

Prof. Paul N. Edwards

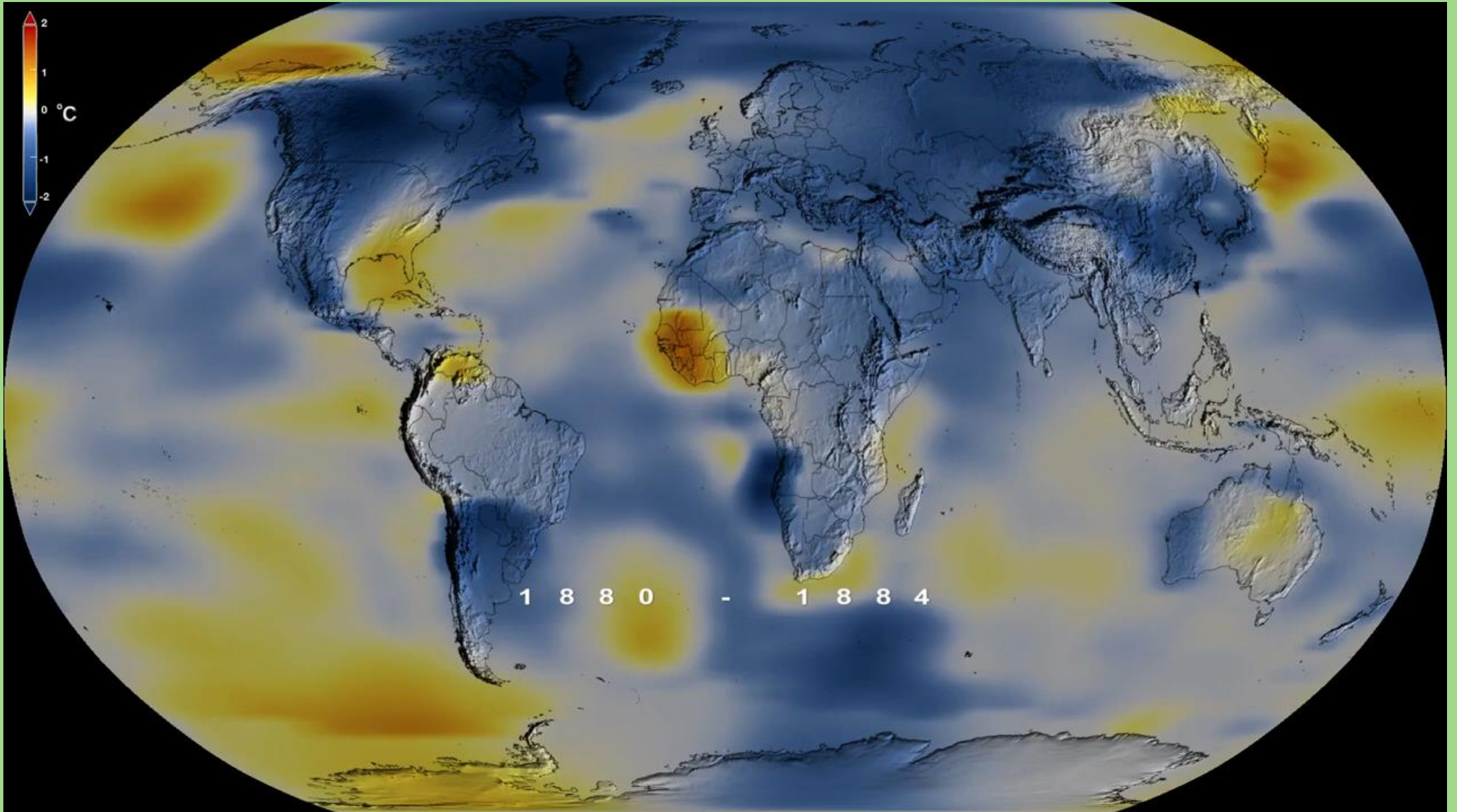
Program in Science, Technology & Society

