UN environment programme | finance initiative

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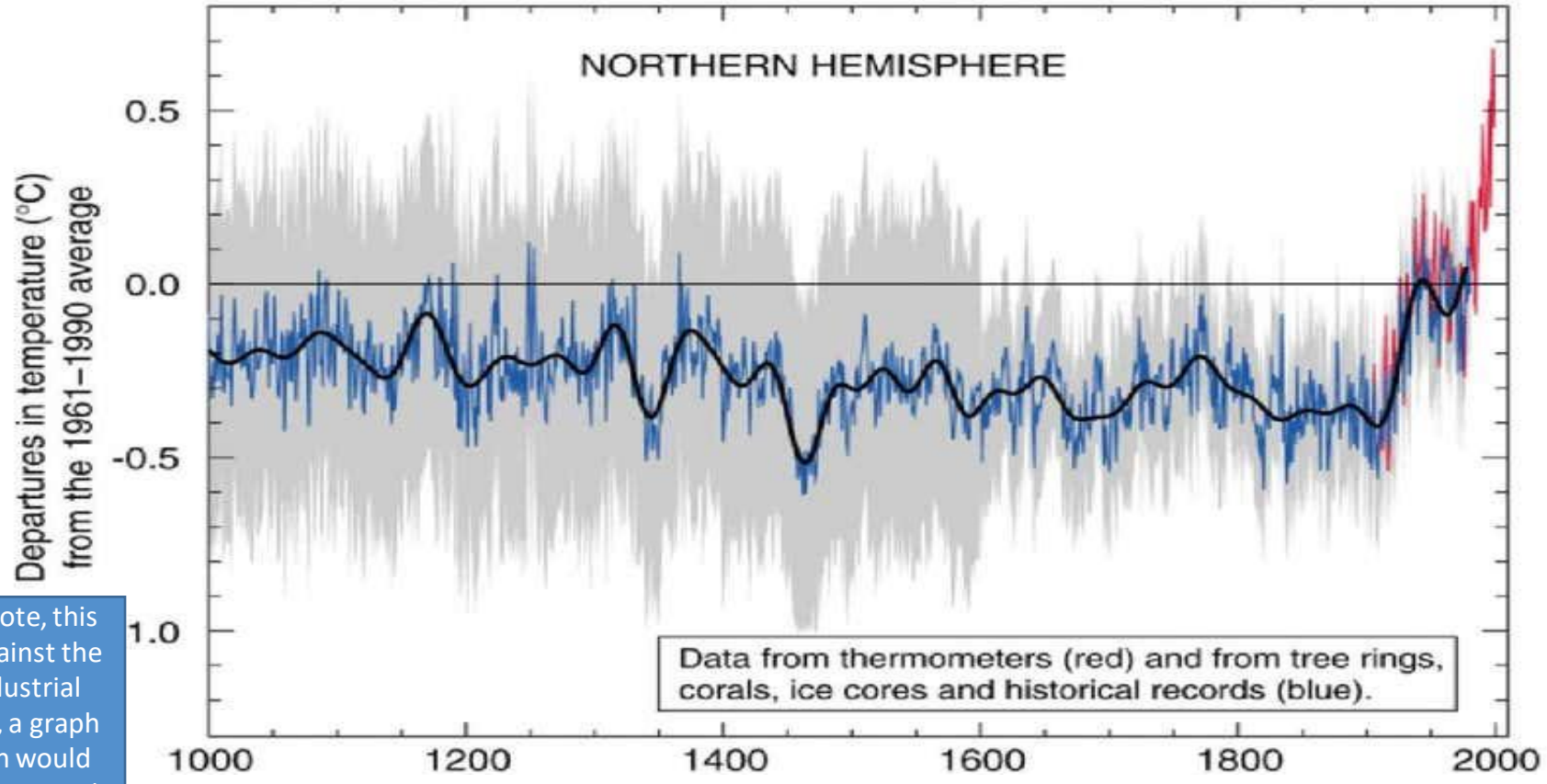
Climate Change: A guide to understanding the science, the risks, and the uncertainties

