Highlights from the IPCC Six Assessment Reports

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With inputs from Valérie Masson-Delmotte, WGI co-chair

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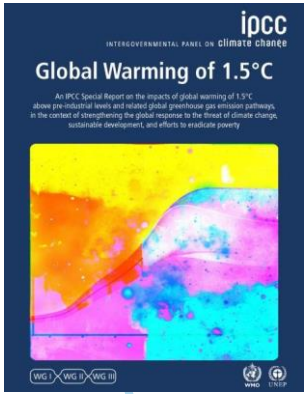
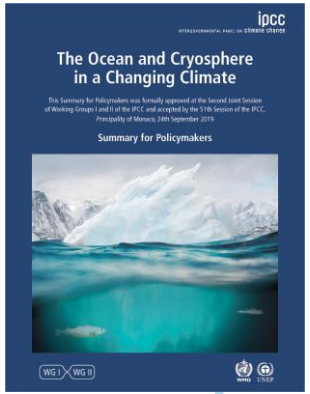
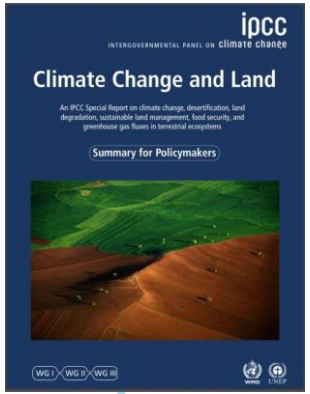
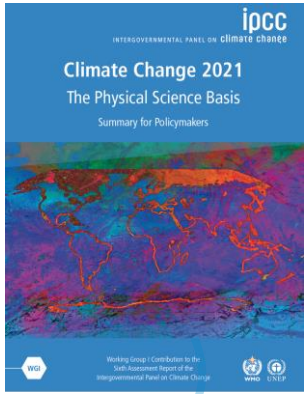
SIXTH ASSESSMENT REPORT

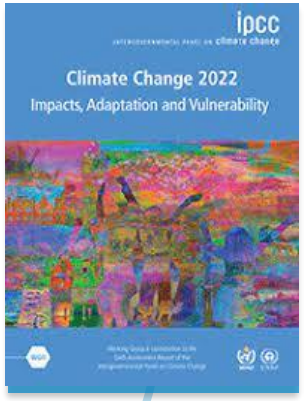
Working Group I – The Physical Science Basis

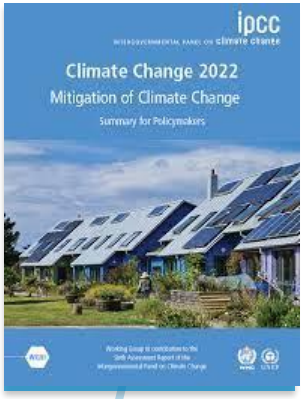












Synthesis Report

It is unequivocal that human influence has warmed the atmosphere, ocean and land.

Widespread and rapid changes in the atmosphere, ocean, cryosphere and biosphere have occurred.

Human influence has warmed the climate at a rate that is unprecedented in at least the last 2000 years

a) Change in global surface temperature (decadal average) as reconstructed (1-2000) and **observed** (1850-2020)

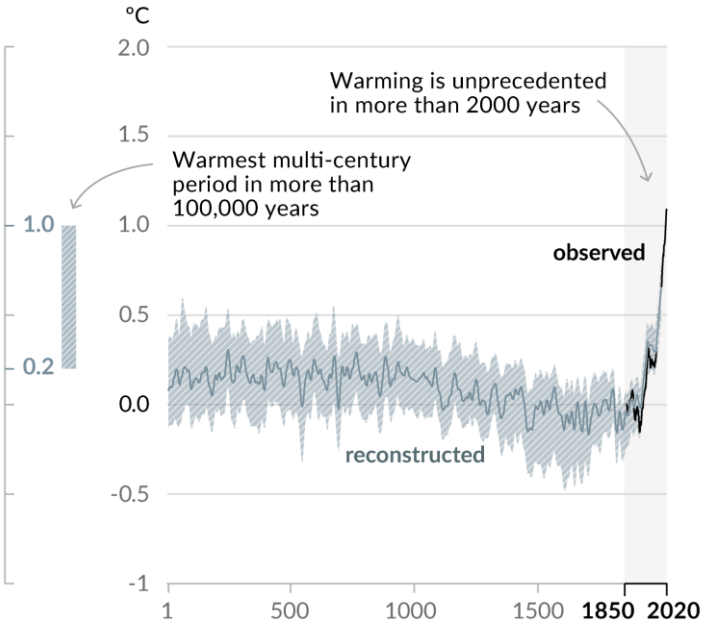
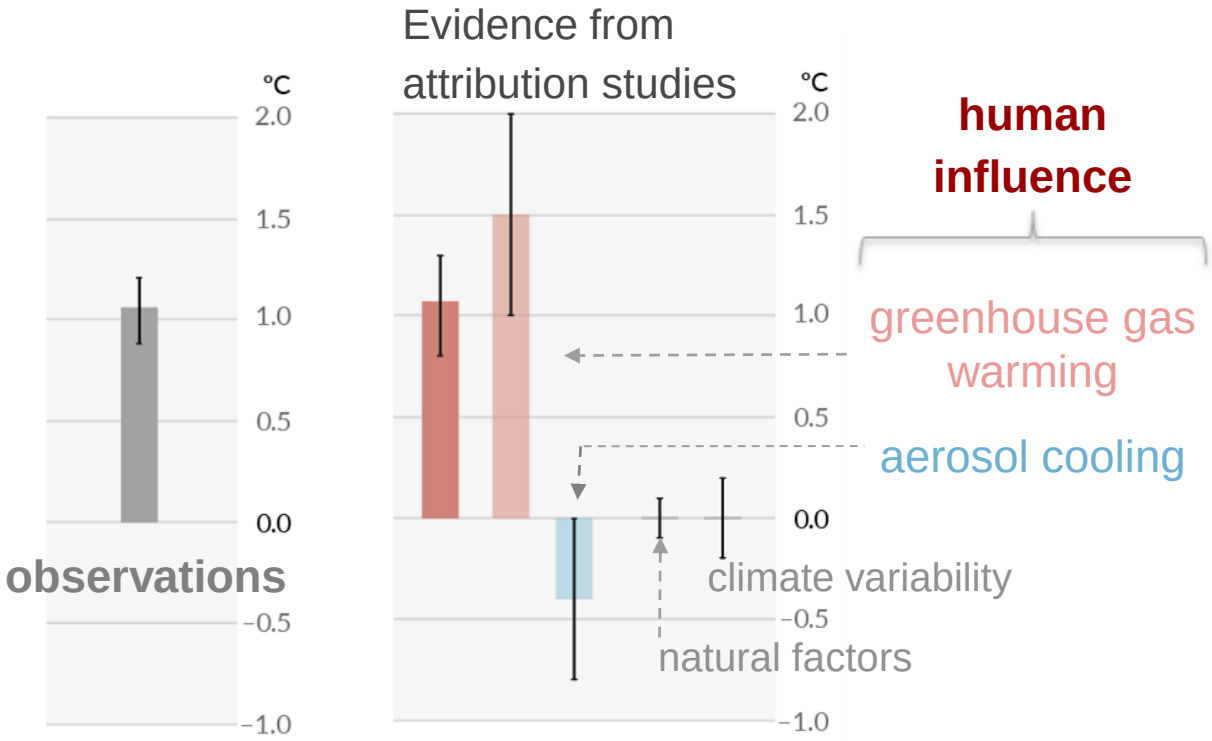


Figure SPM 1

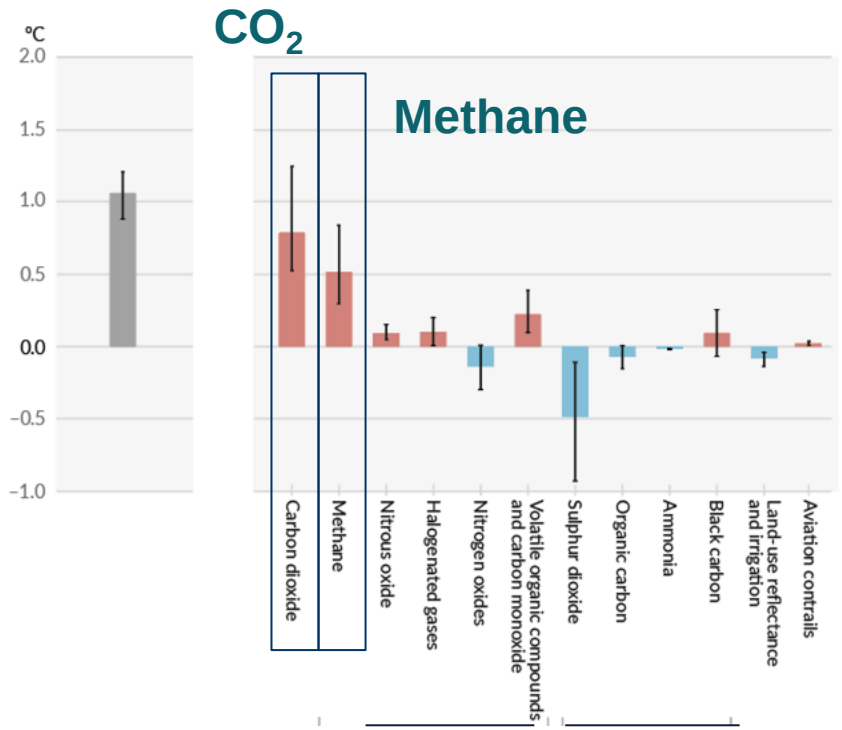
The scale of recent changes across the climate system as a whole, and the present state of many aspects of the climate system are unprecedented over many centuries to many thousands of years.

