



# Introduction to Climate Change: Science and Impacts

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**KFW**

# THE LANCET

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"Climate change is  
the biggest global  
health threat of the  
21st century."

See The Lancet Commissions page 1693

## Comment

Compensation for brain drain  
from developing countries  
See page 1665

## Correspondence

Amnesia from canned tuna?  
See page 1672

## Articles

RECORD4: Rivaroxaban for  
thromboprophylaxis after  
total knee arthroplasty  
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## Articles

TACT: sequential docetaxel as  
adjuvant chemotherapy for  
early breast cancer  
See page 1681

## The Lancet Commissions

Management of health effects  
of climate change  
See page 1693

**CO<sub>2</sub>**  
concentration



**Highest**

in at least

**2 million years**

**Sea level**  
rise



**Fastest rates**

in at least

**3000 years**

**Arctic sea ice**  
area



**Lowest level**

in at least

**1000 years**

**Glaciers**  
retreat



**Unprecedented**

in at least

**2000 years**



**Extreme heat**

More frequent

More intense



**Heavy rainfall**

More frequent

More intense



**Drought**

Increase in some  
regions



**Fire weather**

More frequent

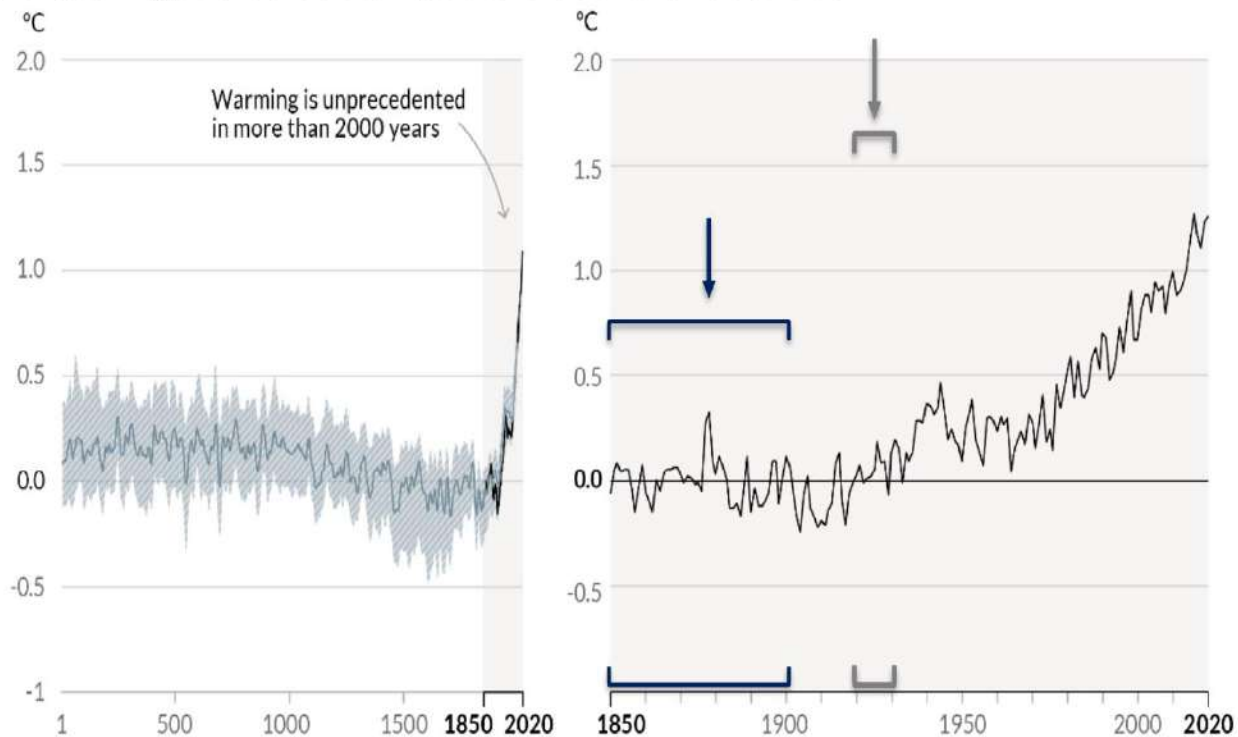


**Ocean**

Warming  
Acidifying  
Losing oxygen

# Temperature pattern in the last 2000 years (IPCC, 2021)

Changes in global surface temperature relative to 1850-1900



**Global surface temperature was 0.99°C higher in 2001-2020 than 1850-1900.**

**Global surface temperature was 1.09 °C higher in 2011-2020 than 1850-1900**

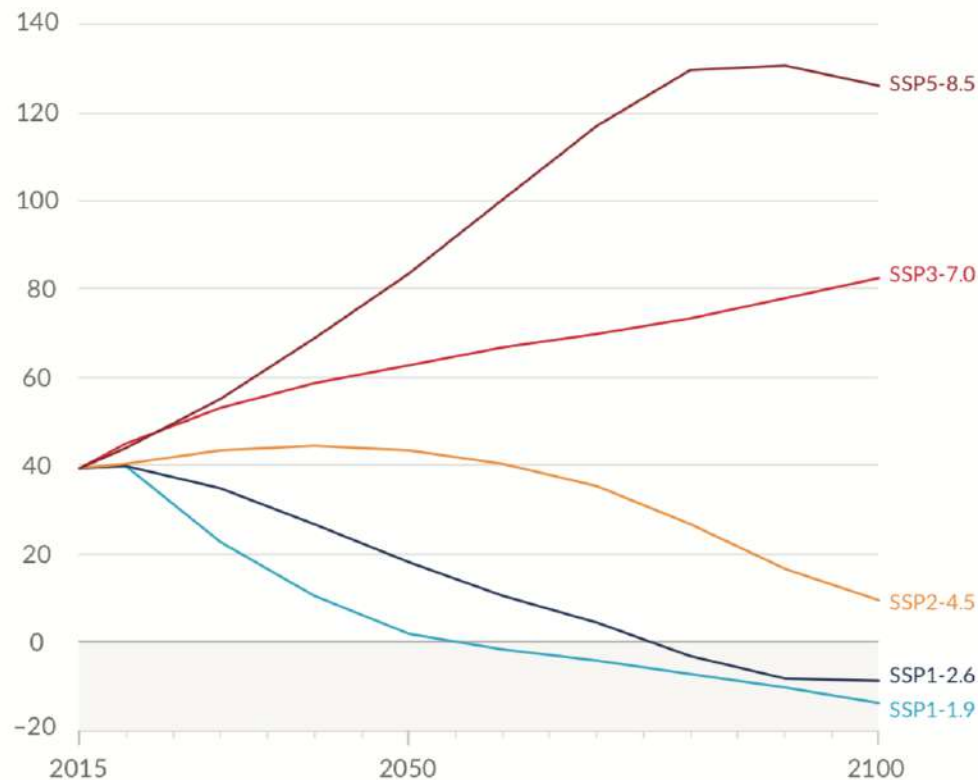
**Global surface temperature has increased faster since 1970 than in any other 50-year period over at least the last 2000 years.**

# GHG Emission Scenario: 2015-2100 (IPCC, 2021)

Future emissions cause future additional warming, with total warming dominated by past and future CO<sub>2</sub> emissions

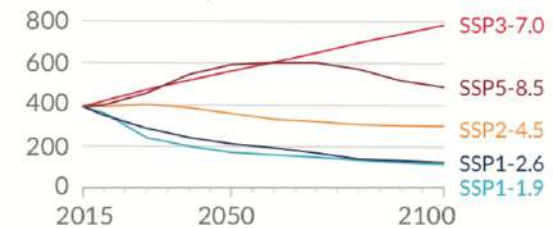
(a) Future annual emissions of CO<sub>2</sub> (left) and of a subset of key non-CO<sub>2</sub> drivers (right), across five illustrative scenarios

Carbon dioxide (GtCO<sub>2</sub>/yr)

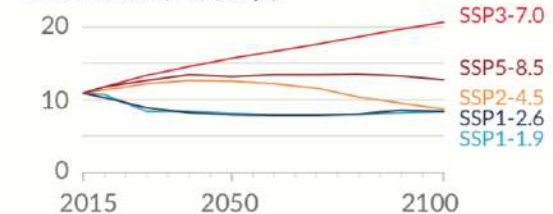


Selected contributors to non-CO<sub>2</sub> GHGs

Methane (MtCH<sub>4</sub>/yr)

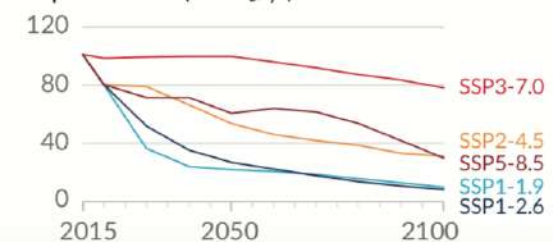


Nitrous oxide (MtN<sub>2</sub>O/yr)

