

Climate Change and Global Politics: A scientific introduction

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X/Twitter: @JPvanYpersele

**CERIS (ULB Diplomatic School of Brussels),
17 February 2024**

**Thanks to the Walloon Government (funding the Walloon Platform for IPCC)
and to my team at the Université catholique de Louvain for their support**

The Essential Truth About Climate Change in Ten Words

The basic facts of climate change, established over decades of research, can be summarized in five key points:

IT'S REAL

Global warming is happening.

IT'S US

Human activity is the main cause.

EXPERTS AGREE

There's scientific consensus on human-caused global warming.

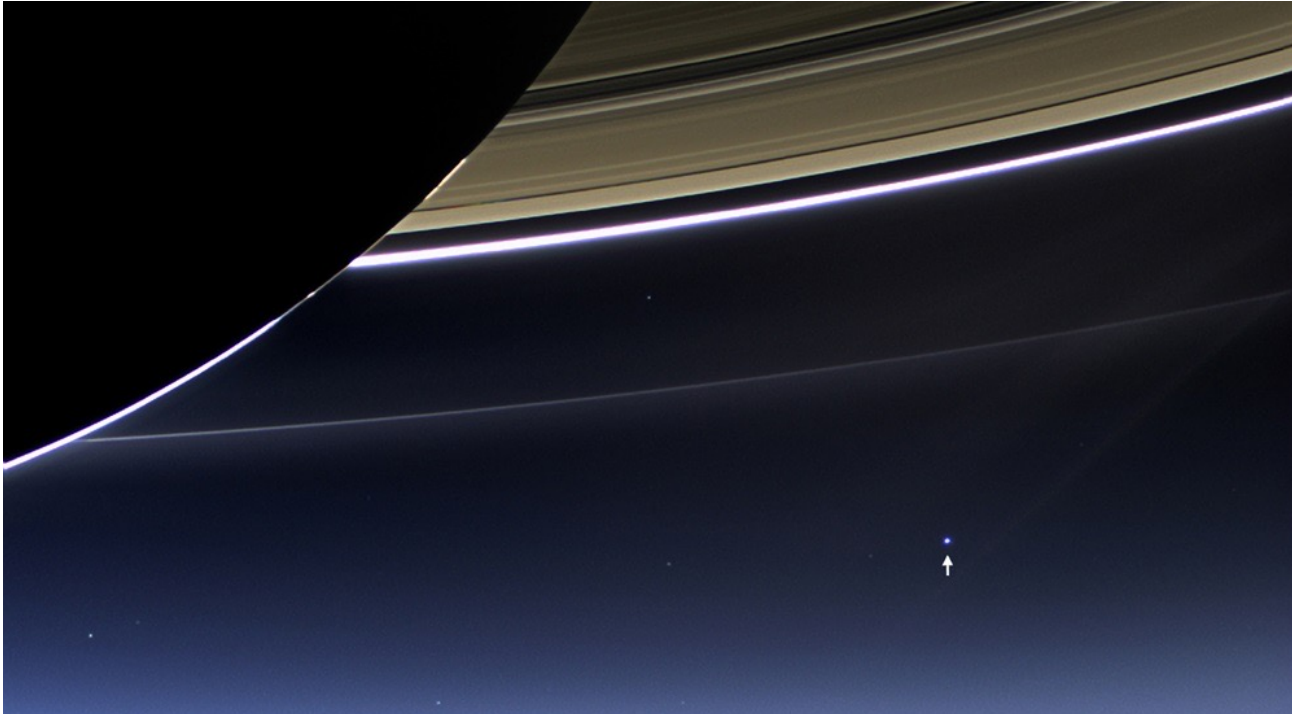
IT'S BAD

The impacts are serious and affect people.

THERE'S HOPE

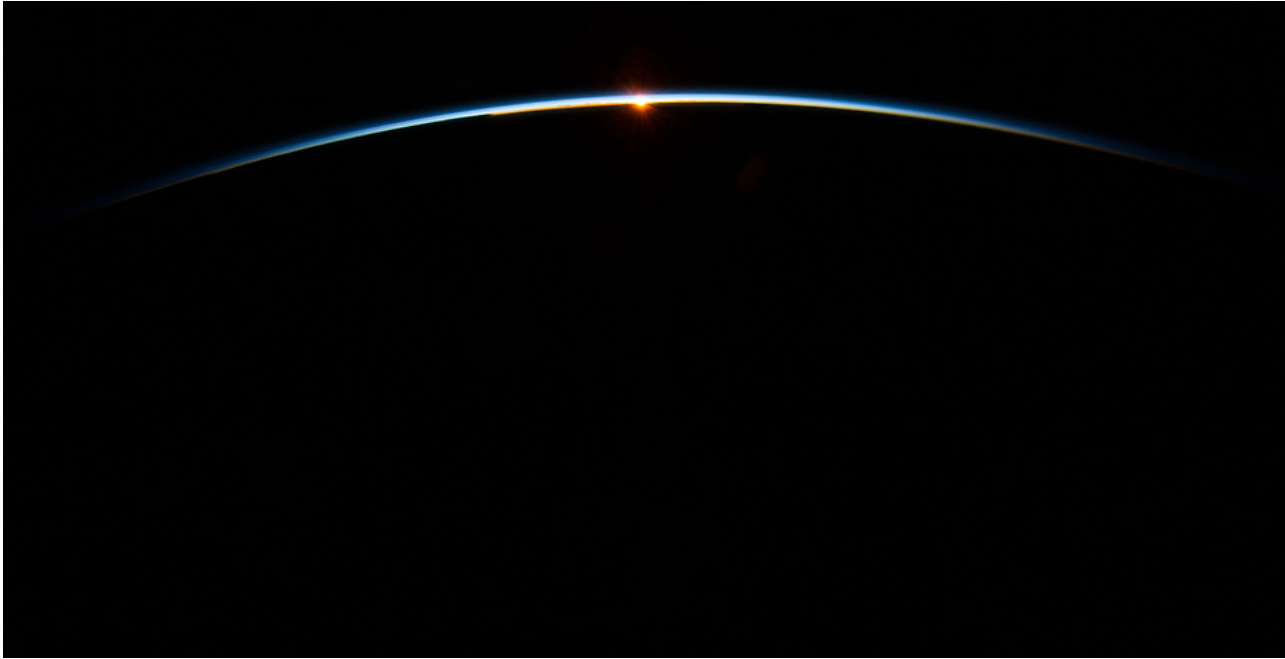
We have the technology needed to avoid the worst climate impacts.

**That small blue dot is the Earth, as seen from
Cassini, orbiting Saturn, 1.44 billion km from
us, on 19-7-2013**



@JPvanYpersele

Our atmosphere is thin and fragile (as seen by ISS crew on 31 July 2013)



Jean-Pascal van Ypersele
(vanyp@climate.be)



Let us think about the future of these children from Machakos in a warming climate



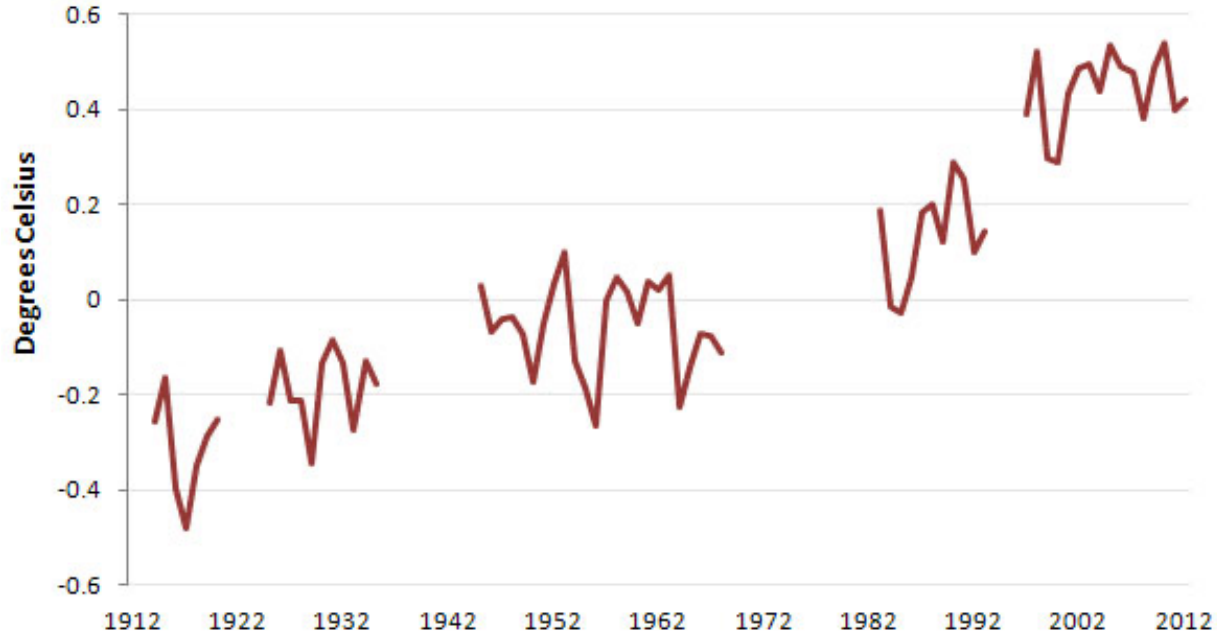
Photo:
@JPvanYpersele
April 2015

Temperature Change From 1961-1990 Average



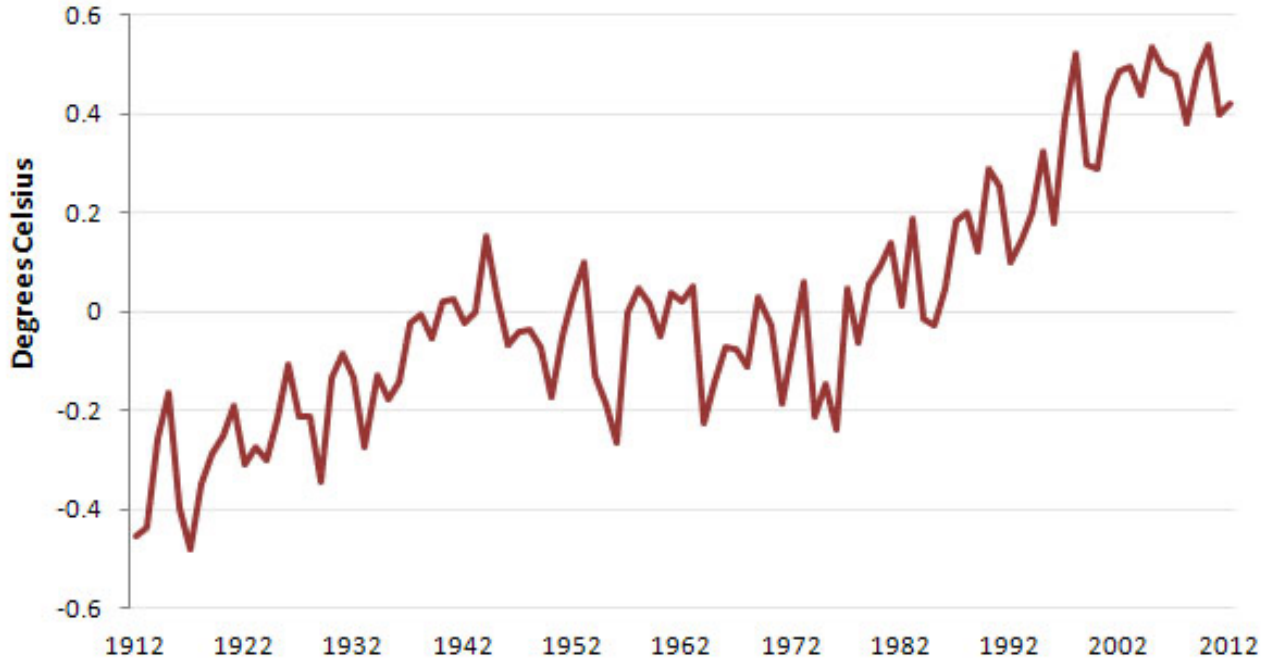
Lying With Statistics, Global Warming Edition

Temperature Plateaus — 1912-2012

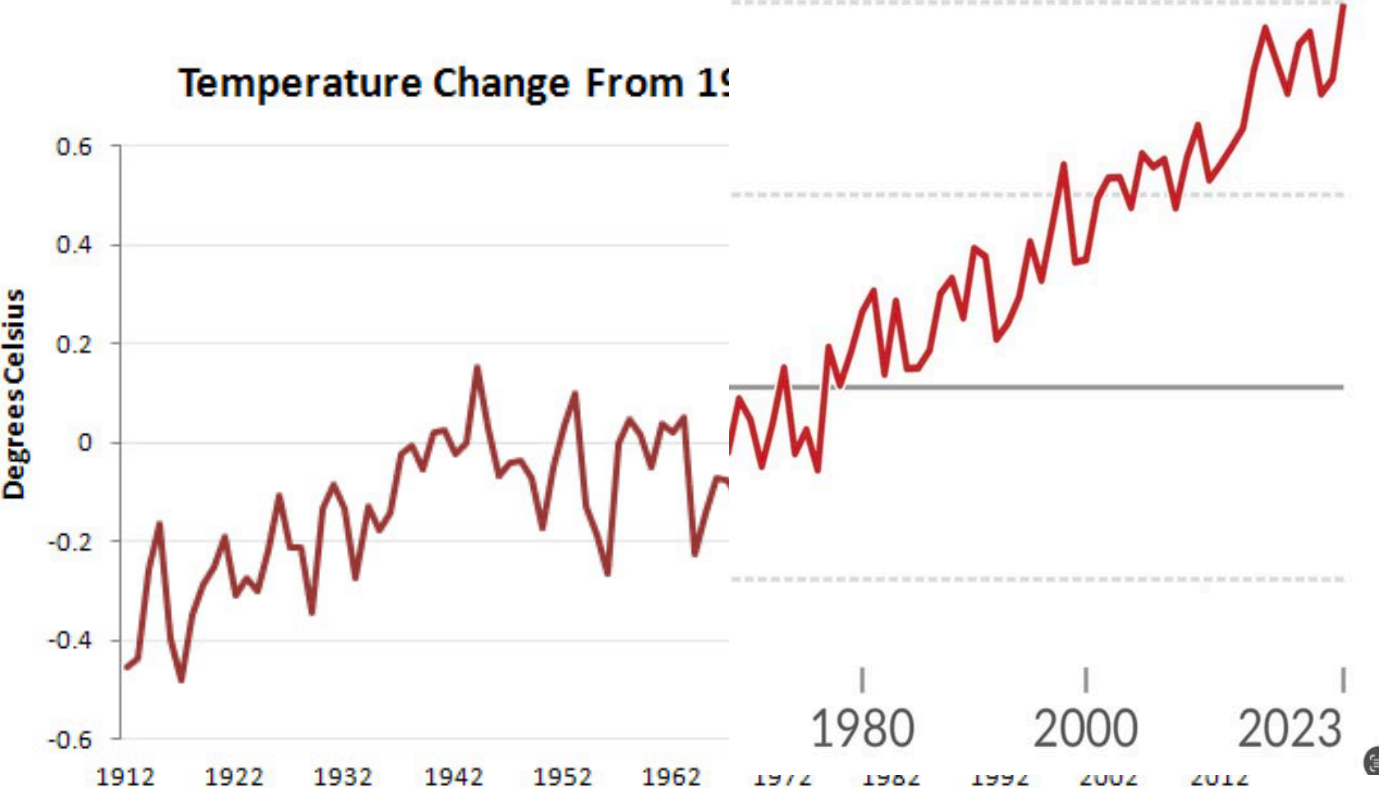


Lying With Statistics, Global Warming Edition

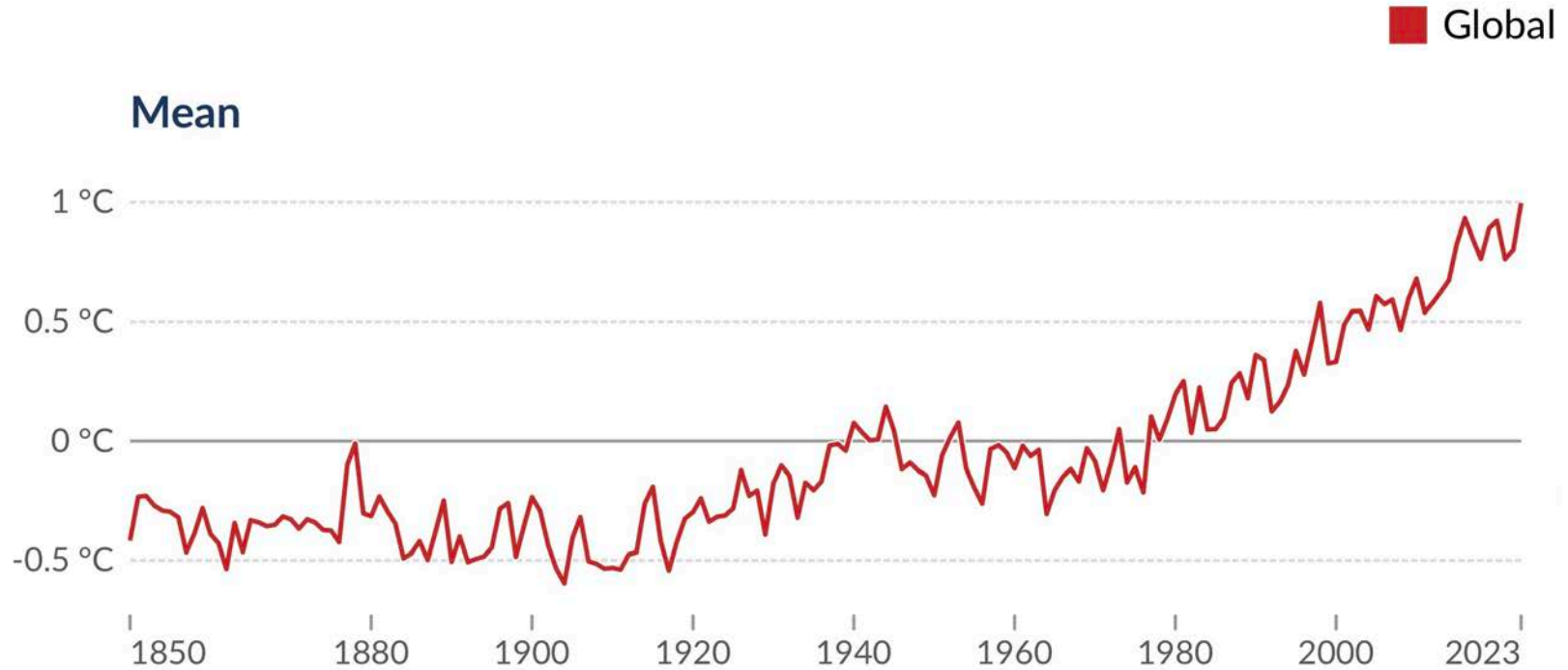
Temperature Change From 1961-1990 Average



Lying With Statistics, Global Warming Edition



Lying With Statistics, Global Warming Edition



Plot: Our World in Data; Data source: Met Office Hadley Centre (2023)

**In the USA alone, organizations
which sow doubt about climate
change spend almost a billion
dollars/year! (Brulle 2014, average numbers for
2003-2010)**

The European Union fares a little better, but
many Brussels lobbyists try to dilute the EU
environmental efforts (see the car
industry...)

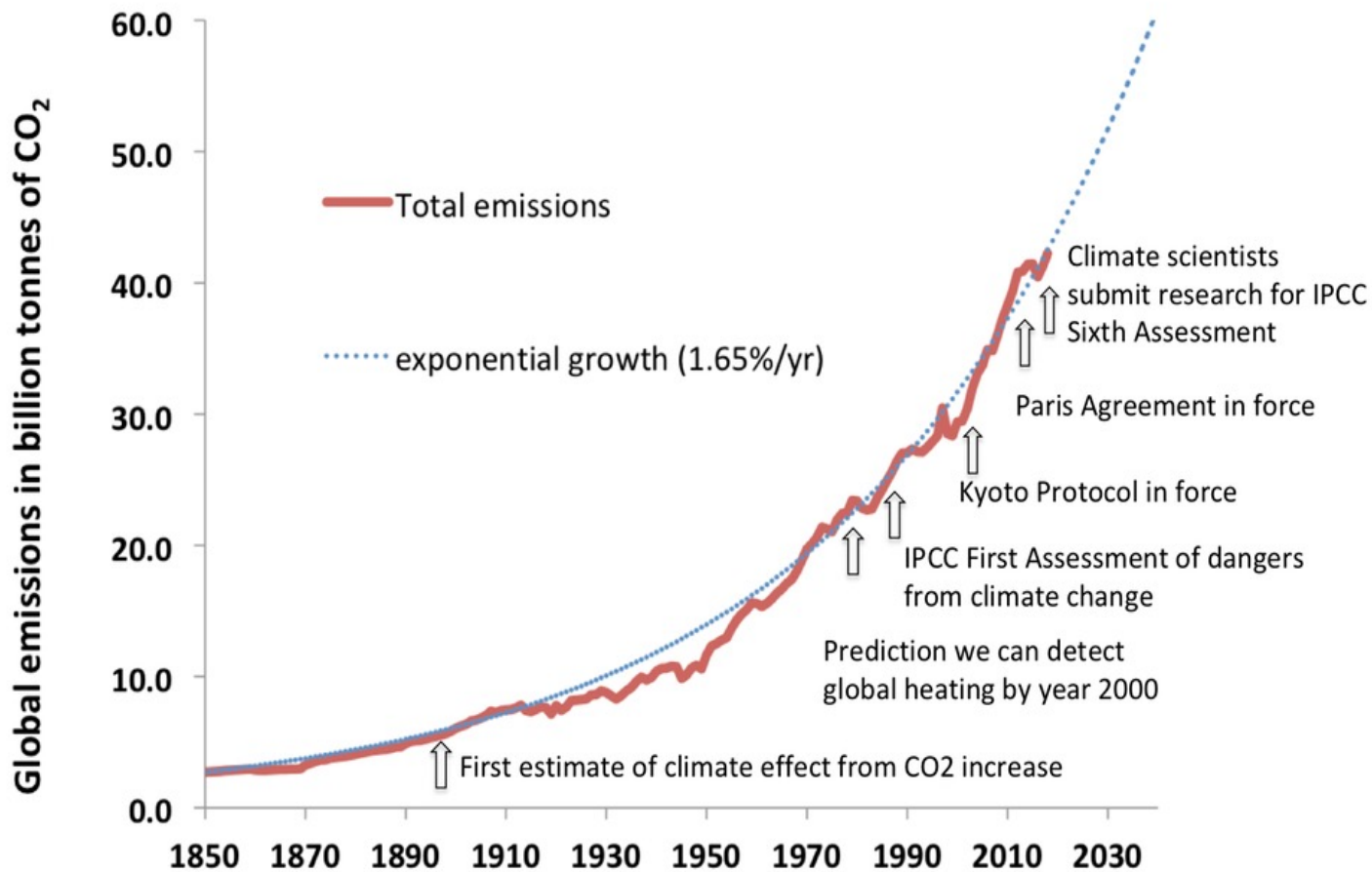
@JPvanYpersele

The « merchants of doubt » have evolved in their arguments:

- Existence of global warming
- Human responsibility in the warming
- Cost of decarbonization
- Drawbacks from alternatives

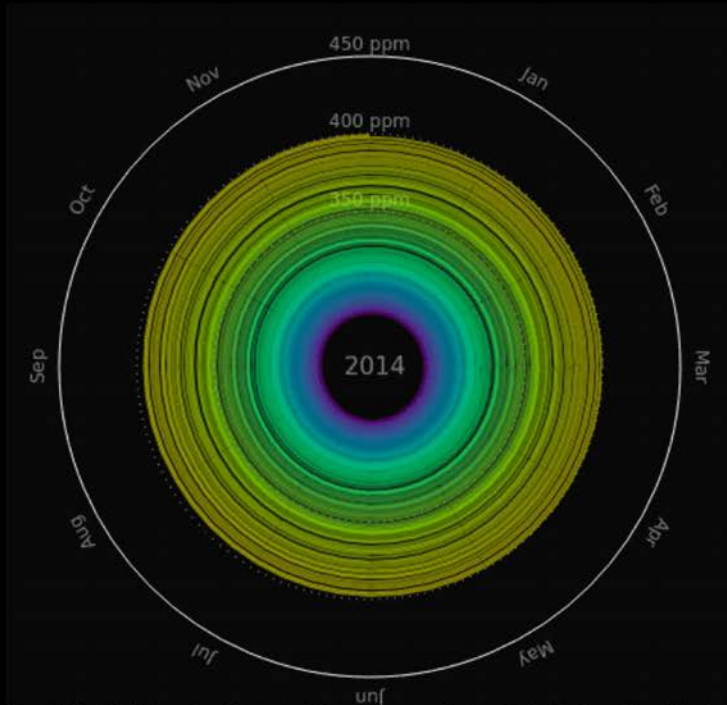
(recent example: so-called enormous needs of cobalt for electric mobility reported on CNN; see critical analysis on

<https://www.desmogblog.com/2018/05/02/cnn-wrongly-blames-electric-cars-unethical-cobalt-mining>)

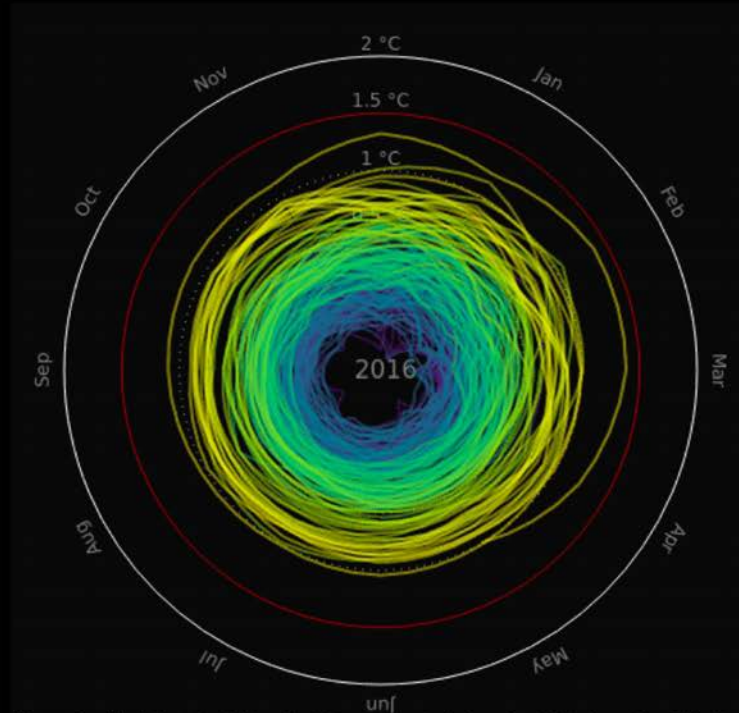


Source: Wolfgang Knorr, in *The Conversation* (2019)

CO₂ Concentration and Temperature spirals



Concentration Spiral pik-potsdam.de/primap-live/ & climatecollege.unimelb.edu.au, Gieseke, Meinshausen. Thx to Ed Hawkins



Temperature Spiral pik-potsdam.de/primap-live/ & climatecollege.unimelb.edu.au, Gieseke, Meinshausen. Thx to Ed Hawkins

CO₂ Concentration since 1850 and Global Mean Temperature in °C relative to 1850 – 1900
Graph: Ed Hawkins (Climate Lab Book) – Data: HadCRUT4 global temperature dataset
Animation available on <http://openclimatedata.net/climate-spirals/concentration-temperature/>

Fact: Extreme weather events are becoming more frequent or intense due to climate change, sealevel rise threatens coastal communities...