Observed warming is driven by emissions from **human activities**, with **greenhouse gas** warming partly masked by **aerosol cooling**



Adapted from Figure SPM.2

Improved understanding of the role of each individual component of human influence



Evidence from radiative forcing and climate sensitivity studies

Mainly contribute to changes in **non-CO_2 greenhouse gases**

Mainly contribute to changes in **anthropogenic aerosols**

Adapted from Figure SPM.2

Evidence of observed changes in extremes such as heatwaves, heavy precipitation, droughts, and tropical cyclones, and, in particular, their attribution to human influence, has strengthened since AR5.

Climate change is already affecting every inhabited region across the globe, with human influence contributing to many observed changes in weather and climate extremes

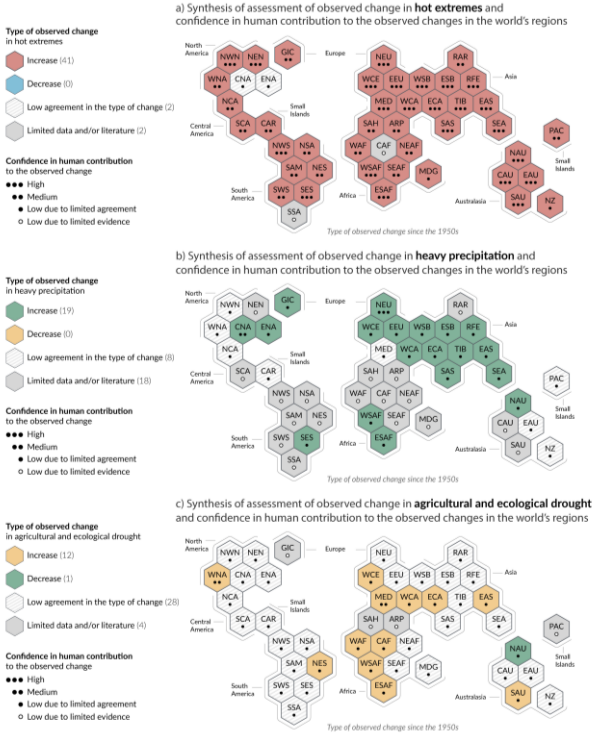


Figure SPM 3

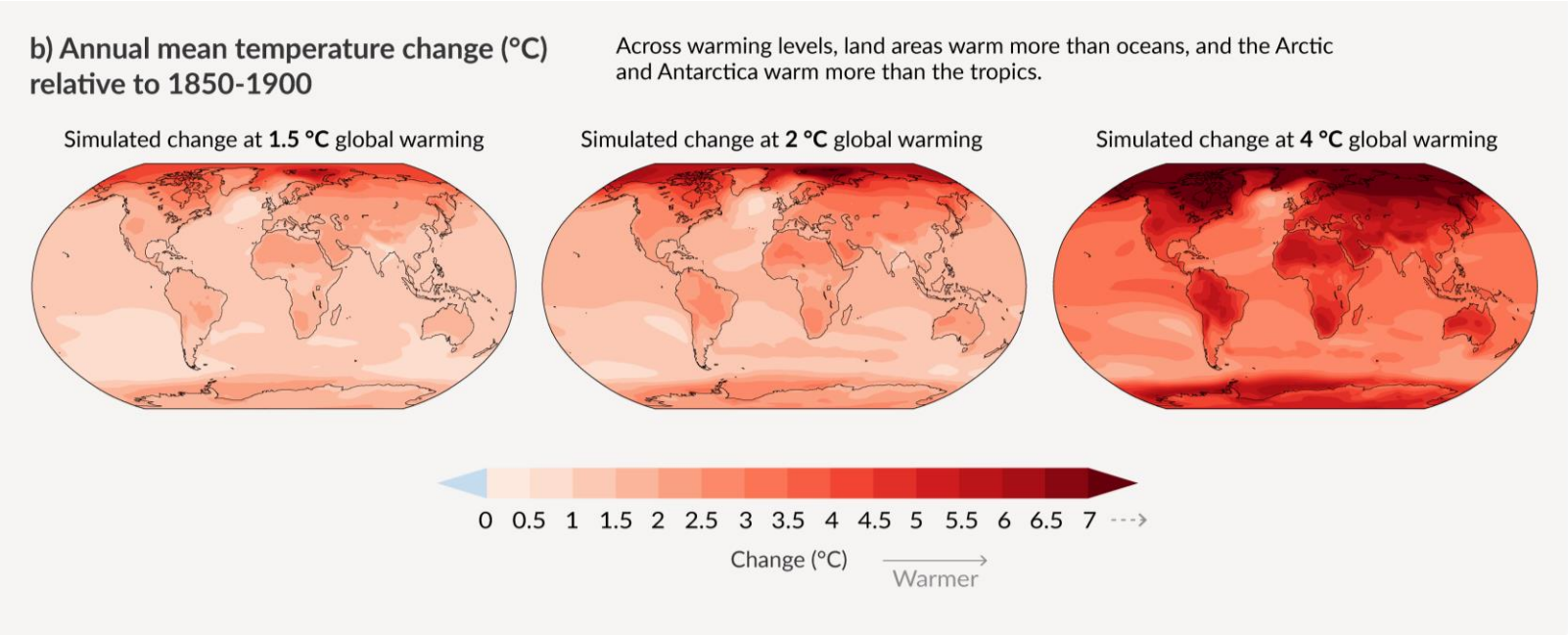
Many changes in the climate system become larger in direct relation to increasing global warming.

They include increases in the frequency and intensity of hot extremes, marine heatwaves, and heavy precipitation, agricultural and ecological drought in some regions, the proportion of intense tropical cyclones as well as reductions in Arctic sea ice, snow cover and permafrost.

Continued global warming is projected to further intensity the global water cycle, including its variability, global monsoon precipitation and the severity of wet and dry events.

With further global warming, every region is projected to increasingly experience concurrent and multiple changes in climatic impact-drivers.

With every increment of global warming, changes get larger in regional mean temperature, precipitation and soil moisture

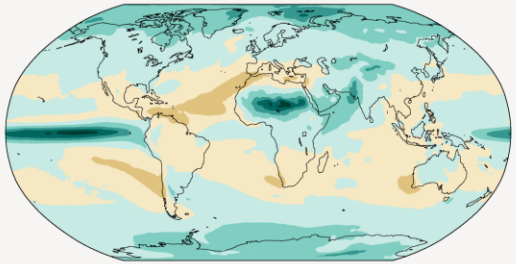


With every increment of global warming, changes get larger in regional mean temperature, precipitation and soil moisture

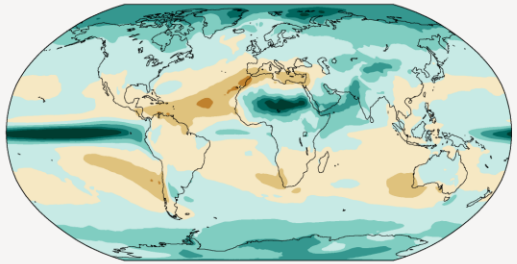
c) Annual mean precipitation change (%) relative to 1850-1900

Precipitation is projected to increase over high latitudes, the equatorial Pacific and parts of the monsoon regions, but decrease over parts of the subtropics and in limited areas of the tropics.