David Carlin

How do we know climate change is happening? The famous hockey stick

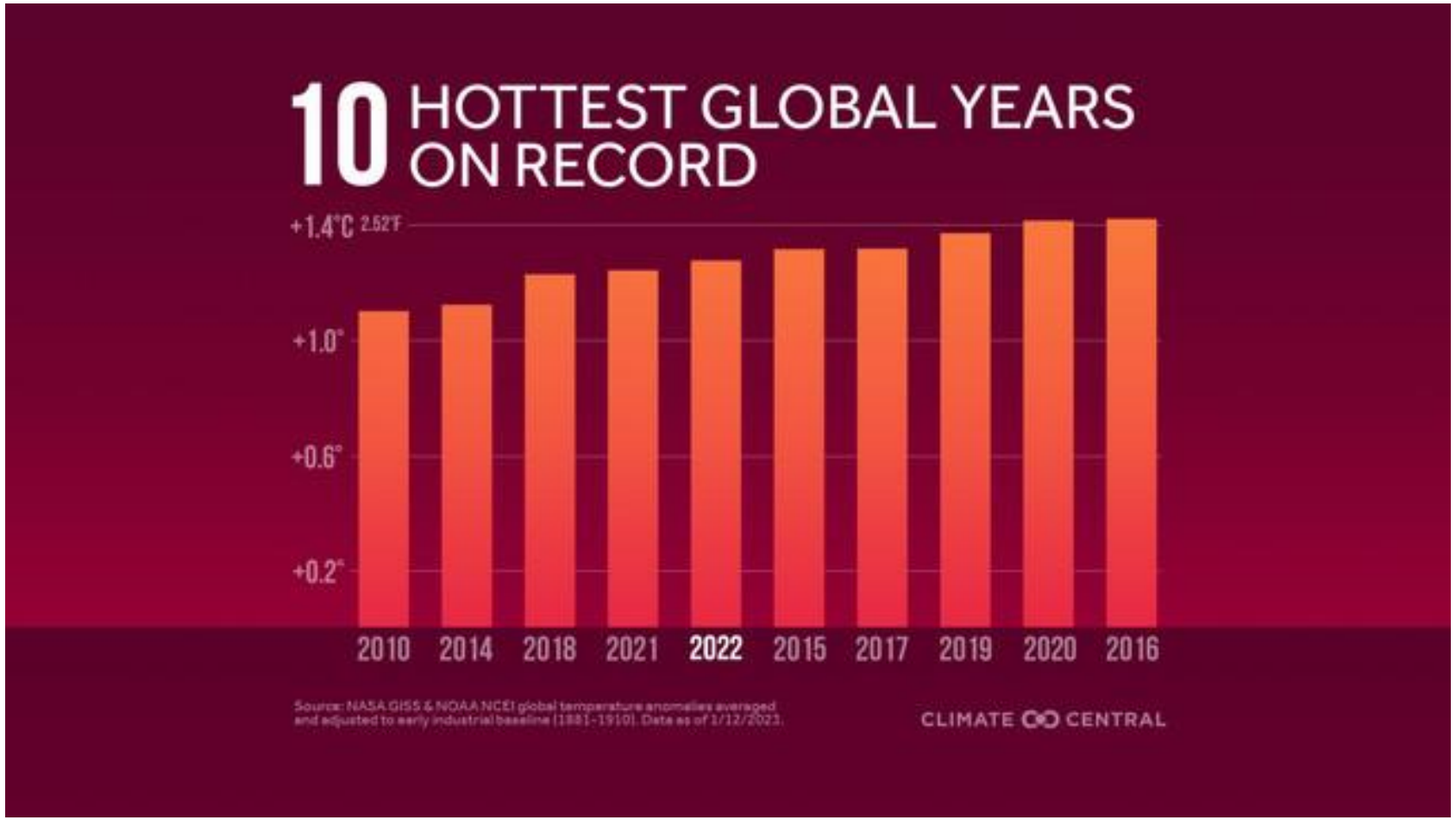


As powerful as the warming signal was around 2000, it has only intensified in the two decades since

Please note, this is not against the pre-industrial baseline, a graph of which would show more total warming

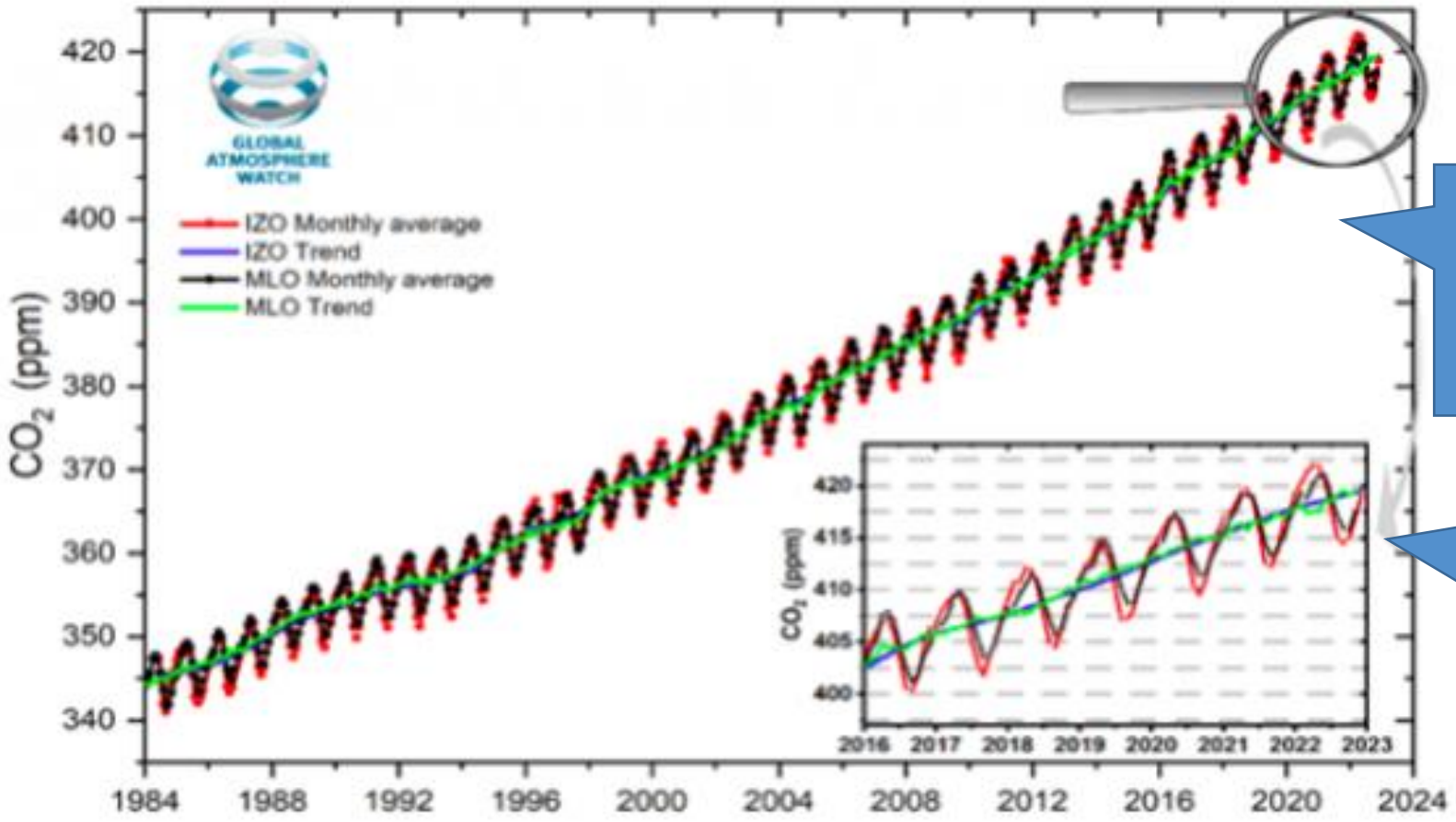
Source:Nature

…A more recent view shows even more warming



2023 is an El Nino year and is likely to smash records

What is driving climate change?