Since 1950, **extreme hot days** and **heavy precipitation** have become more common



There is evidence that anthropogenic influences, including increasing atmospheric **greenhouse gas concentrations**, have changed these extremes

Heat waves kill



Une personne âgée dans un couloir des urgences du centre hospitalier de Versailles en août 2003. | AFP PHOTO MARTIN BUREAU

WARMER AIR



MORE EVAPORATION



MORE PRECIPITATION

Available
water

1°C
7%

increase =
more water vapor

- Temperature +

Wallonia Floods, July 2021



Source:
VRT Nieuws



Felix Schaad (Tages Anzeiger, Switzerland)

Floods cost

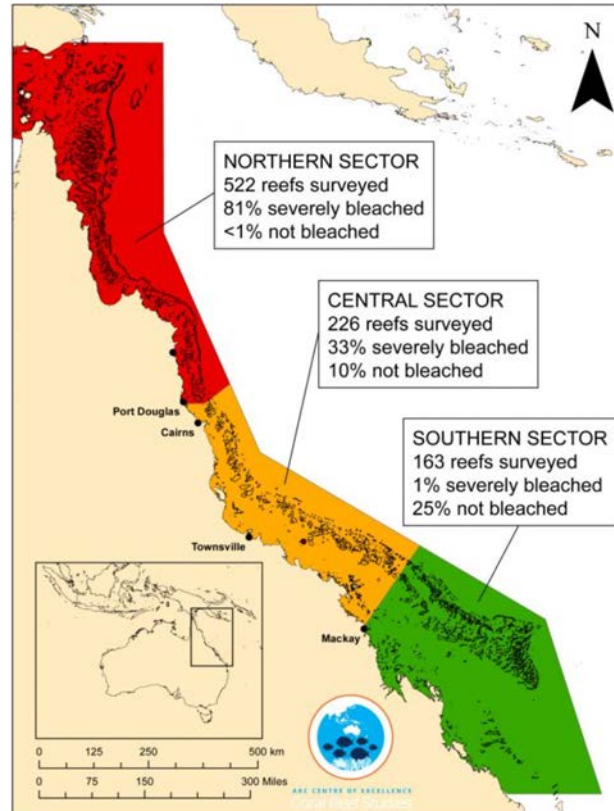


Coral reefs are dying

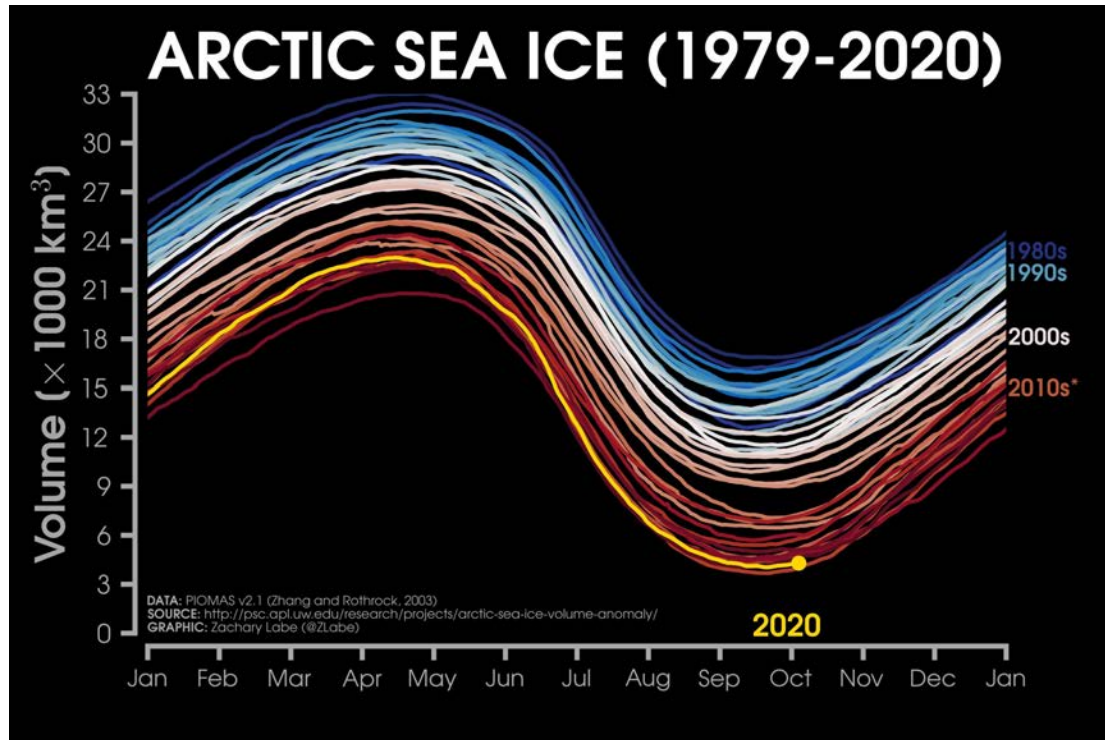


American Samoa (from www.globalcoralbleaching.org)

Only 7% of the Great Barrier Reef has avoided coral bleaching (May 2016)



Arctic sea-ice *volume* 1979-2020



Plateau Glacier (1961) (Alaska)



http://www.weather.com/news/science/environment/alaskas-glaciers-capturing-earth-changing-our-eyes20131125?cm_ven=Email&cm_cat=ENVIRONMENT_us_share

Plateau Glacier (2003) (Alaska)



http://www.weather.com/news/science/environment/alaskas-glaciers-capturing-earth-changing-our-eyes-20131125?cm_ven=Email&cm_cat=ENVIRONMENT_us_share

► Les glaciers, d'un siècle à l'autre

Rédaction : Philippe Marbaix et Bruna Gaino

La Mer de Glace (massif du Mont-Blanc, France)

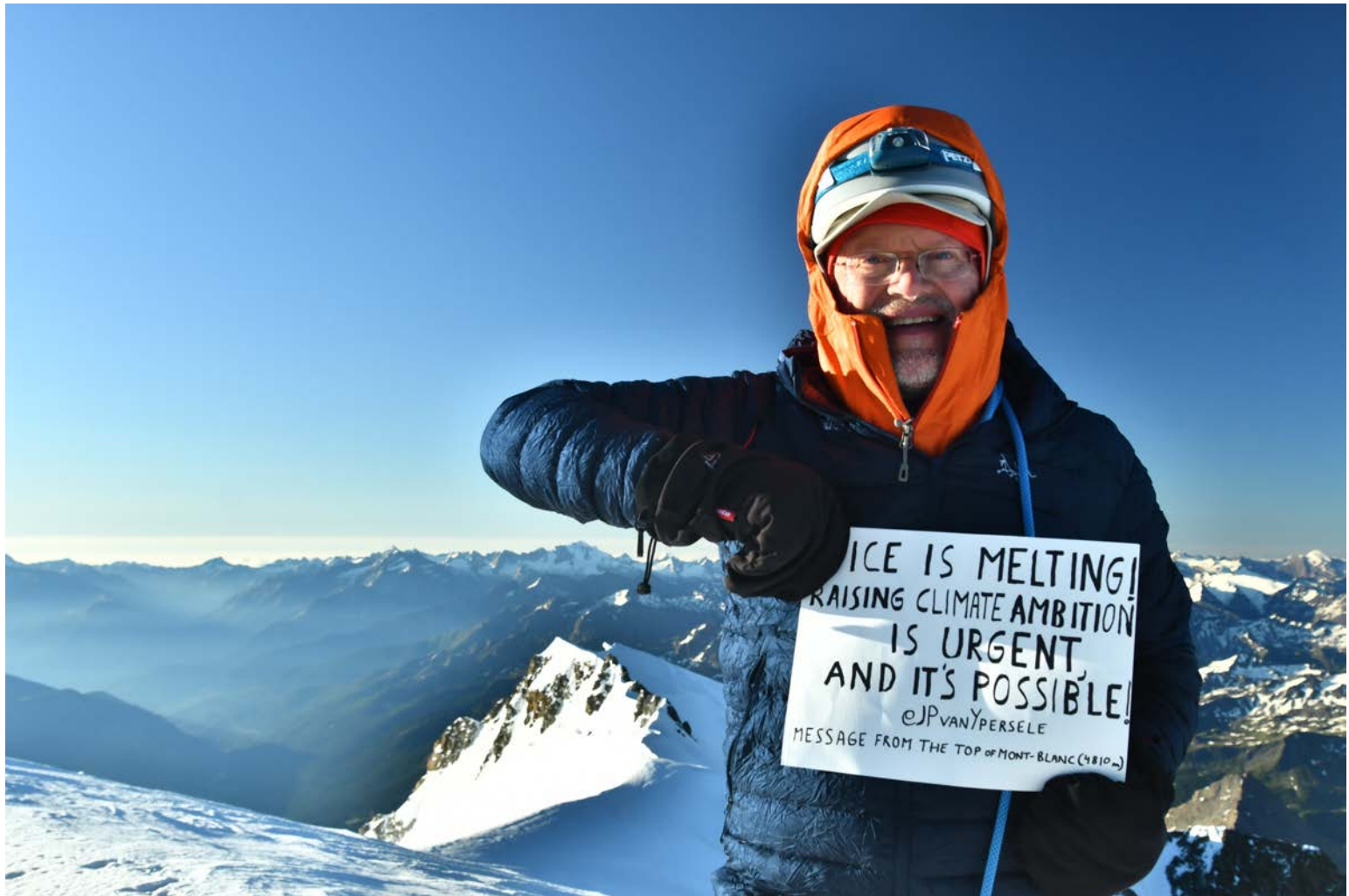
1919

2019



Photo : Walter Mittelholzer, ETH-Bibliothek Zürich

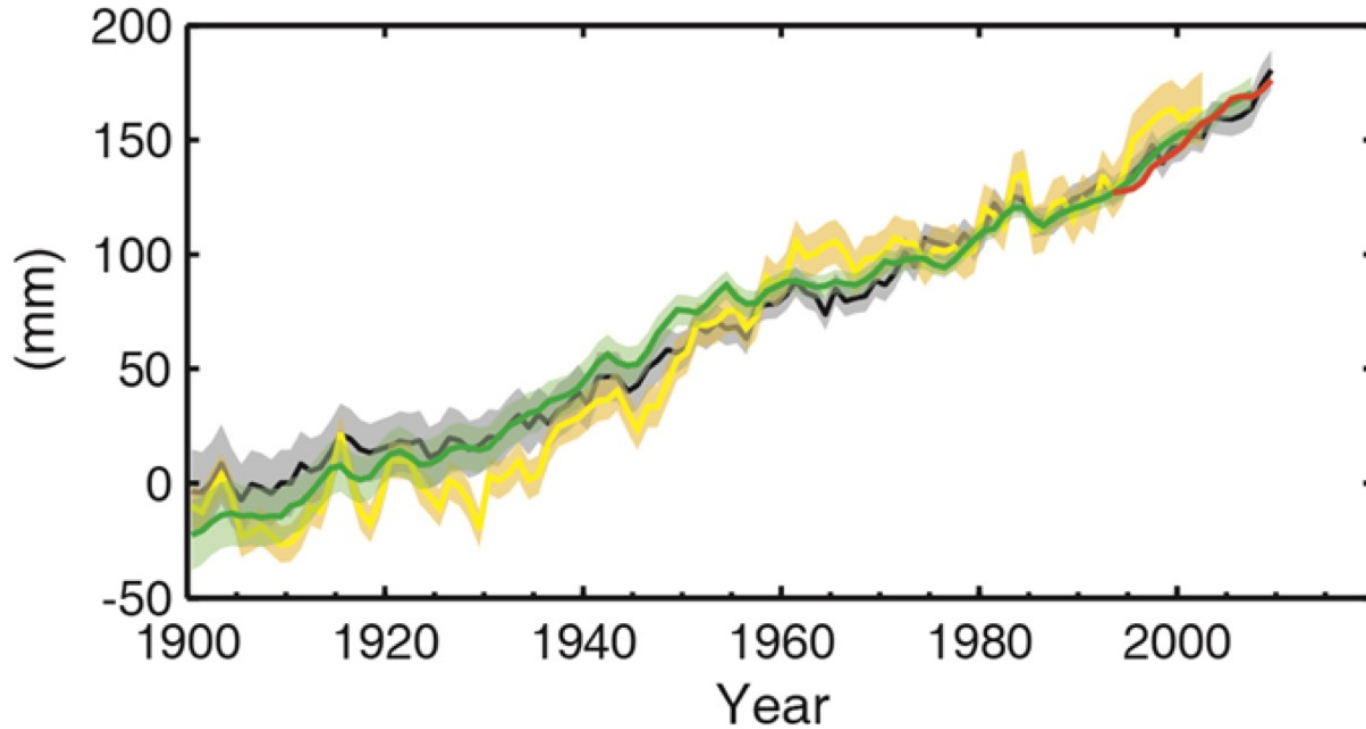
Photo : Dr Kieran Baxter, Université de Dundee



20-7-2020

Photo: @RaphvanYpersele (Instagram)

Change in average sea-level change



Why the IPCC ?

Established by WMO and UNEP in 1988

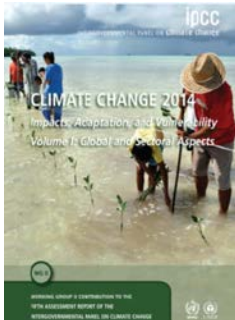
to provide **policy-makers** with an **objective source of information** about

- causes of climate change,
- potential environmental and socio-economic impacts,
- possible response options (adaptation & mitigation).

WMO=World Meteorological Organization

UNEP= United Nations Environment Programme





What is happening in the climate system?

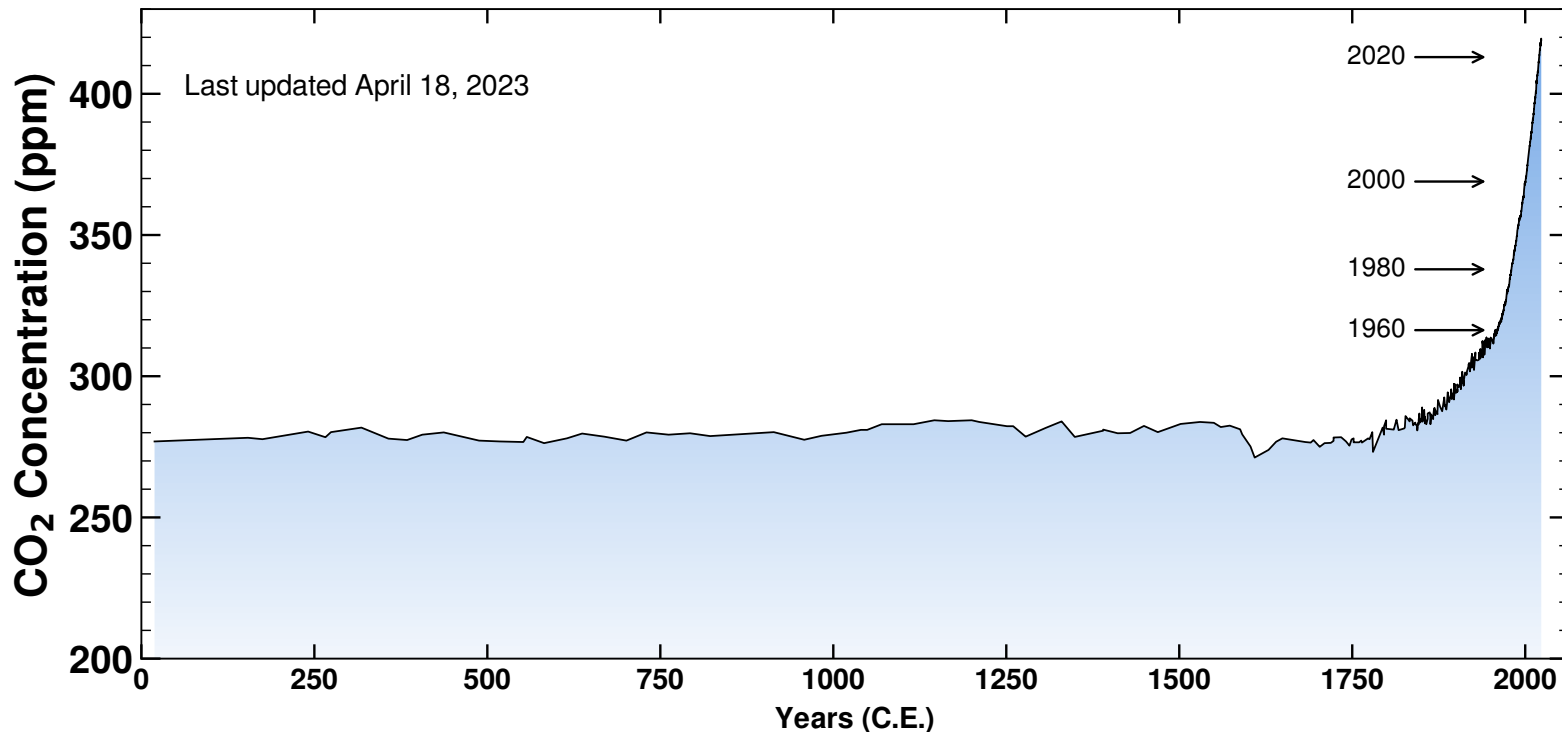
What are the risks?

What can be done?

Key messages from IPCC AR5

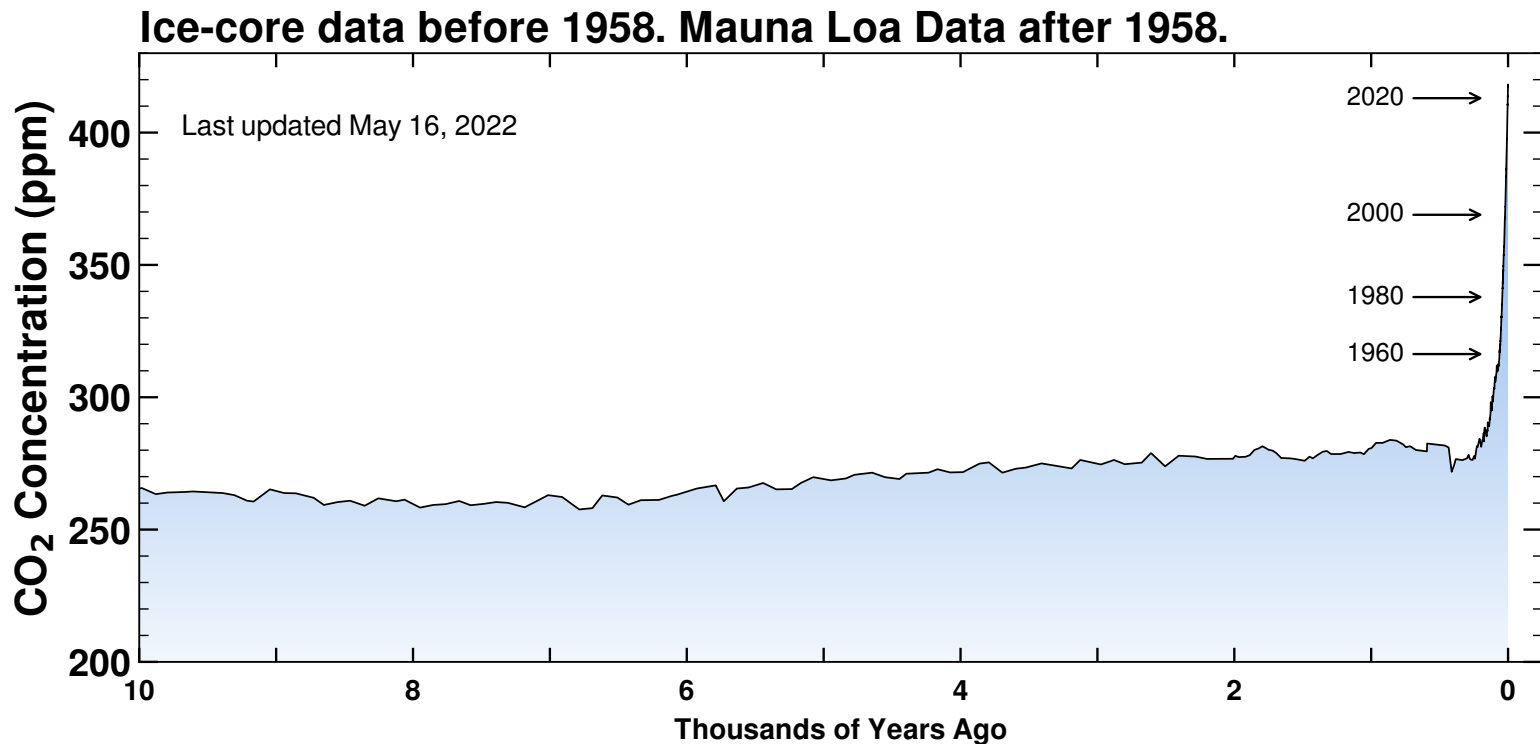
- **Human influence on the climate system is clear**
- **Continued emissions of greenhouse gases will increase the likelihood of severe, pervasive and irreversible impacts for people and ecosystems**
- **While climate change is a threat to sustainable development, there are many opportunities to integrate mitigation, adaptation, and the pursuit of other societal objectives**
- **Humanity has the means to limit climate change and build a more sustainable and resilient future**

CO₂ Concentration 18 April 2023: 424,03 ppm (Keeling curve + last 2000 years)

