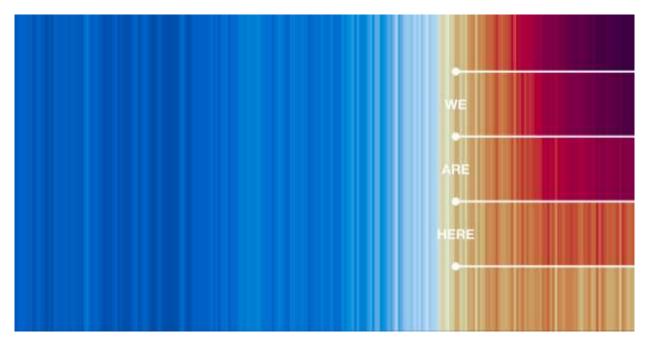
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Climate change : Key findings from IPCC 2021 and 2022 reports

Valérie Masson-Delmotte



www.ipcc.ch

SIXTH ASSESSMENT REPORT

Working Group I – The Physical Science Basis

INTERGOVERNMENTAL PANEL ON CLIMATE CHARGE

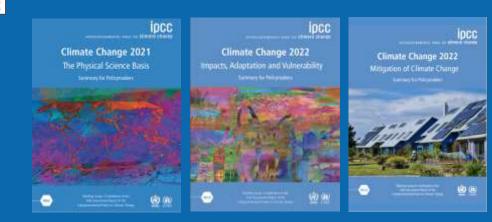


782 lead authors1 546 contributors



200 000+ comments

> 66 000 publications





"

Human influence on climate is unequivocal

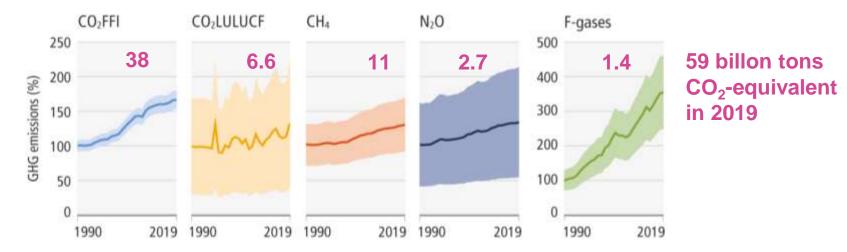
[Credit: NASA]





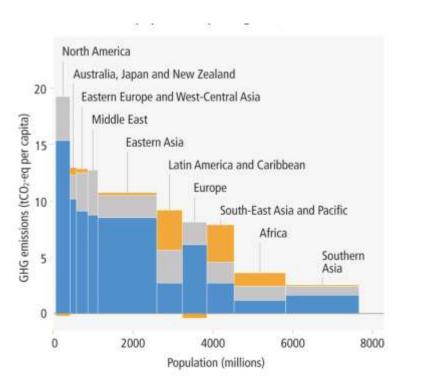
2010-2019 : global greenhouse gas emissions at highest levels in human history

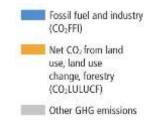
Slowdown of the CO₂ growth rate from fossil fuels and industry



10% wealthiest households : around 40% of global emissions 50% poorest households : < 15% of emissions

Increasing share from urban areas (70%)





Increased evidence of climate action



Some countries have achieved a steady decrease in emissions

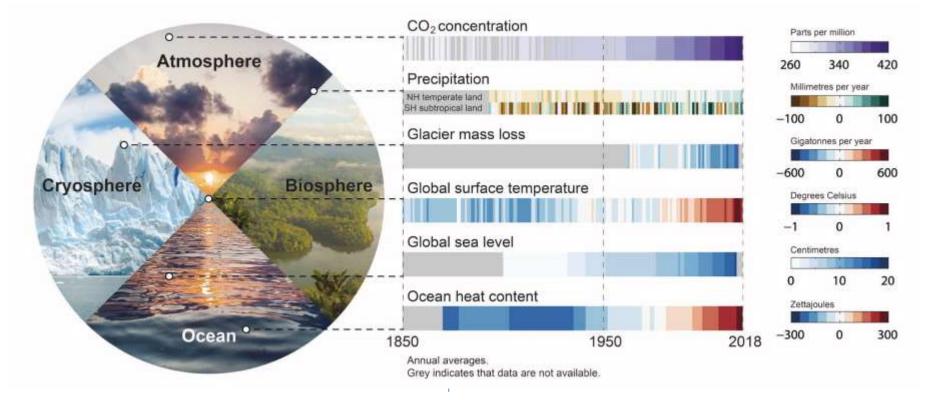


Zero emission targets adopted by at least 826 cities and 103 regions



Costs for renewables and batteries have fallen Capacities installed have increased INTERGOVERNMENTAL PANEL ON CLIMATE CHARGE