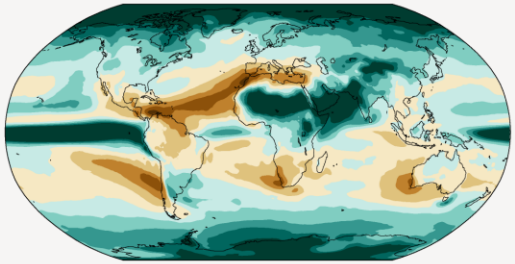
Simulated change at **1.5 °C** global warming



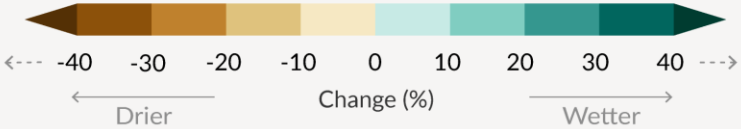
Simulated change at **2 °C** global warming



Simulated change at **4 °C** global warming



Relatively small absolute changes may appear as large % changes in regions with dry baseline conditions

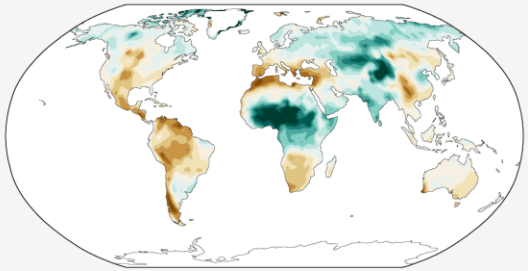


With every increment of global warming, changes get larger in regional mean temperature, precipitation and soil moisture

d) Annual mean total column soil moisture change (standard deviation)

Across warming levels, changes in soil moisture largely follow changes in precipitation but also show some differences due to the influence of evapotranspiration.

Simulated change at **1.5 °C** global warming



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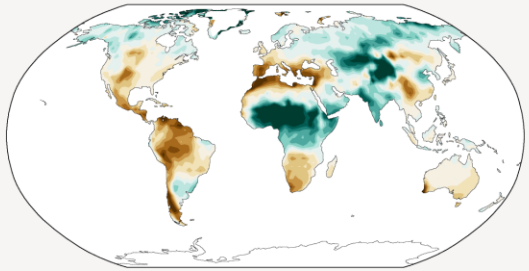
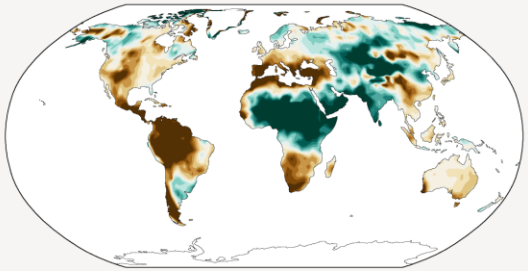
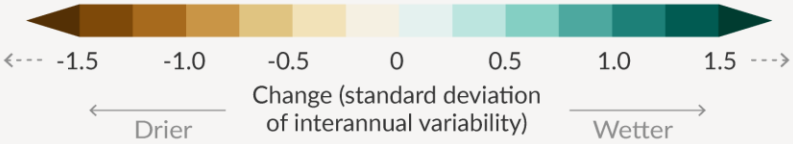


Simulated change at **4 °C** global warming



Relatively small absolute changes may appear large when expressed in units of standard deviation in dry regions with little interannual variability in baseline conditions



Heatwaves, heavy precipitation and droughts are projected to be larger in frequency and intensity with every additional increment of global warming

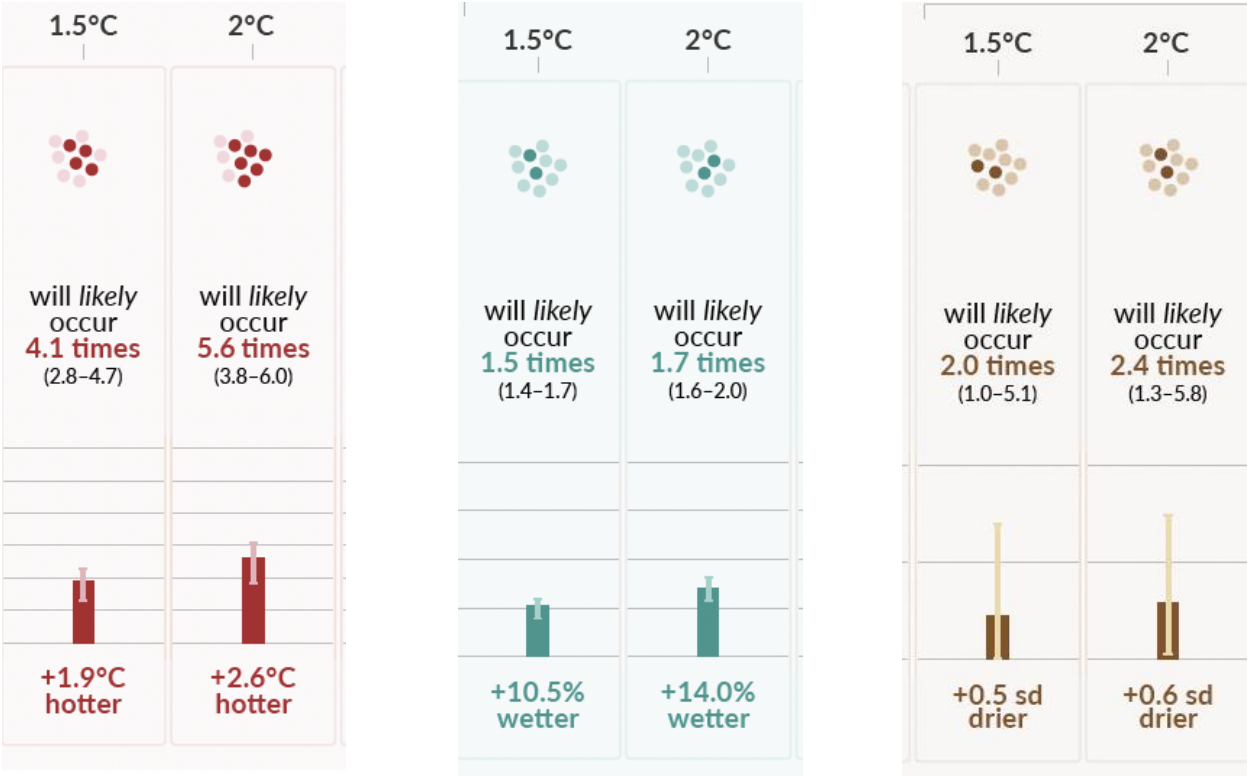


Figure SPM 6

Limiting global warming reduces consequences of climate change that can impact society and natural systems