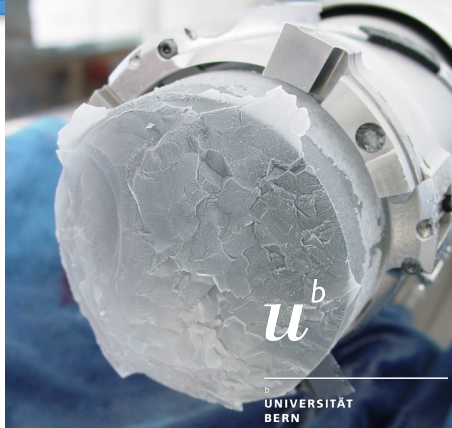


Source: scripps.ucsd.edu/programs/keelingcurve/

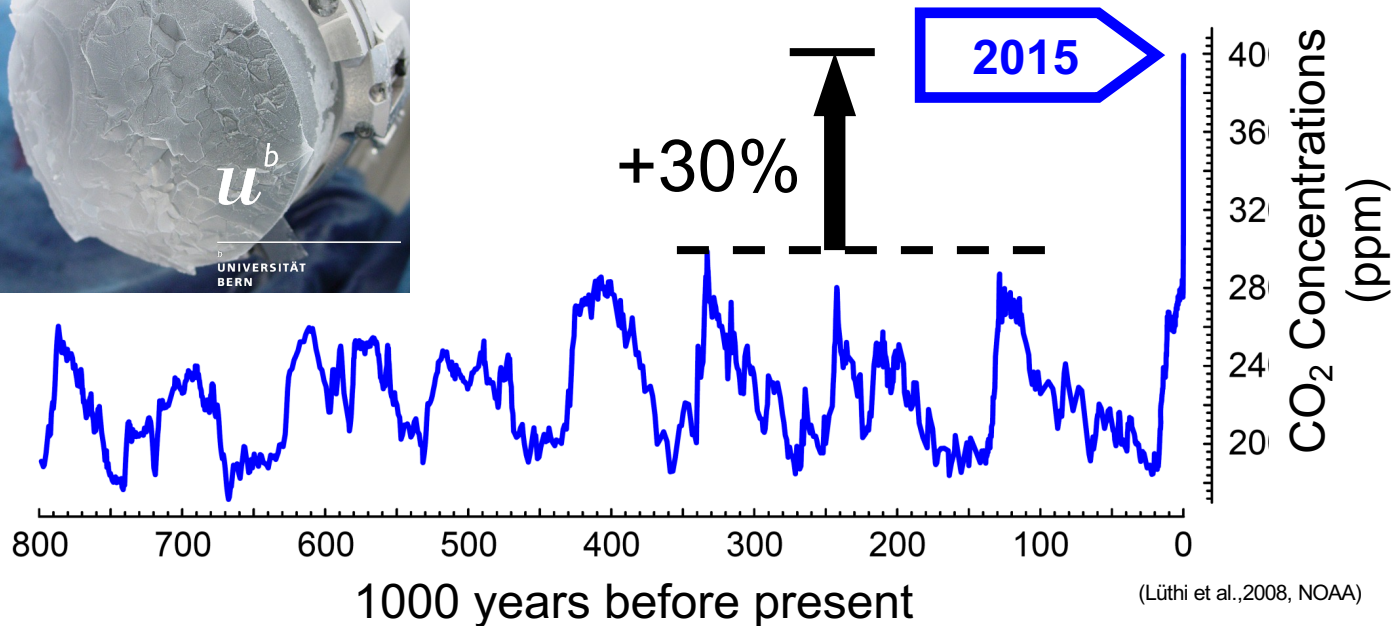
CO₂ Concentration 16 May 2022: 421,36 ppm (Keeling curve + last 10000 years)



Source: scripps.ucsd.edu/programs/keelingcurve/

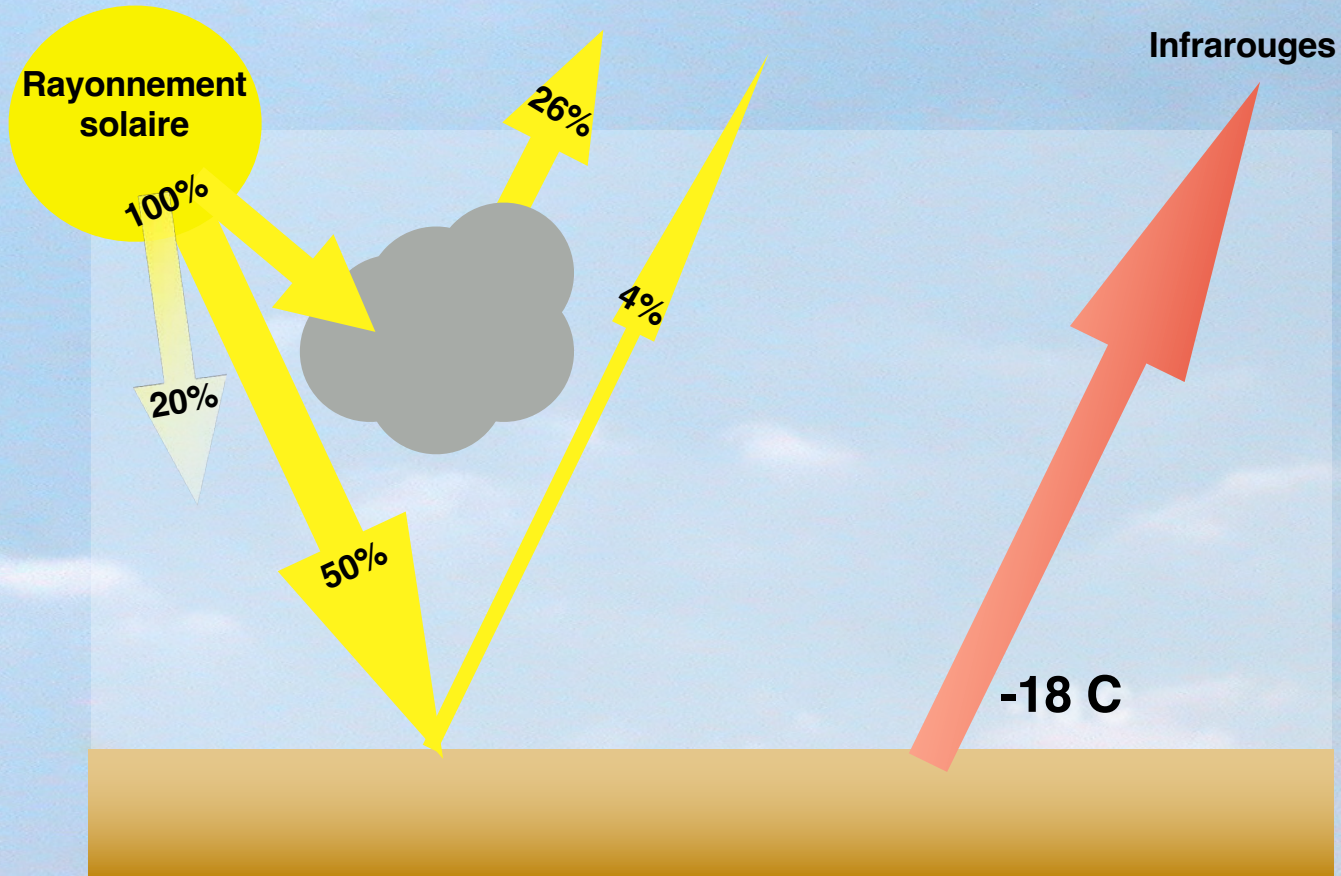


Atmospheric concentrations of CO₂

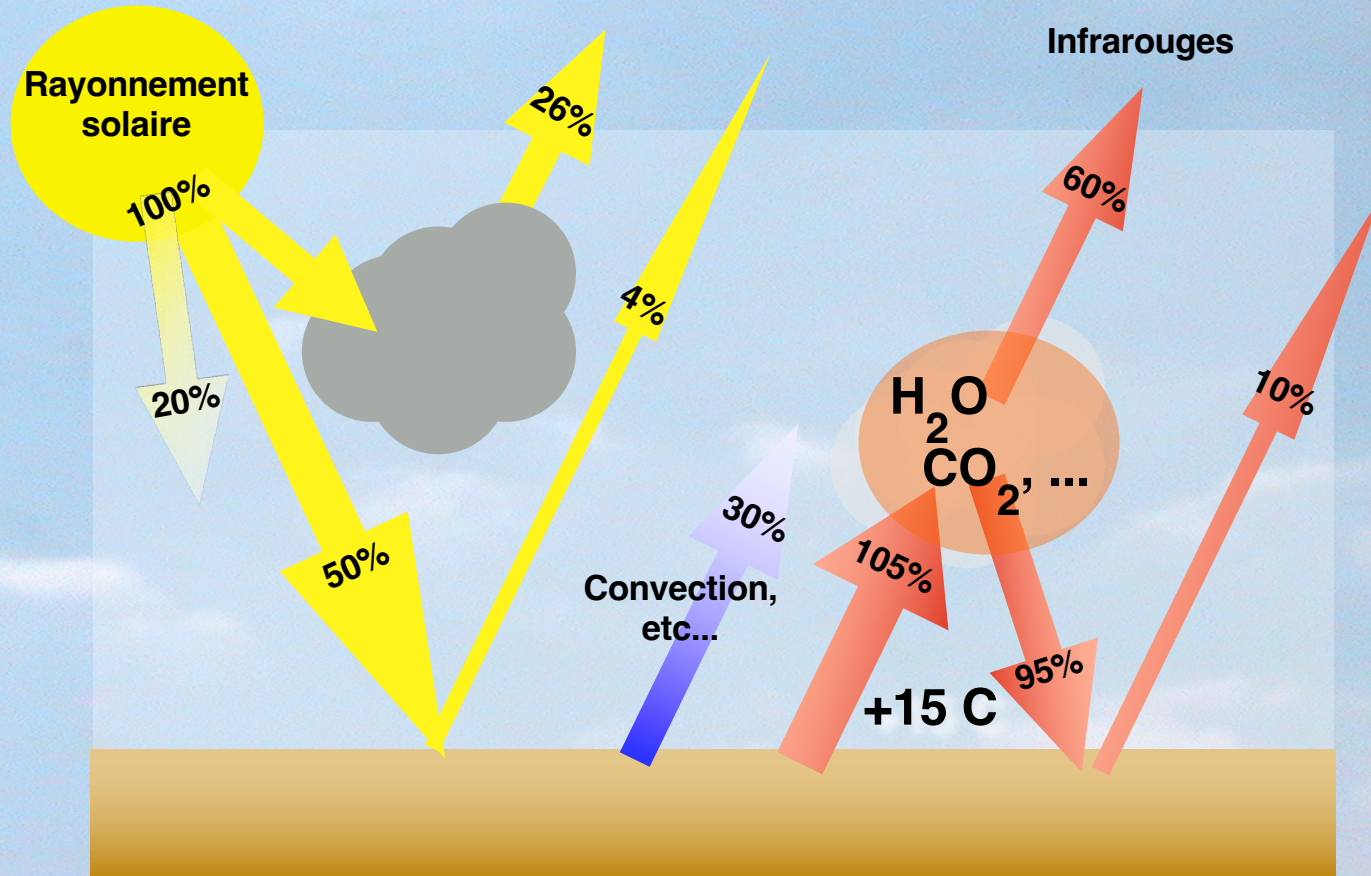


The concentrations of CO₂ have increased to levels unprecedented in at least the last 800,000 years.

Cycle de l' énergie et effet de serre



Cycle de l'énergie et effet de serre



Progression of Understanding: Greater and Greater Certainty in Attribution

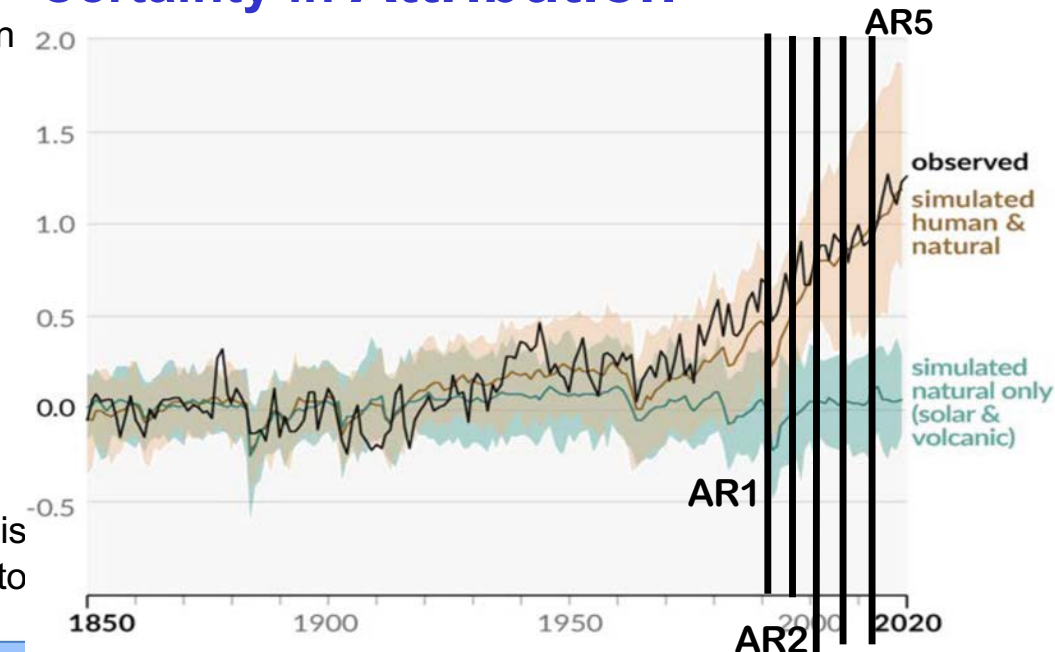
AR1 (1990): “unequivocal detection not likely for a decade”

AR2 (1995): “balance of evidence suggests **discernible** human influence”

AR3 (2001): “most of the warming of the past 50 years is **likely** (odds 2 out of 3) due to human activities”

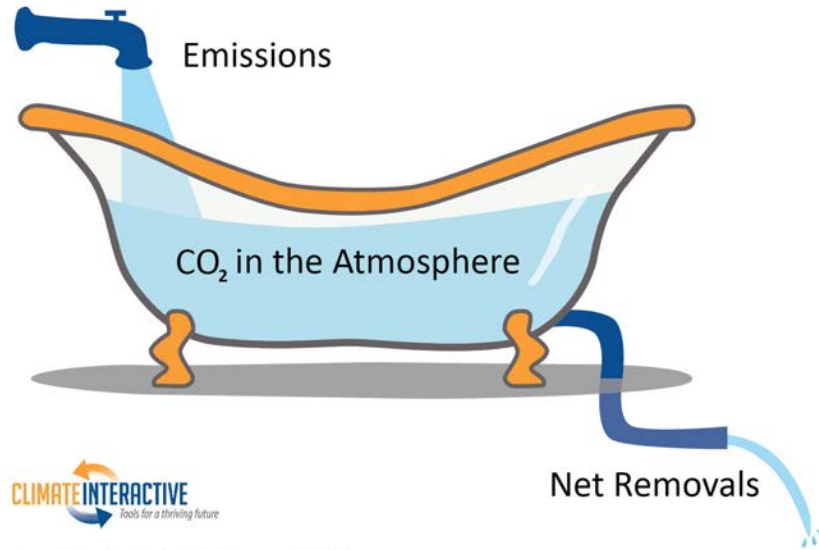
AR4 (2007): “most of the warming is **very likely** (odds 9 out of 10) due to greenhouse gases”

AR5 (2013) «It is **extremely likely** (odds 95 out of 100) that human influence has been the dominant cause... »



AR6 (2021): “It is **unequivocal** that human influence has warmed the atmosphere, ocean, and land.”

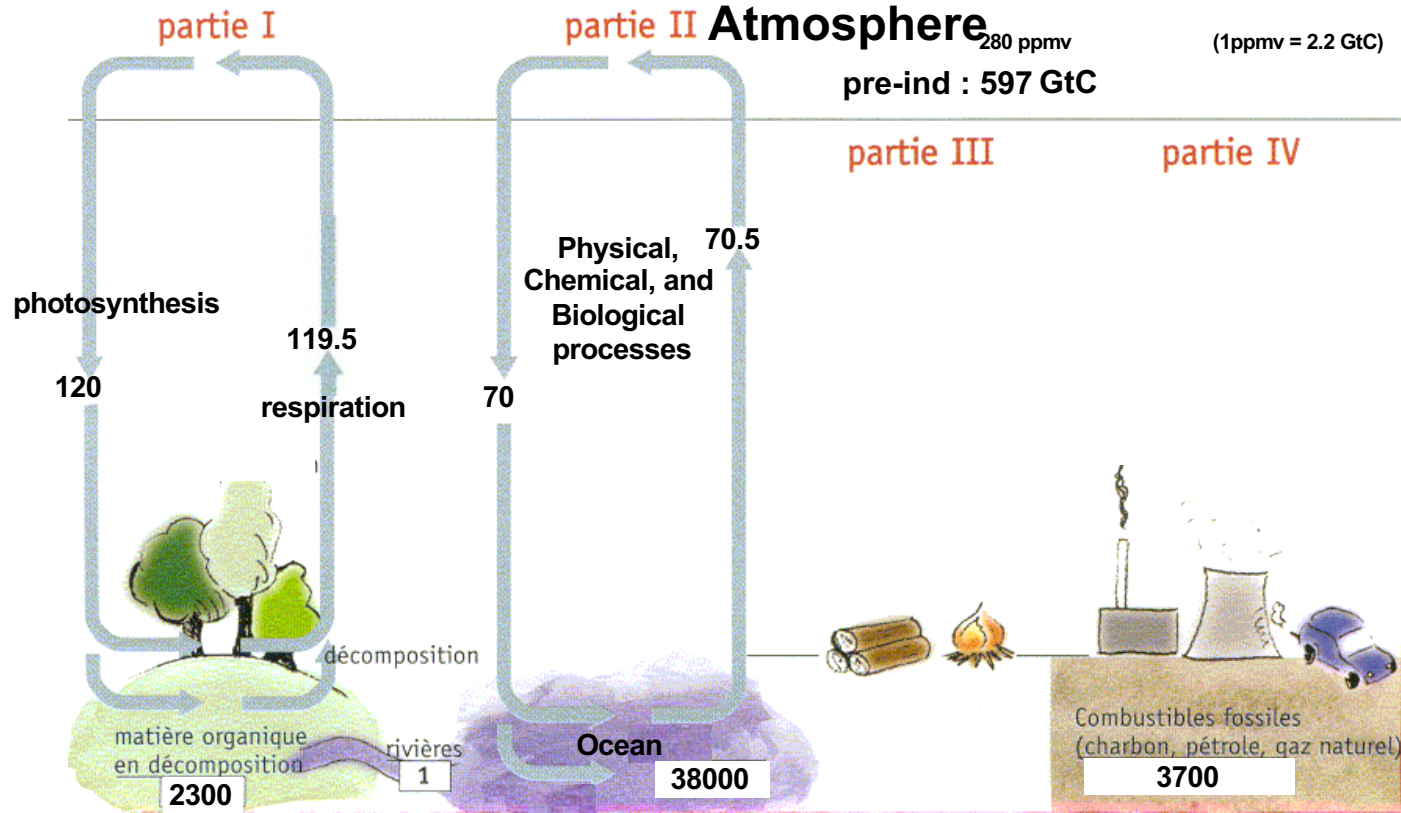
The Carbon Bathtub



Overall framing by Dr. John Sterman, MIT Sloan

Source: @CarbonInteractive

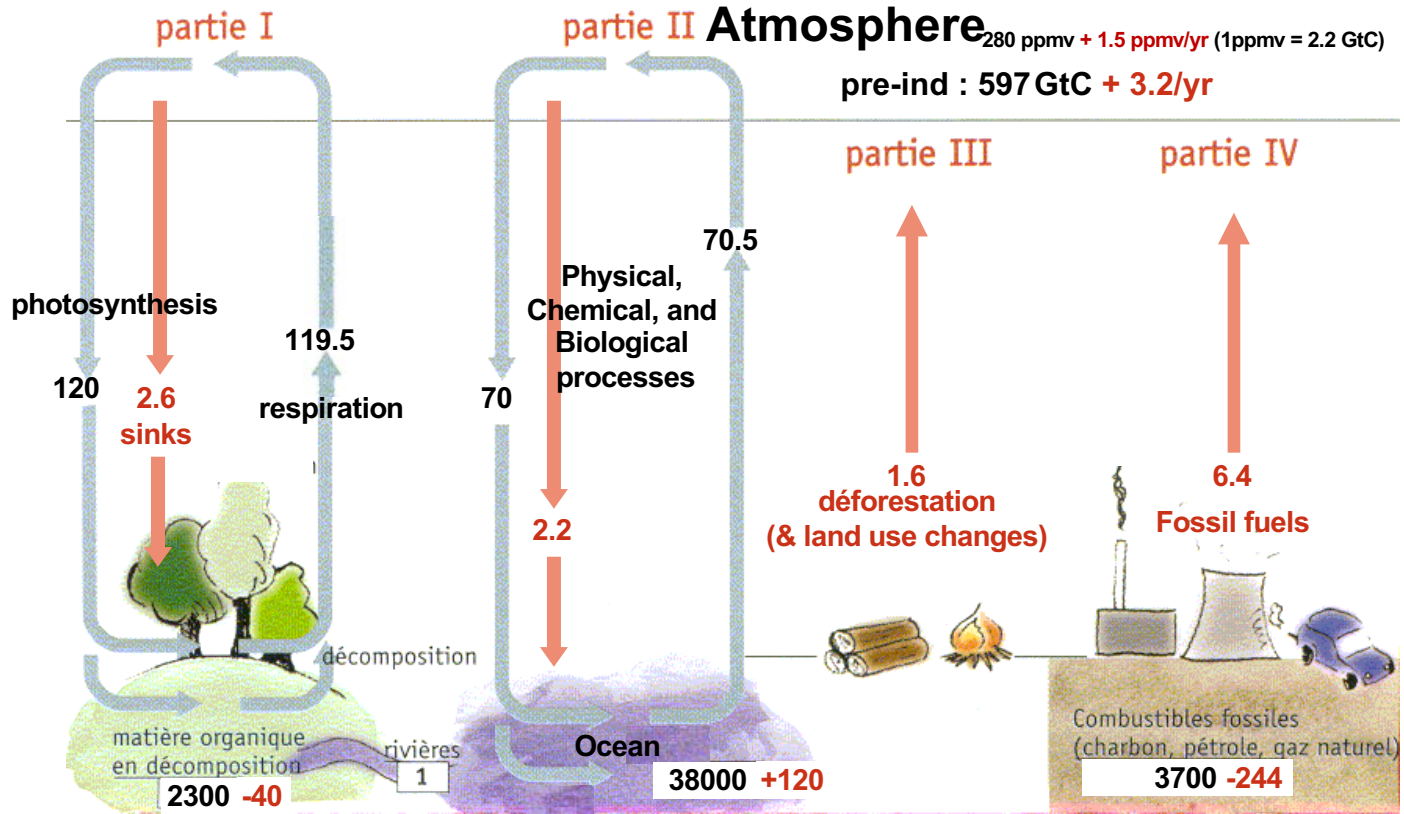
Carbon cycle: unperturbed fluxes



Units: GtC (billions tons of carbon) or GtC/year (multiply by 3.7 to get GtCO₂)

Carbon cycle: perturbed by human activities

(numbers for the decade 1990-1999s, based on IPCC AR4)

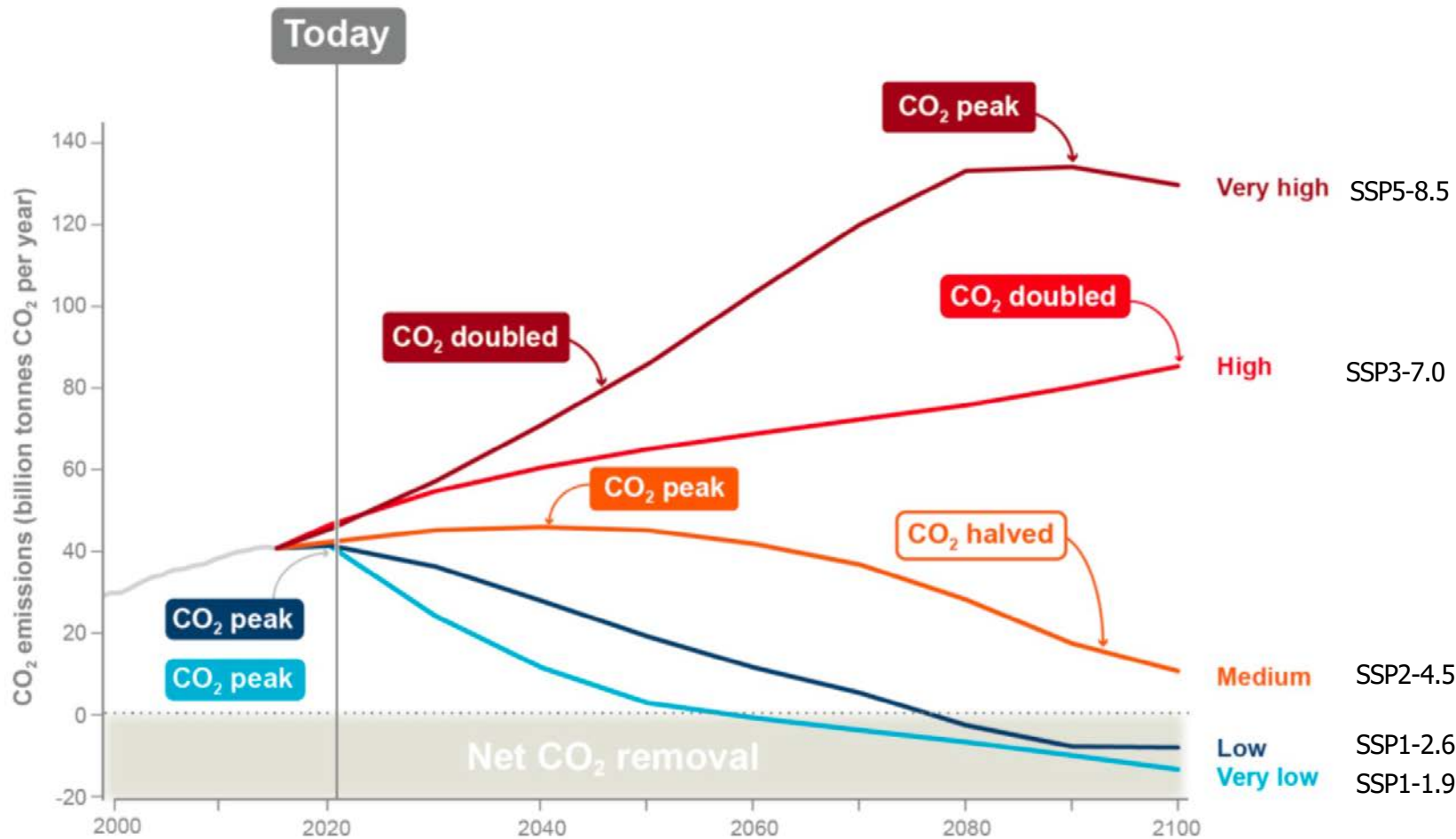
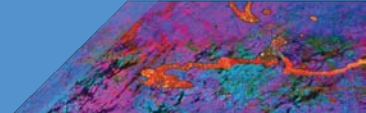


Units: GtC (billions tons of carbon) or GtC/year

Stocks!