Human influence leads to global heating and rapid and widespread changes



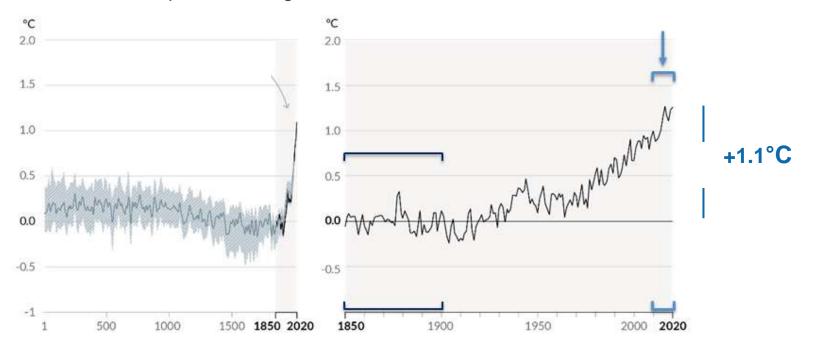
INTERGOVERNMENTAL PANEL ON Climate change

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UNEP

Observed warming is reaching +1,1°C It is unusual in more than 2,000 years

Global surface temperature change since 1850-1900



UNEI

WMO

Observed warming is due to human activities The warming effect of greenhouse gas emissions is partly masked by the cooling effect of aerosols

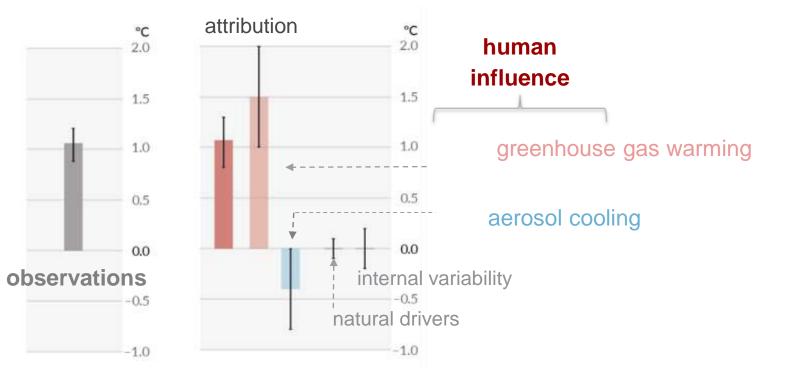


Figure SPM.2

IDCC INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE

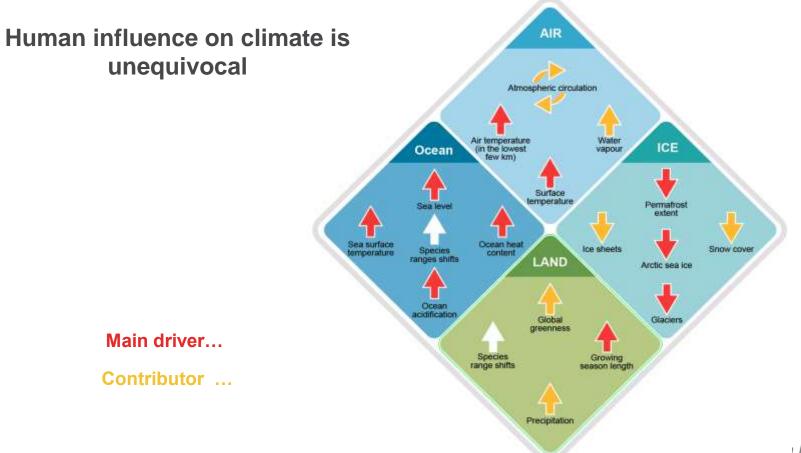
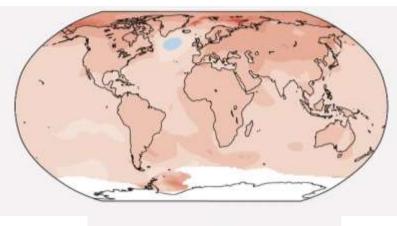


Figure FAQ2.2

intergovernmental panel on **climaτ<mark>e</mark> chanęe**

IOCC

Surface warming is larger over land and in the Arctic



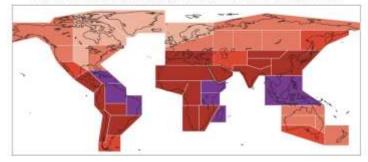


Earlier emergence in the tropics

(

WMO

Year of significant emergence of changes in temperature over land regions (S/N>2)



Dataset: Berkeley Earth. Temperature changes relative to 1850-1900.

				- P		
Before 1981	1981-1988	1989-1996	1997-2004	2005-2012	2013-2020	1



[Credit: Yoda Adaman | Unsplash

It is indisputable that human activities are causing climate change, making extreme climate events, including heat waves, heavy rainfall, and droughts, more frequent and severe

INTERGOVERNMENTAL PANEL ON CLIMATE CHARGE



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Type of observed charge In agricultural and ecological drought Increase 11.1

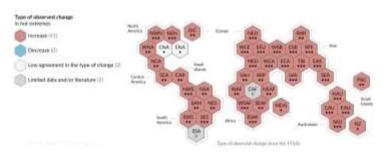
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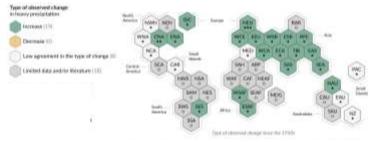
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failey market INTERGOVERNMENTAL PANEL ON Climate change