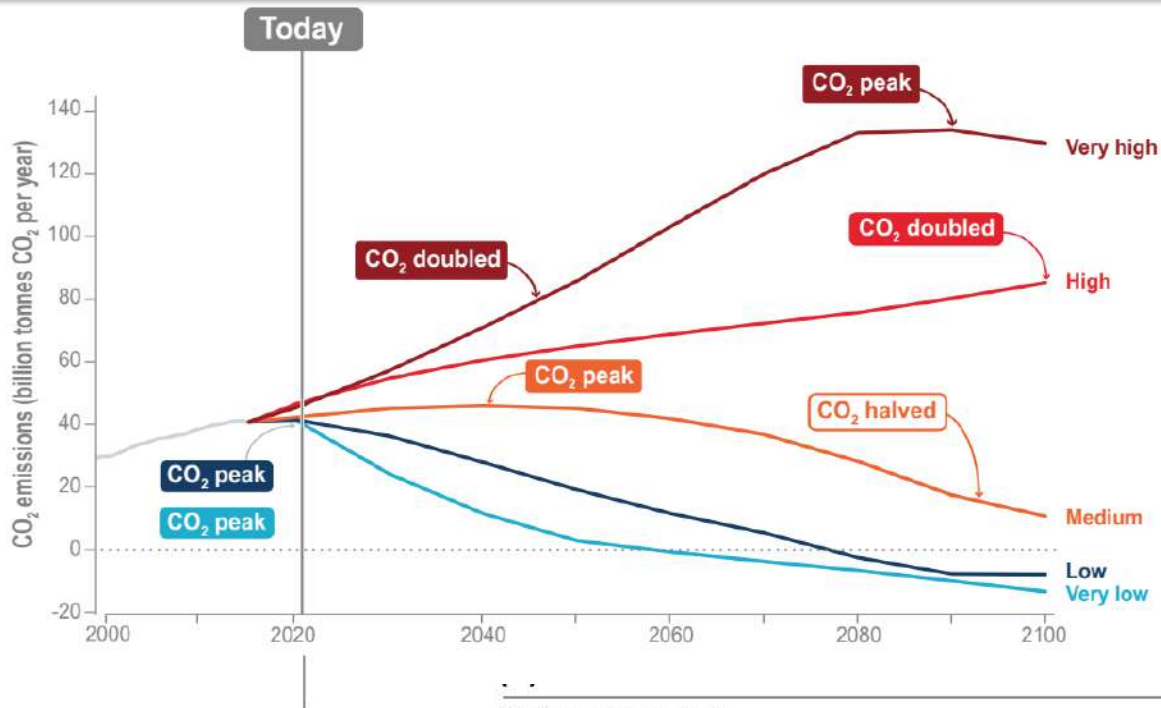


One air pollutant and contributor to aerosols

Sulphur dioxide (MtSO<sub>2</sub>/yr)



# GHG Emission Scenario and Temperature Pattern (IPCC, 2021)



**Emission Pathways:  
Effects on surface  
temperature**

## Reference period



Recent past  
Approximate pre-industrial  
Last Millennium

## Age

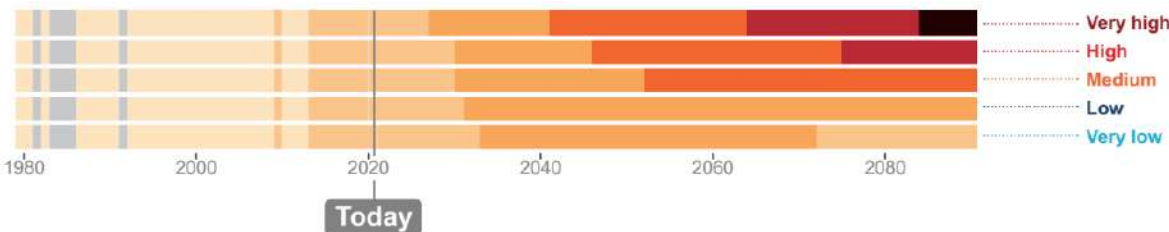
1995–2014 CE  
1850–1900 CE  
850–1850 CE