The carbon cycle is policy-relevant

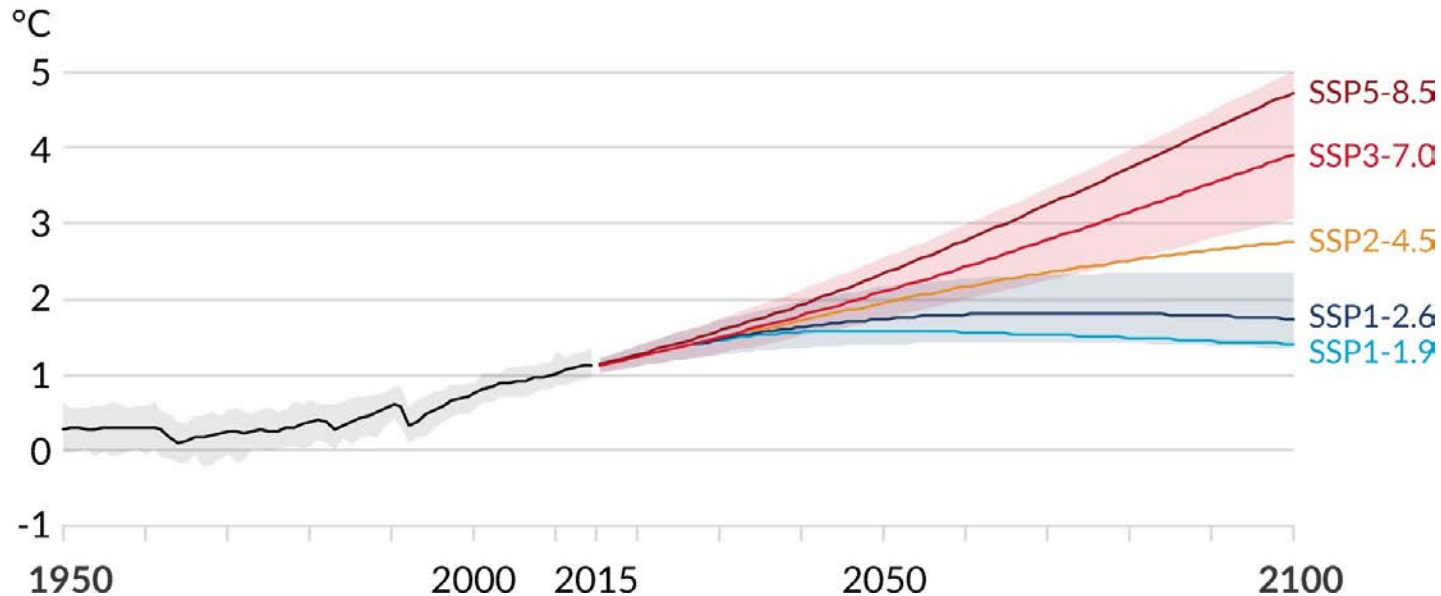
- **CO₂ accumulates in the atmosphere as long as human emissions are larger than the natural absorption capacity**
- **Historical emissions from developed countries therefore matter for a long time**
- **As warming is function of cumulated emissions, the carbon « space » is narrowing fast (to stay under 1.5 or 2° C warming)**



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

Figure SPM.8

a) Global surface temperature change relative to 1850-1900



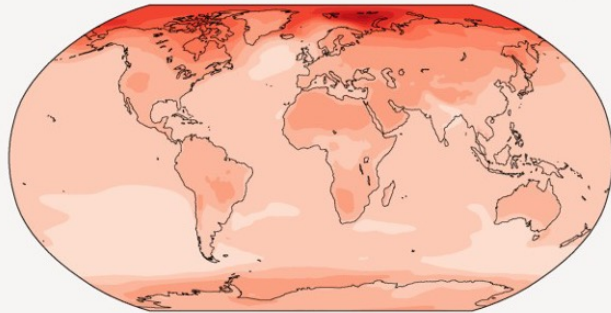
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Across warming levels, land areas warm more than oceans, and the Arctic and Antarctica warm more than the tropics

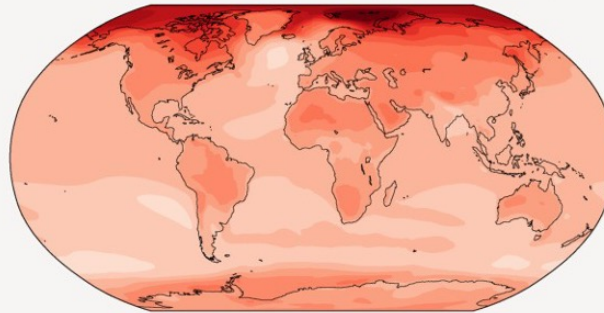
+1.5° C

Simulated change at 1.5 °C global warming



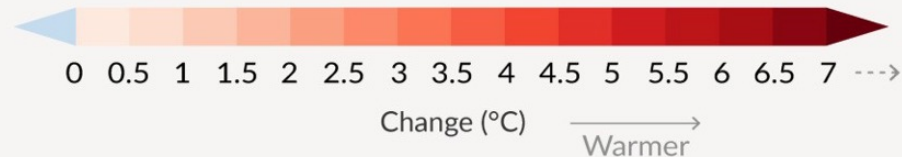
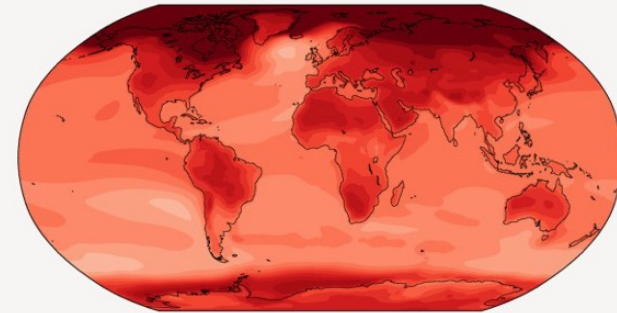
+2° C

Simulated change at 2 °C global warming



+4° C

Simulated change at 4 °C global warming

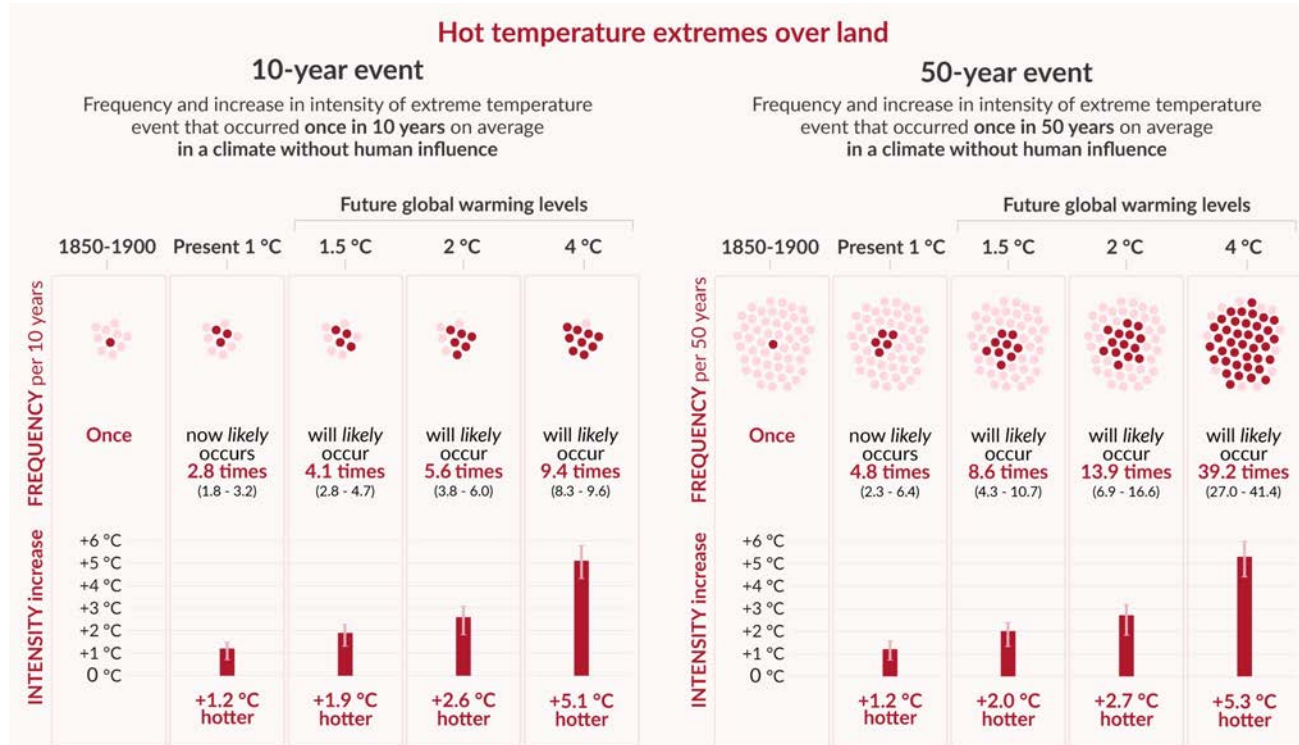


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Projected changes in extremes are larger in frequency and intensity with every additional increment of global warming

Figure SPM.6



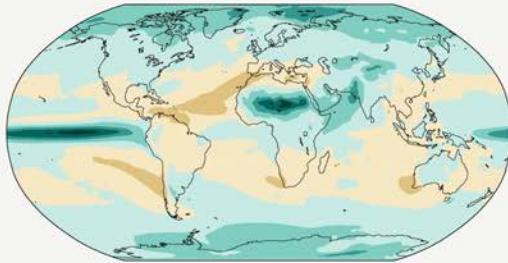
With every increment of global warming, changes get larger in regional mean temperature, precipitation and soil moisture

Figure SPM.5

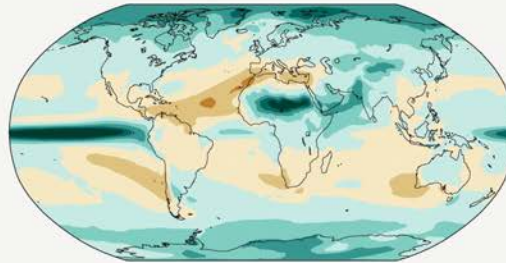
c) Annual mean precipitation change (%) relative to 1850-1900

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.

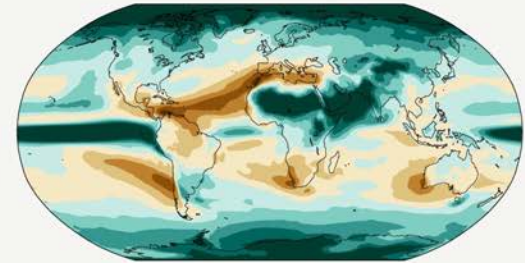
Simulated change at 1.5 °C global warming



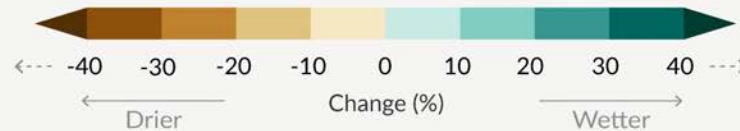
Simulated change at 2 °C global warming



Simulated change at 4 °C global warming



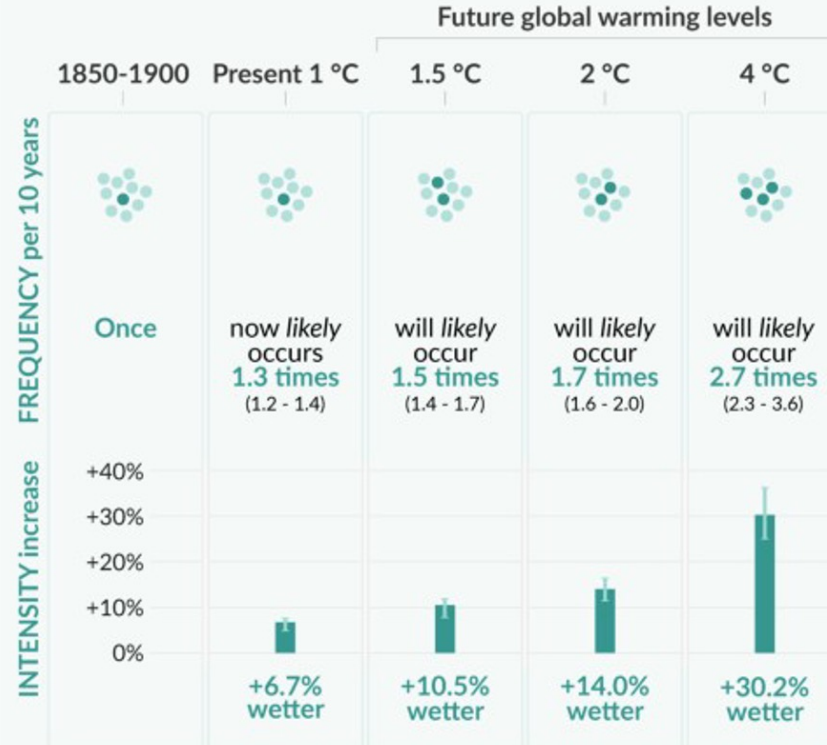
Relatively small absolute changes may appear as large % changes in regions with dry baseline conditions



Heavy precipitation over land

10-year event

Frequency and increase in intensity of heavy 1-day precipitation event that occurred **once in 10 years** on average in a climate without human influence

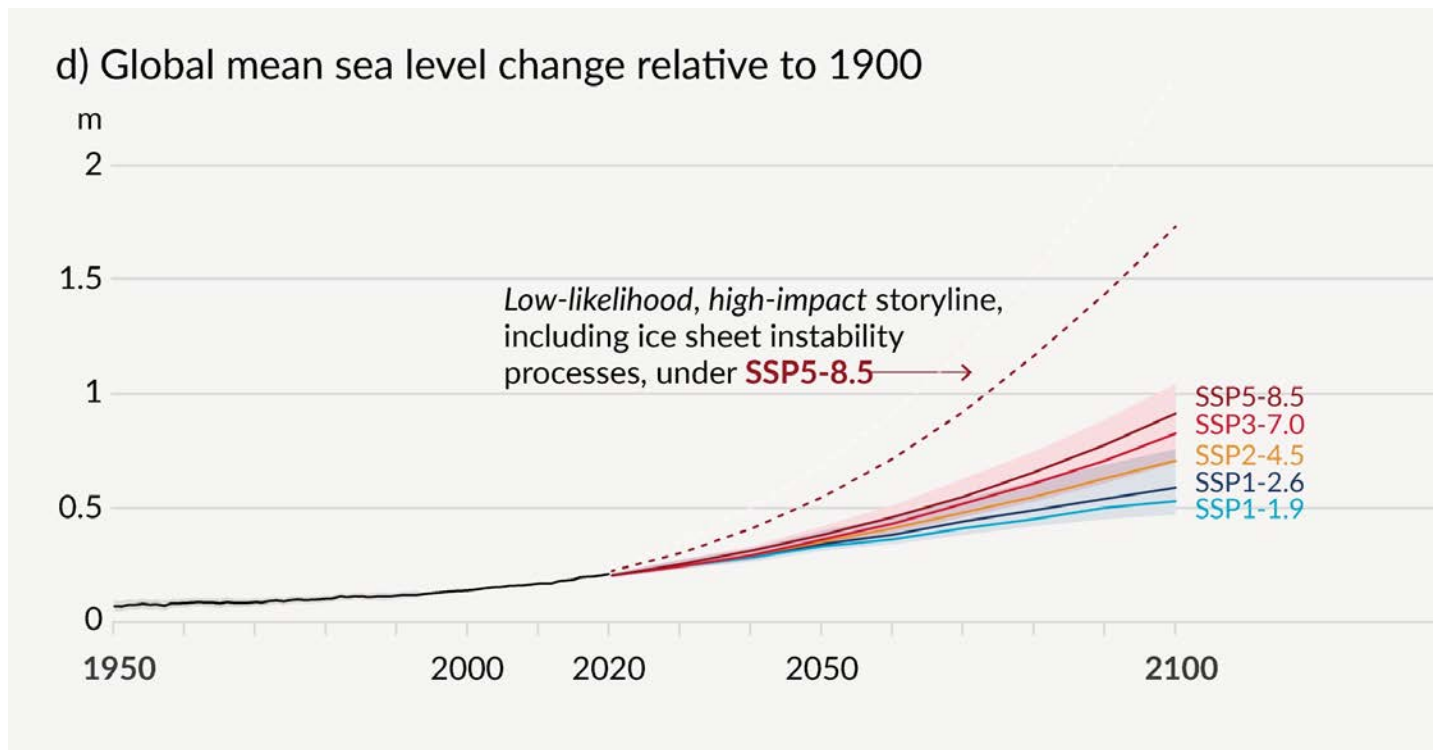


IPCC AR6 WGI SPM
Figure SPM.6

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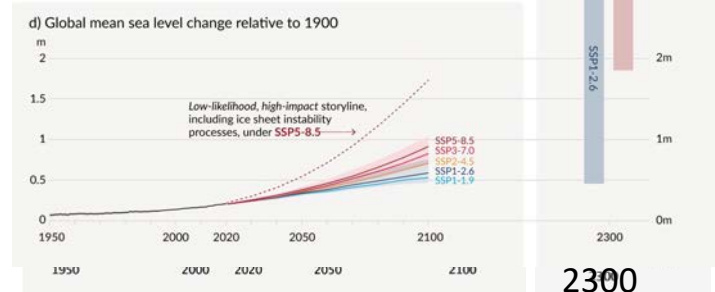
Human activities affect all the major climate system components, with some responding over decades and others over centuries *Figure SPM.8*



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« Sea level rise **greater than 15 m** cannot be ruled out with high emissions »



e) Global mean sea level change in 2300 relative to 1900

Sea level rise greater than 15m cannot be ruled out with high emissions



7 m

2 m

18-20000 years ago (Last Glacial Maximum)

With permission from Dr. S. Jousaume, in « Climat d'hier à demain », CNRS éditions.

3 km thick ice sheets



Sea level: 120 m lower

Il y a
18000 ans

Today, with +4-5° C globally

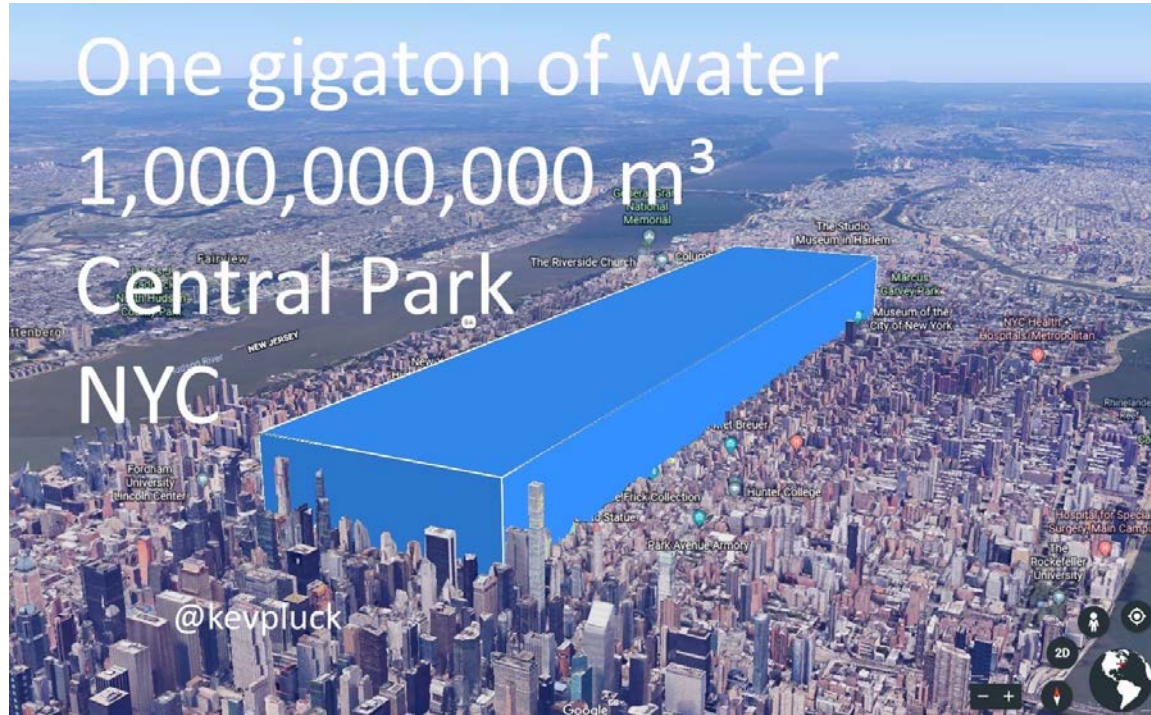
With permission from Dr. S. Joussaume, in « Climat d'hier à demain », CNRS éditions.