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Hot extremes



Type of idearcast change sense that 1791a

Heavy rainfall

Every region is affected in multiple ways

Agricultural drought

Confidence in human contribution to the observed change

••• High

. Medium

· Low due to limited agreement

O Low due to limited evidence

Working Group I – The Physical Science Basis

INTERGOVERNMENTAL PANEL ON CLIMOTE CHORE



Hot extremes and runoff amplified in cities



Compound events



Marine heat waves Acidification Loss of oxygen Sea level rise

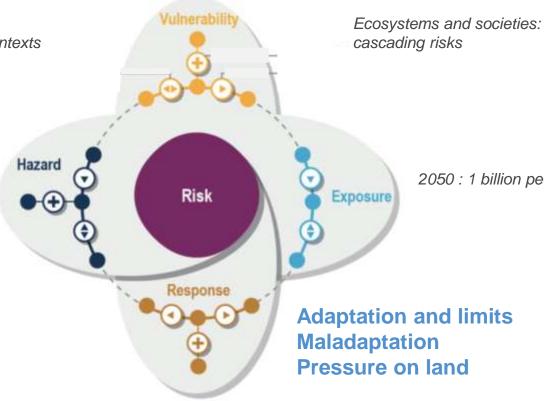
Every region is affected in multiple ways

iocc INTERGOVERNMENTAL PANEL ON Climate chanee

3.3-3.6 billion people in high vulnerability contexts

Climate-related risks

Every increment of global warming intensifies changes in climate impact-drivers



2050 : 1 billion people on coasts

WMO UNEP

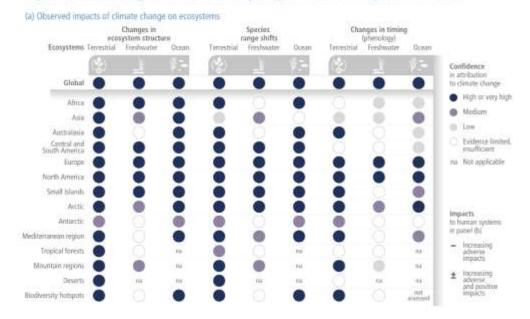
INTERGOVERNMENTAL PANEL ON Climate change

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Half of the assessed species have shifted towards the poles or higher elevations

Global warming has caused dangerous and widespread disruption in nature

Impacts of climate change are observed in many ecosystems and human systems worldwide





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Unsustainable use of natural resources, habitat fragmentation, ecosystem damage by pollutants increase ecosystem vulnerability to climate change (b) Obstroad impacts of climate channe on human customs

INTERGOVERNMENTAL PANEL ON CLIMATE Change

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Despite efforts to adapt, widespread impacts are observed

(b) Observed impa	acts of		1.1	inter syste	1613		4000			1.000	122212.1	
	Impacts on water scarcity and food production			Impacts on health and wellbeing				Impacts on cities, settlements and infrastructure				
Human systems	Watur scaroty	Agriculture/ crap production	Animal and Inestack Bealth and productivity	Federics yields and aquiculture production	Interious diatas	finit, nationalistics and other	Montal health	Diglacement	island hunding and weechand damages	danapis ()	Darnages tu infostructure	Dumages to key economic sectors
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Australasia	0	0	Θ	0	0	0	0	100 thereases	0	0	0	0
Central and South America	0	0	Θ	0	0	0	anetted	0	0	0	0	0
Europe	0	0	0	0	0	0	0	0	0	0	0	0
North America	0	0	0	0	0	0	0	0	0	0	0	0
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Mediterrateon region	0	0	0	0	0	0	autener.	0	0	0		0
Mountain regions	0	Θ	0		0	0	Θ	0	0	101	0	0

Risks due to extreme events are increasingly complex and difficult to manage

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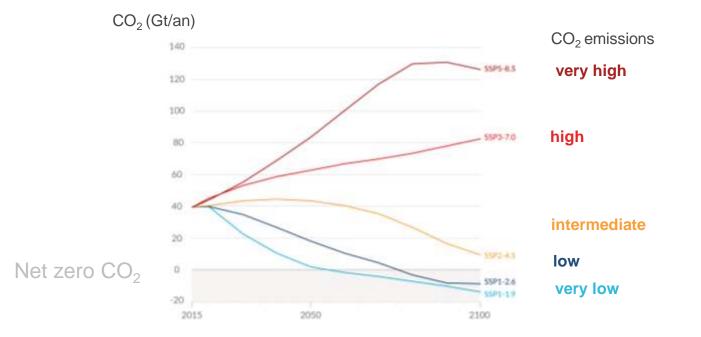
[Credit: Peter John Maridable]

Unless there are immediate and deep greenhouse gas emissions reductions in all sectors, limiting warming close to 1.5°C and well below 2°C will be beyond reach