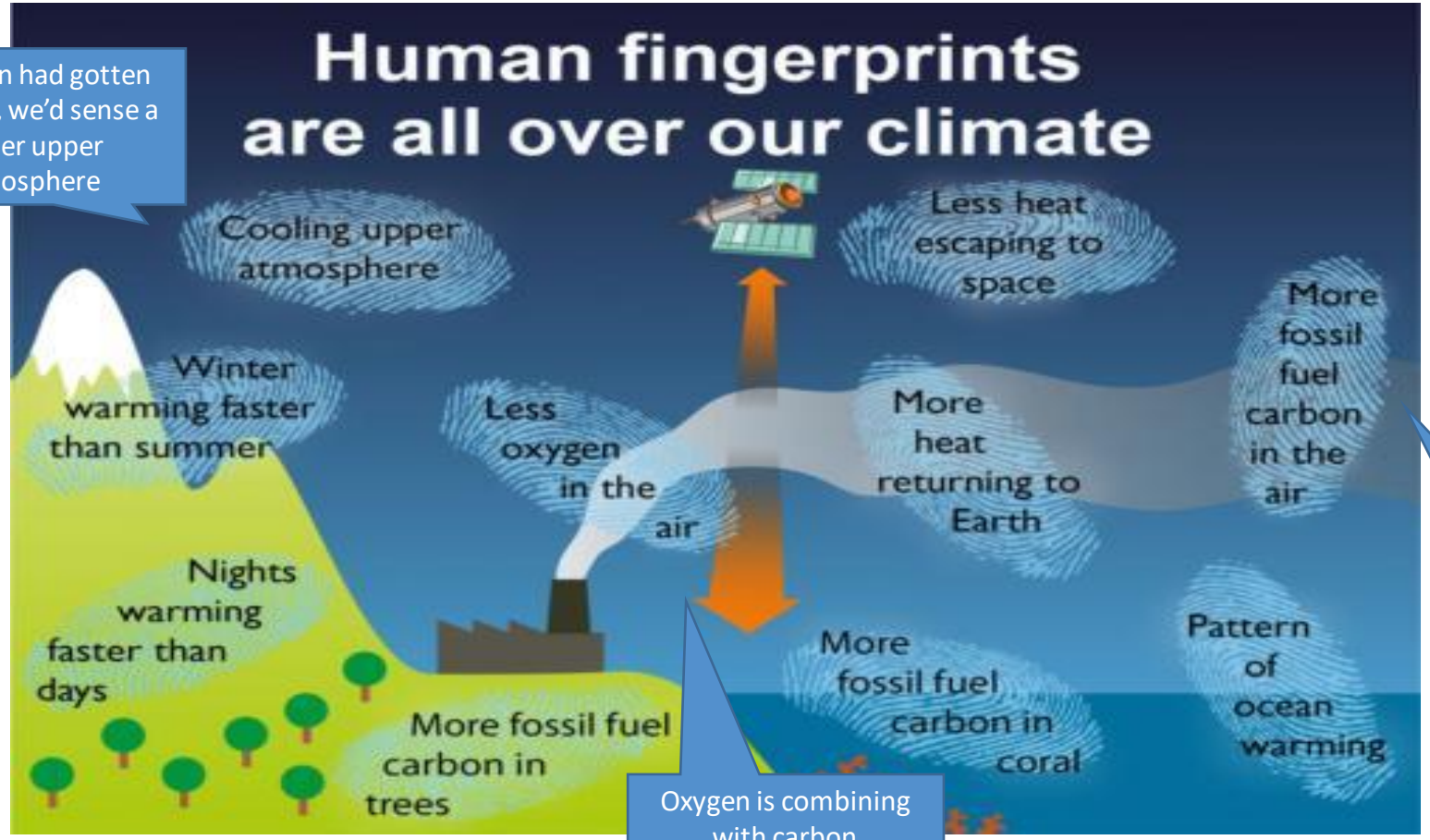
In the past 30 years we've emitted more than 50% of the CO2 humanity has put into the atmosphere

The oscillations are from the Northern Hemisphere having much more land and by extension plant matter. In Northern Spring and Summer, plants take up CO2 in their leaves, and in the Fall and Winter that CO2 is released back as the leaves fall

Source: WMO

How do we know it's us?

