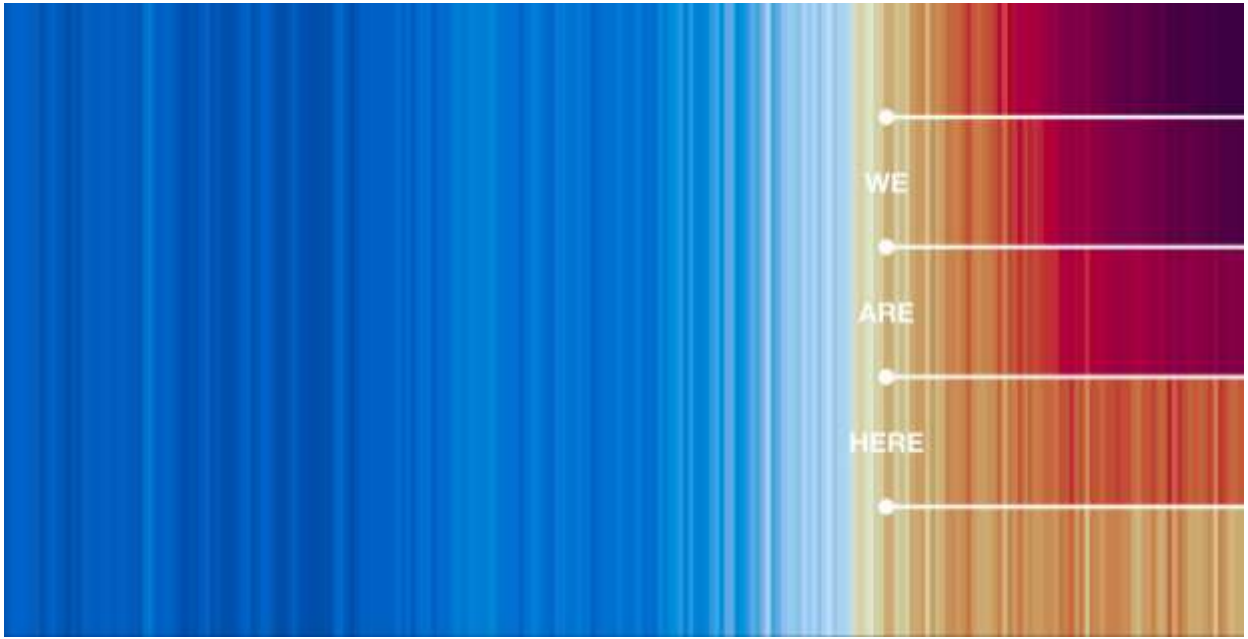
# Climate change :
# Key findings from IPCC 2021 and 2022 reports

Valérie Masson-Delmotte

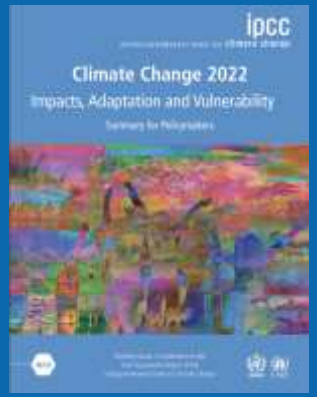


**782** lead authors

**1 546** contributors

**> 66 000** publications

**200 000+** comments

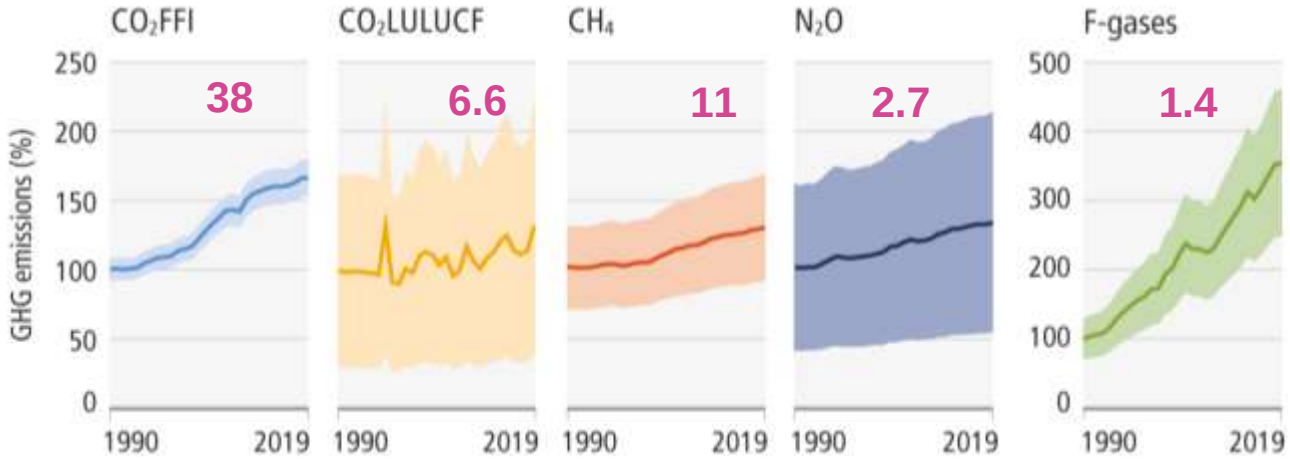

[Credit: NASA]