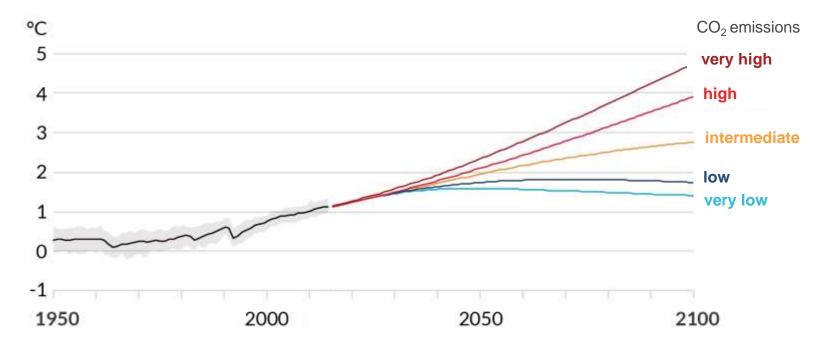
IDCC

5 illustrative pathways, future greenhouse gas emissions and pollutants

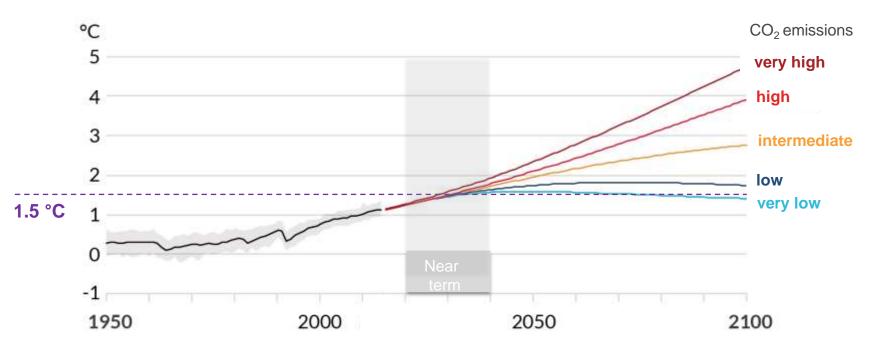


INTERGOVERNMENTAL PANEL ON CLIMATE CHARGE

Future warming will depend on future emissions

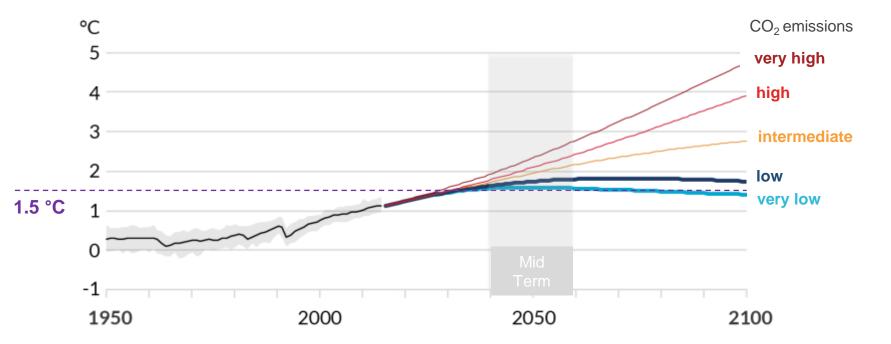


We will reach a global warming level of 1.5°C in the next 20 years



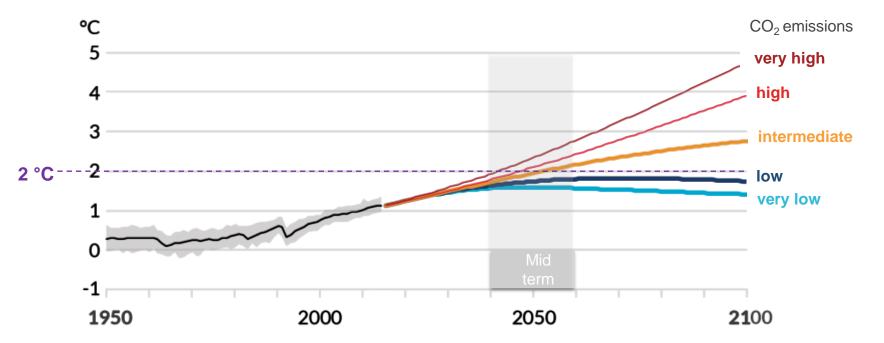
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We could reach or avoid +2°C by 2050



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Future warming depends on future emissions

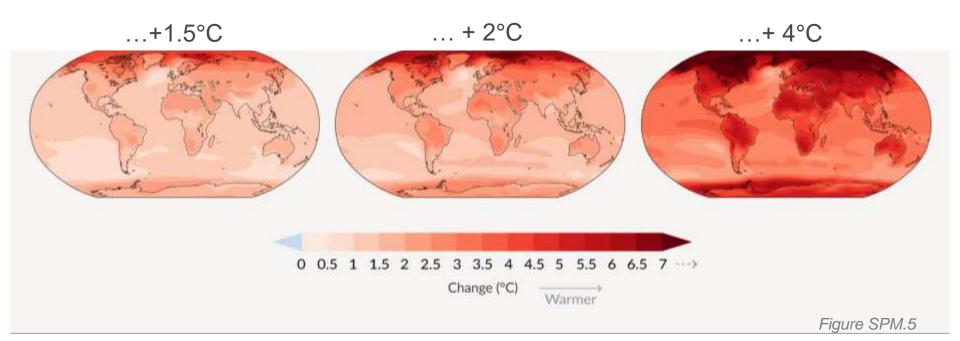


INTERGOVERNMENTAL PANEL ON CLIMATE CHARGE

WMO

For each further increment of global warming, changes are amplified in each region

Change in annual mean temperature ...

