts and risks of different levels of global warming



Confidence level for transition: L=Low, M=Medium, H=High and VH=Very high

Emissions Pathways

Assessed Emission Pathways

- **Integrated, quantitative evolutions of all emissions over 21st century**
  - global energy
  - land use
  - world economy

- **1.5°C-consistent pathways can be identified**
  - economic growth
  - technological developments
  - lifestyles

- **Key impediments to achieving 1.5°C-consistent pathways**
  - lack of global cooperation
  - lack of governance of transformations
  - growing resource intensive consumption

Assessed Pathways

- **Limiting warming to 1.5°C**
  - Depends on GHG emissions over the next decades

- **Pathways with no or limited overshoot of 1.5°C**
  - GHG emissions in 2030
    - 25 – 30 Gt CO_2–eq
  - Global emissions of current nationally stated mitigation ambitions (Paris Agreement)
    - 52 – 58 $GtCO_2eq\ yr^{-1}$

- **Pathways with temporary overshoot before 1.5°C**
  - Large scale deployment of CDR measures
    - uncertain
    - clear risks

Assessed Pathways

- **Limiting warming to 1.5°C**
  - Net zero CO_2 emissions globally around 2050
  - Deep reductions in emissions of non-CO_2 forcers

- **Mitigation pathways characterized by :**
  - *Energy demand reductions*
  - *Decarbonization of electricity and other fuels*
  - *Electrification of energy end use*
  - *Deep reductions in agricultural emissions*
  - *Some forms of CDR with carbon storage on land or sequestration in geological reservoirs*

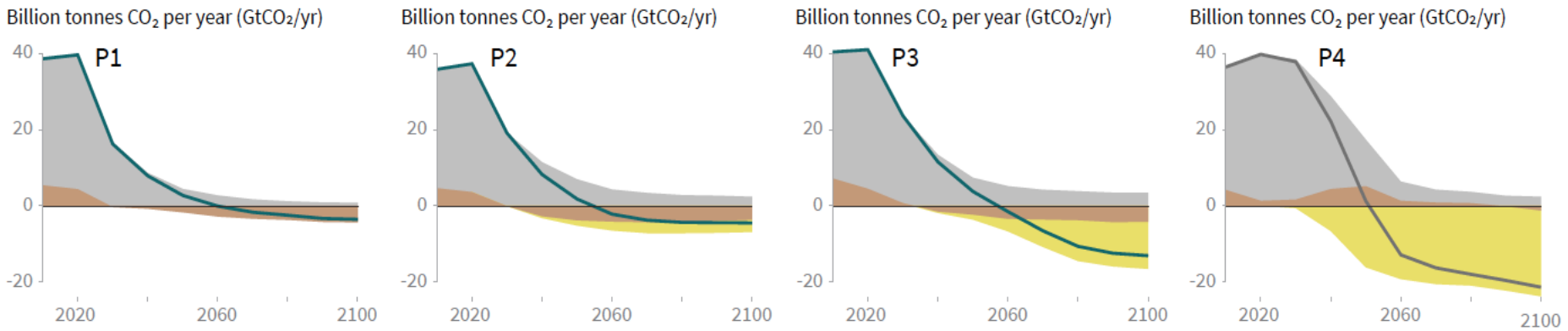
- **1.5°C x 2°C**
  - Similar transformations
  - More pronounced and rapid over the next decades

Key characteristics of 1.5°C-consistent Pathways

- **Rapid phase out of CO_2 emissions**
- **Deep emission reductions in other GHGs and climate forcers**
  - Broad transformation in energy, industry, transport, buildings, agriculture, forestry and other land uses
- **Multiple options and choices are available**
  - Emissions can be apportioned differently across sectors
    - E.g., reducing the overall amount of CO_2 produced in the energy end use sectors and using limited contributions of CDR by AFOLU
    - E.g., being more lenient about the amount of CO_2 that continues to be produced in the energy end use sectors and strongly relying on technological CDR options like BECCS

Breakdown of contributions to global net CO_2 emissions in four illustrative model pathways

Fossil fuel and industry AFOLU BECCS



P1: A scenario in which social, business, and technological innovations result in lower energy demand up to 2050 while living standards rise, especially in the global South. A down-sized energy system enables rapid decarbonisation of energy supply. Afforestation is the only CDR option considered; neither fossil fuels with CCS nor BECCS are used.

P2: A scenario with a broad focus on sustainability including energy intensity, human development, economic convergence and international cooperation, as well as shifts towards sustainable and healthy consumption patterns, low-carbon technology innovation, and well-managed land systems with limited societal acceptability for BECCS.

P3: A middle-of-the-road scenario in which societal as well as technological development follows historical patterns. Emissions reductions are mainly achieved by changing the way in which energy and products are produced, and to a lesser degree by reductions in demand.