Stanford Existential Risks Initiative

Stanford University

▀ The climate crisis and the global village

140 years of climate data in 30 seconds



5-year moving averages. Baseline: 1951-1980 average

Source: NASA Goddard Space Flight Center

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Science

Climate change: Last decade confirmed as warmest on record

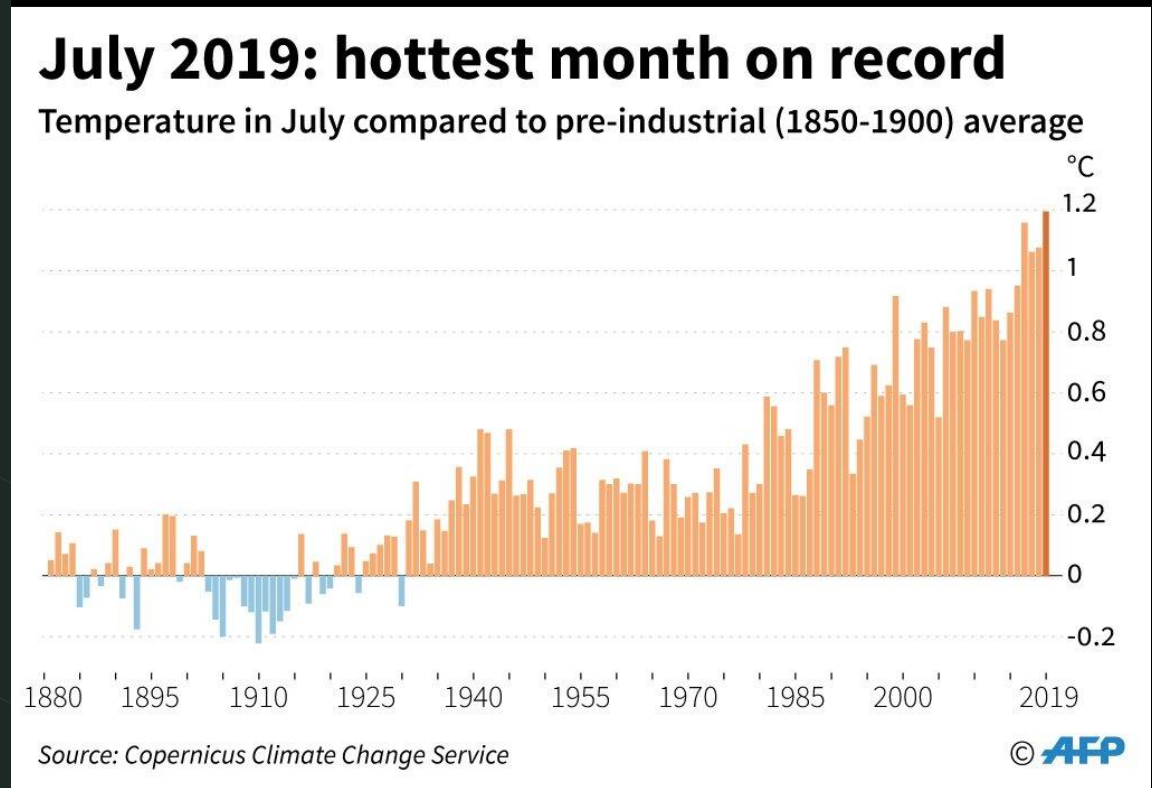
By Matt McGrath
Environment correspondent

15 January 2020

Earth

Jan 14, 2021
RELEASE 21-005

2020 Tied for Warmest Year on Record, NASA Analysis Shows



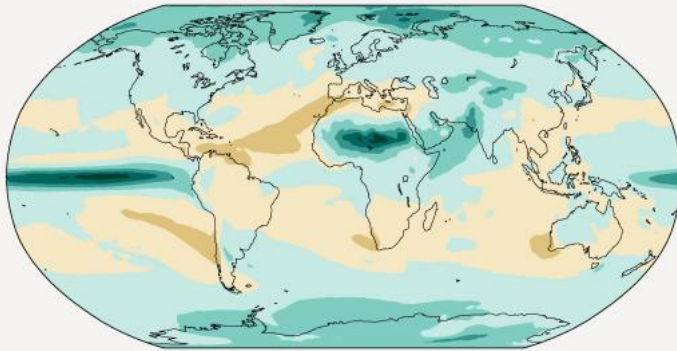
With every increment of global warming, changes get larger in regional mean temperature, precipitation and soil moisture

Figure SPM.5

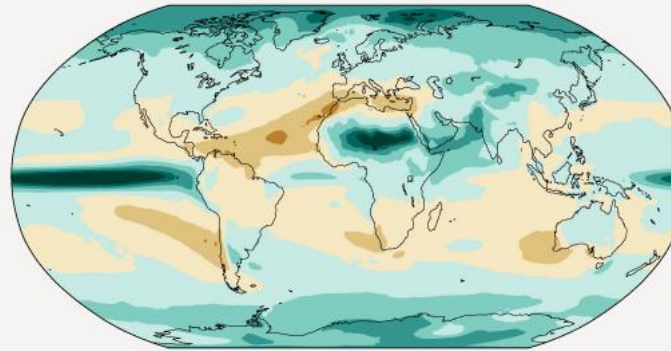
c) Annual mean precipitation change (%) relative to 1850-1900

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.

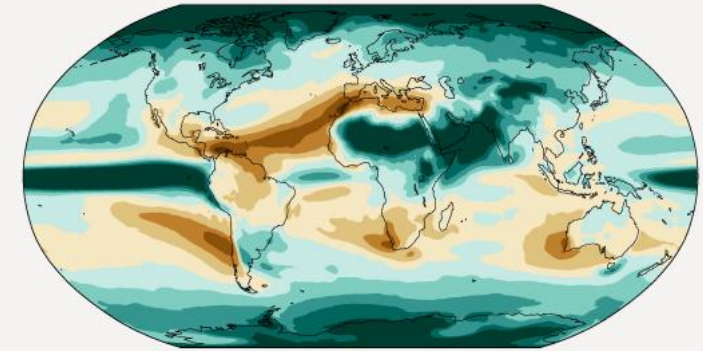
Simulated change at 1.5 °C global warming