If the sun had gotten stronger, we'd sense a hotter upper atmosphere

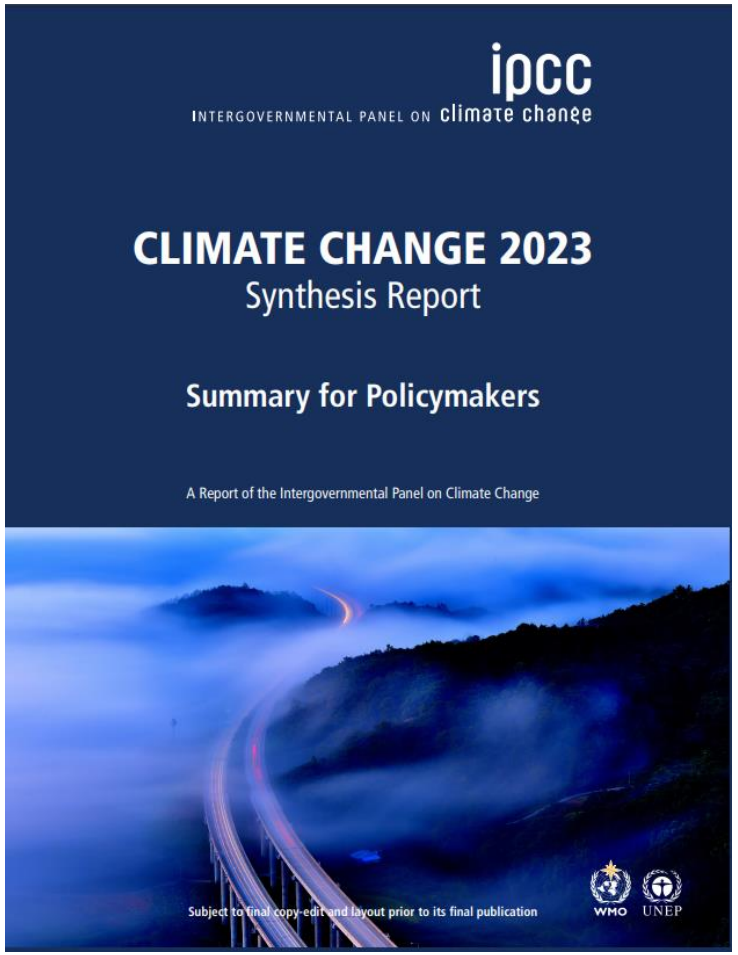


Source: Skeptical Science

Oxygen is combining with carbon (combustion) to form CO2

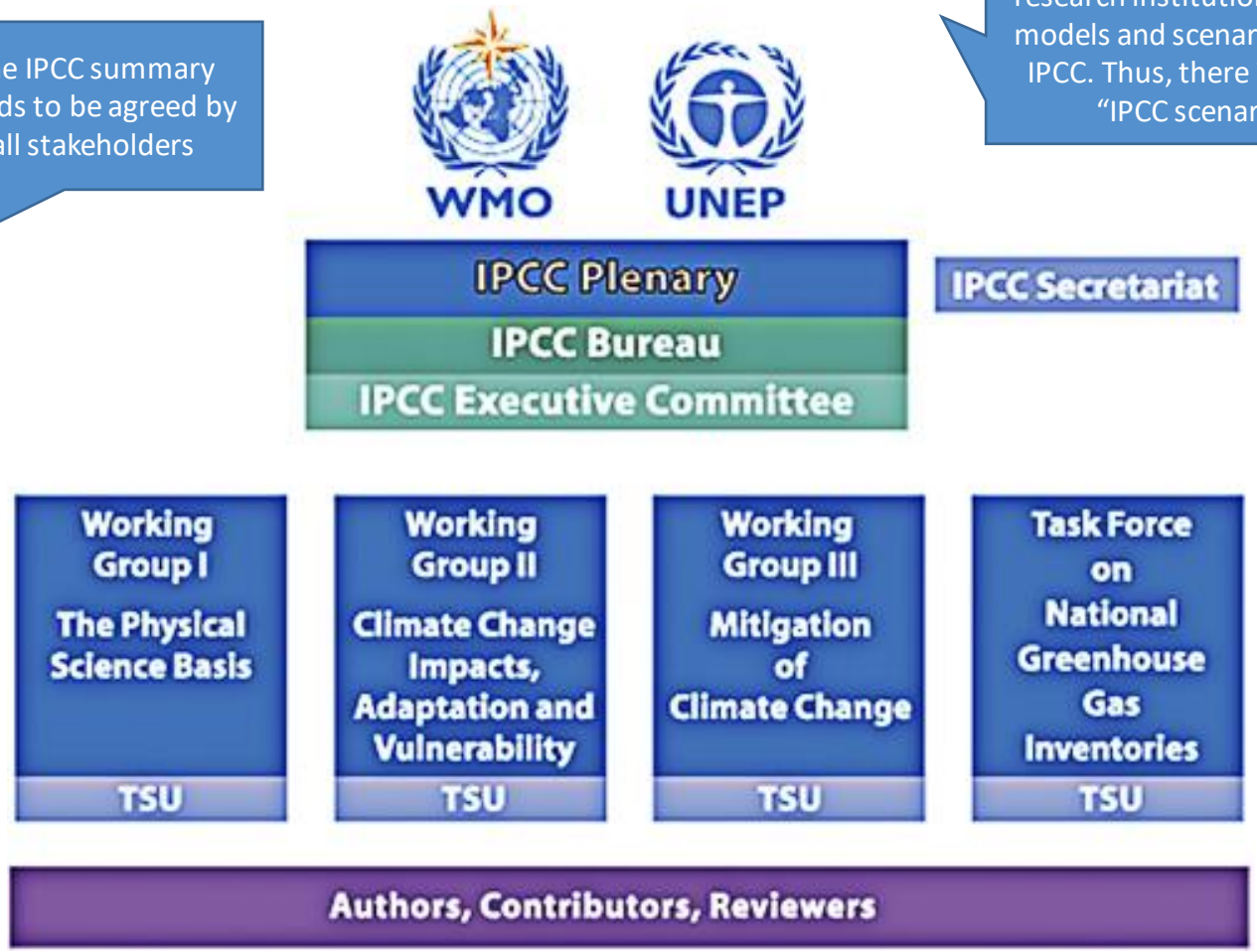
We can tell that CO2 is from fossil fuel sources since it has a different prevalence of carbon's radioactive isotope