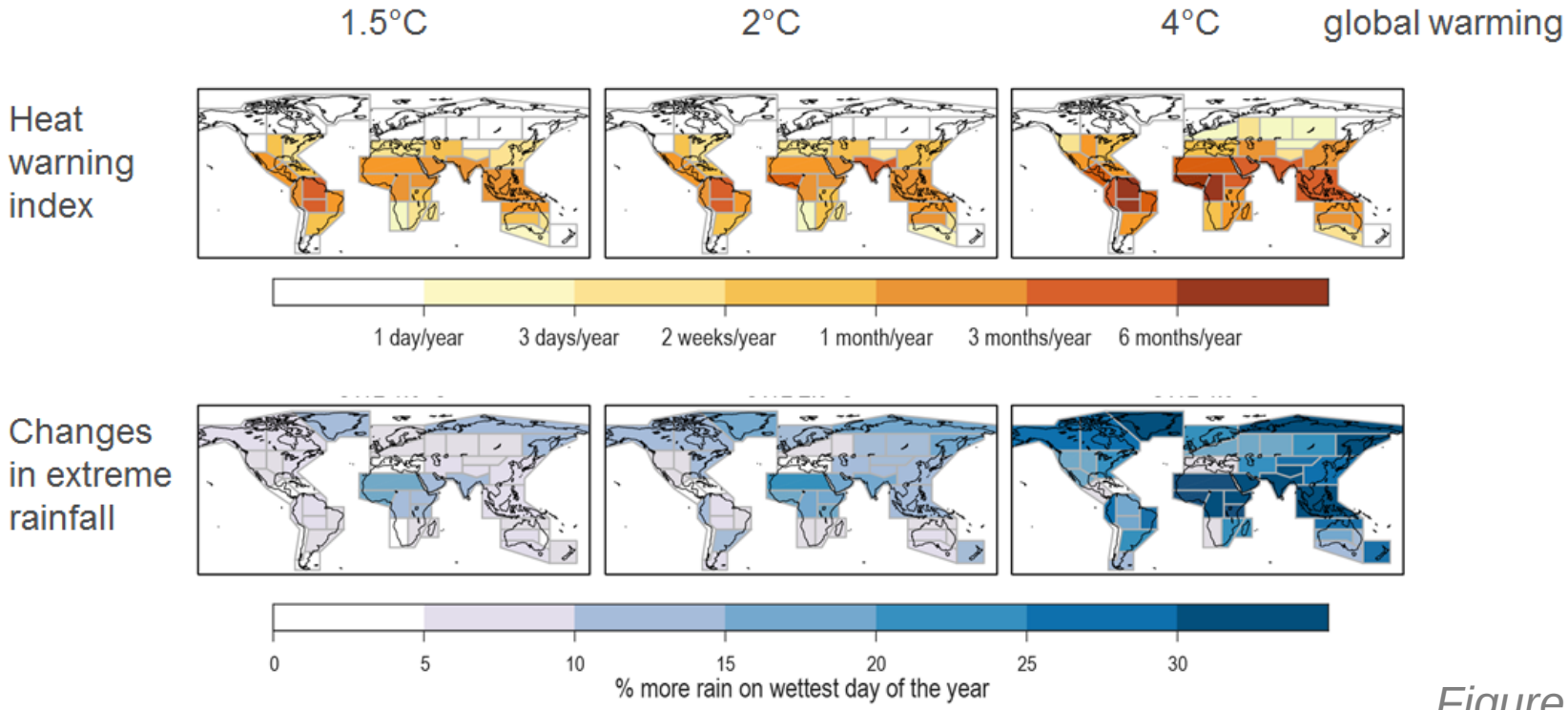


Figure TS.6

For some changes, there is no going back

Human activities affect all the major climate system components, with some responding over decades and others over centuries

Global mean sea level rise relative to 1900 (m)

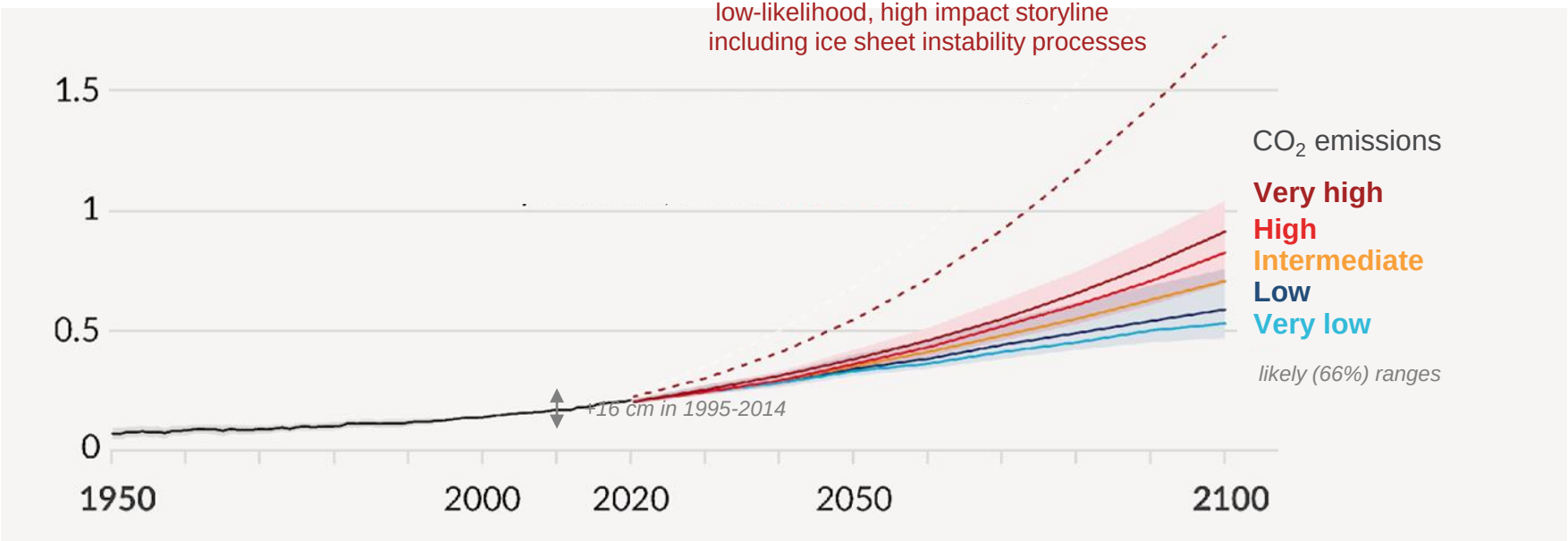
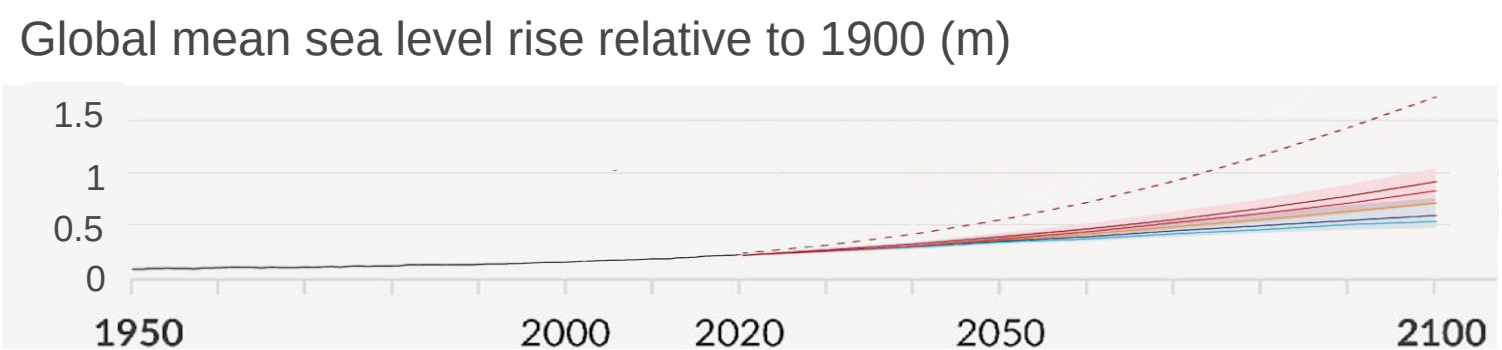
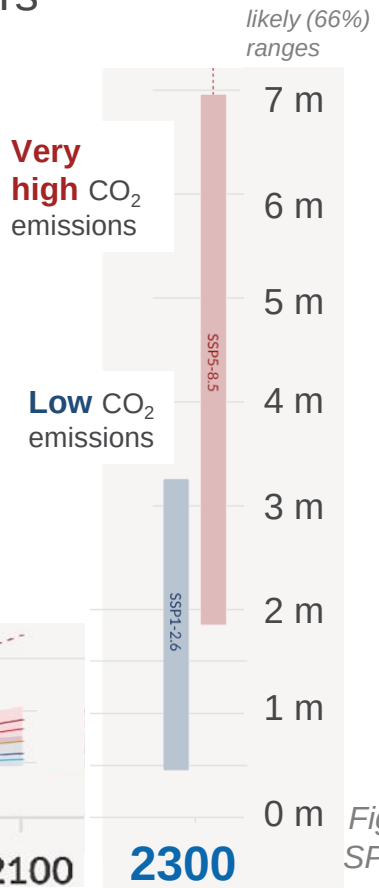


Figure SPM.8

Global mean sea level will continue to rise over thousands of years with a rate and magnitude depending on global greenhouse gas emissions

Sea level rise greater than 15 m cannot be ruled out with high emissions due to deep uncertainty on Antarctic ice sheet dynamics