CO<sub>2</sub>  
(ppm)

Temperature  
(°C)

Sea level  
(m)

360 → 397	0.66 to 1.00	0.15 to 0.25
286 → 296	-0.15 to +0.11	-0.03 to 0.00
278 to 285	-0.14 ~ 0.24	-0.05 to 0.03

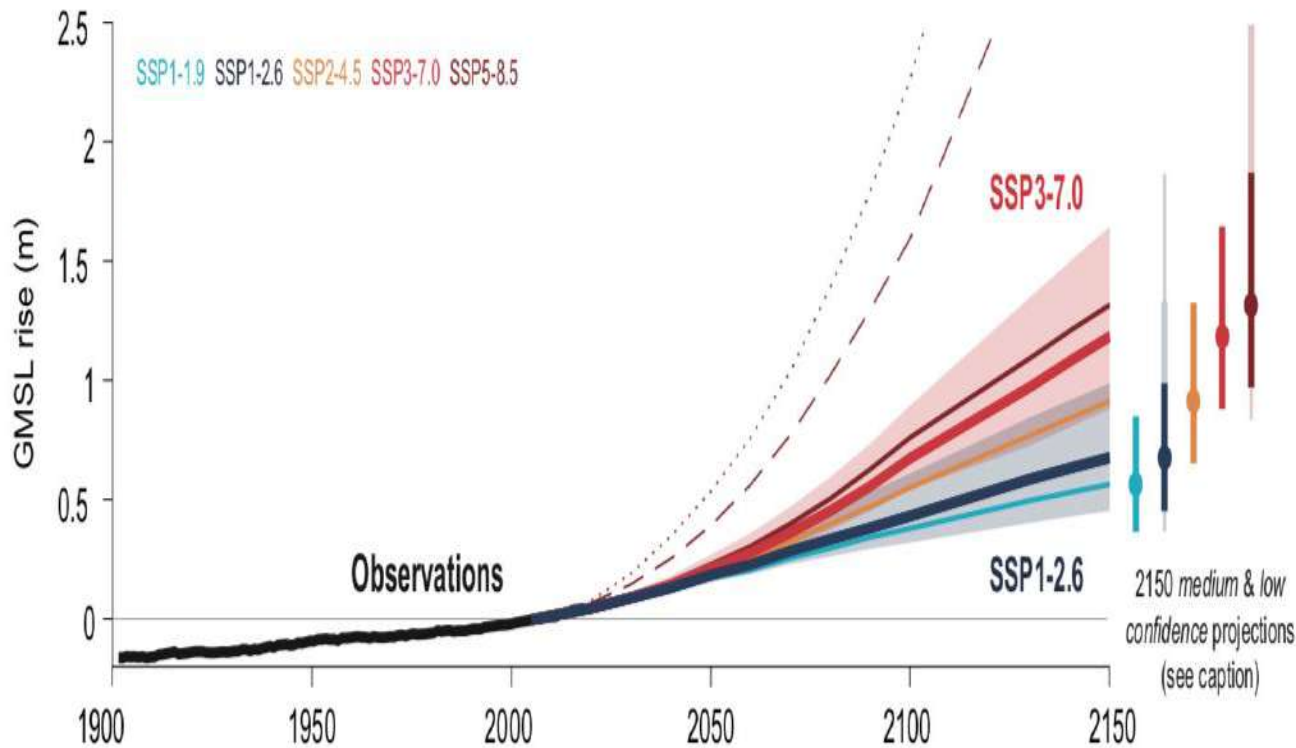


## Global warming since 1850–1900 (°C)



# GHG Emission Scenario and Global Mean SLR (IPCC, 2021)

(a) Global mean sea level rise from 1900–2150



The average rate of sea level rise was

- 1.3 mm yr<sup>-1</sup> between 1901 and 1971
- increasing to 1.9 mm yr<sup>-1</sup> between 1971 and 2006, and
- further increased to **3.7 mm yr<sup>-1</sup> between 2006 and 2018**