Where does our latest understanding of climate come from? IPCC AR 6



The IPCC summary needs to be agreed by all stakeholders

The IPCC does not "create" models or scenarios, research institutions submit models and scenarios to the IPCC. Thus, there is not an "IPCC scenario"

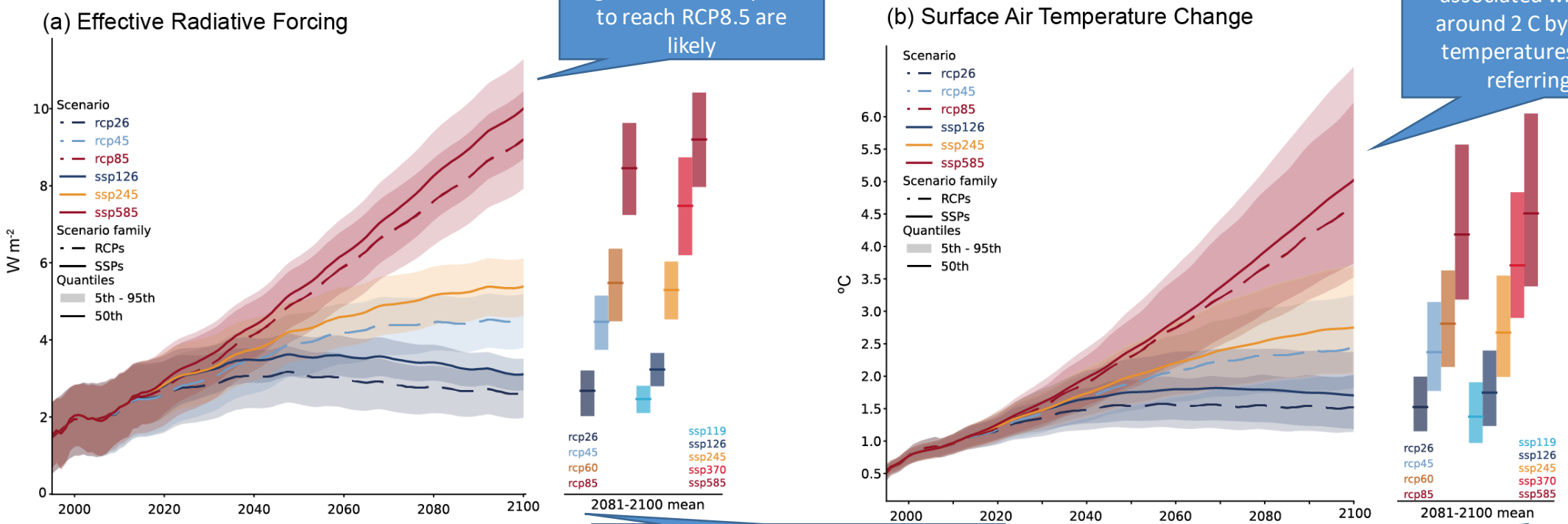


Source: IPCC

What does the latest IPCC report say about future climate change? WG 1

Few now believe the high emissions required to reach RCP8.5 are likely

Modelers think in terms of RCPs when calibrating their models rather than temperatures. Temperatures are an outcome or an approximation. For example, RCP2.6 is typically associated with warming of around 2 C by 2100. Also, all temperatures and RCPs are referring to 2100.

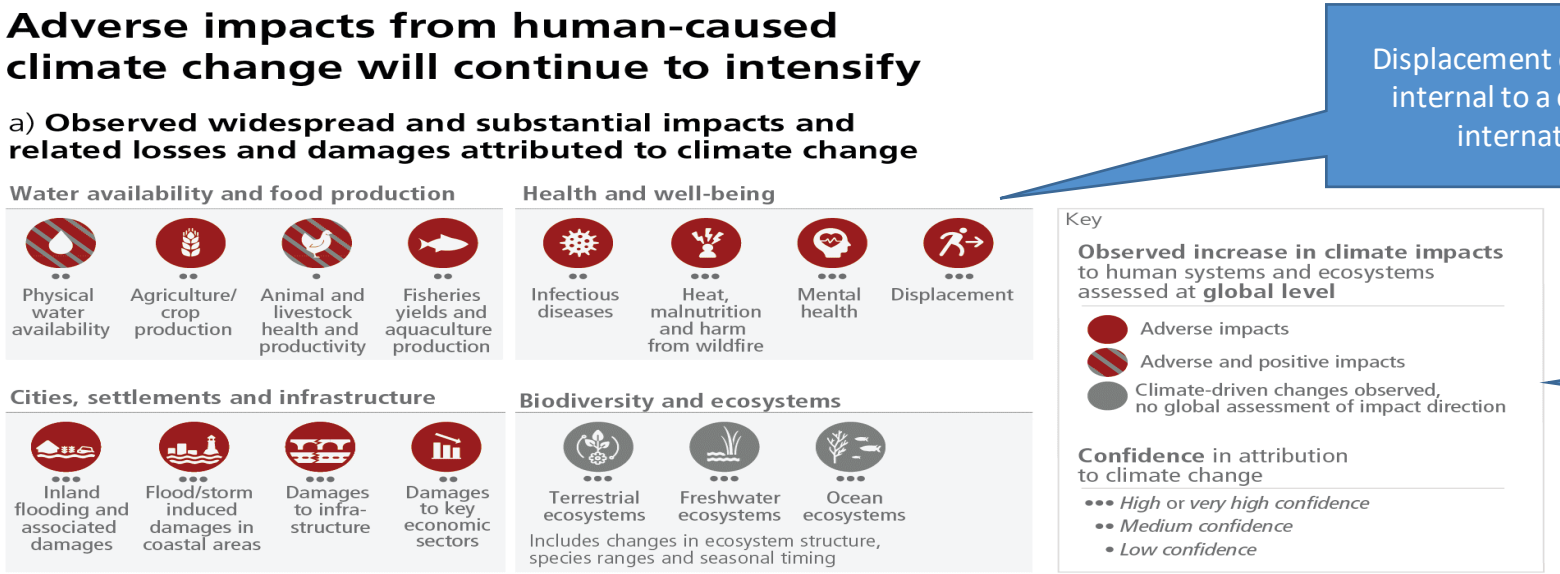


Radiative forcings are the extra energy added to the climate system in W/m2 so RCP2.6 (Representative Concentration Pathway) means additional energy of 2.6 W/m2