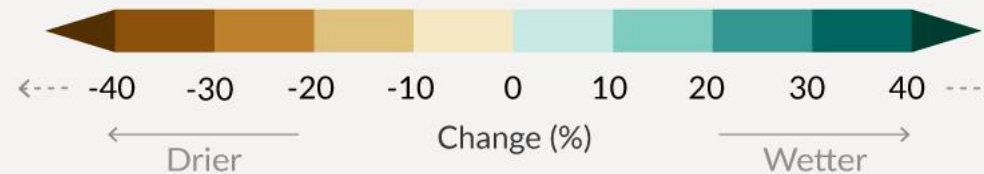
Simulated change at 2 °C global warming



Simulated change at 4 °C global warming



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



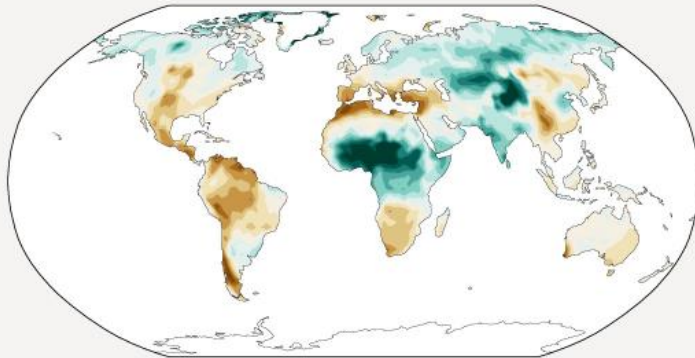
With every increment of global warming, changes get larger in regional mean temperature, precipitation and soil moisture

Figure SPM.5

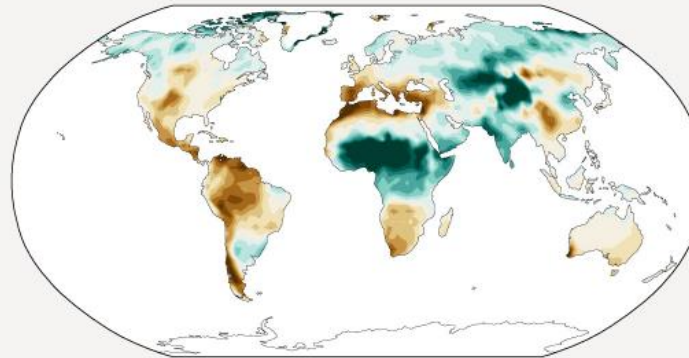
d) Annual mean total column soil moisture change (standard deviation)

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

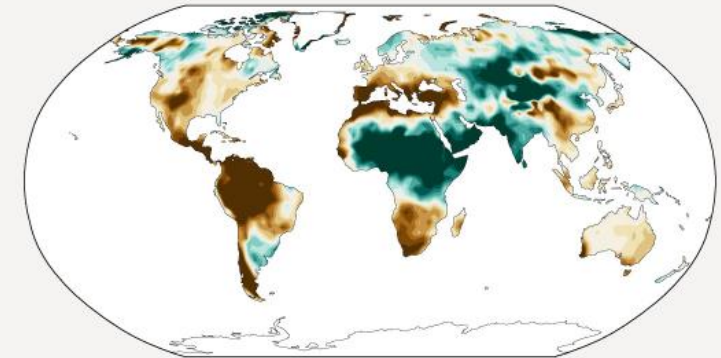
Simulated change at 1.5 °C global warming



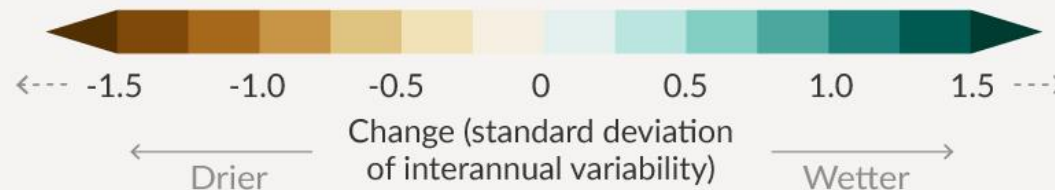
Simulated change at 2 °C global warming



Simulated change at 4 °C global warming

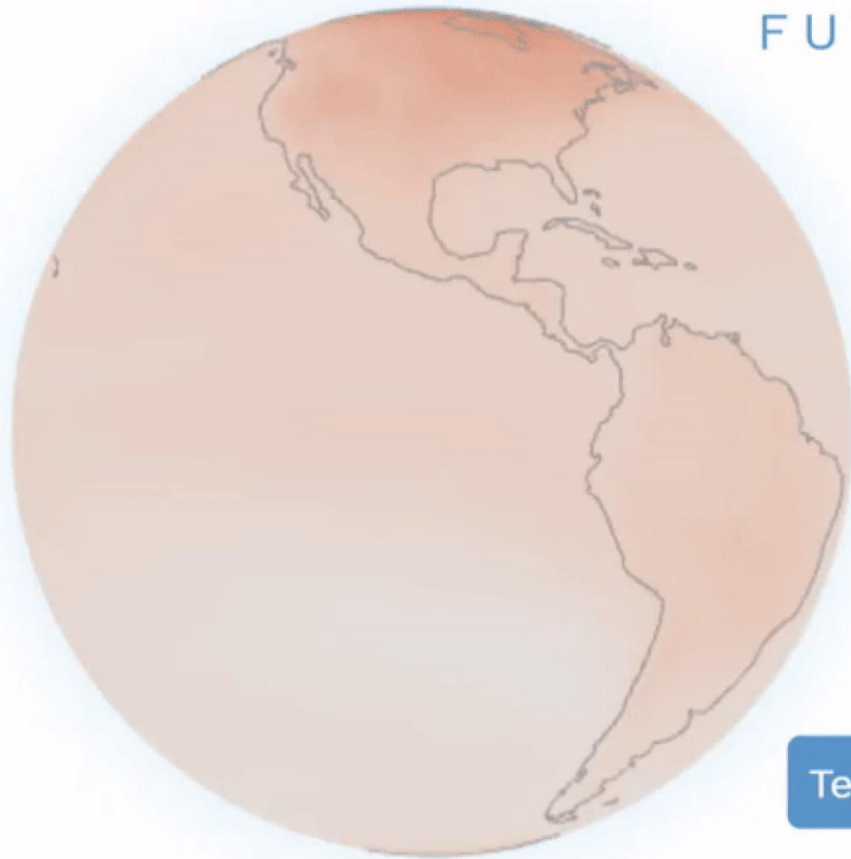


Relatively small absolute changes may appear large when expressed in units of standard deviation in dry regions with little interannual variability in baseline conditions