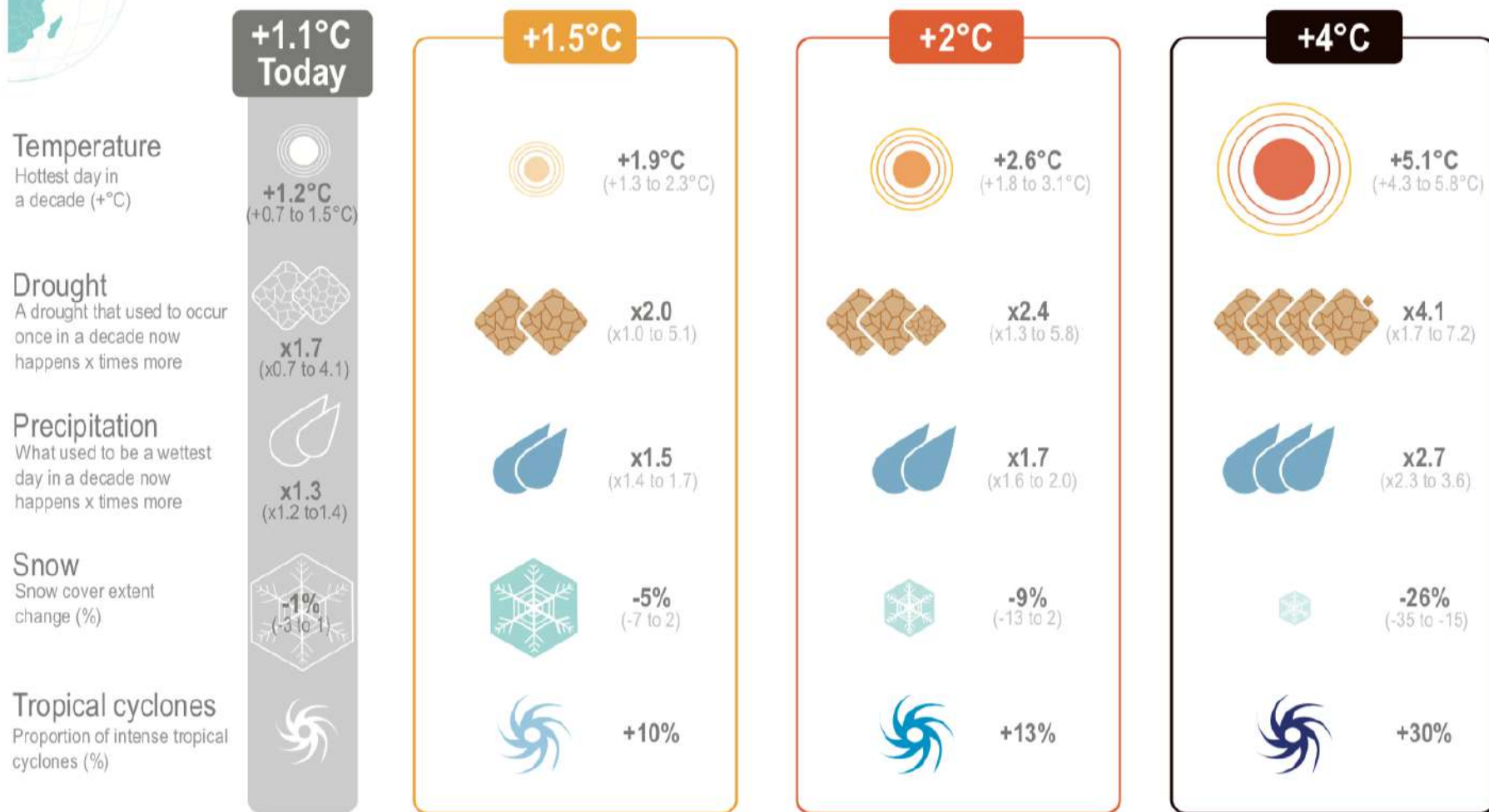
# Climate Futures: Changes in Projections (IPCC, 2021)



## Response of the climate system relative to 1850–1900

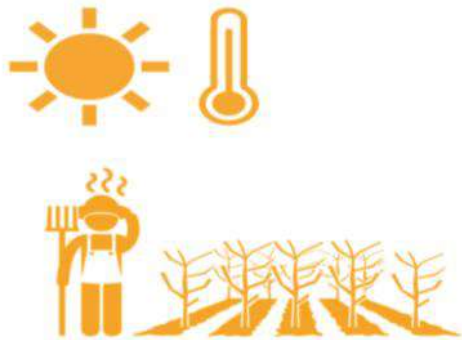
Many aspects of the climate system react quickly to temperature changes.

At progressively higher levels of global warming there are greater consequences (min/max range shown).