SSPs are shared socioeconomic pathways, narratives used within the scenarios. For example SSP1 involves international commitments to green energy and climate goals, SSP5 prioritizes fossil fuels.

Source: IPCC

What does the latest IPCC report say about climate impacts? WG 2



Displacement can be both internal to a country or international

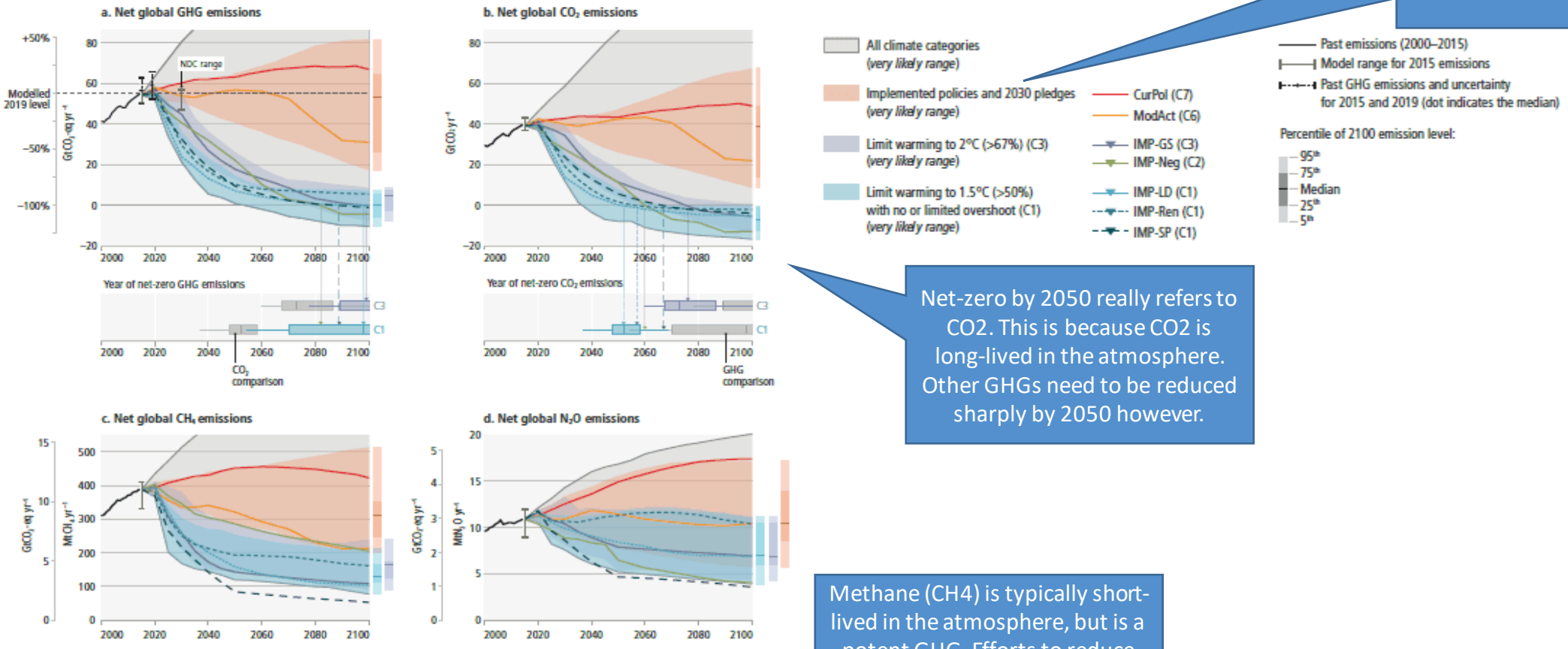
What is notable is the extent of adverse impacts already being experienced globally due to climate change. These are not future forecasts, but current crises.

As time goes on, the impacts of climate change on natural systems is likely to become more apparent

Source: IPCC

What does the latest IPCC report say about climate mitigation? WG 3

We face an ambition gap between commitments and our Paris goals.