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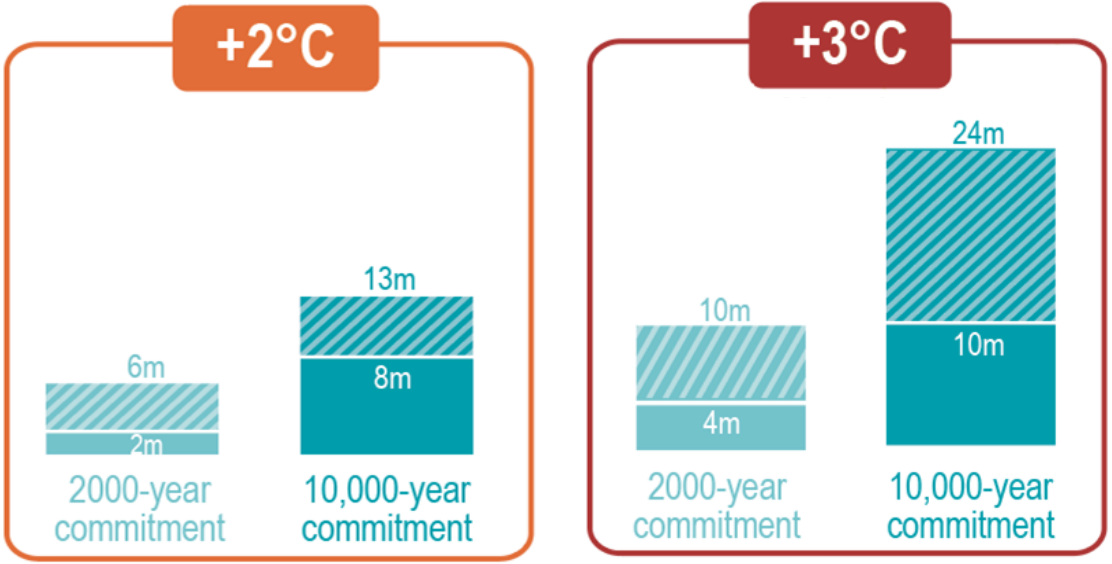


Infographic TS.1

Global warming of 1.5°C and 2°C at the end of the century will be exceeded unless deep reductions in CO_2 and other greenhouse gas emissions occur in the coming decades

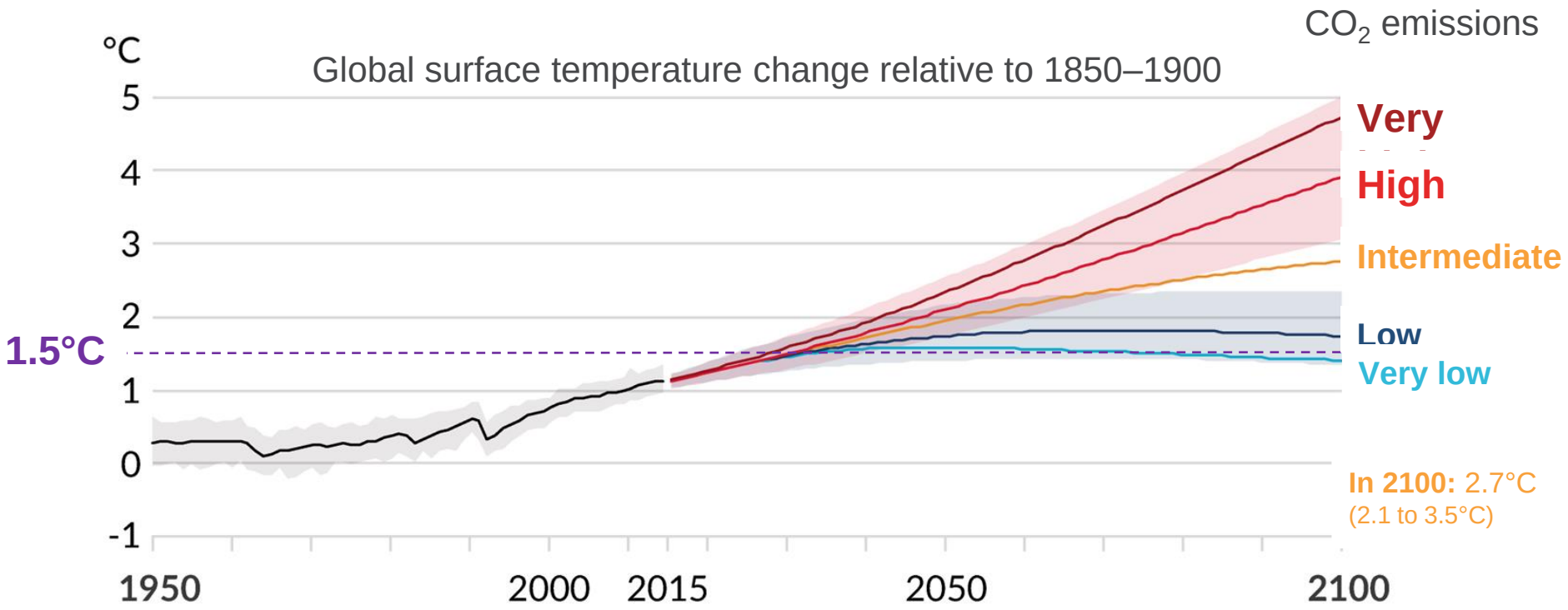

Global surface temperature change relative to 1850–1900
°C
5
4
3
2
1
0
-1
1.5°C
1950
2000
2015
2050
2100
CO_2 emissions
Very
High
Intermediate
Low
Very low
In 2100: 2.7°C
(2.1 to 3.5°C)

Figure SPM.8

Global surface temperature will continue to increase until at least the mid-century

1.5°C will be reached around 2030

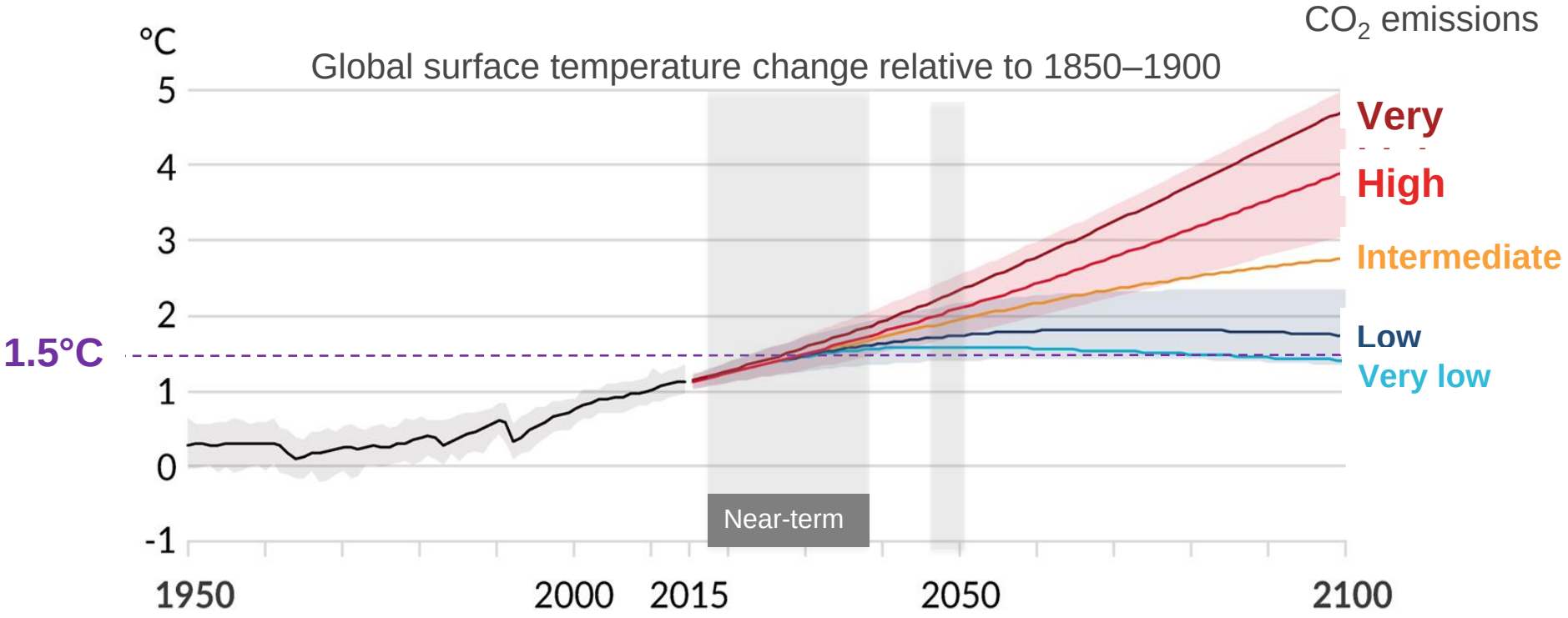
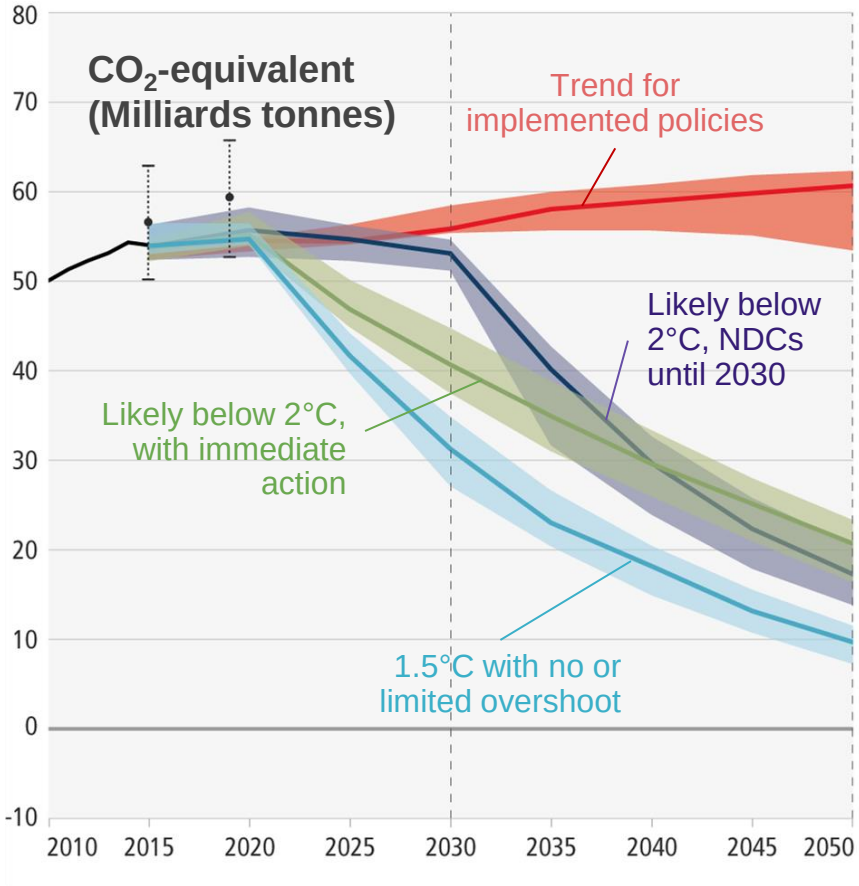