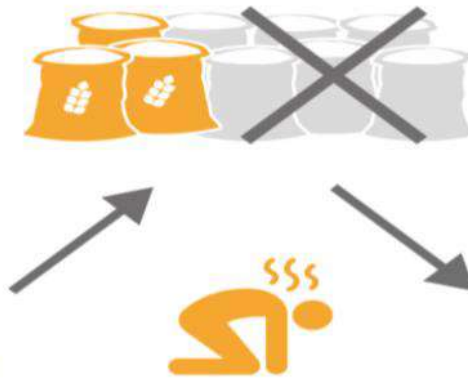
# Observed and projected impacts from climate change in the water cycle for human managed systems and crop yield productivity (IPCC, 2022)

Increasing heat and drought



Heat stress among farm workers

Reduced crop yield



Reduced productivity

Increased food prices



Reduced household incomes

Local effects



Potentially global effects

# Observed and projected impacts from climate change in the water cycle for human managed systems and crop yield productivity (IPCC, 2022)

Most regions have already experienced negative impacts on the water cycle and agricultural productivity.

## Direction of impact



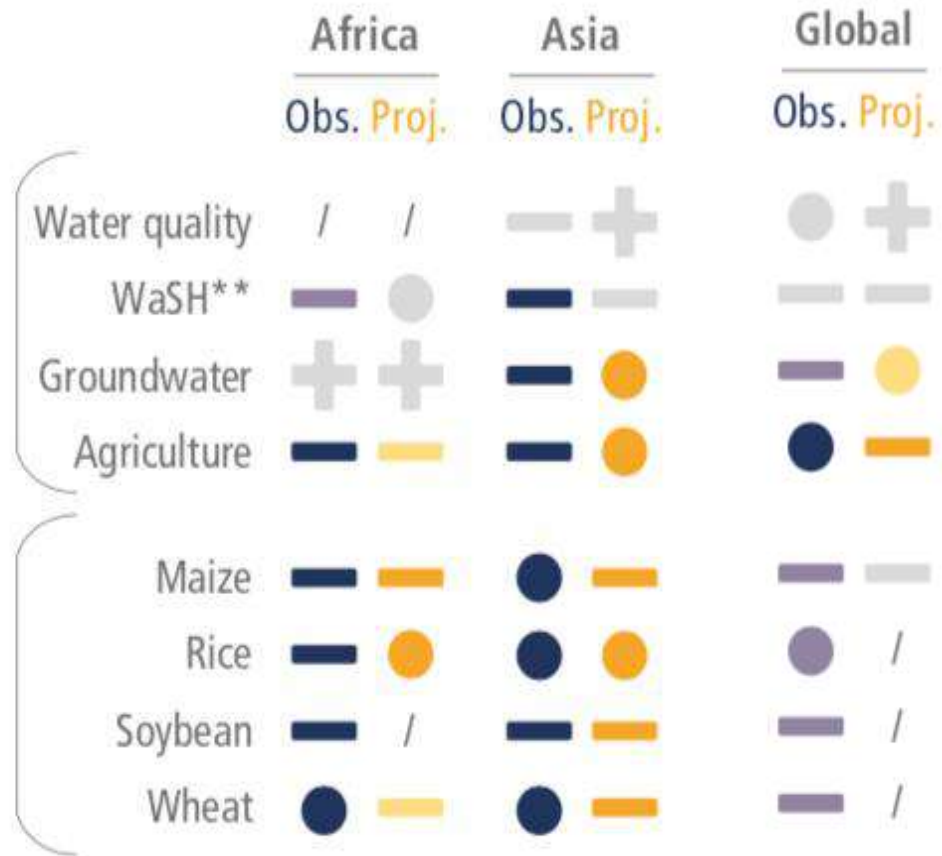
## Confidence in attribution to climate change

### Observed / Projected\*



## Impacts on human managed systems

## Impacts on crop yield productivity



\*Mid-century at RCP4.5 (~2°C Global Warming Level)