Interactive atlas

OUR POSSIBLE
CLIMATE
FUTURES



+1.5°C

+2°C

+3°C

+4°C

Temperature

Precipitation

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

#IPCCData

#IPCCAtlas

Lethal wet-bulb temps

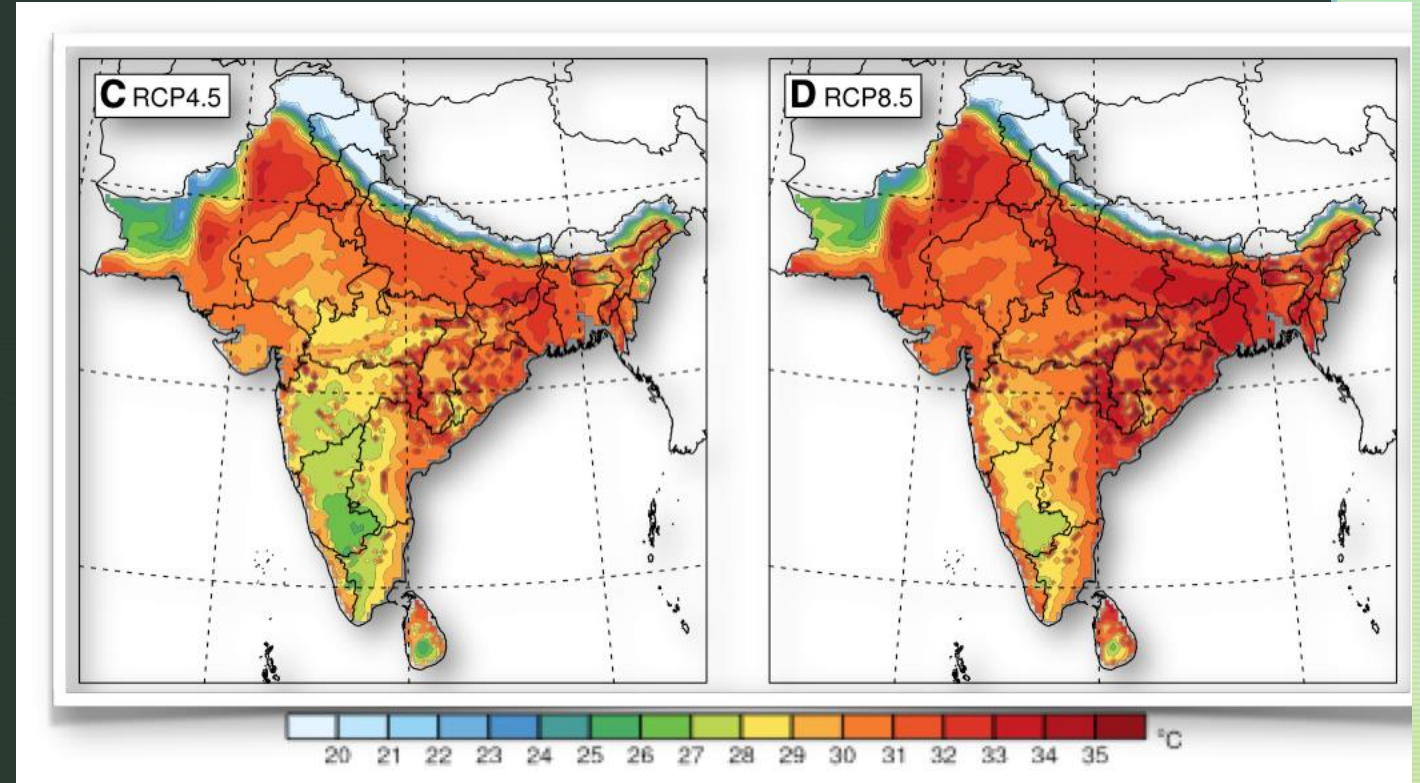
Projections for the Indian subcontinent, 2071-2100

In high humidity, sweating cannot cool a person because the air is already saturated with water and the sweat can't evaporate.

35°C is lethal within 6 hours at 95% humidity

Medium climate policy
(partial emissions
reductions)