Figure SPM.8

Policies that were implemented by December 2020, would project, without strengthening mitigation efforts, GHG emissions to global warming of 3.2°C.



By 2030…

Limiting warming close to 1,5 °C

- CO_2-equivalent : - 43% by 2030
- Methane : - 34% by 2030

Limiting warming well below 2°C

- CO_2-equivalent: - 27% by 2030

Fig. SPM 4

We are not on track to limiting globl warming to 1.5°C.

A deep reduction of emissions requires major transformations at unprecedented scales in all sectors of the economy.

Decarbonisation options for aviation still require R&D, though advanced biofuels are emerging as viable options.

We are not on track to limit warming to 1.5 °C.

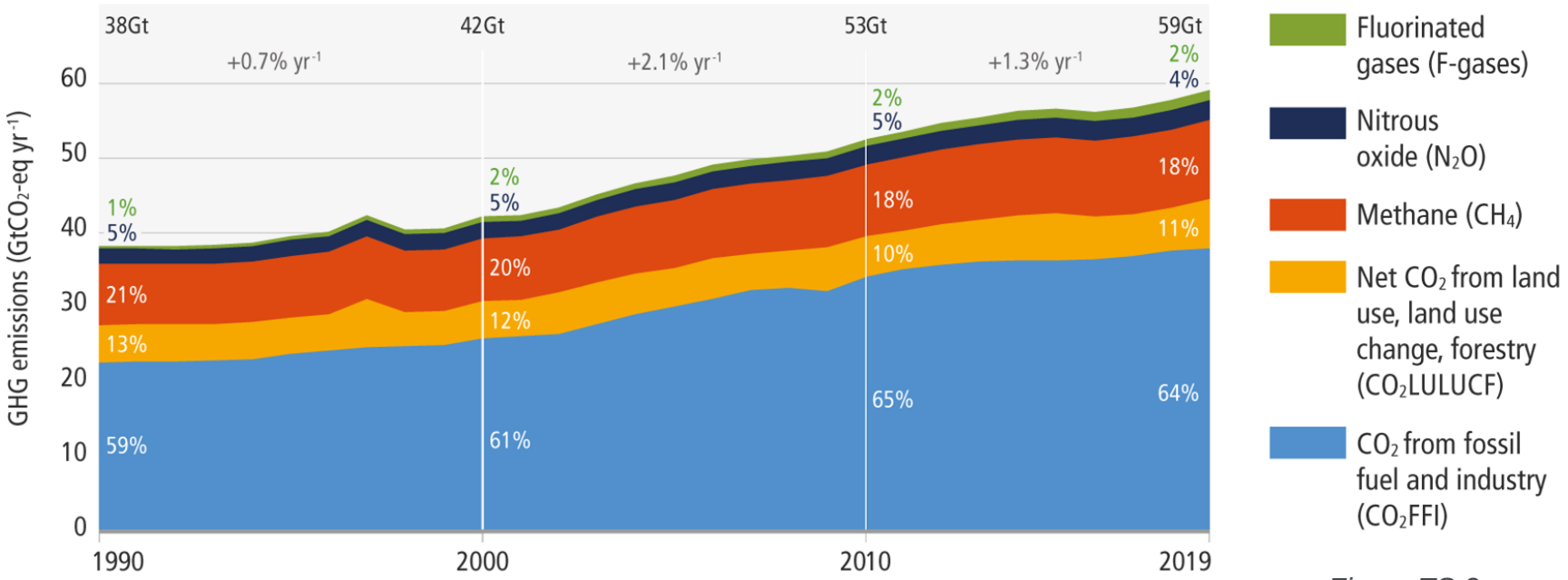


Figure TS 2

Net GHG emissions have increased since 2010 across all major sectors globally