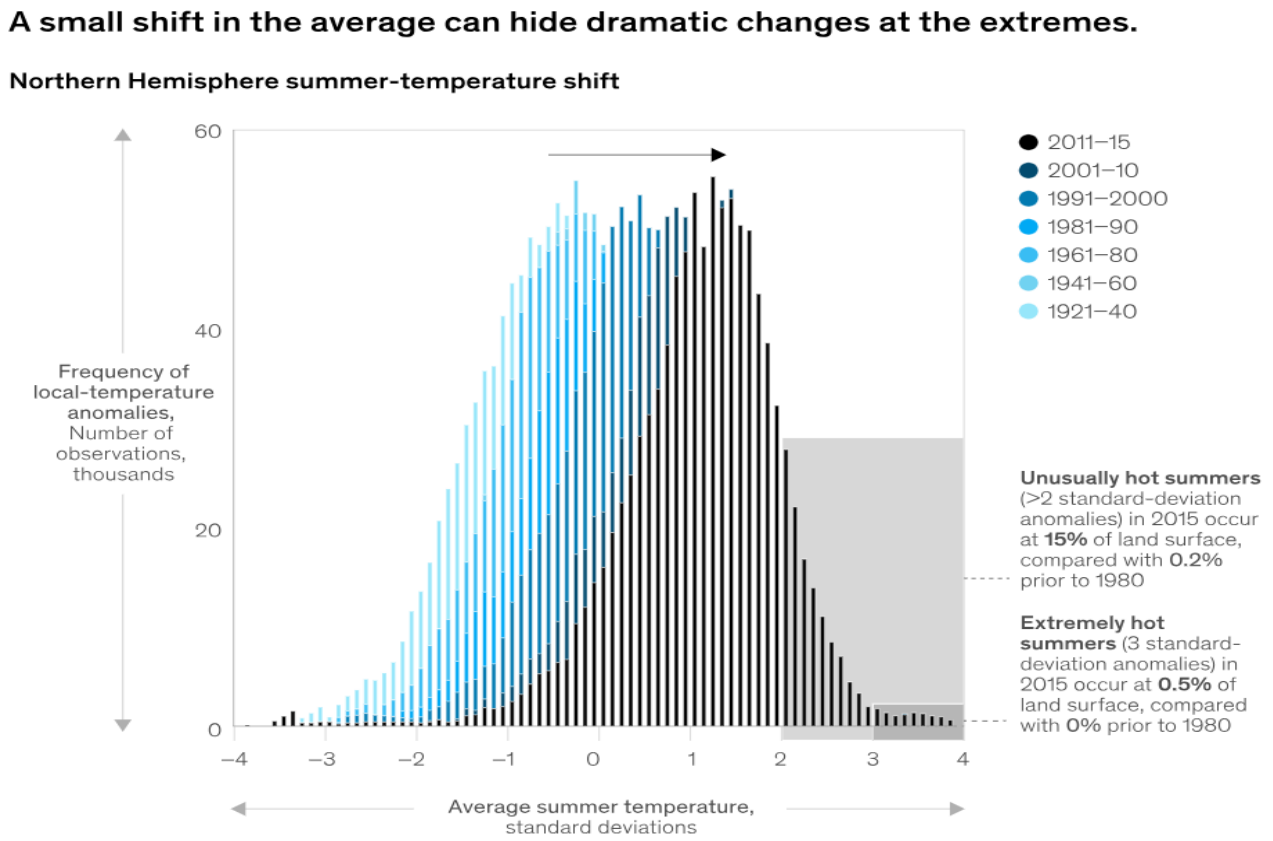


Net-zero by 2050 really refers to CO2. This is because CO2 is long-lived in the atmosphere. Other GHGs need to be reduced sharply by 2050 however.

Methane (CH4) is typically short-lived in the atmosphere, but is a potent GHG. Efforts to reduce CH4 emissions now can play an important role in limiting dangerous temperature rise

Source: IPCC

How do we think of climate impacts from a risk perspective?

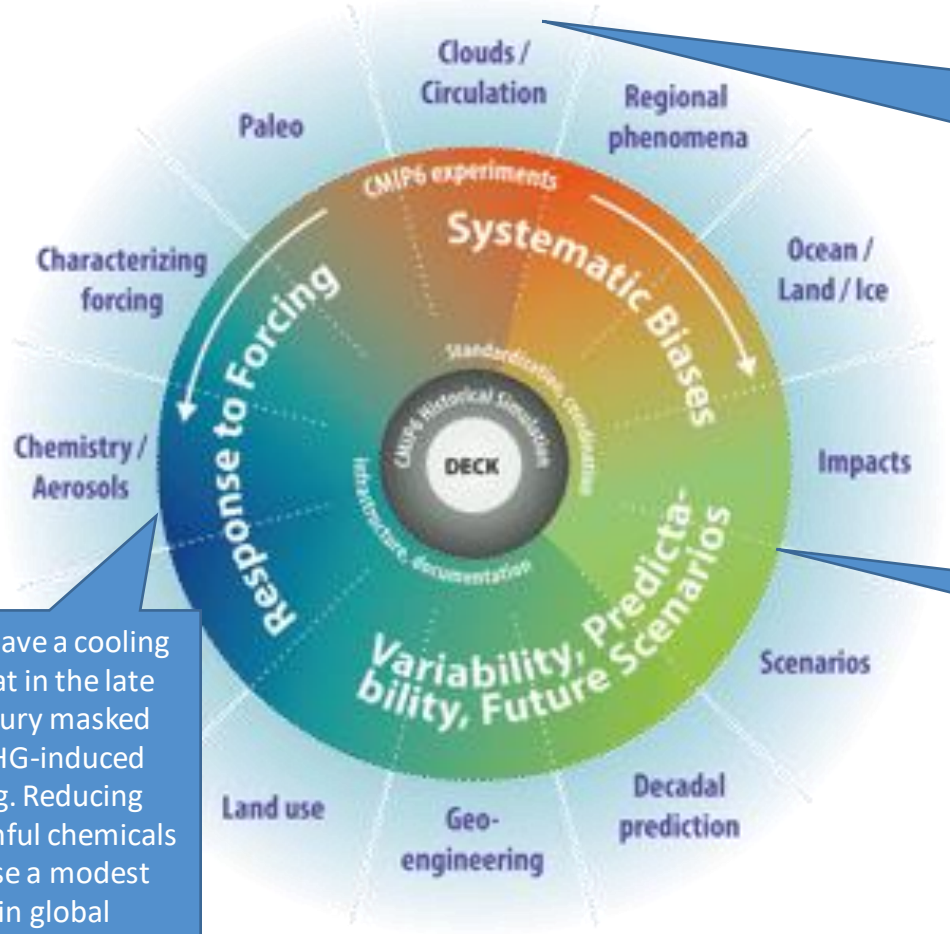


Extreme events or acute risks such as storm-driven flooding or a heatwave can be thought of as the tail of the distribution

Chronic or incremental risks such as average temperatures or sea levels can be understood as shifts in the mean of a distribution

Source: McKinsey

What uncertainties exist in our understanding of climate change?