P4: A resource and energy-intensive scenario in which economic growth and globalization lead to widespread adoption of greenhouse-gas intensive lifestyles, including high demand for transportation fuels and livestock products. Emissions reductions are mainly achieved through technological means, making strong use of CDR through the deployment of BECCS.

Strengthening the Global Response in the Context of Sustainable Development

Strengthening the Global Response

- **Requires transformative systemic change**
  - Upscaling and acceleration of far-reaching, multi-level and cross sectoral climate mitigation
  - Greater scale and pace of change to transform energy, land and ecosystem, urban and infrastructure, and industrial system transitions globally

- **All countries would need to significantly raise their level of ambition**
  - **Developing countries and poor and vulnerable people**
    - **Financial, technological and other forms of support to build capacity**

Energy System Transition

- Meet energy service demand with lower energy use
  - Enhanced energy efficiency
  - Faster electrification of energy end use compared to 2°C
- Higher share of low emission energy sources compared to 2°C pathways, particularly before 2050
- Renewables are projected to supply 70 – 85% of electricity in 2050

Energy System Transition

In electricity generation

- Shares of nuclear and fossil fuels with CCS are modelled to increase in most 1.5°C pathways
- CCS would allow the electricity generation share of gas to be approximately 8% of global electricity in 2050
- Use of coal shows a steep reduction in all pathways and would be reduced to close to 0% of electricity

CO_2 Emissions in Industry

- Projected to be about 75 – 90% lower in 2050 relative to 2010
  - 50 – 80% for global warming of 2°C
- Reductions with new and existing technologies/practices
  - electrification, hydrogen, sustainable bio-based feedstocks, product substitution, and carbon capture, utilization and storage.
- Options technically proven at various scales
  - large-scale deployment may be limited by economic, financial, human capacity and institutional constraints

Urban and Infrastructure System Transition

- Changes in land and urban planning practices
- Deeper emissions reductions in transport and buildings compared to pathways that limit global warming below 2^{o}C
- 1.5^{o}C : electricity share of energy demand in buildings would be about 55 – 75% in 2050

Urban and Infrastructure System Transition

Transport Sector

- Share of low-emission final energy would rise from less than 5% in 2020 to about 35-64% in 2050

Economic, institutional and socio-cultural barriers, depending on national, regional and local circunstances, capabilities and the availability of capital.

Climate Change and People

- Close links to United Nations Sustainable Development Goals (SDGs)
- Mix of measures to adapt to climate change and options to reduce emissions can have benefits for SDGs
- National and sub-national authorities, civil society, the private sector, indigenous peoples and local communities can support ambitious action
- International cooperation is a critical part of limiting warming to 1.5°C

IPCC Sixth Assessment Cycle

Sixth Cycle of the IPCC – AR6

Special Reports

October 2018

Global warming of 1.5° C
An IPCC 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

August 2019

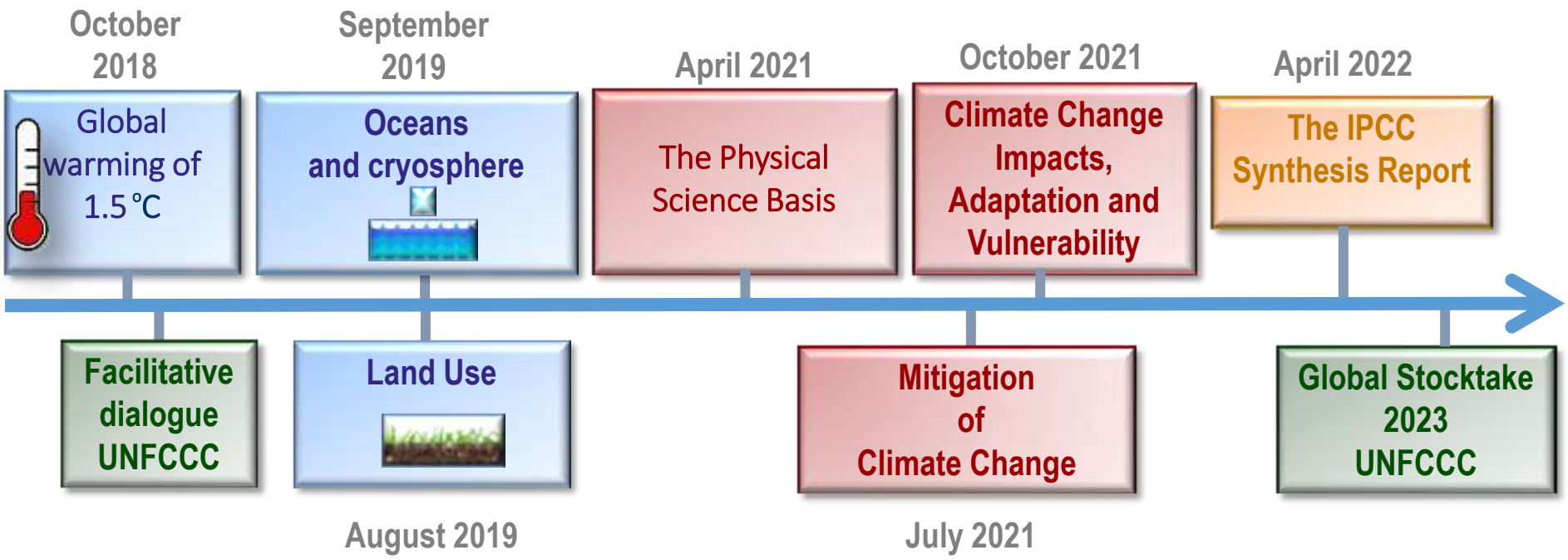
Climate Change and Land:
An IPCC special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems