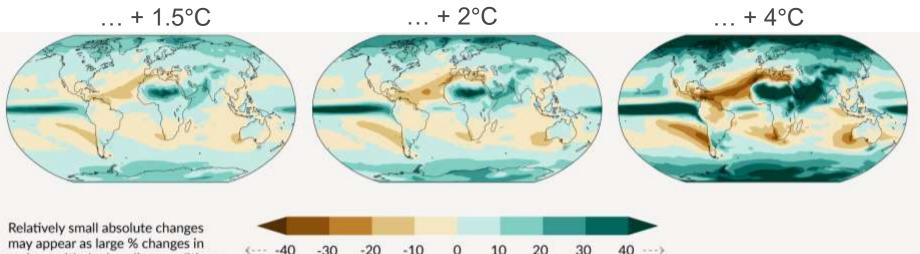


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Global warming intensifies the global water cycle and its variability, strengthening the severity of very wet and very dry seasons and events

Change in annual mean precipitation ...



regions with dry baseline conditions

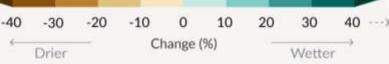
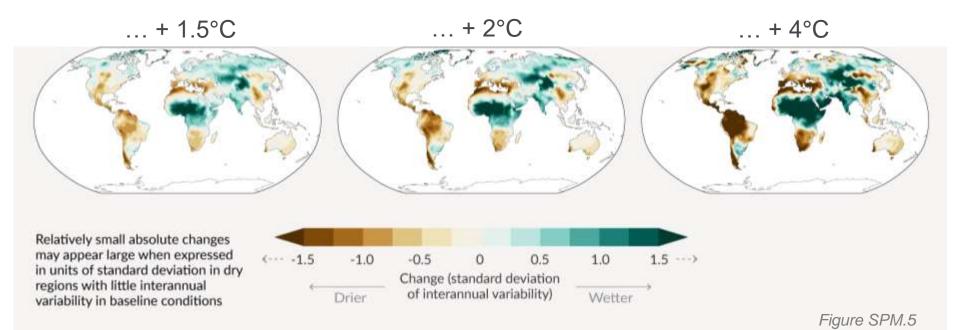


Figure SPM.5

For each further increment of global warming, changes are amplified in each region

Change in annual mean soil moisture...



Many changes in the climate system are amplified in direct relationship with global warming

INTERGOVERNMENTAL PANEL ON **Climate chanee**

Frequency and intensity

- Hot extremes
- Heavy rainfall (+7% per °C)
- Drought in some regions
- Compound events

Proportion of most intense tropical cyclones
Arctic sea ice retreat
Thaw of frozen soils
Spring snow cover loss

Intensification of the water cycle and its variability

	1850-1900	Present 1 °C	1.5 °C	2 °C	4 °C
Y per 50 years			*	*	
FREQUENCY	Once	now likely occurs 4.8 times (2.3 - 6.4)	will likely occur 8.6 times (4.3 - 10.7)	will <i>likely</i> occur 13.9 times (6.9 - 16.6)	will likely occur 39.2 times (27.0 - 41.4)

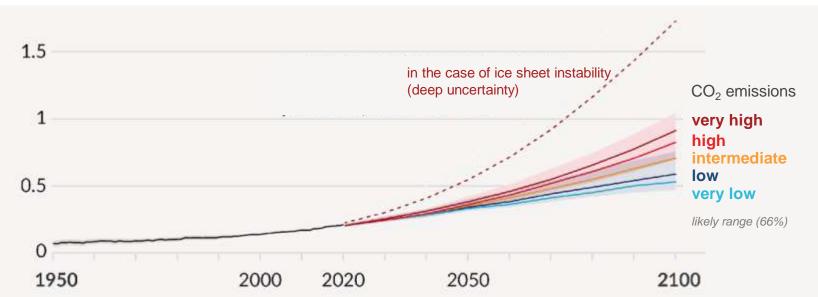


[Credit: Jenn Caselle | UCSB]

There is no going back for some changes in the climate system...