Fact: Average temperature is probably on its way to exceed the « conservation temperature » for the Greenland and (some of the) Antarctic ice sheet

There is therefore a very high risk that average sea level would increase by several metres over the next century or two

The Antarctic Ice Sheet presently loses 1 Gt of water every 1.5 day

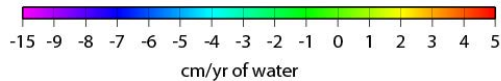
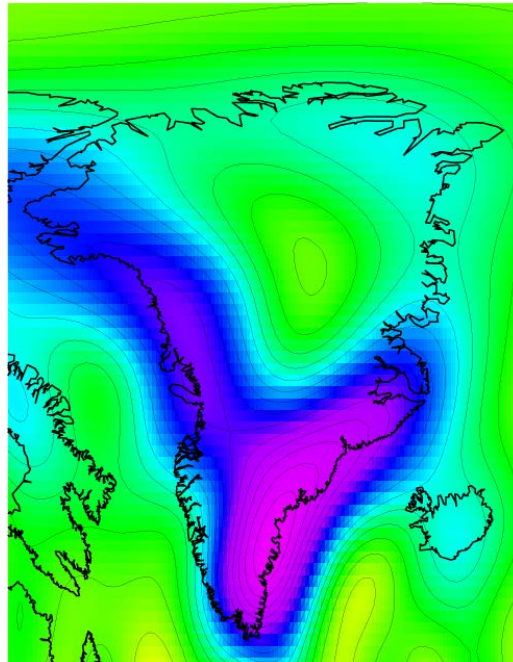


Source: @Kevpluck, June 2018

Greenland Ice Mass Loss 2002-2009

Derived From NASA GRACE Gravity Mission

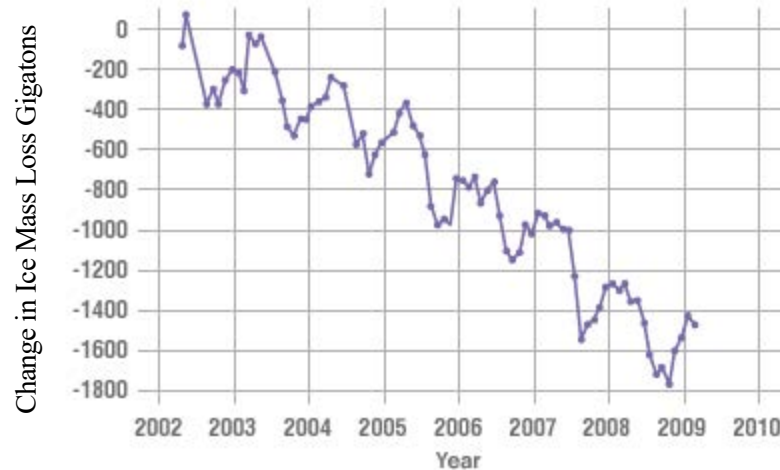
Greenland



J. Wahr, U. Colorado

GREENLAND MASS VARIATION SINCE 2002

Data source: Ice mass measurement by NASA's Grace satellites.



Velicogna, Geophysical Research Letters, 2009

• **Contributes to sea level rise**

Effets sur le Delta du Nil, où vivent plus de 10 millions de personnes à moins d'1 m d'altitude



(Time 2001)

On the frontline: The Maldives



@JPvanYpersele

In front of Environment Ministry, Maldives,
Aug. 2015



@JPvanYpersele

In front of Ministry of Foreign Affairs, Maldives, Aug. 2015



@JPvanYpersele

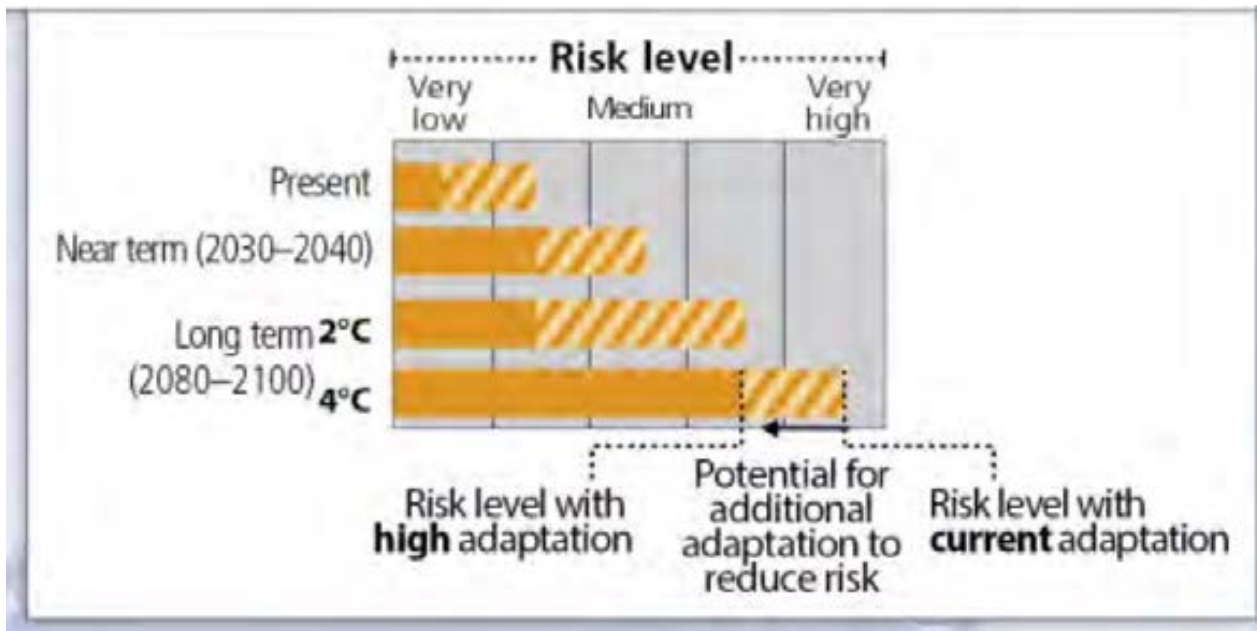


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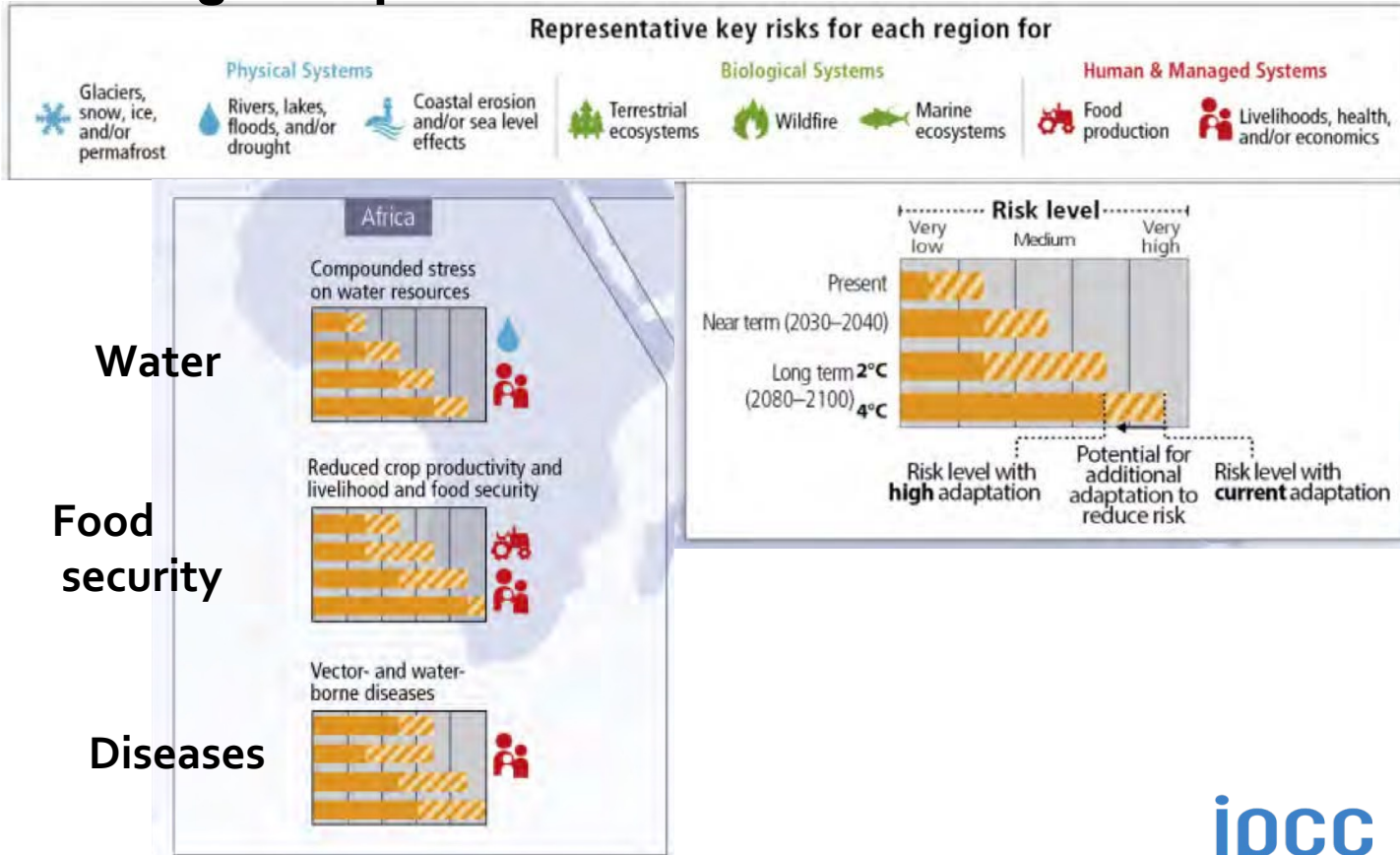


VULNERABILITY AND EXPOSURE IN THE ENTIRE WORLD

Regional key risks and potential for risk reduction through adaptation



Regional key risks and risk reduction through adaptation: Africa

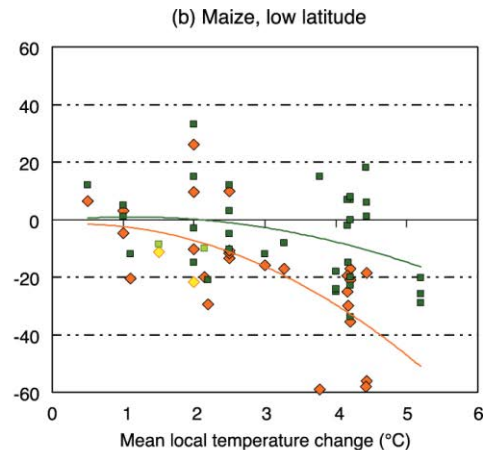
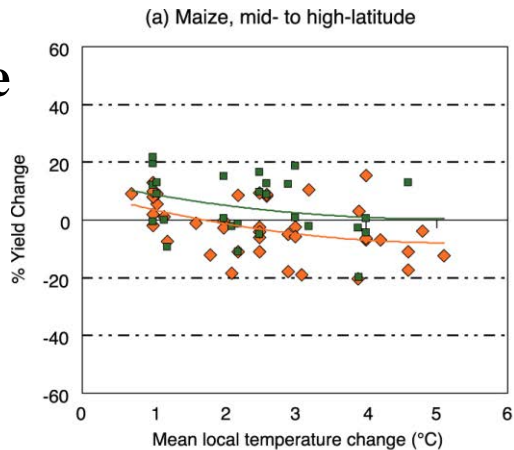


Selected key risks and potential for adaptation for Africa the present day to the long term

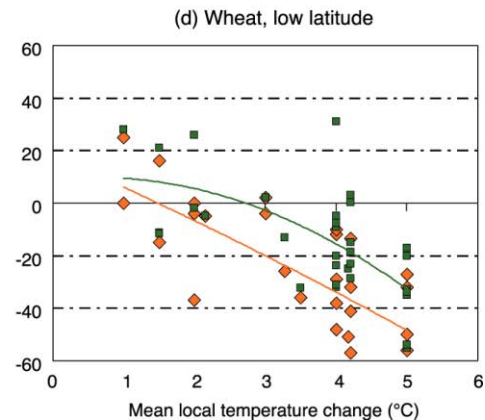
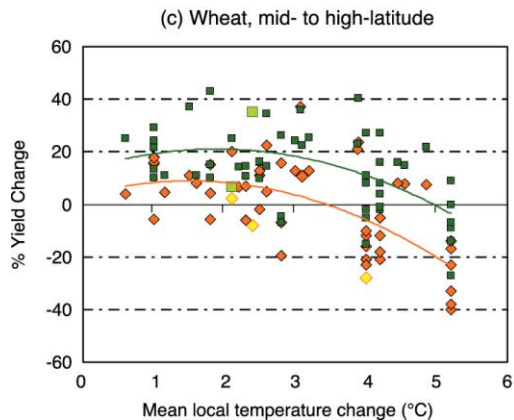
Climate-related drivers of impacts								Level of risk & potential for adaptation															
Warming trend	Extreme temperature	Drying trend	Extreme precipitation	Damaging cyclone	Sea level	Ocean acidification	Sea surface temperature																
Key risk	Adaptation issues & prospects		Climatic drivers	Timeframe	Risk & potential for adaptation																		
<p>Compounded stress on water resources facing significant strain from overexploitation and degradation at present and increased demand in the future, with drought stress exacerbated in drought-prone regions of Africa (<i>high confidence</i>)</p> <p>[22.3-4]</p>	<ul style="list-style-type: none"> Reducing non-climate stressors on water resources Strengthening institutional capacities for demand management, groundwater assessment, integrated water-wastewater planning, and integrated land and water governance Sustainable urban development 			<table border="1"> <tr> <td></td> <td>Very low</td> <td>Medium</td> <td>Very high</td> </tr> <tr> <td>Present</td> <td colspan="3"></td> </tr> <tr> <td>Near-term (2030-2040)</td> <td colspan="3"></td> </tr> <tr> <td rowspan="2">Long-term (2080-2100)</td> <td>2°C</td> <td colspan="2"></td> </tr> <tr> <td>4°C</td> <td colspan="2"></td> </tr> </table>		Very low	Medium	Very high	Present				Near-term (2030-2040)				Long-term (2080-2100)	2°C			4°C		
	Very low	Medium	Very high																				
Present																							
Near-term (2030-2040)																							
Long-term (2080-2100)	2°C																						
	4°C																						
<p>Reduced crop productivity associated with heat and drought stress, with strong adverse effects on regional, national, and household livelihood and food security, also given increased pest and disease damage and flood impacts on food system infrastructure (<i>high confidence</i>)</p> <p>[22.3-4]</p>	<ul style="list-style-type: none"> Technological adaptation responses (e.g., stress-tolerant crop varieties, irrigation, enhanced observation systems) Enhancing smallholder access to credit and other critical production resources; Diversifying livelihoods Strengthening institutions at local, national, and regional levels to support agriculture (including early warning systems) and gender-oriented policy Agronomic adaptation responses (e.g., agroforestry, conservation agriculture) 			<table border="1"> <tr> <td></td> <td>Very low</td> <td>Medium</td> <td>Very high</td> </tr> <tr> <td>Present</td> <td colspan="3"></td> </tr> <tr> <td>Near-term (2030-2040)</td> <td colspan="3"></td> </tr> <tr> <td rowspan="2">Long-term (2080-2100)</td> <td>2°C</td> <td colspan="2"></td> </tr> <tr> <td>4°C</td> <td colspan="2"></td> </tr> </table>		Very low	Medium	Very high	Present				Near-term (2030-2040)				Long-term (2080-2100)	2°C			4°C		
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Present																							
Near-term (2030-2040)																							
Long-term (2080-2100)	2°C																						
	4°C																						
<p>Changes in the incidence and geographic range of vector- and water-borne diseases due to changes in the mean and variability of temperature and precipitation, particularly along the edges of their distribution (<i>medium confidence</i>)</p> <p>[22.3]</p>	<ul style="list-style-type: none"> Achieving development goals, particularly improved access to safe water and improved sanitation, and enhancement of public health functions such as surveillance Vulnerability mapping and early warning systems Coordination across sectors Sustainable urban development 			<table border="1"> <tr> <td></td> <td>Very low</td> <td>Medium</td> <td>Very high</td> </tr> <tr> <td>Present</td> <td colspan="3"></td> </tr> <tr> <td>Near-term (2030-2040)</td> <td colspan="3"></td> </tr> <tr> <td rowspan="2">Long-term (2080-2100)</td> <td>2°C</td> <td colspan="2"></td> </tr> <tr> <td>4°C</td> <td colspan="2"></td> </tr> </table>		Very low	Medium	Very high	Present				Near-term (2030-2040)				Long-term (2080-2100)	2°C			4°C		
	Very low	Medium	Very high																				
Present																							
Near-term (2030-2040)																							
Long-term (2080-2100)	2°C																						
	4°C																						

Figure TS.7. Sensitivity of cereal yield to climate change

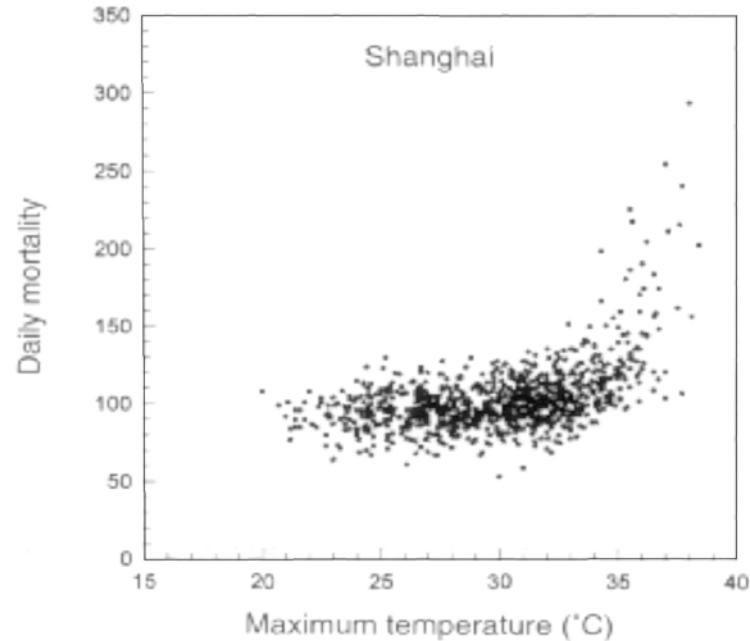
Maize



Wheat



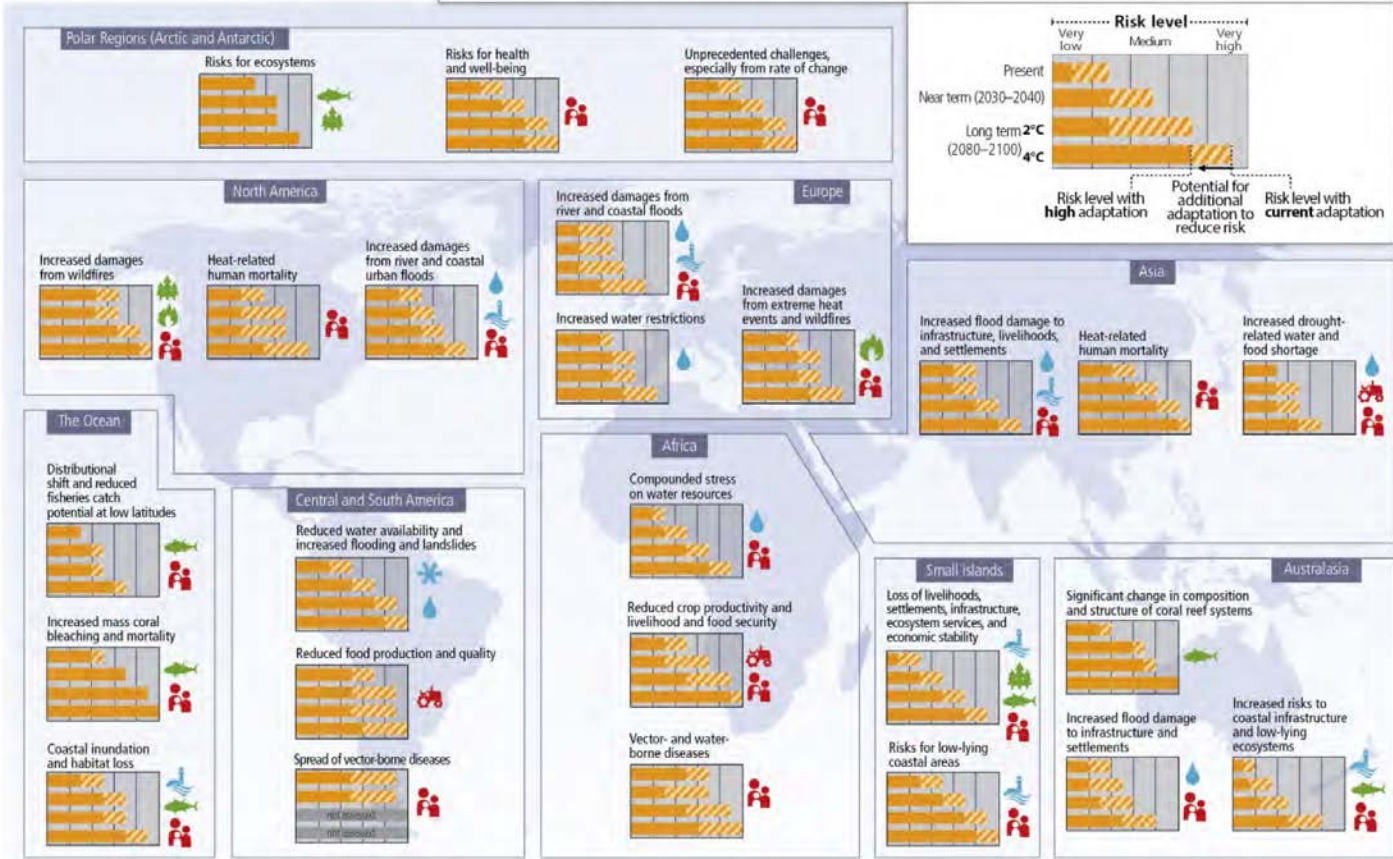
Relationship between maximum temperature and mortality in Shanghai, China, 1980-89



Référence : CLIMATE CHANGE AND HUMAN HEALTH, 1996

Jean-Pascal van Ypersele
(vanyp@climate.be)

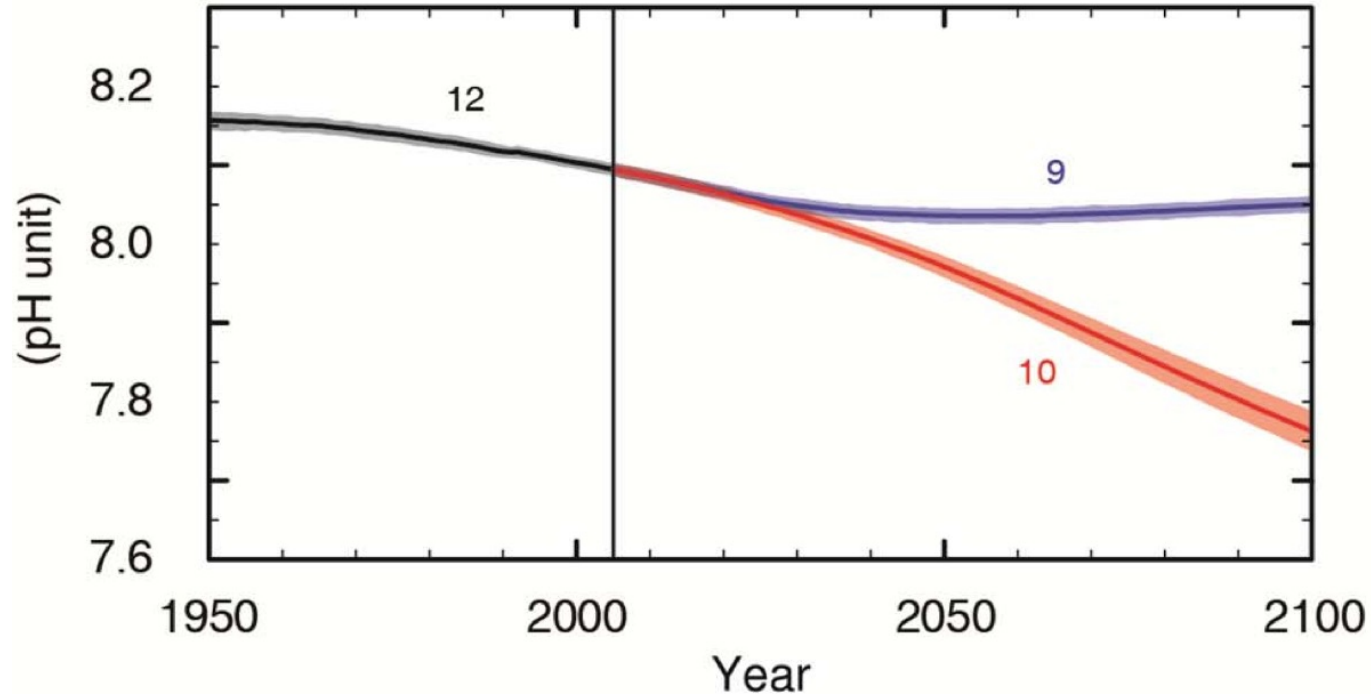
Regional key risks and potential for risk reduction



IPCC, AR5, SPM, Figure SPM.8

Global ocean surface pH (projections)

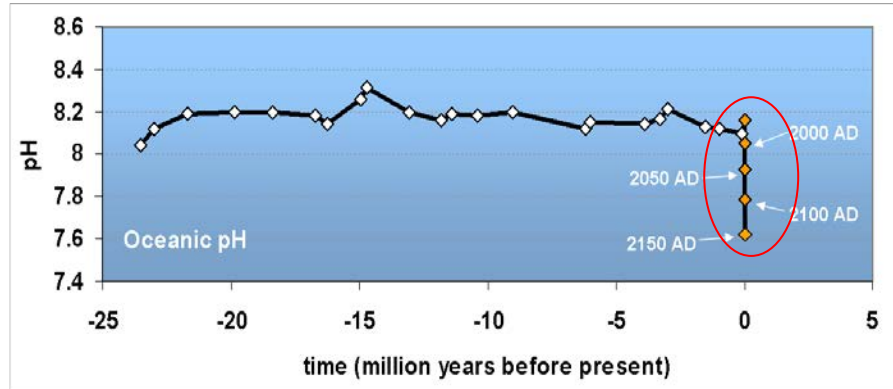
Ocean Acidification, for RCP 8.5 (orange) & RCP2.6 (blue)



IPCC AR5 WGI, Fig SPM 07

Oceans are Acidifying Fast

Changes in pH over the last 25 million years



“Today is a rare event in the history of the World”

- It is happening now, at a **speed and to a level** not experienced by marine organisms for about 60 million years
- Mass extinctions linked to previous ocean acidification events
- Takes 10,000' s of years to recover

Impacts are already underway

- **Tropics to the poles**
- **On all continents and in the ocean**
- **Affecting rich and poor countries (but the poor are more vulnerable everywhere)**



AR5 WGII SPM

Potential Impacts of Climate Change



Food and water shortages



Increased displacement of people



Increased poverty



Coastal flooding

AR5 WGII SPM

Risk = Hazard x Vulnerability x Exposure
(Katrina flood victim, New Orleans, 2005)



AP Photo - Lisa Krantz (<http://lisakrantz.com/hurricane-katrina/zspbn1k4cn17phidupe4f9x5t1mzdr>)

A group of people, including children and adults, are standing in shallow, clear water, planting small mangrove saplings. The water is light green and reflects the sky. In the background, there is a line of trees and a cloudy sky. A man in a red shirt and a straw hat is in the foreground, holding a sapling and a long pole. A child in a yellow shirt is bent over, planting a sapling. A white rope is stretched across the water, marking a line for the planting activity.