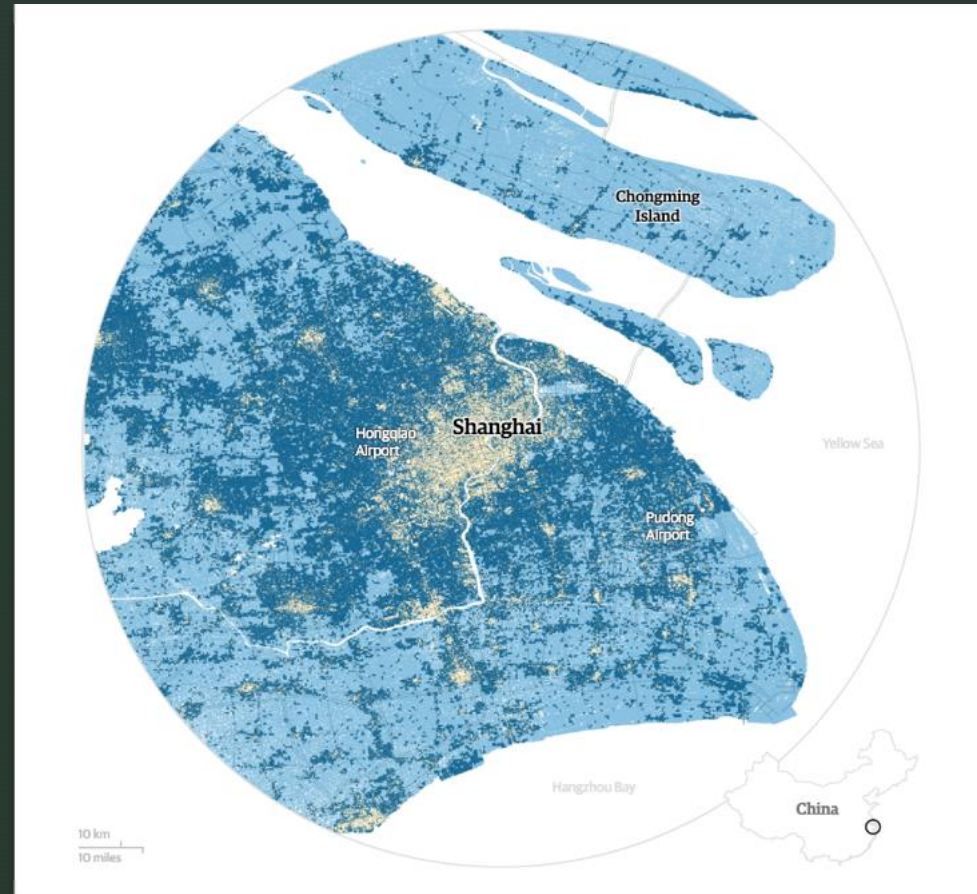
Very high emissions



Source: Im, E. S., J. S. Pal, and E. A. B. Eltahir. 2017. "Deadly Heat Waves Projected in the Densely Populated Agricultural Regions of South Asia." *Science Advances* 3 (8): e1603322.

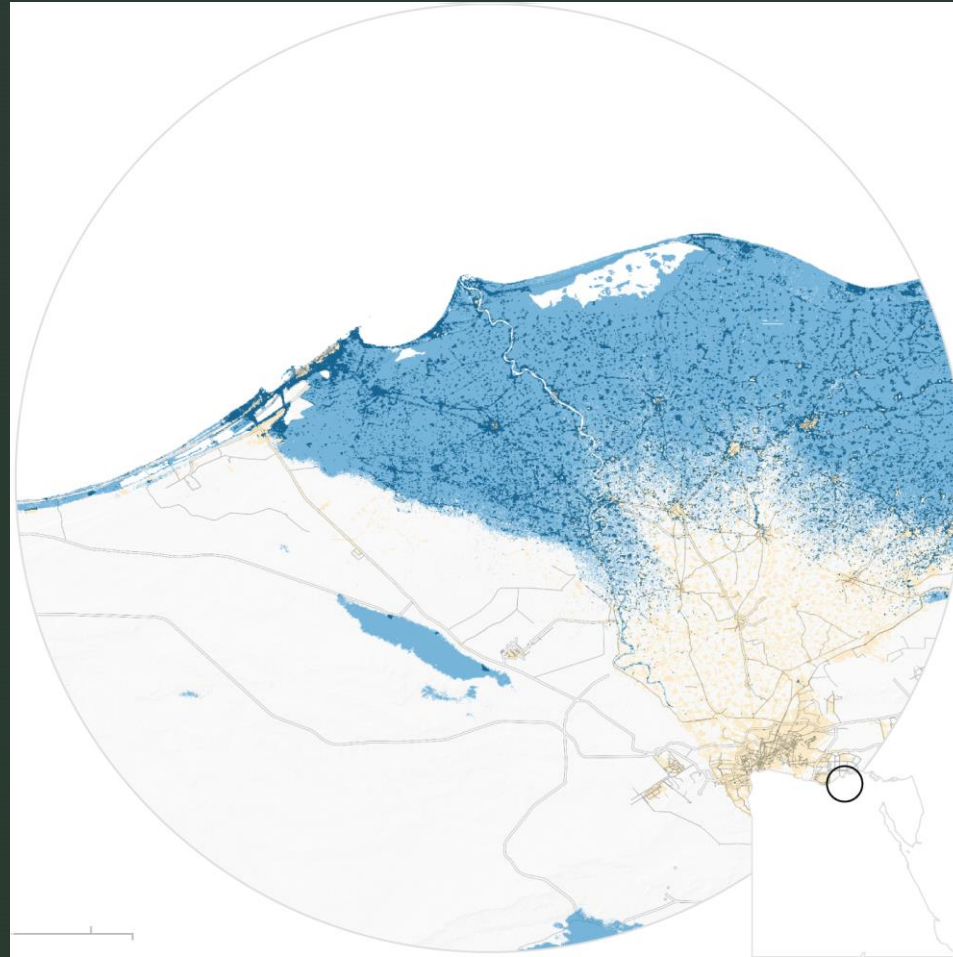
35°C = 95°F

- Sea level rise:
Shanghai (17.5 million people) at 3°C



Source: Holder et al., “The three-degree world: the cities that will be drowned by global warming,” *The Guardian*, November 2017