Sea level rise will continue during thousands of years, with rates and magnitudes depending on future emissions

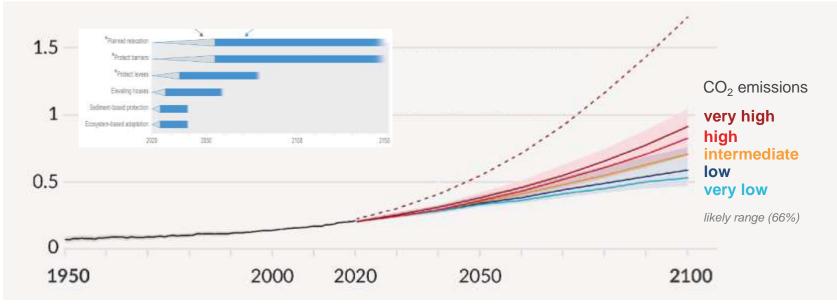


Sea level rise since 1900 (m)

Figure SPM.8

Sea level rise will continue during thousands of years, with rates and magnitudes depending on future emissions

Sea level rise since 1900 (m)





[Credit: Hong Nguyen | Unsplash]

Climate change is already affecting every region on Earth, in multiple ways

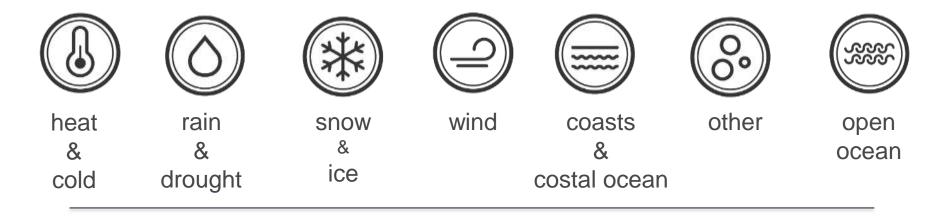
The changes we experience will increase with further warming

INTERGOVERNMENTAL PANEL ON Climate change



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33 climatic impact-drivers



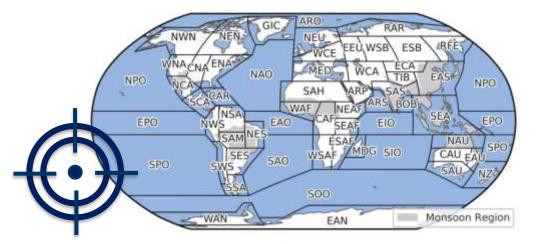


+2°C by 2050 : 96% of regions : 10 factors or + 50% of regions : 15 factorrs or + Working Group I – The Physical Science Basis

INTERGOVERNMENTAL PANEL ON CLIMBTE CHBAGE

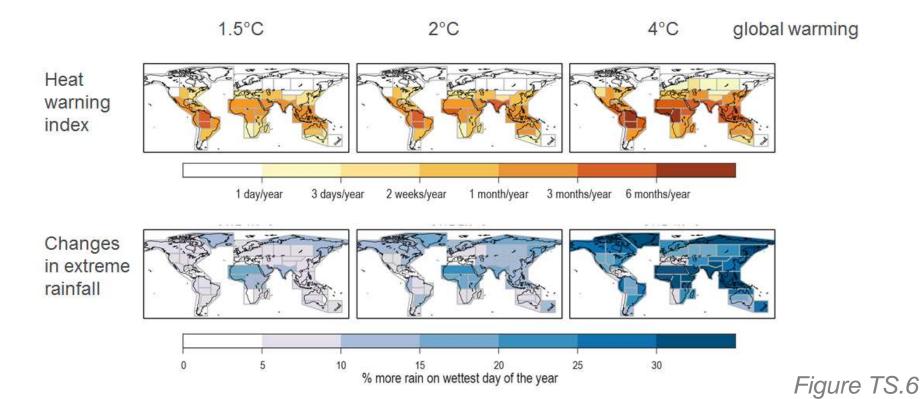


https://interactive-atlas.ipcc.ch/



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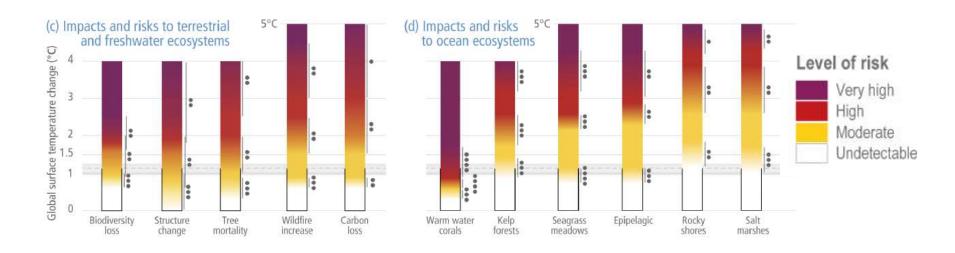
Climate risks will depend on the level of global warming



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Every further increment of global warming will increase the severity of impacts, in particular for biodiversity

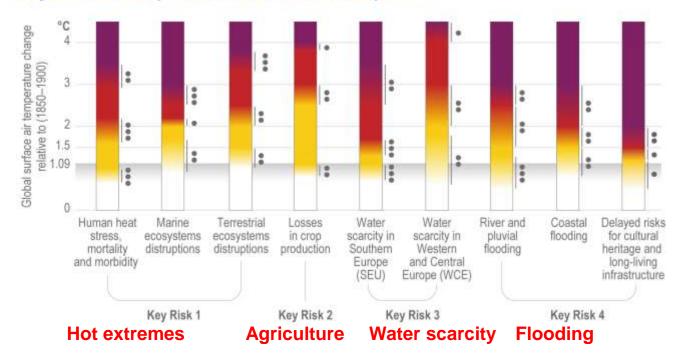


In Europe, progress in adaptation is not sufficient to limit the increase in risks