ADAPTATION IS
ALREADY
OCCURRING

Flood risk adaptation in Bangladesh (example):
cyclone shelters, awareness raising, forecasting and warning



photo: Dr Thorsten Klose/German Red Cross (2010), evaluation of the
Community Based Disaster Preparedness Programme run by the Red Cross in 1996-2002

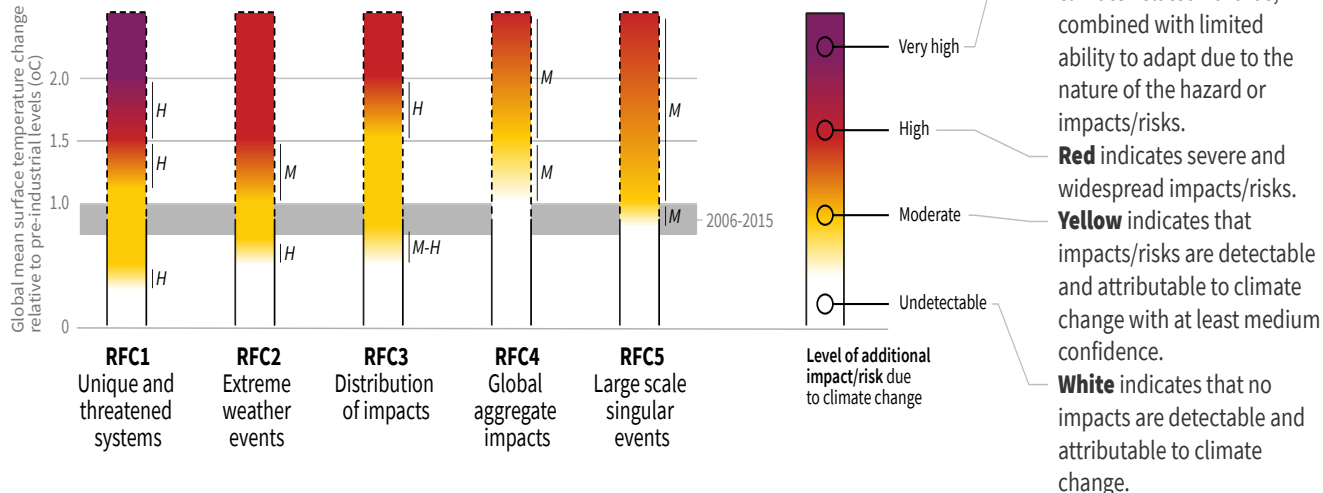


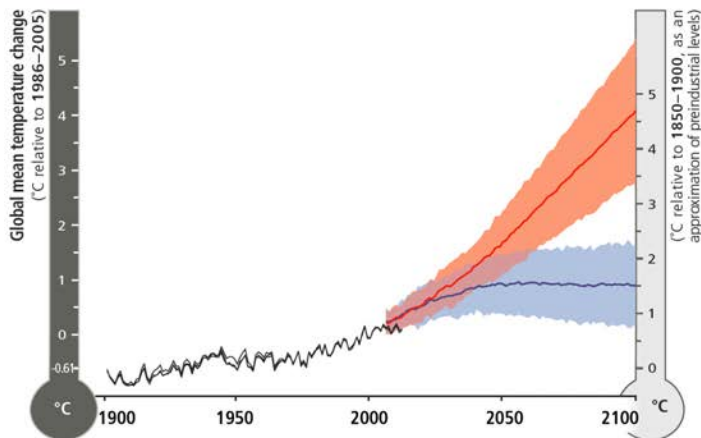
RISKS OF
CLIMATE CHANGE
INCREASE
WITH CONTINUED
HIGH EMISSIONS

How the level of global warming affects impacts and/or risks associated with the Reasons for Concern (RFCs) and selected natural, managed and human systems

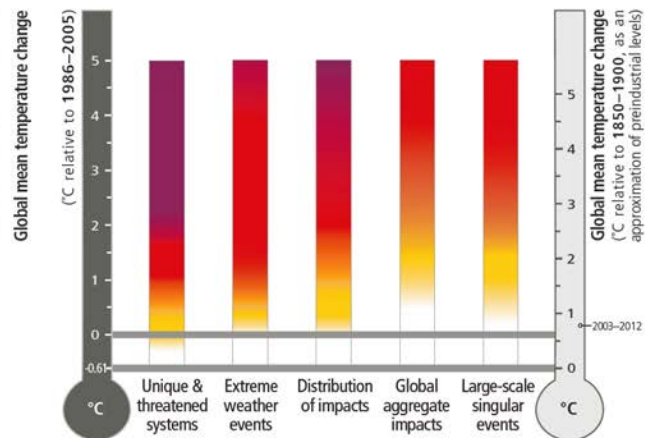
Five Reasons For Concern (RFCs) illustrate the impacts and risks of different levels of global warming for people, economies and ecosystems across sectors and regions.

Impacts and risks associated with the Reasons for Concern (RFCs)





— Observed
 RCP8.5 (a high-emission scenario)
 Overlap
 RCP2.6 (a low-emission mitigation scenario)



Level of additional risk due to climate change
 Undetectable Moderate High Very high

Why net zero emissions are needed as soon as possible

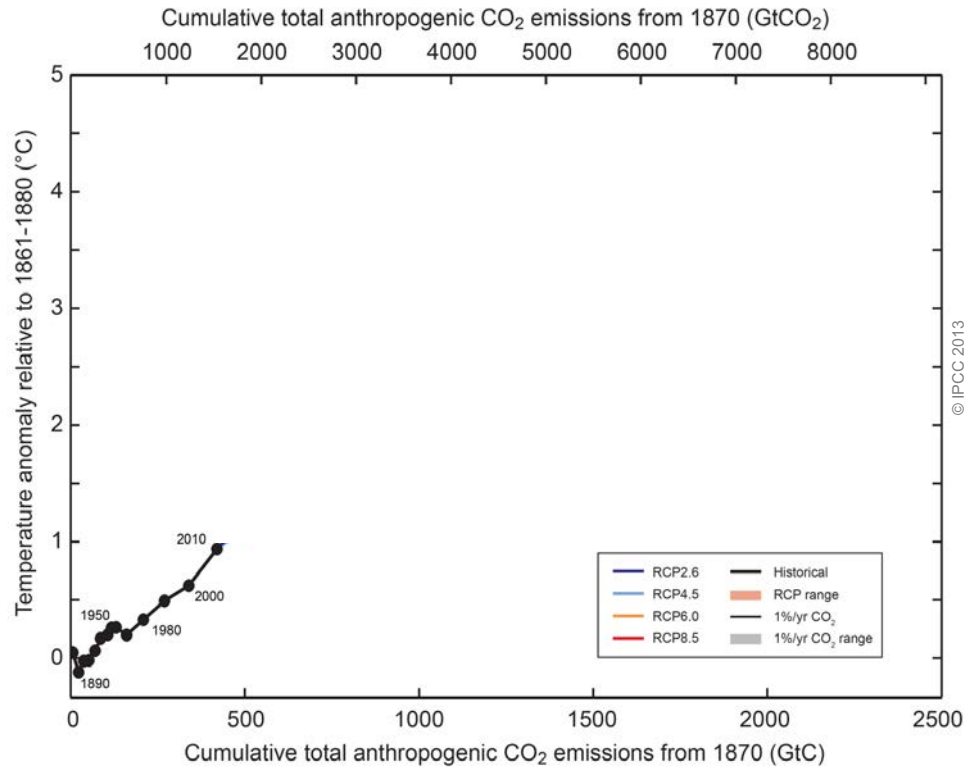


Fig. SPM.10

Cumulative emissions of CO₂ largely determine global mean surface warming by the late 21st century and beyond.

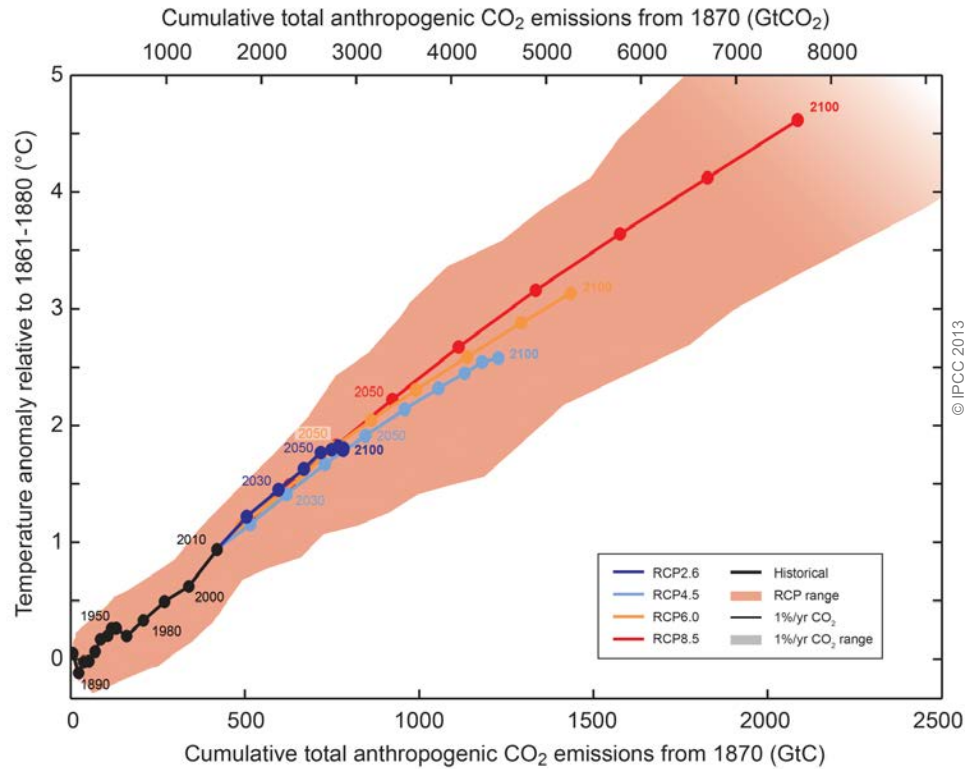


Fig. SPM.10

Limiting climate change will require substantial and sustained reductions of greenhouse gas emissions.

GLOBAL

The temperature will stabilise when we reach net zero carbon dioxide emissions



(based on IPCC-assessed scenarios)

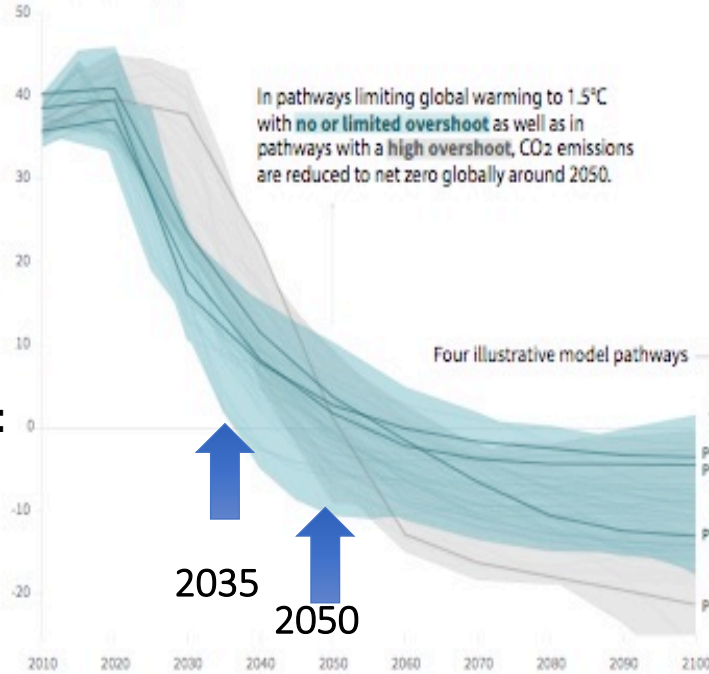


Source: Centre for Science and Environment, Delhi

Emission pathways compatible with below 1.5° C warming:

Global total net CO₂ emissions

Billion tonnes of CO₂/yr



Net ZERO:

2035

2050

Timing of net zero CO₂

Line widths depict the 5-95th percentile and the 25-75th percentile of scenarios



Pathways limiting global warming to 1.5°C with no or low overshoot

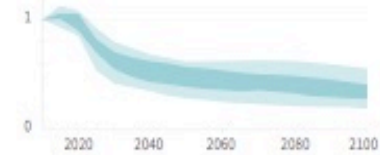
Pathways with high overshoot

Pathways limiting global warming below 2°C (Not shown above)

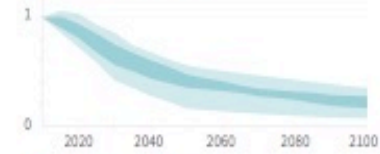
Non-CO₂ emissions relative to 2010

Emissions of non-CO₂ forcers are also reduced or limited in pathways limiting global warming to 1.5°C with **no or limited overshoot**, but they do not reach zero globally.

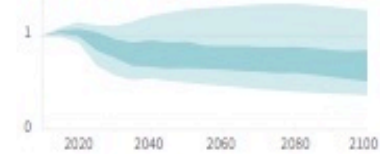
Methane emissions



Black carbon emissions



Nitrous oxide emissions



Greenhouse gas emissions pathways

- Limiting warming to 1.5° C would require changes on an unprecedented scale
 - Deep emissions cuts in all sectors
 - A range of technologies
 - Behavioural changes
 - Increase investment in low carbon options

Climate Change 2022

Mitigation of Climate Change



Climate Change 2022

Mitigation of Climate Change



**2010-2019:
Average annual
greenhouse gas
emissions at
highest levels in
human history**



Unless there are immediate and deep emissions reductions across all sectors, 1.5°C is beyond reach.

There are options available **now** in every sector that can at least **halve** emissions by 2030



Demand and services



Energy



Land use



Industry



Urban



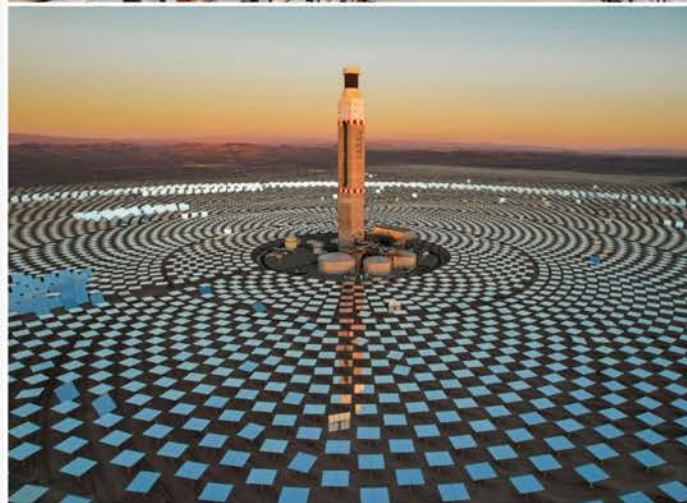
Buildings



Transport

Energy

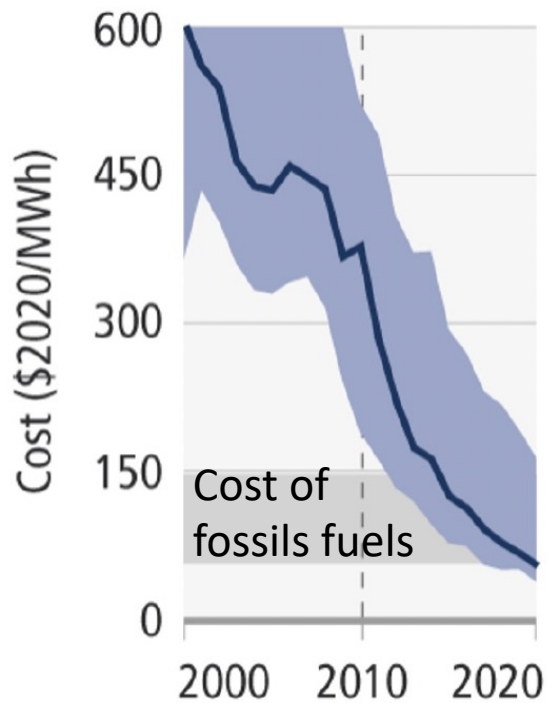
- **major transitions** are required to limit global warming
- reduction in fossil fuel use and use of carbon capture and storage
- low- or **no-carbon** energy systems
- widespread **electrification** and improved energy **efficiency**
- **alternative fuels**: e.g. hydrogen and sustainable biofuels



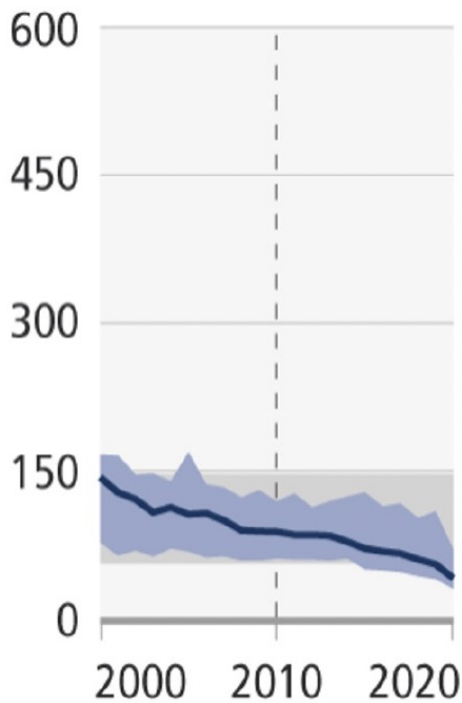
[Portland General Electric CC BY-ND 2.0, Harry Cunningham/Unsplash, Stéphane Bellerose/UNDP in Mauritius and Seychelles CC BY-NC 2.0, IMF Photo/Lisa Marie David, Tamara Merino CC BY-NC-ND 2.0]

Good news: solar & wind energy become cheaper than fossil fuels

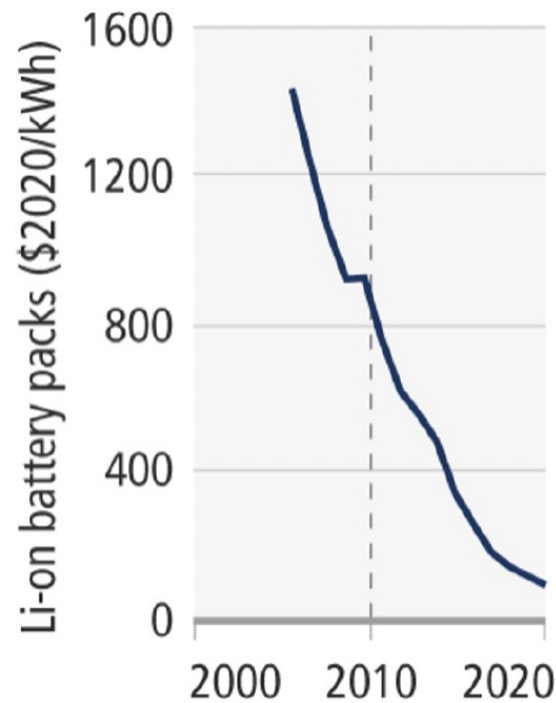
Photovoltaics (PV)



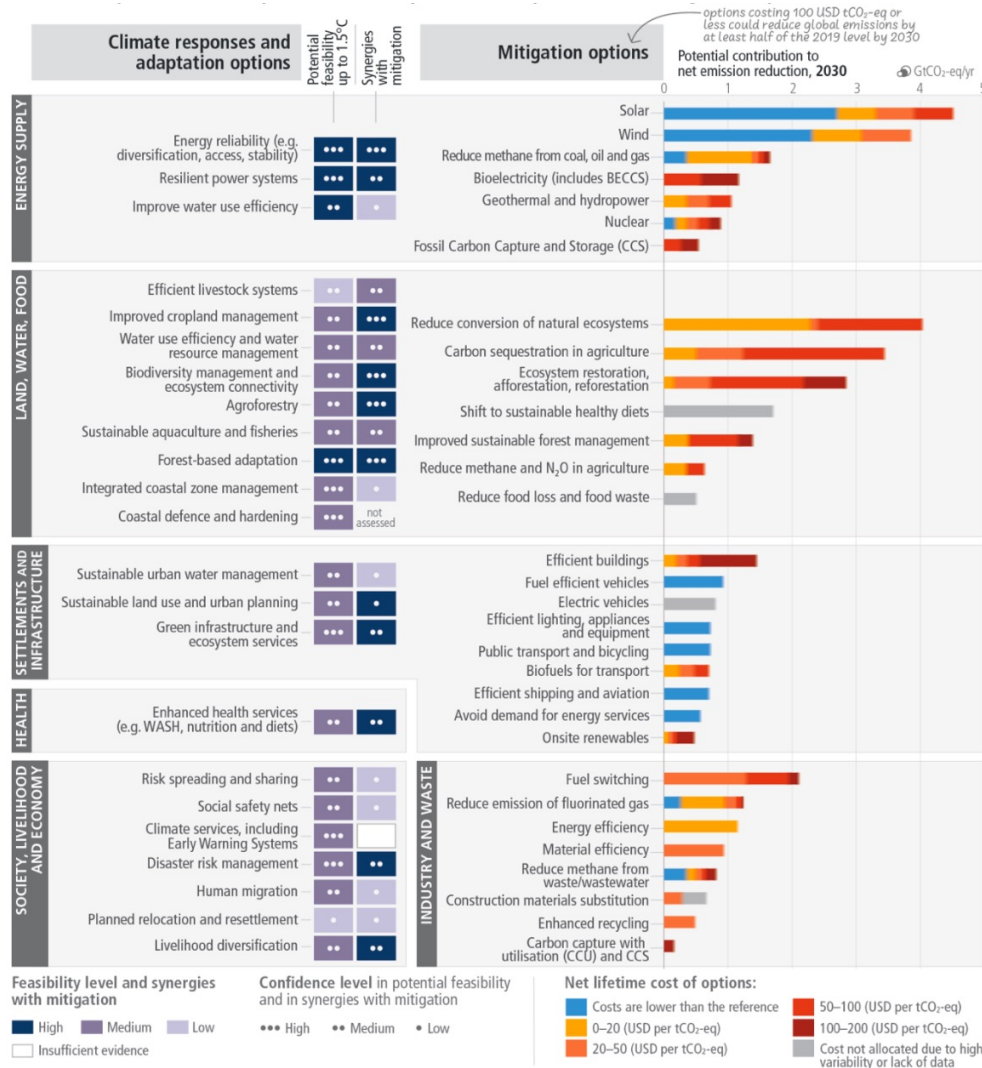
Onshore wind



Batteries for passenger electric vehicles (EVs)