- Sea level rise:
Alexandria, Egypt (3 million people) at 3°C



Source: Holder et al., "The three-degree world: the cities that will be drowned by global warming," *The Guardian*, November 2017



Consequences of climate change

- Geographically widespread – no region untouched
- Most dramatic in the Arctic (largest warming) and the Global South (humid tropical climates could become uninhabitable)
- Disruptive to
 - Seacoasts and flood plains
 - Wetlands
 - Food supplies, especially in subsistence economies
 - Human health: heat waves, insect-borne diseases
 - Forests in dry regions
 - Fisheries, especially shellfish (ocean acidification)

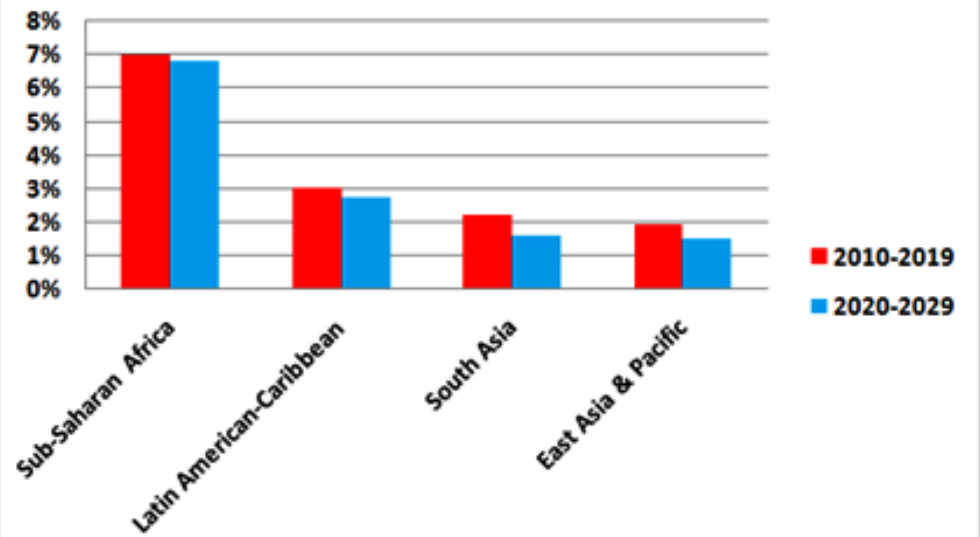
Economic impacts of climate change

Average real GDP loss by 2050

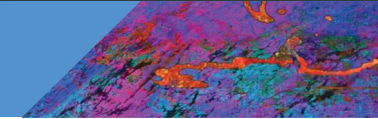


Source: Economist Intelligence Unit © AFP

Adaptation Costs as Percentage of GDP



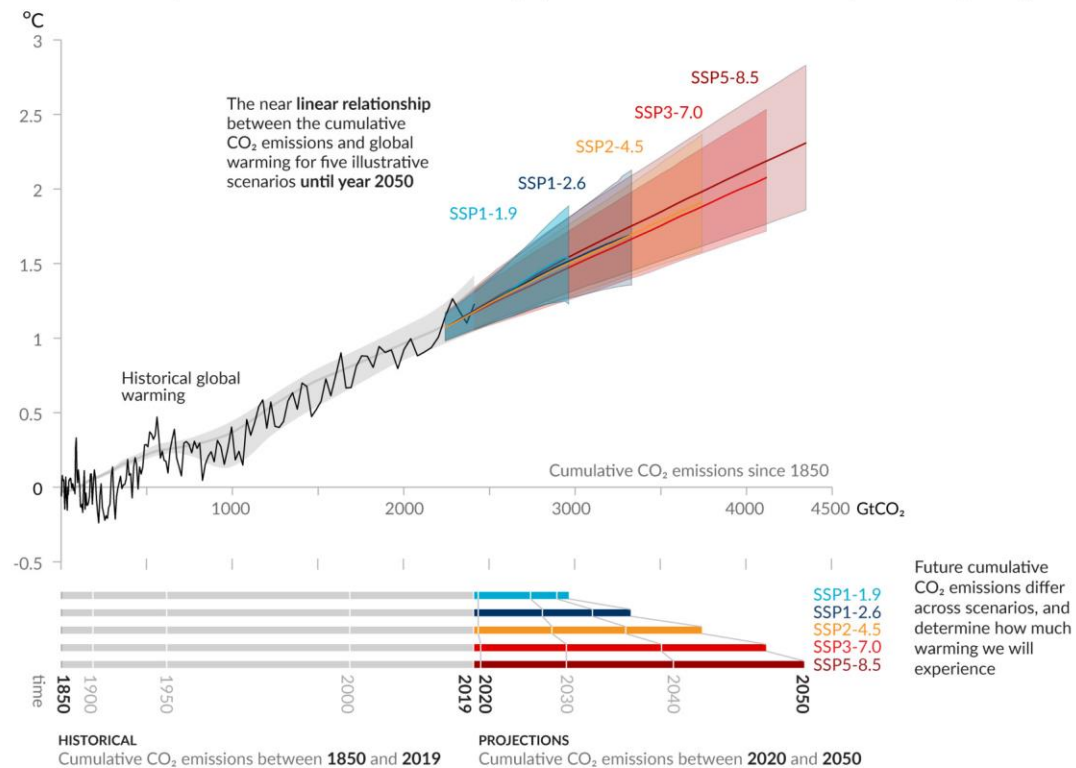
Based on "Costs to Developing Countries of Adapting to Climate Change," World Bank, 2009