“

Human influence on climate is unequivocal

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

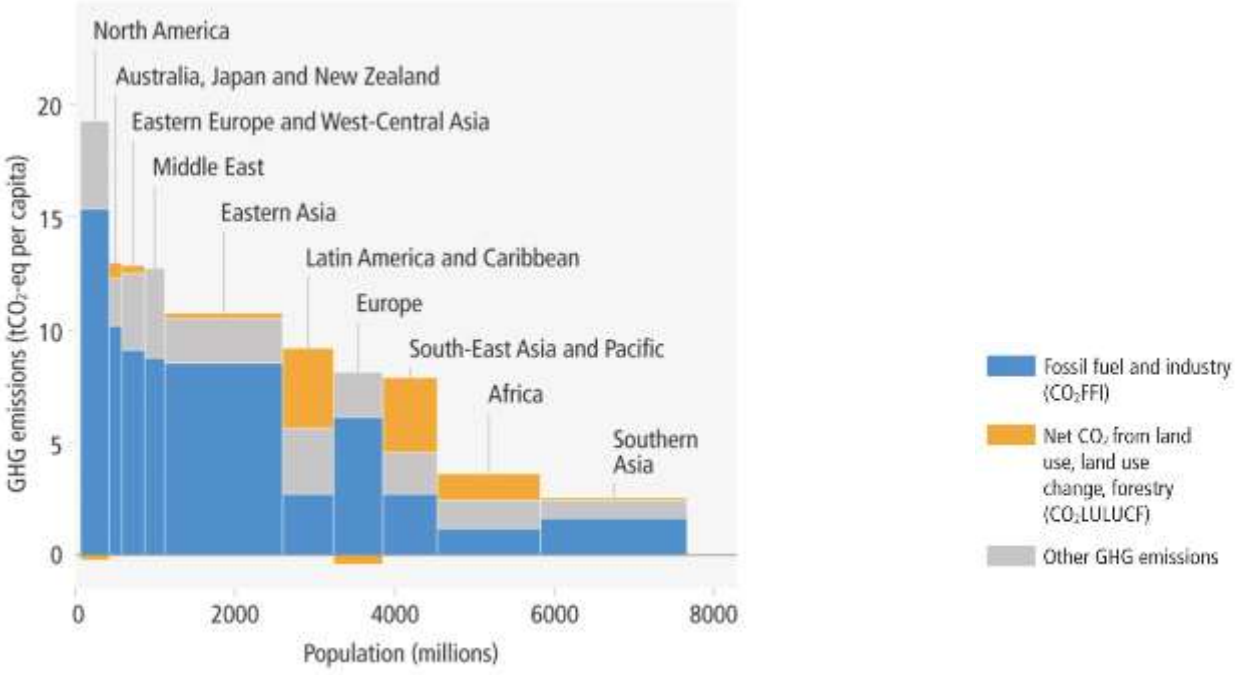
*Slowdown of the $CO_2$ growth rate from fossil fuels and industry*