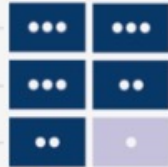
Feasibility of climate responses and adaptation, and potential of mitigation in the near-term



Climate responses and adaptation options

Potential feasibility up to 1.5°C
Synergies with mitigation

Energy reliability (e.g. diversification, access, stability)
Resilient power systems
Improve water use efficiency



Efficient livestock systems
Improved cropland management
Water use efficiency and water resource management
Biodiversity management and ecosystem connectivity
Agroforestry
Sustainable aquaculture and fisheries
Forest-based adaptation
Integrated coastal zone management
Coastal defence and hardening

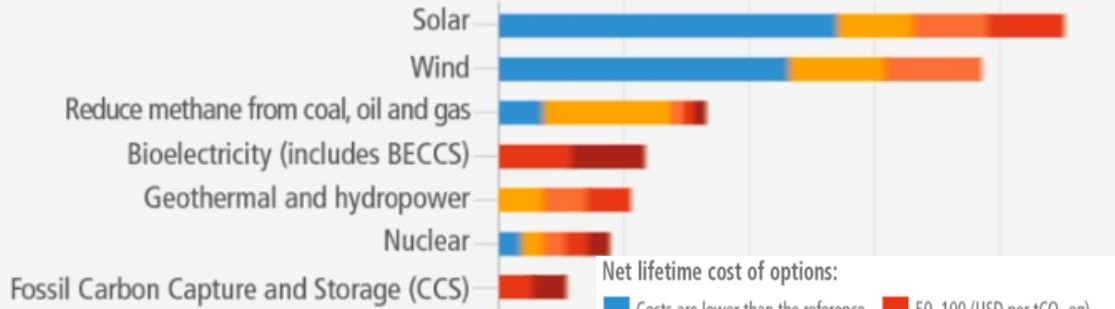


Mitigation options

Potential contribution to net emission reduction, 2030

GtCO₂-eq/yr

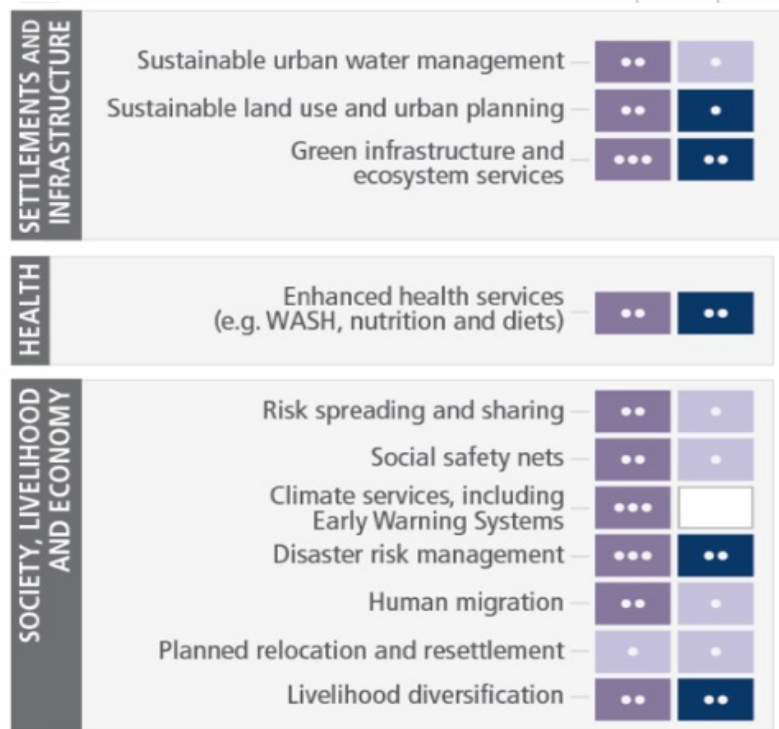
0 1 2 3 4



Net lifetime cost of options:
 Blue: Costs are lower than the reference
 Yellow: 0–20 (USD per tCO₂-eq)
 Orange: 20–50 (USD per tCO₂-eq)
 Red: 50–100 (USD per tCO₂-eq)
 Dark Red: 100–200 (USD per tCO₂-eq)
 Grey: Cost not allocated due to high variability or lack of data

Climate responses and adaptation options

Potential feasibility up to 1.5°C
Synergies with mitigation



Feasibility level and synergies with mitigation

High Medium Low
Insufficient evidence

Confidence level in potential feasibility and in synergies with mitigation

High Medium Low

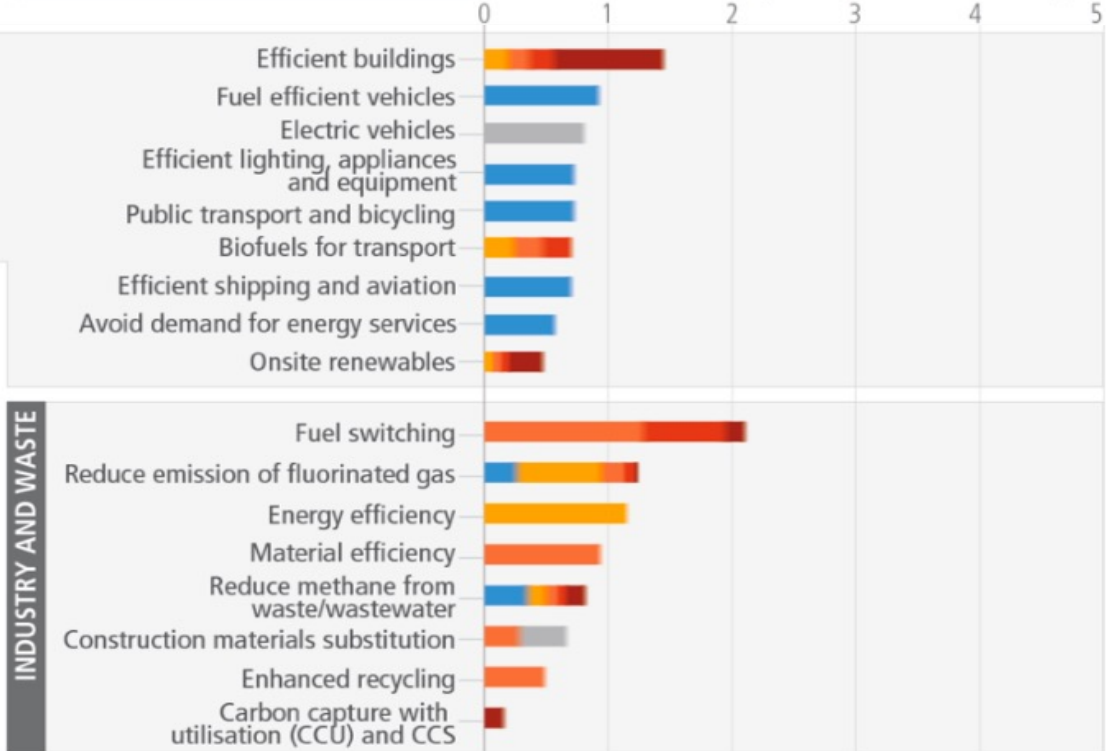
IPCC AR6 SYR Fig SPM.7a (bottom)

Mitigation options

options costing 100 USD tCO₂-eq or less could reduce global emissions by at least half of the 2019 level by 2030

Potential contribution to net emission reduction, 2030

GtCO₂-eq/yr



Net lifetime cost of options:

Costs are lower than the reference
0-20 (USD per tCO₂-eq)
20-50 (USD per tCO₂-eq)
50-100 (USD per tCO₂-eq)
100-200 (USD per tCO₂-eq)
Cost not allocated due to high variability or lack of data

Demand and services

- potential to **bring down global emissions by 40-70%** by 2050
- walking and cycling, electrified transport, reducing air travel, and adapting houses make large contributions
- **lifestyle changes** require **systemic changes** across all of society
- **some** people require additional **housing, energy and resources** for human wellbeing



Transport

- **reducing demand and low-carbon technologies** are key to reducing emissions
- **electric vehicles:** greatest potential
- **battery technology:** advances could assist electric rail, trucks
- **aviation and shipping:** alternative fuels (low-emission **hydrogen** and **biofuels**) needed
- Overall, substantial potential but depends on **decarbonising the power sector.**



Cities and urban areas

- better urban planning, as well as:
- sustainable production and consumption of goods and services,
- **electrification** (low-emission energy),
- enhancing **carbon uptake and storage** (e.g. green spaces, ponds, trees)

There are options for existing, rapidly growing *and* new cities.



Buildings

- buildings: possible to reach net zero emissions in 2050
- action in this decade is critical to fully capture this potential
- involves retrofitting existing buildings and effective mitigation techniques in new buildings
- requires ambitious policy packages
- zero energy and **zero-carbon** buildings exist in new builds and **retrofits**



Industry

- using materials more **efficiently, reusing, recycling, minimising waste**; currently **under-used** in policies and practice
- **basic materials**: low- to zero-greenhouse gas production processes at **pilot to near-commercial** stage
- achieving **net zero** is challenging



Land use

- can provide large-scale emissions reductions **and** remove and store CO₂ at scale
- protecting and restoring **natural ecosystems** to remove carbon: forests, peatlands, coastal wetlands, savannas and grasslands
- competing demands have to be **carefully managed**
- **cannot compensate** for **delayed** emission **reductions** in other sectors



Technology and Innovation

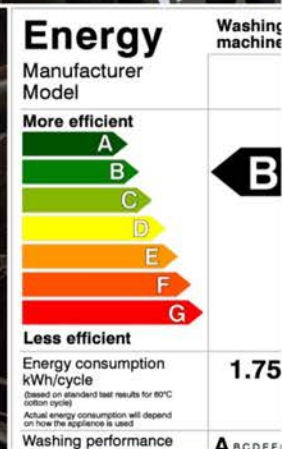
- investment and policies **push forward low emissions** technological **innovation**
- **effective decision making** requires assessing potential benefits, barriers and risks
- **some options** are technically **viable**, rapidly becoming **cost-effective**, and have relatively **high public support**. Other options face barriers

Adoption of low-emission technologies is slower in most developing countries, particularly the least developed ones.





Policies, regulatory and economic instruments



- regulatory and economic instruments have **already proven effective** in reducing emissions
- **policy packages** and **economy-wide packages** are able to achieve **systemic change**
- ambitious and effective mitigation requires **coordination across government and society**



[World Bank/Simone D. McCourtie, Dominic Chavez CC BY-NC-ND 2.0, Trent Reeves/MTA Construction & Development CC BY 2.0, IMF Photo/Tamara Merino CC BY-NC-ND 2.0, Olga Delawrence/Unsplash.]

Closing investment gaps

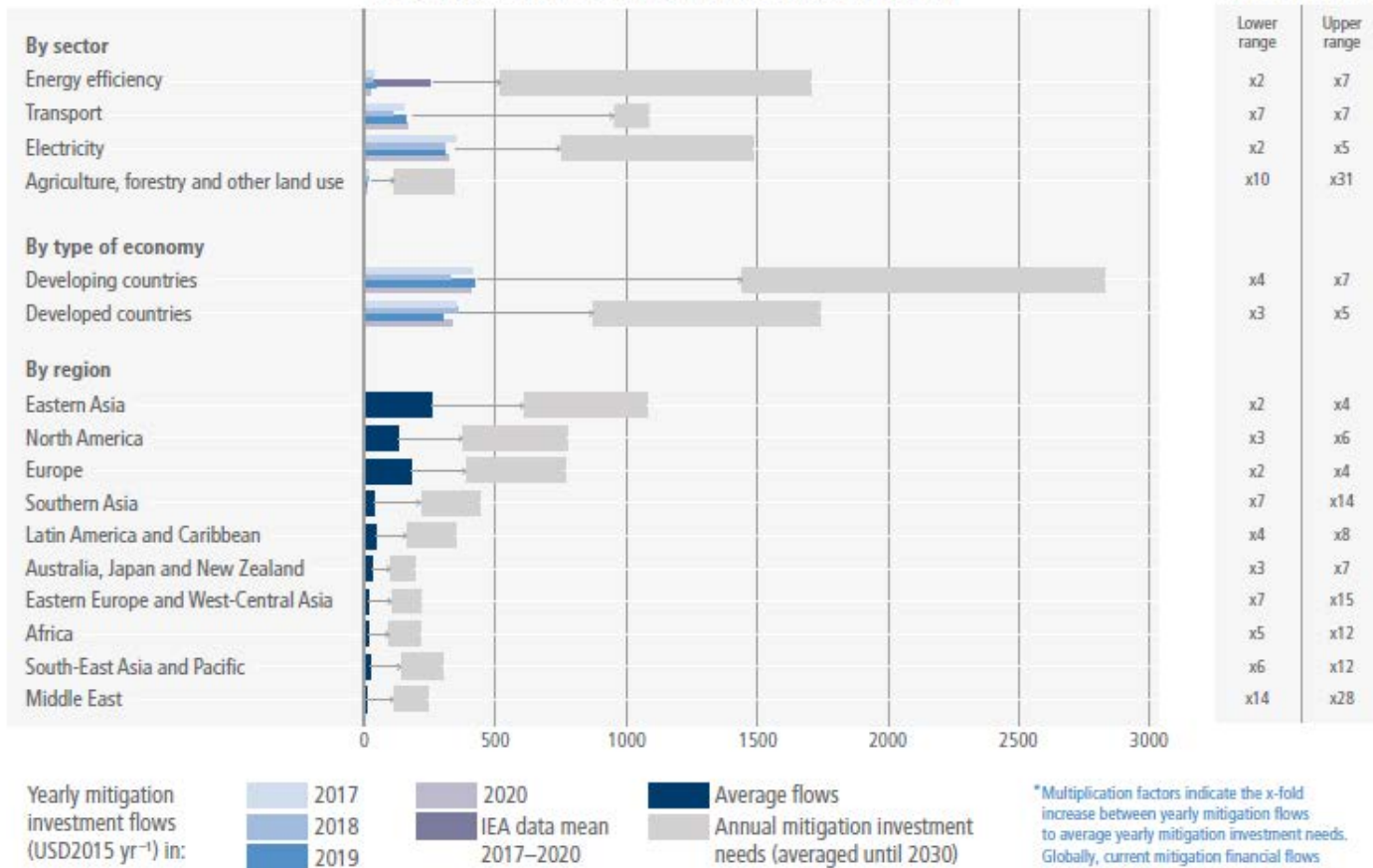
- financial flows: **3-6x lower** than levels needed **by 2030** to limit warming to below 1.5°C or 2°C
- there is **sufficient global capital** and liquidity to close investment gaps
- challenge of closing gaps is widest for developing countries



Climate finance gap

Actual yearly flows compared to average annual needs (billion USD 2015 yr⁻¹)

Multiplication factors*



UNFCCC COP27: Key outcomes

- COP27 agreed on an overarching 'cover decision', the [Sharm el-Sheikh Implementation Plan](#).
It reuses language on 1.5°C and phasing down coal from last year's [Glasgow Climate Pact](#)
Makes the first ever mentions of food security risks, climate [tipping points](#) and the need for [financial system reform](#) (next slide).
- Key delivery was the '[loss and damage](#)' fund. Targeting vulnerable developing countries, the fund will respond to [loss and damage](#), the adverse effects of climate change. A transitional committee is to make recommendations at COP28 next year on operationalising the fund, with an emphasis on finding new and innovative funding arrangements.
- COP27 also finalised a [mitigation work programme](#) focused on pooling ideas to accelerate action, with no binding elements.
NB: Calls to ensure a peak in emissions by 2025 and a phase-down of fossil fuels **were not included in the final text.**

From the COP27 cover decision

30. *Highlights* that about USD 4 trillion per year needs to be invested in renewable energy up until 2030 to be able to reach net zero emissions by 2050,¹⁸ and that, furthermore, a global transformation to a low-carbon economy is expected to require investment of at least USD 4–6 trillion per year;

31. *Also highlights* that delivering such funding will require a *transformation of the financial system* and its structures and processes, engaging governments, central banks, commercial banks, institutional investors and other financial actors;

From the COP27 cover decision

32. *Notes with concern* the growing gap between the needs of developing country Parties, in particular those due to the increasing impacts of climate change and their increased indebtedness, and the support provided and mobilized for their efforts to implement their nationally determined contributions, highlighting that such needs are currently estimated at USD 5.8–5.9 trillion²⁰ for the pre-2030 period;

35. *Notes* that global climate finance flows are small relative to the overall needs of developing countries, with such flows in 2019–2020 estimated to be USD 803 billion,²³ which is 31–32 per cent of the annual investment needed to keep the global temperature rise well below 2 °C or at 1.5 °C, and also below what would be expected in the light of the *investment opportunities* identified and the cost of failure to meet climate stabilization targets;

« Integrity Matters »

Report published during COP27

**INTEGRITY MATTERS:
NET ZERO COMMITMENTS
BY BUSINESSES,
FINANCIAL INSTITUTIONS,
CITIES AND REGIONS**

REPORT FROM THE UNITED NATIONS'
HIGH-LEVEL EXPERT GROUP ON THE
NET ZERO EMISSIONS COMMITMENTS
OF NON-STATE ENTITIES



« Integrity Matters »

Five Principles

- 1. Ambition which delivers significant near— and medium —term emissions reductions on a path to global net zero by 2050**
- 2. Demonstrated integrity by aligning commitments with actions and investments**
- 3. Radical transparency in sharing relevant, non-competitive, comparable data on plans and progress**
- 4. Established credibility through plans based in science and third-party accountability**
- 5. Demonstrable commitment to both equity and justice in all actions**

« Integrity Matters »

Ten Recommendations

1. Announcing a Net Zero Pledge
2. Setting Net Zero Targets
3. Using Voluntary Credits
4. Creating a Transition Plan
5. Phasing out of Fossil Fuels and Scaling Up Renewable Energy
6. Aligning Lobbying and Advocacy
7. People and Nature in the Just Transition
8. Increasing Transparency and Accountability
9. Investing in Just Transitions
10. Accelerating the Road to Regulation

The priorities I suggest

**(Element) of solution n° 1: The survival of
humanity and ecosystems must become a
much higher political priority**

... as if we were all running for our life.

Nations Unies
Conférence sur les Changements Climatiques

COP21/CMP11

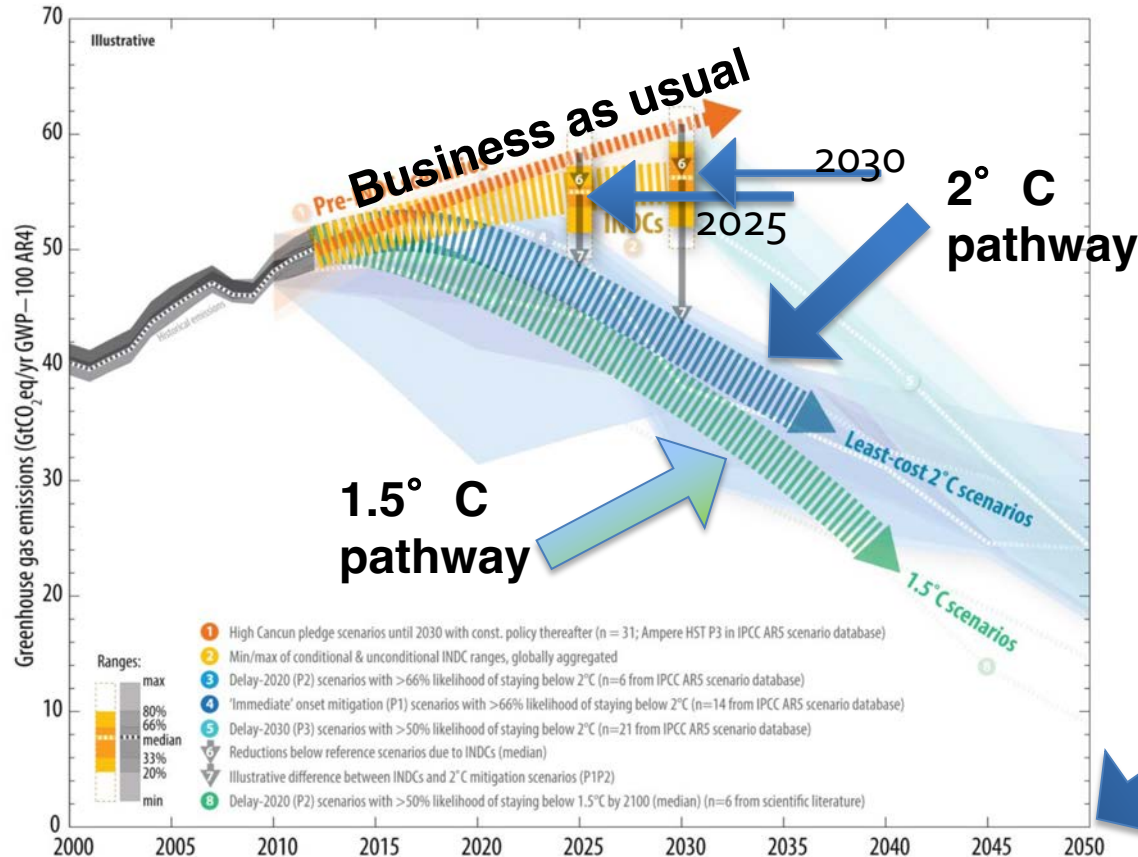
Paris, France



Paris Agreement

- Article 2:
 - ♦ (...) to strengthen the global response to the threat of climate change, in the context of sustainable development and efforts to eradicate poverty, including by:
 - ▶ Holding the increase in the global average temperature to **well below 2 °C** above pre-industrial levels and to **pursue efforts** to limit the temperature increase to **1.5 °C** above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change;
 - ▶ **Increasing the ability to adapt** (...) and foster climate resilience and low greenhouse gas emissions development, in a manner that does not threaten food production;
 - ▶ Making **finance flows consistent** with a pathway towards low greenhouse gas emissions and climate-resilient development

Paris Agreement: plans not sufficient yet!



UNFCCC, Aggregate effect of the intended nationally determined contributions: an update
<http://unfccc.int/resource/docs/2016/cop22/eng/02.pdf>

Solution n° 2: Economic actors must be confronted much more clearly with their responsibilities

**Degrowth of climate-unfriendly activities
must be accepted, while growth of activities
helping climate protection and poverty
eradication must be encouraged**

**Yes, the planet got destroyed. But
for a beautiful moment in time we
created value for shareholders**



*"Yes, the planet got destroyed. But for a beautiful moment
in time we created a lot of value for shareholders."*

Solution n° 3: The best understood language is the price. Destroying the environment must become more and more expensive. Collected funds must be used to help the decarbonization, and avoid impacting the poor disproportionately

EU Emission Trading System, CO₂ taxes, fines, internal CO₂ price (firms do « as if » CO₂ emission was expensive). NB: Price must match the effect desired!

**Solution n° 4: Transition towards
a clean and sustainable economy
and energy system must be
« just », and other synergies with
the SDGs must be sought**

**Ex : The Polish energy system
cannot be transformed without
facilitating the coal miners
reconversion**

@JPvanYpersele



SUSTAINABLE DEVELOPMENT GOALS





Joel Pett, USA Today

Solution n° 5: Before looking at how to produce energy cleanly, much more attention must be given to reducing energy demand and efficiency, in all sectors

All production and consumption patterns must be reconsidered, helped by energy audits, etc.

- **Substantial reductions in emissions to stay under 2° C would require large changes in investment patterns e.g., from 2010 to 2029, in billions US dollars/year:** (mean numbers rounded, IPCC AR5 WGIII Fig SPM 9)

- **energy efficiency: +330**
- **renewables: + 90**
- **power plants w/ CCS: + 40**
- **nuclear: + 40**
- **power plants w/o CCS: - 60**
- **fossil fuel extraction: - 120**

**Solution n° 6: Building sector: offers
many opportunities in energy
saving, economic activity, improving
wellbeing...**

Solution n° 7: Mobility : much more space and priority to pedestrians, bicycles, and public transport; reduce priority given too long to individual transport in urban planning

Electrify remaining vehicles (with clean electricity). Fly less, only if essential.