Every tonne of CO₂ emissions adds to global warming

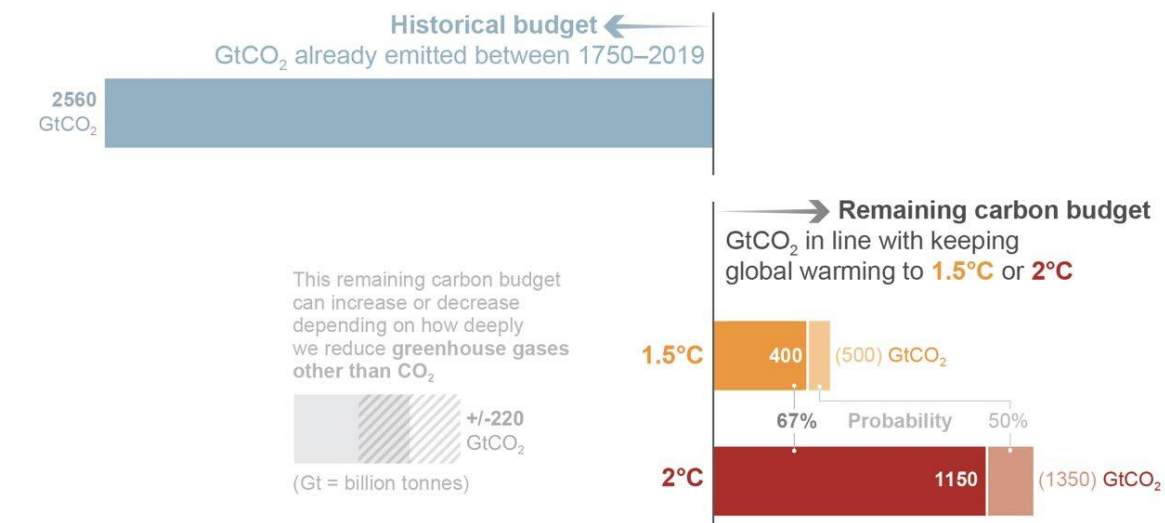
Figure SPM.10

Global surface temperature increase since 1850-1900 (°C) as a function of cumulative CO₂ emissions (GtCO₂)

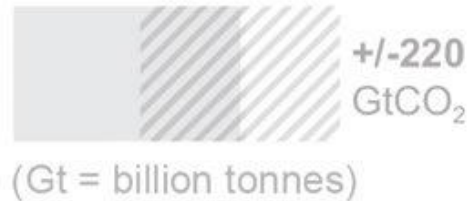


FAQ 5.4: What are Carbon Budgets?

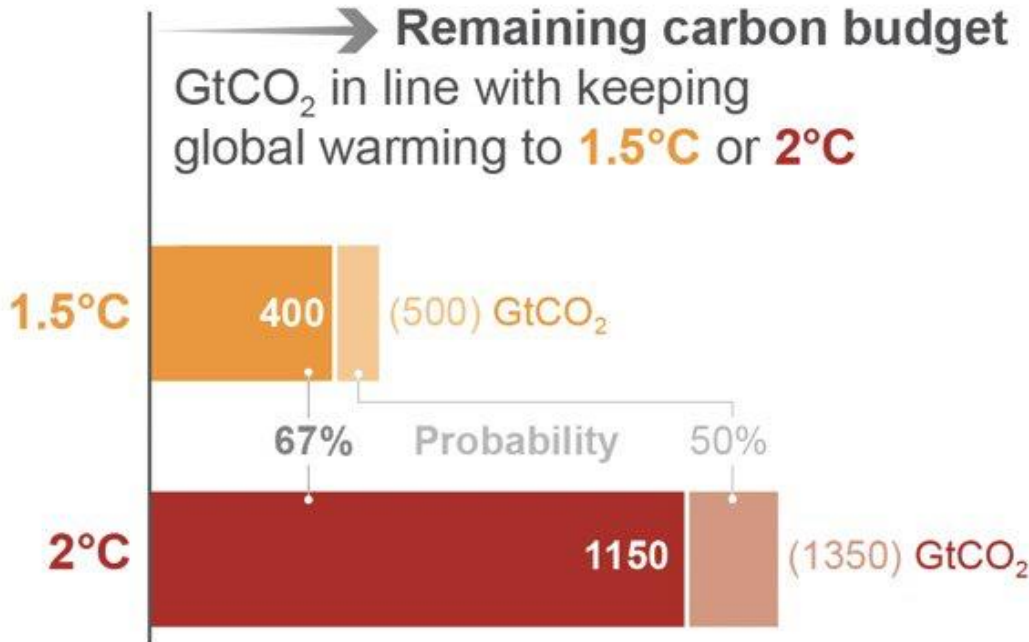
The term carbon budget is used in several ways. Most often the term refers to the total net amount of carbon dioxide (CO₂) that can still be emitted by human activities while limiting global warming to a specified level.