September 2019

Special Report on the Ocean and Cryosphere in a Changing Climate

Sixth Cycle of the IPCC – AR6

Timeline for the forthcoming AR6 reports



Special Report on Climate Change and Land

Climate Change and Land: an IPCC special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems

Chapter 1: Framing and Context
Chapter 2: Land–Climate interactions
Chapter 3: Desertification
Chapter 4: Land Degradation
Chapter 5: Food Security
Chapter 6: Interlinkages between desertification, land degradation, food security and GHG fluxes: synergies, trade-offs and integrated response options
Chapter 7: Risk management and decision making in relation to sustainable development

Special Report on the Ocean and Cryosphere in a Changing Climate

Chapter 1: Framing and Context of the Report
Chapter 2: High Mountain Areas
Chapter 3: Polar Regions
Chapter 4: Sea Level Rise and Implications for Low Lying Islands, Coasts and Communities
Chapter 5: Changing Ocean, Marine Ecosystems, and Dependent Communities
Chapter 6: Extremes, Abrupt Changes and Managing Risks

2019 Refinement to the 2006 IPCC Guidelines for National GHG Inventories

Overview Chapter
Volume 1: General Guidance and Reporting
Volume 2: Energy
Volume 3: Industrial Processes and Product Use
Volume 4: Agriculture, Forestry and Other Land Use
Volume 5: Waste

Working Group I : the Physical Basis of CC

Chapter 1: Framing, context, methods
Chapter 2 : Changing state of the climate system
Chapter 3 : Human influence on the climate system
Chapter 4 : Future global climate: scenario-based projections and near-term information
Chapter 5 : Global carbon and other biogeochemical cycles and feedbacks
Chapter 6 : Short-lived climate forcers
Chapter 7 : The Earth's energy budget, climate feedbacks, and climate sensitivity
Chapter 8 : Water cycle changes
Chapter 9 : Ocean, cryosphere, and sea level change
Chapter 10 : Linking global to regional climate change
Chapter 11 : Weather and climate extreme events in a changing climate
Chapter 12 : Climate change information for regional impact and for risk assessment

Working Group II : Impacts, Adaptation, Vulnerability

SECTION 2: Regions
Chapter 9 : Africa
Chapter 10 : Asia
Chapter 11 : Australasia
Chapter 12 : Central and South America
Chapter 13 : Europe
Chapter 14 : North America
Chapter 15 : Small Islands

SECTION 3: Sustainable development pathways: integrating adaptation and mitigation
Chapter 16 : Key risks across sectors and regions
Chapter 17 : Decision-making options for managing risk
Chapter 18 : Climate resilient development pathways

Working Group II : Impacts, Adaptation, Vulnerability

Chapter 1 : Point of departure and key concepts

SECTION 1: Risks, adaptation and sustainability for systems impacted by climate change

Chapter 2 : Terrestrial and freshwater ecosystems and their services
Chapter 3 : Ocean and coastal ecosystems and their services
Chapter 4 : Water
Chapter 5 : Food, fibre, and other ecosystem products
Chapter 6 : Cities, settlements and key infrastructure
Chapter 7 : Health, wellbeing and the changing structure of communities
Chapter 8 : Poverty, livelihoods and sustainable development

Working Group III : Mitigation of CC

Chapter 1 : Introduction and Framing
Chapter 2 : Emissions trends and drivers
Chapter 3 : Mitigation pathways compatible with long-term goals
Chapter 4 : Mitigation and development pathways in the near- to mid-term
Chapter 5 : Demand, services and social aspects of mitigation
Chapter 6 : Energy systems
Chapter 7 : Agriculture, Forestry, and Other Land Uses (AFOLU)
Chapter 8 : Urban systems and other settlements

Working Group III : Mitigation of CC

Chapter 9 : Buildings
Chapter 10 : Transport
Chapter 11 : Industry
Chapter 12 : Cross sectoral perspectives
Chapter 13 : National and sub-national policies and institutions
Chapter 14 : International cooperation
Chapter 15 : Investment and finance
Chapter 16 : Innovation, technology development and transfer
Chapter 17 : Accelerating the transition in the context of sustainable development

Thank you!

The Special Report can be accessed at:
http://www.ipcc.ch/report/sr15/

Questions?
IPCC-Media@WMO.int