\*\* = Water, sanitation and hygiene

/ = Not observed or insufficient evidence

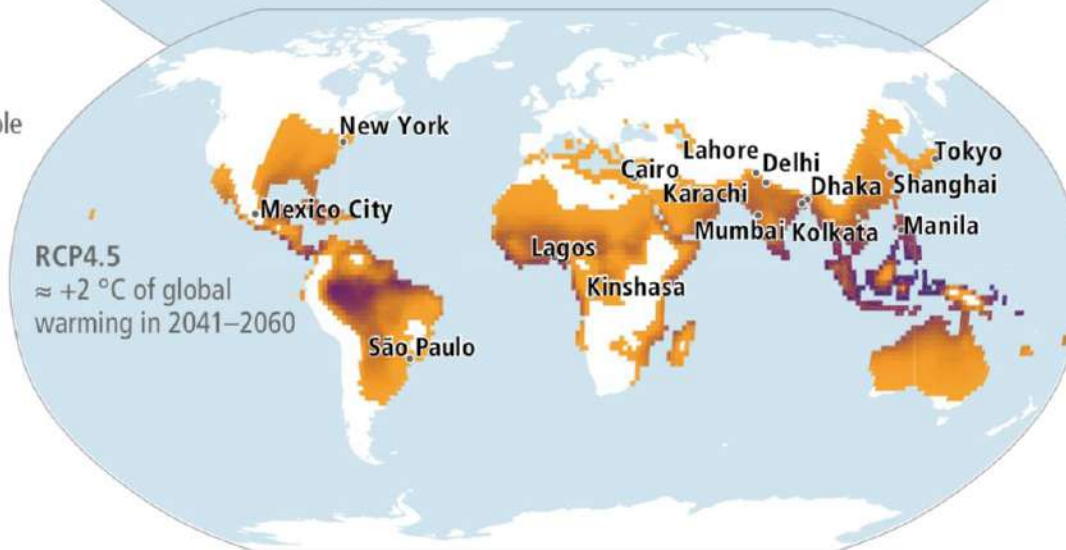
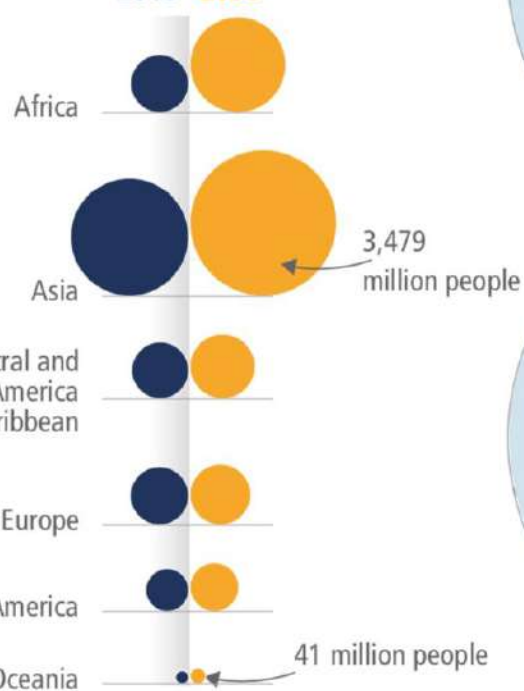
# Impacts of climate change are observed in many ecosystems and human systems worldwide (IPCC, 2022)

Map data without accounting for heatwaves.

Named cities are the largest 15 urban areas by population size.

## Urban population growth

2018 2050



Days per year when air temperature and humidity conditions pose a risk of death

365 days

1 day

# Climate Change Impacts in Asia, South Asia and Bangladesh

- **Urban infrastructure damage** and impacts on human well-being and health due to flooding, especially in coastal cities and settlements
- **Food and water insecurity** due to increased temperature extremes, rainfall variability and drought
- **Decline in coastal fishery** resources due to sea level rise, decrease in precipitation in some parts and increase in temperature
- **Biodiversity loss and habitat shifts** and disruptions in dependent human systems e.g. freshwater, land and ocean ecosystems
- More frequent and extensive coral bleaching and mortality induced by **ocean warming, acidification & SLR**
- In South Asia, **35.7 million people pushed to extreme poverty** by 2030

# Climate Change Impacts in Asia, South Asia and Bangladesh

- **South Asia** will loss 2% of annual GDP due to climate change impacts by 2050 & 9% by 2100 based on BAU – this number is same for Bangladesh.
- **In South Asia**, climate change will cause up to 40 million climate migrations by 2050.
- Nearly 26 million people are currently exposed to very high salinity in shallow groundwater in **coastal Bangladesh**
- From 2012 to 2050, freshwater river area is expected to decrease from 40.8% to 17.1%- 19.7% under different sea-level rise scenarios in the **southwest coastal zone of Bangladesh**
- **In Bangladesh**, approximately one-third of power plants may need to be relocated by 2030 to avoid inundations caused by SLR.

# Thank you

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**Thank you**