**59 billon tons $CO_2$-equivalent in 2019**

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

*Increasing share from urban areas (70%)*



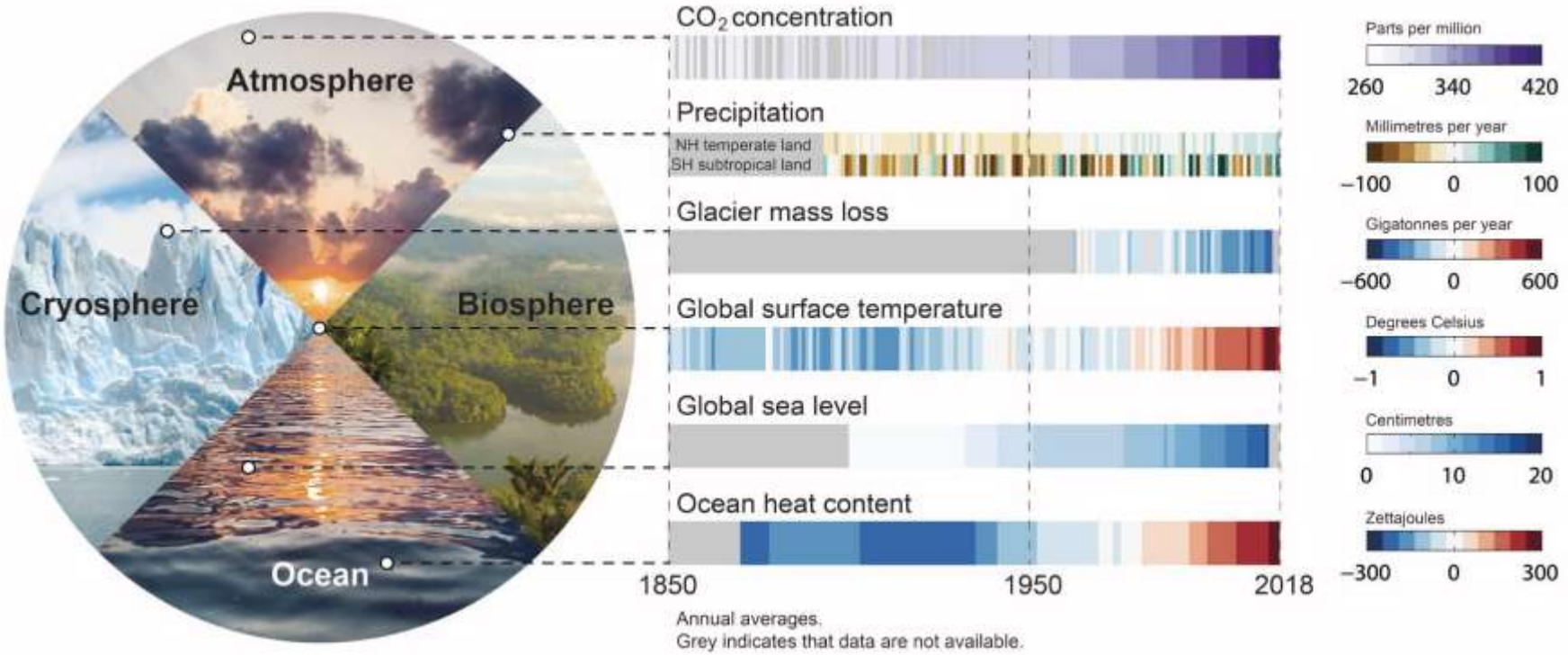
# Increased evidence of climate action

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

# Human influence leads to global heating and rapid and widespread changes