Clouds present a big uncertainty in our estimates as low clouds reflect sunlight (cooling), while high clouds trap outgoing radiation (warming).

Aerosols have a cooling effect that in the late 20th century masked some GHG-induced warming. Reducing these harmful chemicals may cause a modest spike in global temperatures.

Human choices represent perhaps the biggest uncertainty in efforts to model the future climate. What mitigation efforts will we try?

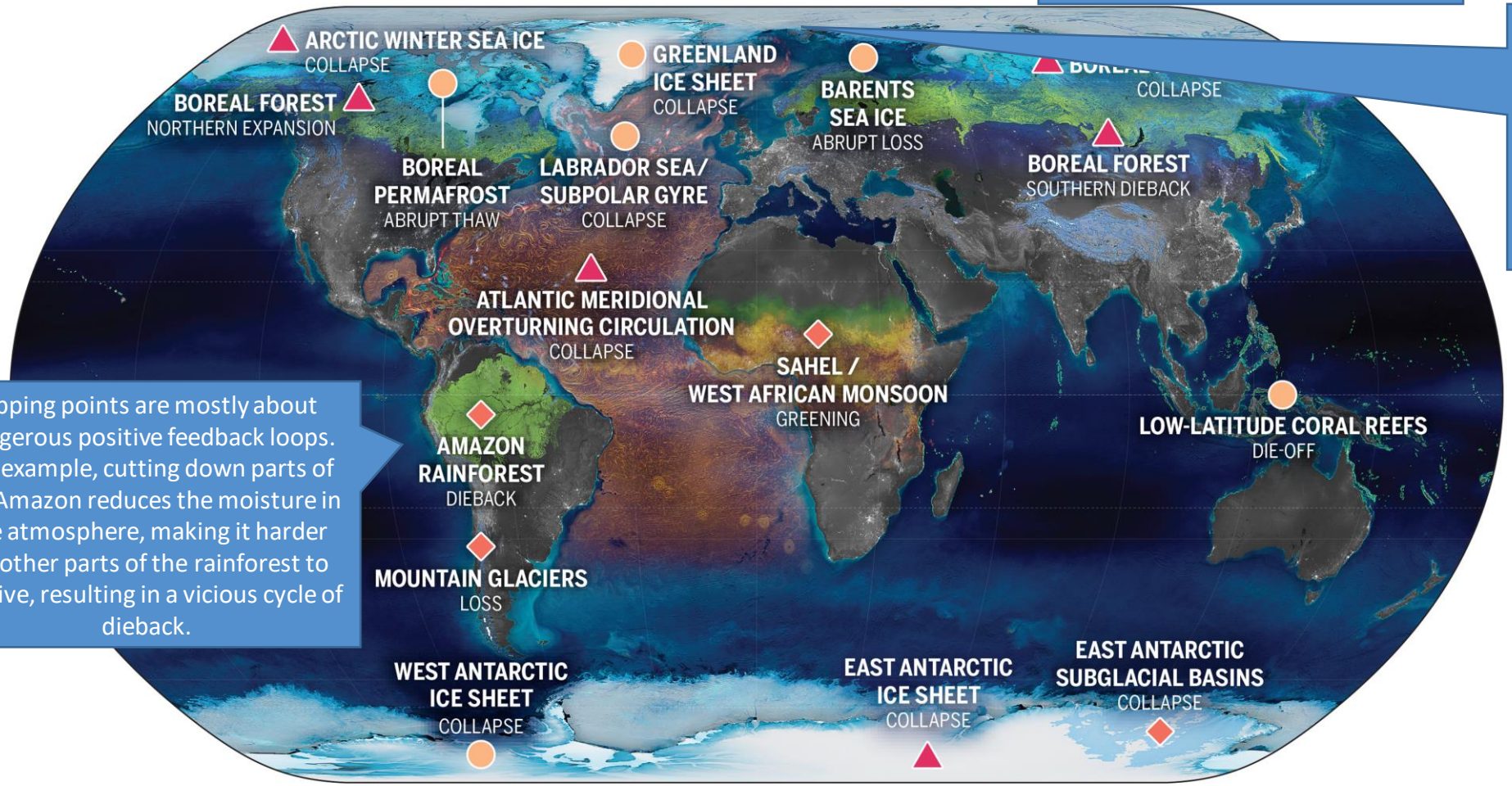
Source: ResearchGate

What are climate tipping points?

Tipping points represent discontinuities in the climate system, where that system shifts from one state to another. They can be irreversible on human timescales.

The last time Earth was as warm as it was today, Greenland lacked an ice sheet. Has this tipping point already been reached? It is estimated that Greenland's ice sheet melting would raise sea levels by 7 meters. A key unknown is how long that melting would take.

Tipping points are mostly about dangerous positive feedback loops. For example, cutting down parts of the Amazon reduces the moisture in the atmosphere, making it harder for other parts of the rainforest to survive, resulting in a vicious cycle of dieback.



Source: Science

Thank you!

If you have any questions about this content or questions on climate and environmental risks, please do not hesitate to reach out!

David Carlin
Head of Risk, UNEP FI
Founder, Cambium Global Solutions
David Carlin@un.org