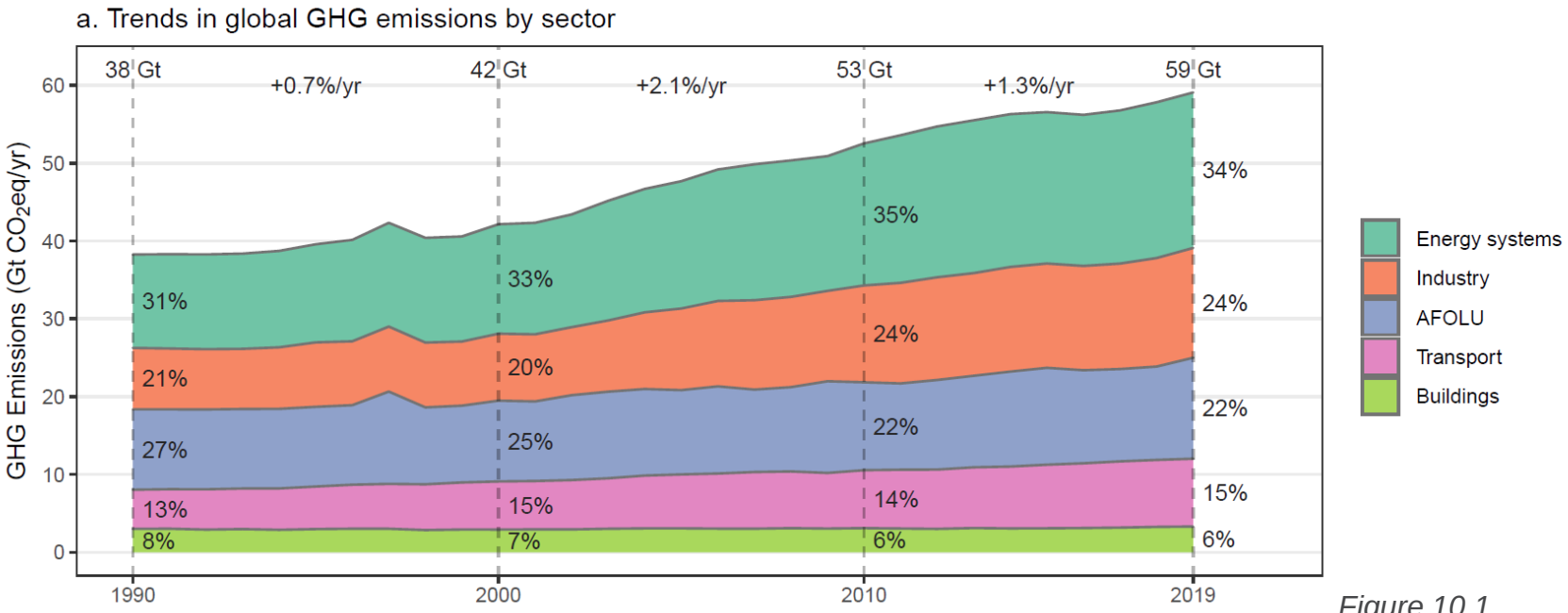
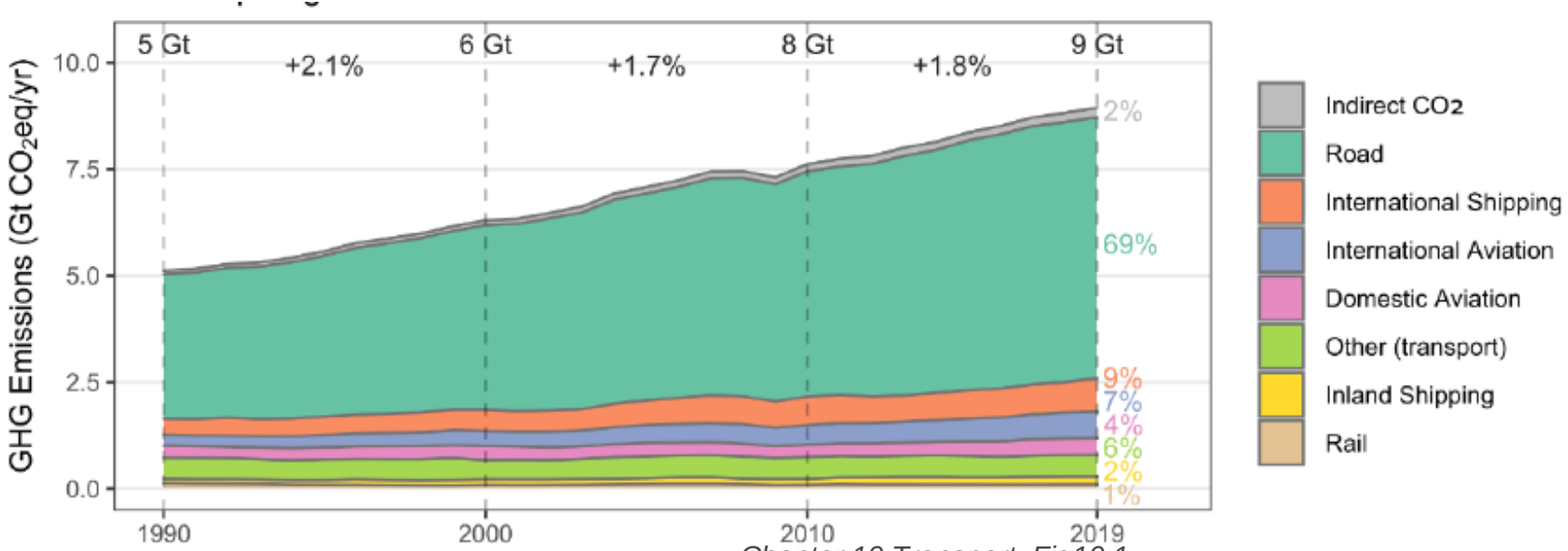
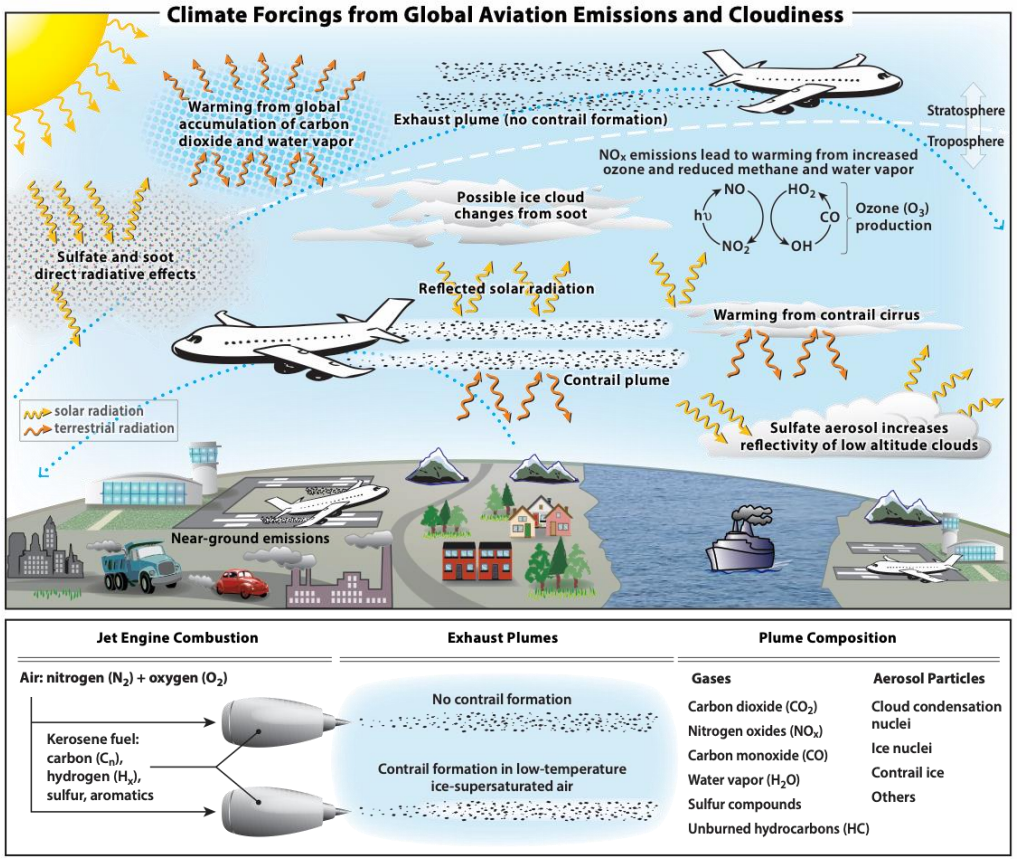


Figure 10.1

Transport, including Aviation emissions



Chapter 10 Transport, Fig10.1



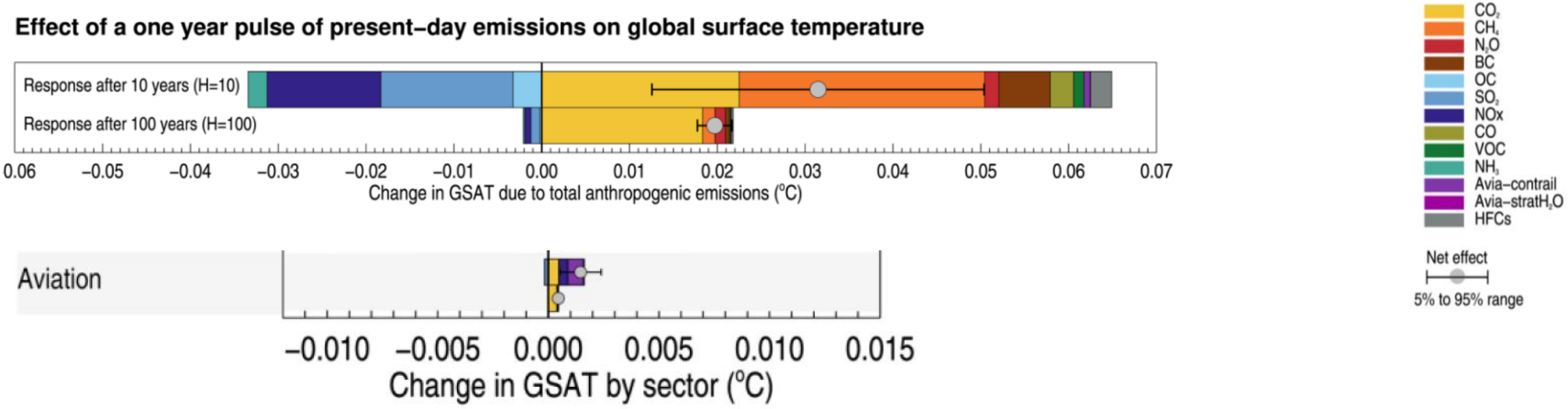
Result from Emissions of

1. CO_2, 2.4% of total anthropogenic emissions

2. non-CO_2 (short-lived climate forcers)
   - water vapour,
   - soot,
   - sulphur dioxide,
   - nitrogen oxides , NOx,

Lee et al. (2020) Atmospheric Environment

Ten years after **a one-year pulse** of present-day aviation emissions, short-lived climate forcers induce strong, but short-lived warming contributions to the global surface temperature response, while CO_2 both gives a warming effect in the near term and dominates the long-term warming impact.