**Solution n° 8: Food and
agriculture. A possible change with
big positive impact: eat less (red)
meat and cheese, of better quality!
Eat more plant-based food
(produced cleanly)**

...It is good for health as well!

Solution n° 9: The Sun gives us in two hours about as much energy as the world uses in *one year*, all forms of energy considered

The cost of solar kWh is crashing, wind power, heat and electricity storage, and smart grids are moving forward

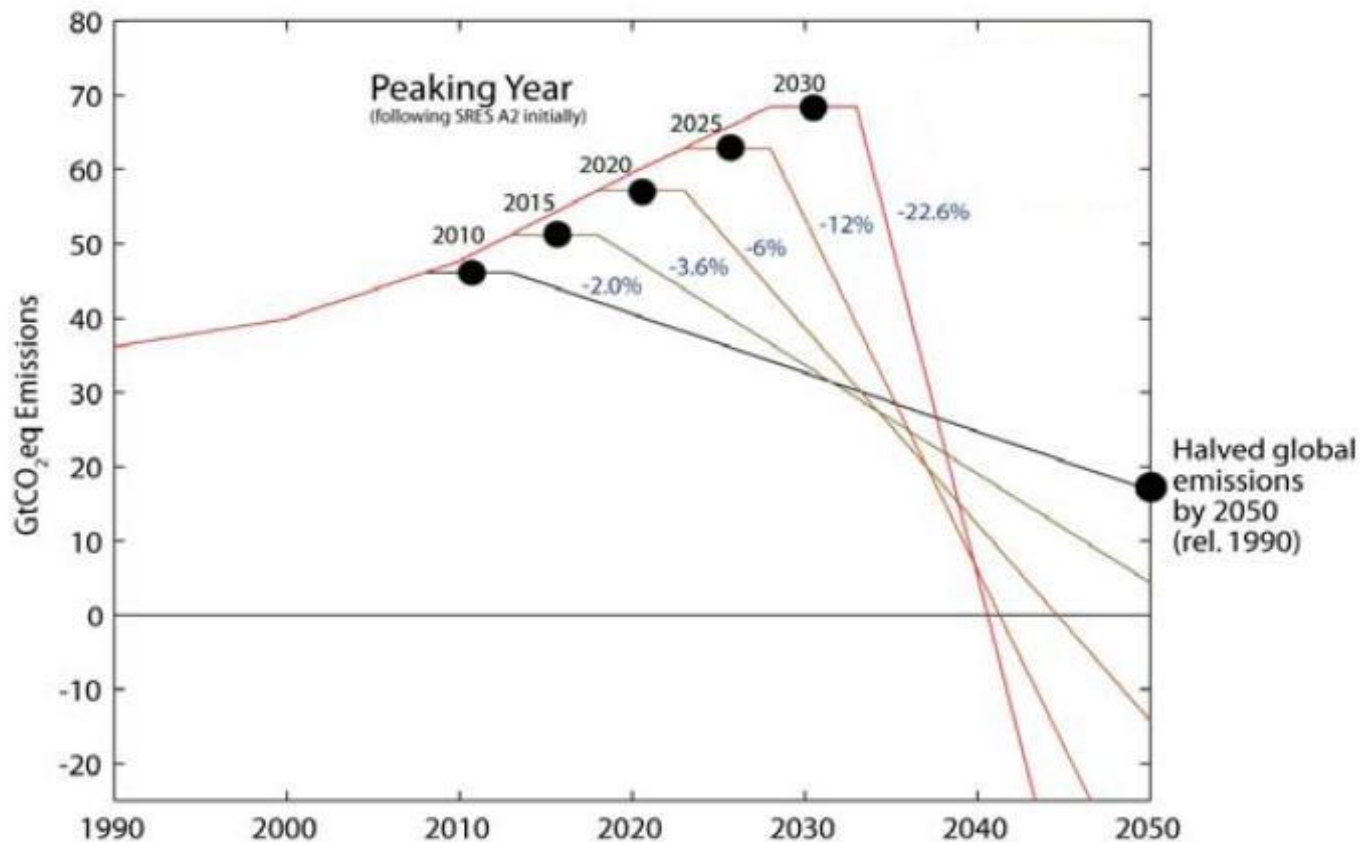
If well designed, measures to prevent climate change could offer so many opportunities:

- **Co-benefits in reduced pollution, health improvement, employment, gender equality, food security, reduced poverty, energy independence...**
- **Opportunities to shift the tax burden away from labour and implement sustainable development**
- **Opportunities to integrate research results in a useful, policy-relevant way, accross disciplines (including social sciences)**



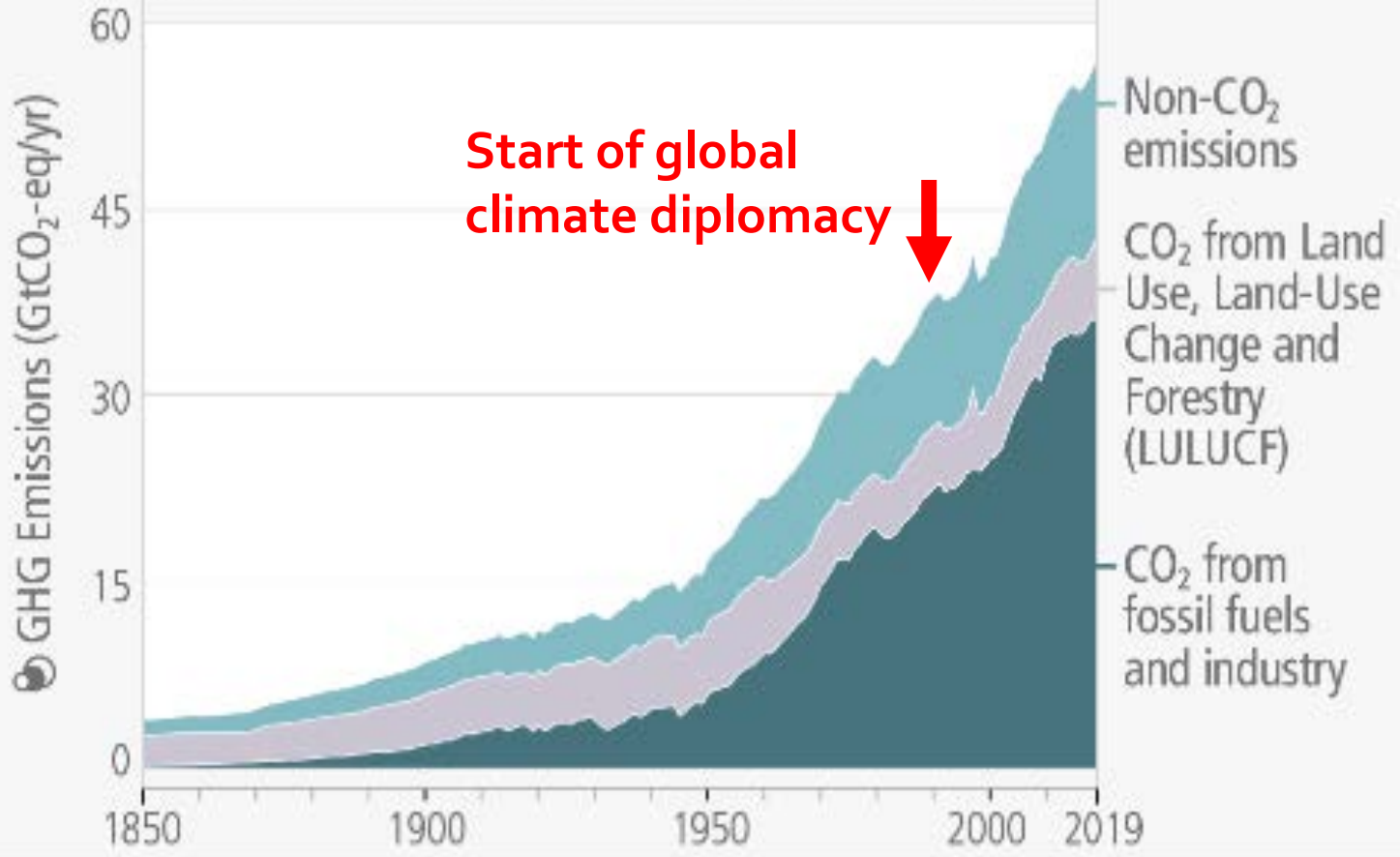
Joel Pett, USA Today

The more we wait, the more difficult it will be



Source: Meinshausen et al. - Nature, 30th April 2009

Greenhouse gas (GHG) emissions resulting from human activities continue to increase



Start of global climate diplomacy



Non-CO₂ emissions

CO₂ from Land Use, Land-Use Change and Forestry (LULUCF)

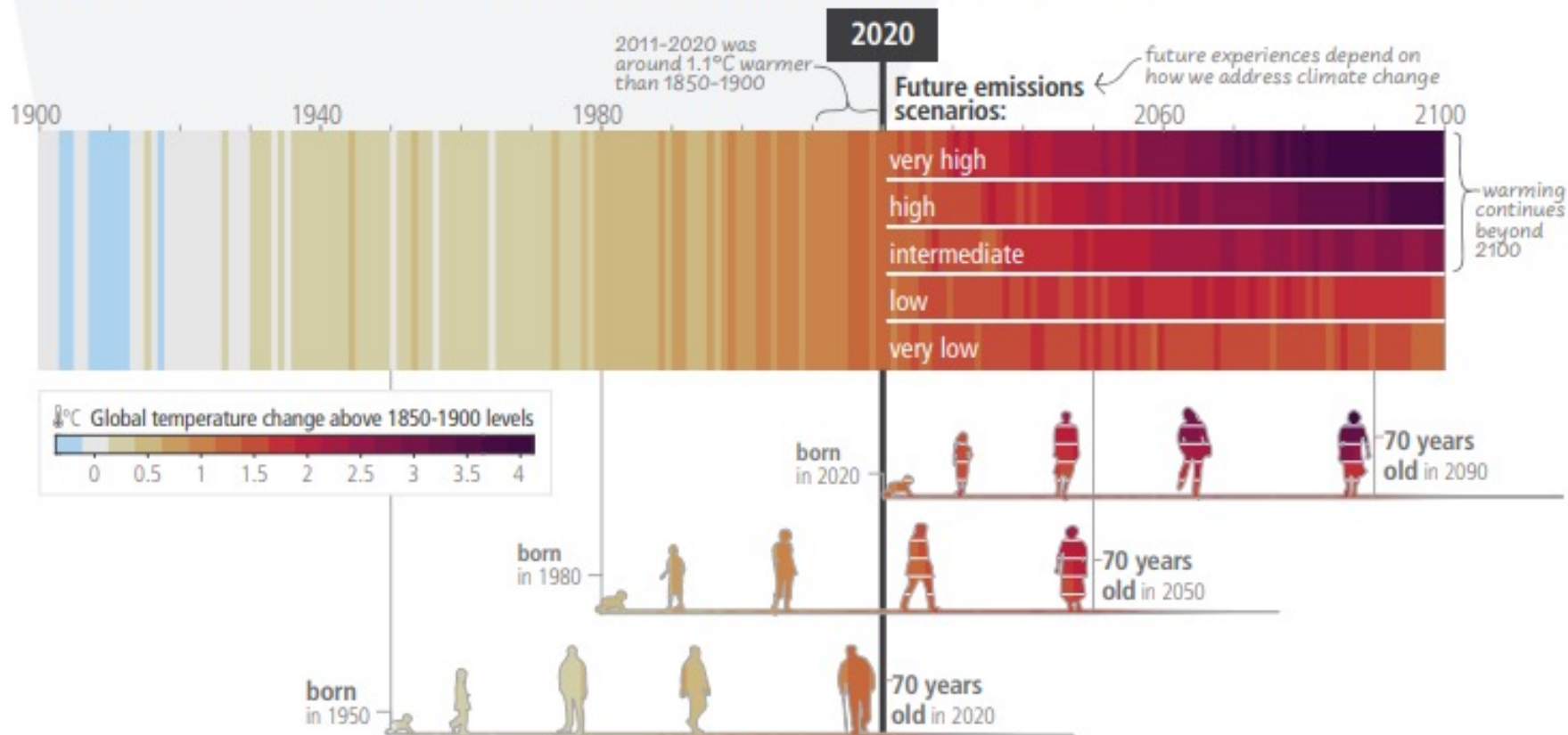
CO₂ from fossil fuels and industry

GHG Emissions (GtCO₂-eq/yr)

1850 1900 1950 2000 2019

Modified from IPCC AR6 by Hans Bruyninckx

c) The extent to which current and future generations will experience a hotter and different world depends on choices now and in the near term

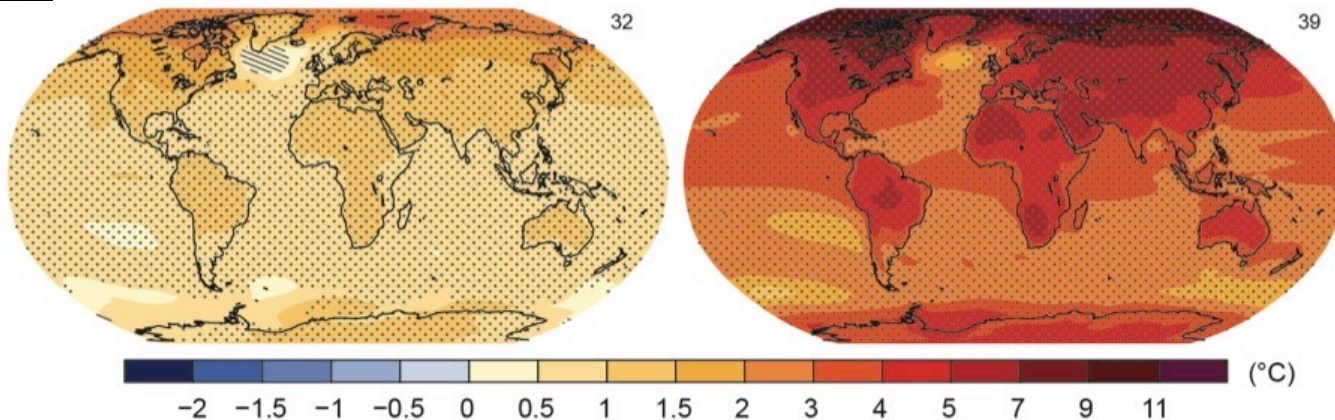


RCP2.6

RCP8.5

Change in average surface temperature (1986–2005 to 2081–2100)

Fig. SPM.8



Humanity has the choice

Conclusions

The challenge is huge: transform the world in a few decades so that the whole world activities are decarbonized, while poverty and hunger are eliminated in a few decades

Addressing it open so many opportunities, for research in all disciplines and across disciplines and for integrating results of this research in meaningful actions by all: governments, cities, businesses, NGOs, and citizens.

It opens also economic opportunities, and opportunities to address in a synergistic manner other societal goals, such as the 17 Sustainable Development Goals.

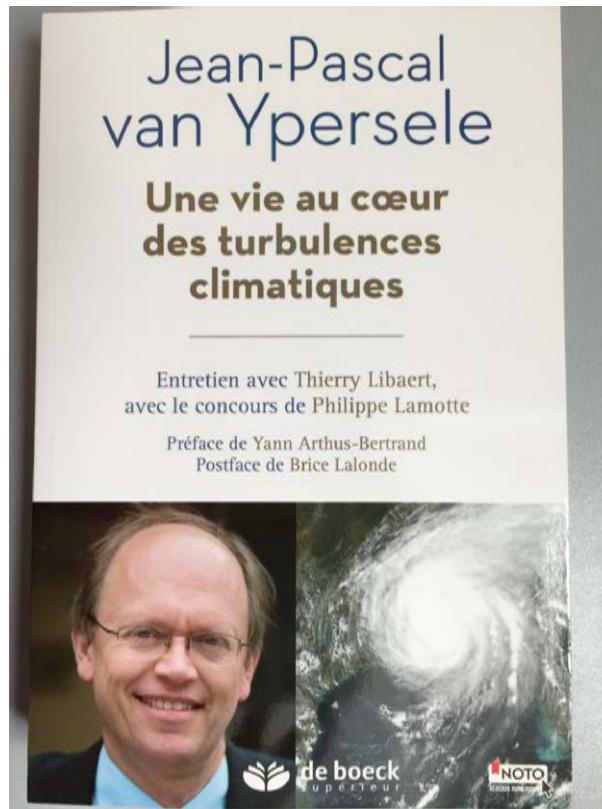
Pour en savoir plus:

**Lisez mon livre, où
j'aborde tous ces
sujets**

**Publié chez De Boeck
supérieur**

**Préface: Yann Arthus-
Bertrand**

Postface: Brice Lalonde



Om meer te weten:

Bij EPO (2018)

**Voorwoord:
Jill Peeters**



Ecrit pour les
jeunes (et moins
jeunes), avec des
liens vers des
ressources utiles

Plateforme Wallonne pour le GIEC
Lettre N°13 - avril 2019

**'Sauver le climat' :
les bases**

te Saint-Louis & social sciences
tions against climate change

Suite à l'intense mobilisation des jeunes, les changements climatiques ont fait l'objet de beaucoup d'attention au cours des derniers mois. Lèves du secondaire, étudiants, professeurs, parents et grand parents sont descendus dans la rue pour montrer leur désarroi face à la lenteur de l'action vis-à-vis des changements climatiques.

Nous nous réjouissons de cette mobilisation, car notre rôle nous met encore plus fréquemment que l'ensemble de la population en position de témoin des risques que font courir les changements climatiques ainsi que de l'ampleur des efforts nécessaires pour mettre en œuvre les objectifs que se sont fixés les membres des Nations Unies à Paris en 2015 (COP21).

Une démarche essentielle en faveur de ces jeunes est de les aider à se former, à appréhender les principaux éléments de la problématique du climat, et plus largement, de l'influence de nos activités sur notre environnement et sur le futur de l'humanité. L'éducation est un des instruments essentiels pour évoluer vers une société plus durable et plus juste.

Pour y contribuer, nous présentons ici une brève synthèse de la problématique et une sélection de références commentées. Nous espérons que cette Lettre aidera enseignants et élèves à disposer d'une base d'information solide et ainsi à prendre leur part dans la solution à ce problème planétaire : agir à leur niveau et favoriser l'action dans leur entourage et au niveau societal.

Plusieurs témoignages d'élèves ou de professeurs sont également présentés.

Nous vous souhaitons une bonne lecture !
Jean-Pascal van Ypersele, Philippe Marbaix et Bruna Gaiino

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Wallonie
environnement
Awac



Disponible gratuitement, 6X/an: www.plateforme-wallonne-giec.be



Dresde, Allemagne, 2002



Magdeburg, Allemagne, 2007



Draguignan, France, 2010



Santarem, Portugal, 2017



Glacier de Briksdal, Norvège, 2019



Liège (Angleur), Belgique, 2021



Ardennes françaises, 2022



Tellin (Bure), Belgique, 2022

Impacts et adaptation en Europe et en Afrique

Inondations, vagues de chaleur, sécheresses et incendies : les événements météorologiques et climatiques ont déjà de graves conséquences pour les écosystèmes et pour les humains. Ces situations sont appelées à devenir plus fréquentes dans un monde plus chaud. Il est maintenant évident que nos régions sont touchées, mais d'autres parties du monde, particulièrement les plus chaudes, sont encore plus affectées. Quelles sont les mesures d'adaptation potentielles et leurs limites ?

Cette Lettre présente d'abord le chapitre dédié aux impacts et à l'adaptation en Europe dans le 6^e rapport d'évaluation du GIEC, d'une manière que nous espérons accessible. Les articles suivants abordent plus spécifiquement les conséquences pour la biodiversité et en particulier pour les forêts. Nous présentons également un aperçu du chapitre consacré à l'Afrique, où beaucoup de régions sont très vulnérables.

Bruna Gaino, Pénélope Lamarque, Philippe Marbaix, Alain Tondeur et Jean-Pascal van Ypersele.



La Wamme, Jemelle, Belgique, 2022

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Kenya, 2006



Sud de l'Éthiopie, 2011



Barrage/lac de Theewaterskloof, Afrique du Sud, 2018

Lettre PwG n° 27 (novembre 2022)
 Disponible sur :
www.pwG-wallonne-giec.be



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Gratuit sur
www.levif.be/reveil-climatique

Le réveil climatique

JEAN-PASCAL VAN YPERSELE - DIRK DRAULANS

LE VIF



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PROGRAMME

CLIMAT : ÉTAT D'URGENCE

POURQUOI IL N'Y A PLUS DE TEMPS À PERDRE

JEAN-PASCAL VAN YPERSELE - DIRK DRAULANS



DAT POLITICI OVER TWINTIG JAAR NIET KOMEN JANKEN DAT ZE HET NIET WISTEN.



DIRK DRAULANS
(1956) is bioloog, doctor in de wetenschappen en was gastonderzoeker aan de University of Oxford. Sinds 1987 is hij journalist bij Knack.



JEAN-PASCAL VAN YPERSELE (1957) is fysicus en klimatoloog. Hij is hoogleraar klimatologie en milieuwetenschappen aan de UCLouvain en was ondervoorzitter van het Intergovernmental Panel on Climate Change (IPCC).

BIJLAGE BIJ KNACK VAN 16 SEPTEMBER 2020. MAG NIET LOS VERKOCHT WORDEN.

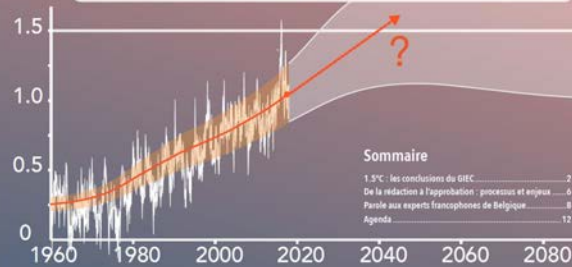
HET KLIMAAT ALARM

Dirk Draulans en
Jean-Pascal van Ypersele



Knack

Le rapport spécial du GIEC Réchauffement planétaire de 1.5°C



Pour de nombreuses populations et écosystèmes, il est essentiel de limiter le réchauffement à 1.5°C ou de ne dépasser ce niveau que temporairement. Et c'est potentiellement encore réalisable. Le 6 octobre 2018, l'Assemblée Plénière du GIEC a adopté le Rapport Spécial sur un « Réchauffement planétaire de 1.5°C », qui fait le point au sujet des impacts et scénarios correspondant à ce niveau de réchauffement.

Ce rapport conclut que pour limiter le réchauffement climatique à 1.5°C, il faut des transformations radicales et rapides dans tous les domaines de notre société. Il précise que ces changements sont sans précédent en termes d'échelle, mais pas nécessairement en termes de rapidité.

L'origine du rapport est une demande formelle au GIEC de la part des Parties à la Convention cadre des Nations Unies sur les changements climatiques (CCNUCC) lors de l'adoption de l'Accord de Paris, en 2015 (21^e Conférence des Parties, COP21). La COP21 avait aussi indiqué que le rapport du GIEC devrait identifier le niveau auquel les émissions mondiales devraient être ramenées en 2030 pour contenir l'élévation de température en-dessous de 1.5°C.

Image de fond : extrait adapté de la figure SPM1 du Rapport spécial

Le rapport a été adopté à l'issue d'une semaine de discussions intenses au sujet de la formulation du Résumé à l'intention des décideurs, sur la base des chapitres et du projet de résumé rédigés par les scientifiques - qui ont toujours le dernier mot en ce qui concerne le contenu, il forme une base scientifique essentielle pour les prochaines négociations internationales dans le cadre de la CCNUCC, qui auront lieu à Katowice (Pologne) en décembre 2018 (COP24).

Dans cette Lettre, nous donnons d'abord un aperçu des conclusions du rapport, ensuite un aperçu du processus d'approbation et des enjeux associés. Pour ouvrir le débat et fournir un ensemble de points de vue, nous avons ensuite donné la parole aux experts francophones de Belgique, qui nous ont aimablement fait part des commentaires que vous trouverez en troisième partie. L'agenda indique les prochaines périodes de relecture de rapports du GIEC et annonce deux événements à venir en Belgique.

Nous vous en souhaitons une bonne lecture,
Jean-Pascal van Ypersele, Bruna Gaino et Philippe Marbaix



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To go further :

- www.climate.be/vanyp : my slides (under « conferences »)
- www.ipcc.ch : IPCC
- www.realclimate.org : answers to the merchants of doubt arguments
- www.skepticalscience.com : same
- www.plateforme-wallonne-giec.be : IPCC-related in French, Newsletter, latest on climate, basic climate science
- **Twitter: @JPvanYpersele & @IPCC_CH**