This remaining carbon budget can increase or decrease depending on how deeply we reduce greenhouse gases other than CO₂



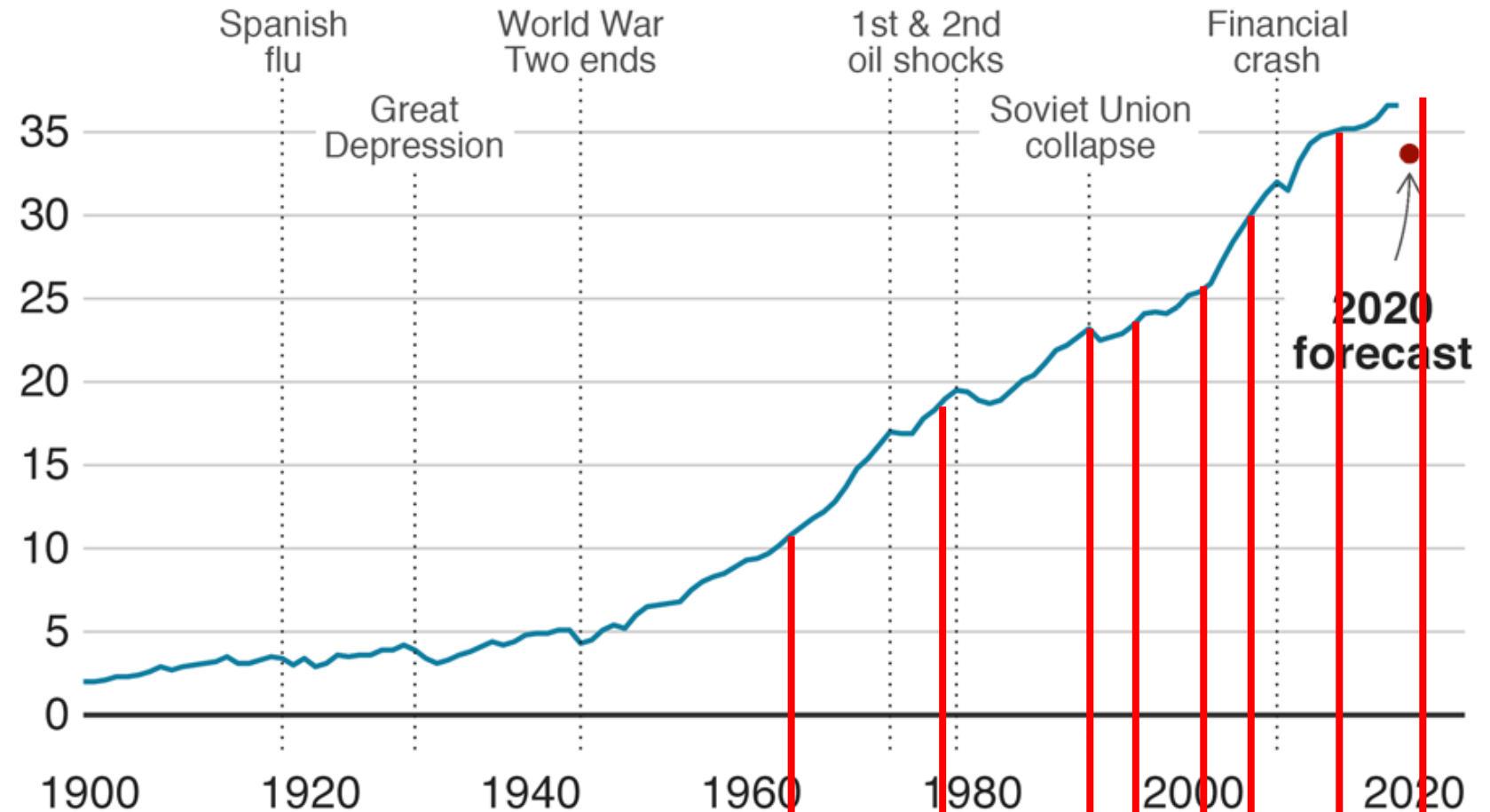
ie term refers to the total net amount of carbon dioxide g global warming to a specified level.



Climate
knowledge
versus
global
CO₂
emissions

Global CO₂ emissions, 1900-present

Billion tonnes of CO₂ per year



Source: Global Carbon Project, CDIAC & IEA

BBC

PSAC report
on climate
change risk

Scientific
consensus
on climate
sensitivity

IPCC reports:
1990, 1995, 2001, 2007, 2013, 2021

Surprising solutions: *Drawdown* modeling (Hawken et al.)

Rank	Solution	Sector	TOTAL ATMOSPHERIC CO2-EQ REDUCTION (GT)	NET COST (BILLIONS US \$)	SAVINGS (BILLIONS US \$)
1	Refrigerant Management	Materials	89.74	N/A	\$-902.77
2	Wind Turbines (Onshore)	Electricity Generation	84.60	\$1,225.37	\$7,425.00
3	Reduced Food Waste	Food	70.53	N/A	N/A
4	Plant-Rich Diet	Food	66.11	N/A	N/A
5	Tropical Forests	Land Use	61.23	N/A	N/A
6	Educating Girls	Women and Girls	51.48	N/A	N/A
7	Family Planning	Women and Girls	51.48	N/A	N/A
8	Solar Farms	Electricity Generation	36.90	\$-80.60	\$5,023.84
9	Silvopasture	Food	31.19	\$41.59	\$699.37
10	Rooftop Solar	Electricity Generation	24.60	\$453.14	\$3,457.63



Can we prevent a climate catastrophe?

People have intentionally taken on great problems and addressed them successfully.

- We ended African slavery
- We eradicated smallpox
- We dismantled 80 percent of nuclear weapons
- We saved the ozone layer from destruction

**Courage is resistance to fear,
mastery of fear, not absence
of fear.**

Mark Twain