Chapter 6 (short-lived climate forcers), Figure 6.16

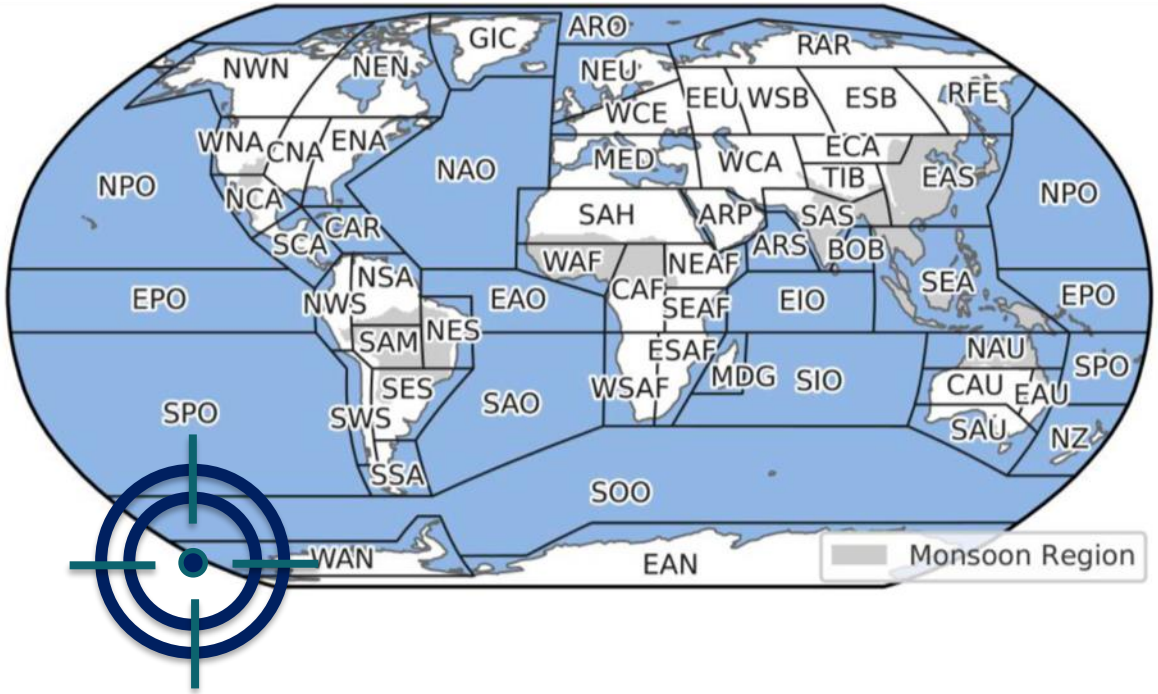
To speed up mitigation strategies in the aviation sector, the IPCC WG III AR6 report highlights six major strategies to reduce emissions

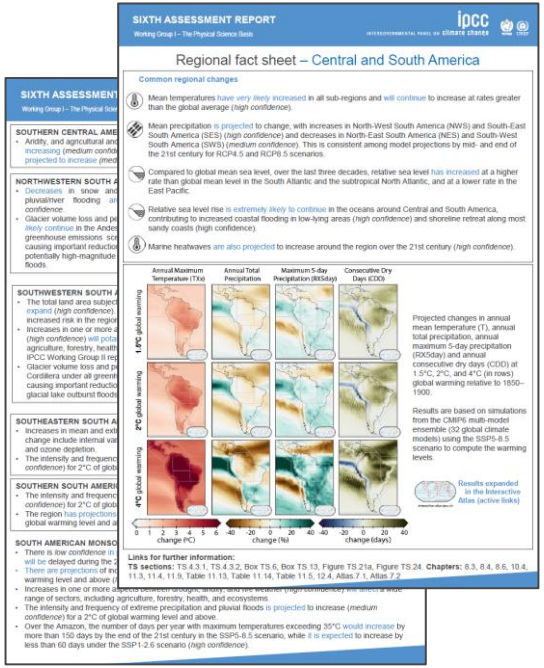
1. Technology options for engine and airframe,
2. Operational improvements for navigation,
3. Bio-based, synthetic, and liquid hydrogen-based sustainable aviation fuels,
4. Technological and operational trade-offs between CO2 and non-CO2 effects
5. Market-based offsetting measures - CORSIA
6. Modal shift to High-Speed Rail.

Bio Sustainable Aviation Fuels Bio-SAFs

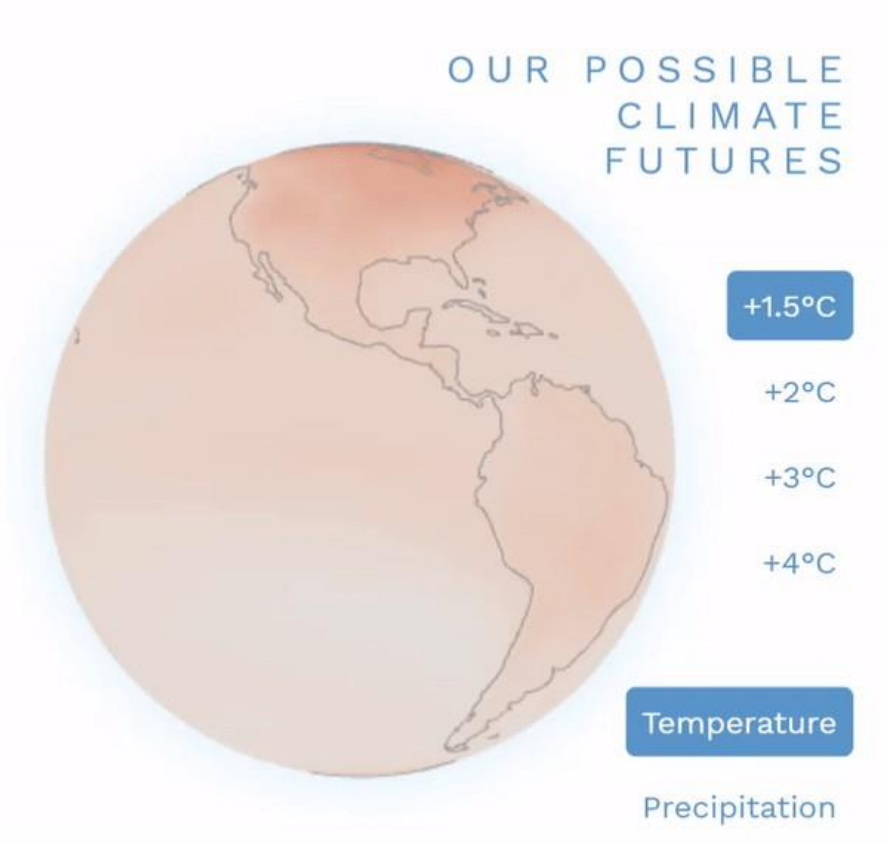
- High potential to support mitigation scenarios in the short- and mid-term while supporting demand for aviation to continue to grow
- Highest potential and technology readiness level (TRL)
- Growing area of interest and research with different types of sustainable aviation fuels with maximum blends ranging from 10% to 50%
- Production from a variety of feedstocks including cultivated feedstock crops, crop residues, municipal solid waste, waste fats, oils and greases, wood products and forestry residues
- Different associated life cycle emissions with associated emissions of CO2 or other GHGs from their production and distribution
- Land use changes and adverse side-effects for food security and terrestrial ecosystem services (e.g. displacement of food production, increased food price, water availability).
- Costs around three times the price of kerosene

Regional climate assessment



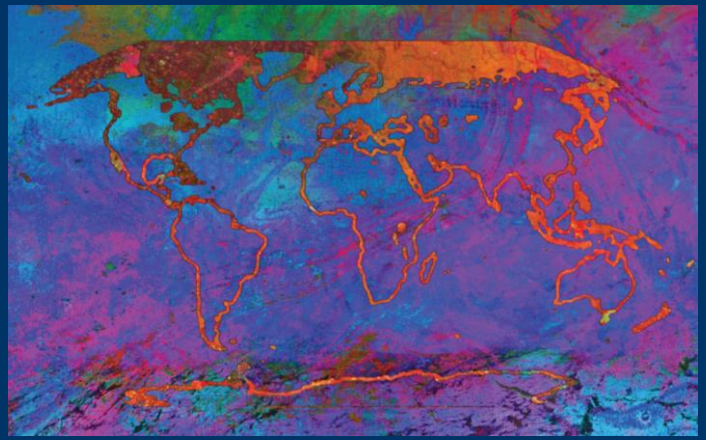


Interactive atlas



https://interactive-atlas.ipcc.ch/

#IPCCData #IPCCAtlas



“ The climate we experience in the future depends on our decisions now.

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Thank you.

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