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Key risks for Europe under low to medium adaptation



Level of risk

Very high High Moderate Undetectable INTERGOVERNMENTAL PANEL ON CLIMBTE CHARGE

Feasible adaptation options can reduce near-term risks







Food security Water management Urban transformation Coastal risk management

System transitions	Climate responses' and adaptation options	
Land and ocean ecosystems	Coastal defence and hardening Integrated coastal zone management	
	Forest-based adaptation ² Sustainable aquaculture and fisheries	
	Agroforestry Biodiversity management and ecosystem connectivity	
	Water use efficiency and water resource management	
	Improved cropland management Efficient livestock systems	
Urban and infrastructure systems	Green infrastructure and ecosystem services Sustainable land use and urban planning Sustainable urban water management	
	Improve water use efficiency	
Energy systems	Besiliert prever systems Energy reliability	
Cross- sectoral	Health and health systems adaptation	
	Livelihood diversification	
	Planned infocation and resettlement Human migration ³	
	Disaster risk management Climate services, including Early Warning Systems Social safety nets	

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Adaptation gaps and limits

+1,5°C : limits for nature-based solutions Decline in water availability for snowmelt dependent river basins +2°C : limits for staple crops in many tropical growing areas



Lack of finance



1	Climate responses' and adaptation options	System transitions
	Coastal defence and hardening Integrated coastal zone management	
	Forest-based adaptation ² Sostainable aquaculture and fisheries Agroforestry Biodiversity management and ecosystem connectivity	Land and ocean ecosystems
	Water use efficiency and water resource management	
	Improved cropland management Efficient livestock systems	
	Green infrastructure and ecosystem services Sustainable land use and urban planning Sustainable urban water management	Urban and infrastructure systems
	Improve water use efficiency	
	Besiliert power systems Energy reliability	Energy systems
	Health and health systems adaptation	
	Livelihood diversification	
	Planned relocation and resettlement Human migration ⁸	Cross- sectoral
	Déaster risk management	
	Climate services, including Early Warning Systems Social cafety nets	



[Credit: Andy Mahoney | NSIDC]

Some changes could be slowed and others could be stopped by limiting warming



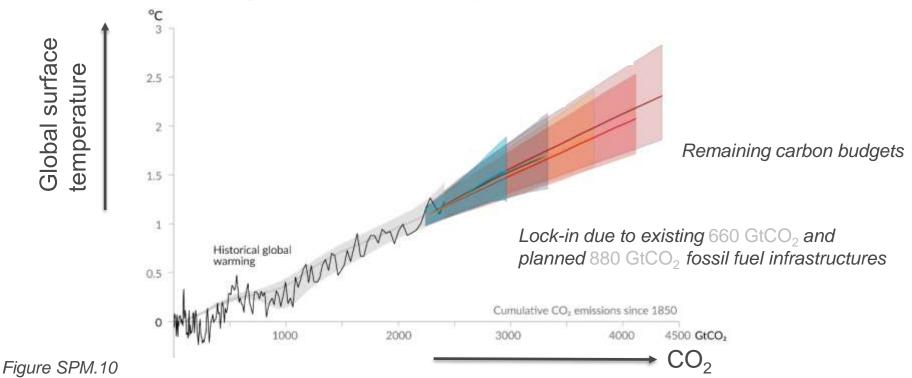
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Every ton of CO₂ adds to global warming

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





[Credit: evgeny-nelmin.]

To limit global warming, strong and rapid reductions in CO_2 emissions and reaching at least net CO_2 is necessary

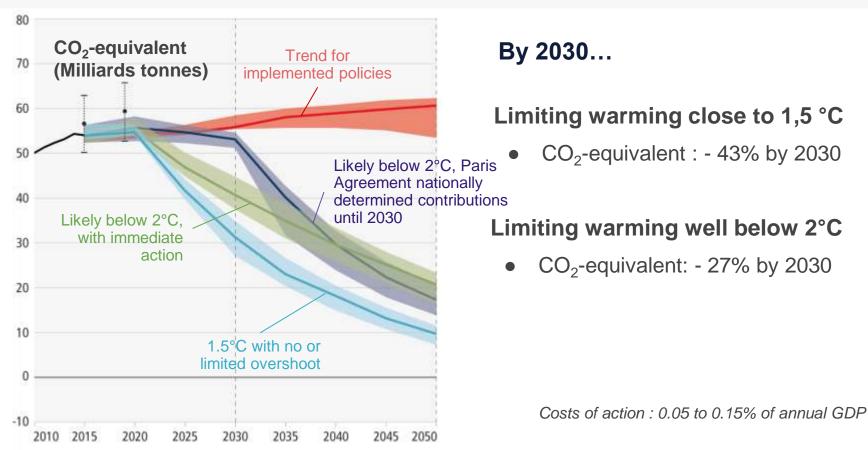
Strong reductions in methane emissions would counteract the reduction in the pollution particle cooling effect and further improve air quality

INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE



Sixth Assessment Report

WORKING GROUP III - MITIGATION OF CLIMATE CHANGE







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



Demand and services Low-carbon lifestyles













Energy

Land use

Industry

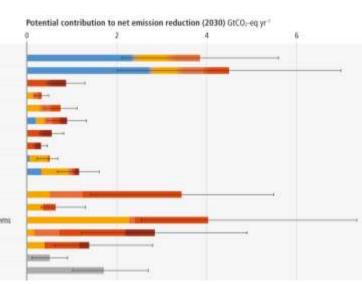
Urban

Buildings

Transport

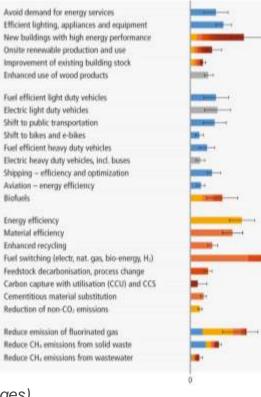
There are feasible options to reduce greenhouse gas emissions in all sectors

	Mitigation options
	Wind energy
Ifoun i	Solar energy
	Bioelectricity
	Hydropower
	Geothermal energy
	Nuclear energy
	Carbon capture and storage (CCS)
	Bioelectricity with CCS
	Reduce CH ₄ emission from coal mining
	Reduce CH ₄ emission from oil and gas
i	Carbon sequestration in agriculture
	Reduce CH ₄ and N ₂ O emission in agriculture
1	Reduced conversion of forests and other ecosyster
	Ecosystem restoration, afforestation, reforestation
Ē	Improved sustainable forest management
	Reduce food loss and food waste
U	Shift to balanced, sustainable healthy diets

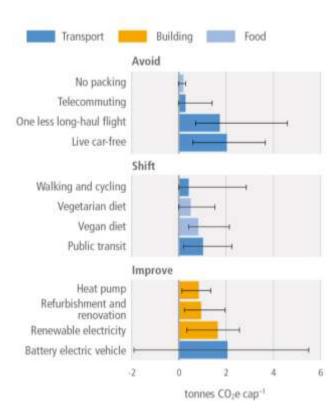


Costs are lower than the reference 0–20 (USD tCO₂-eq.") 20–50 (USD tCO₂-eq.") 50–100 (USD tCO₂-eq.") 100–200 (USD tCO₂-eq.") Cost not allocated due to high variability or lack of data

Higher near-term investments : increased long-term economic gains (even without accounting for avoided damages)



... and strategies that can support low carbon lifestyles

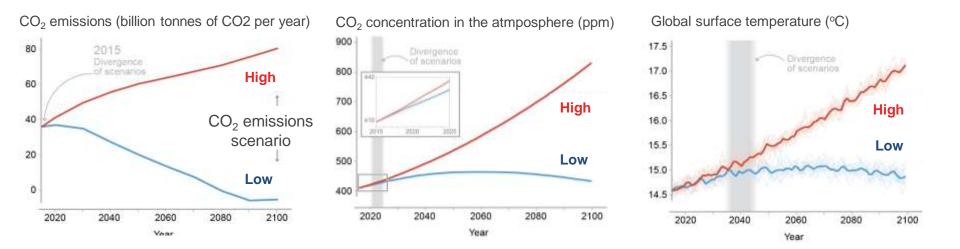


with health and wellbeing benefits

IPUU (1990) INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE

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If emissions decrease strongly, air quality would improve quickly and the effect on global surface temperature would be discernable within 20 years



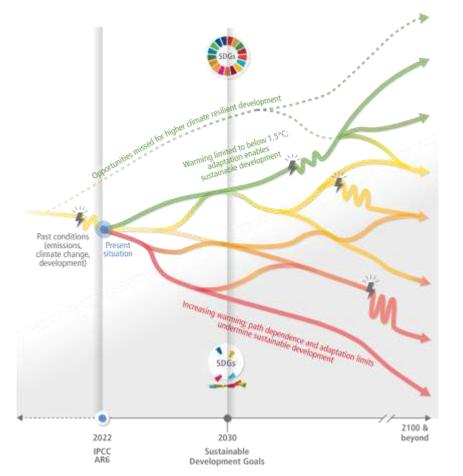
SIXTH ASSESSMENT REPORT

Working Group II - Impacts, Adaptation and Vulnerability

INTERGOVERNMENTAL PANEL ON Climate change

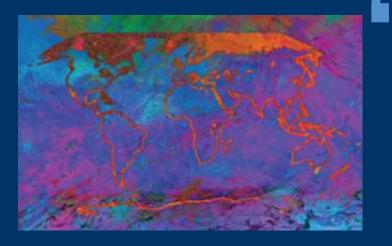
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Every decision matters

Each of them can take us away from, or towards, a climate resilient world



The climate and related risks we experience in the future depend on our decisions

The evidence is clear : the time for action is now