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

Global surface temperature change since 1850-1900

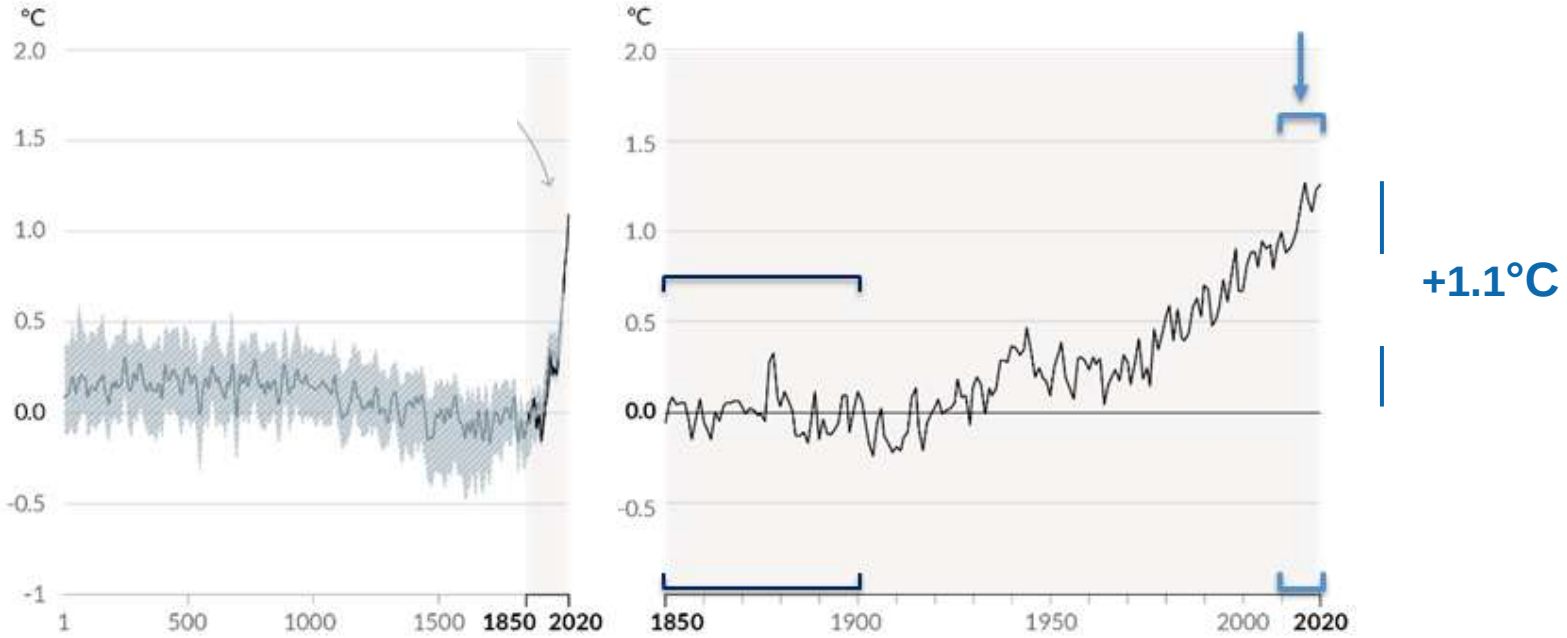



*Figure SPM.1*

# Observed warming is due to human activities

## The warming effect of greenhouse gas emissions is partly masked by the cooling effect of aerosols

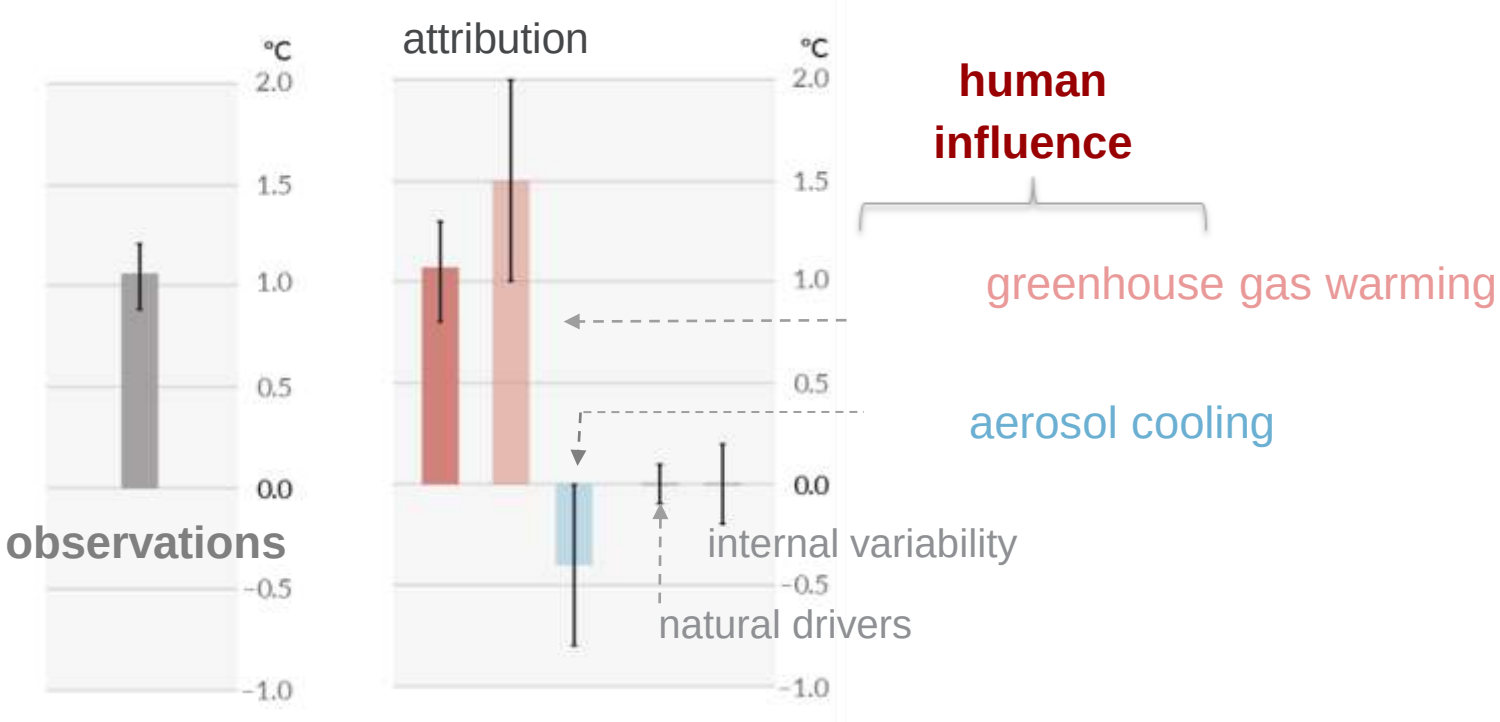
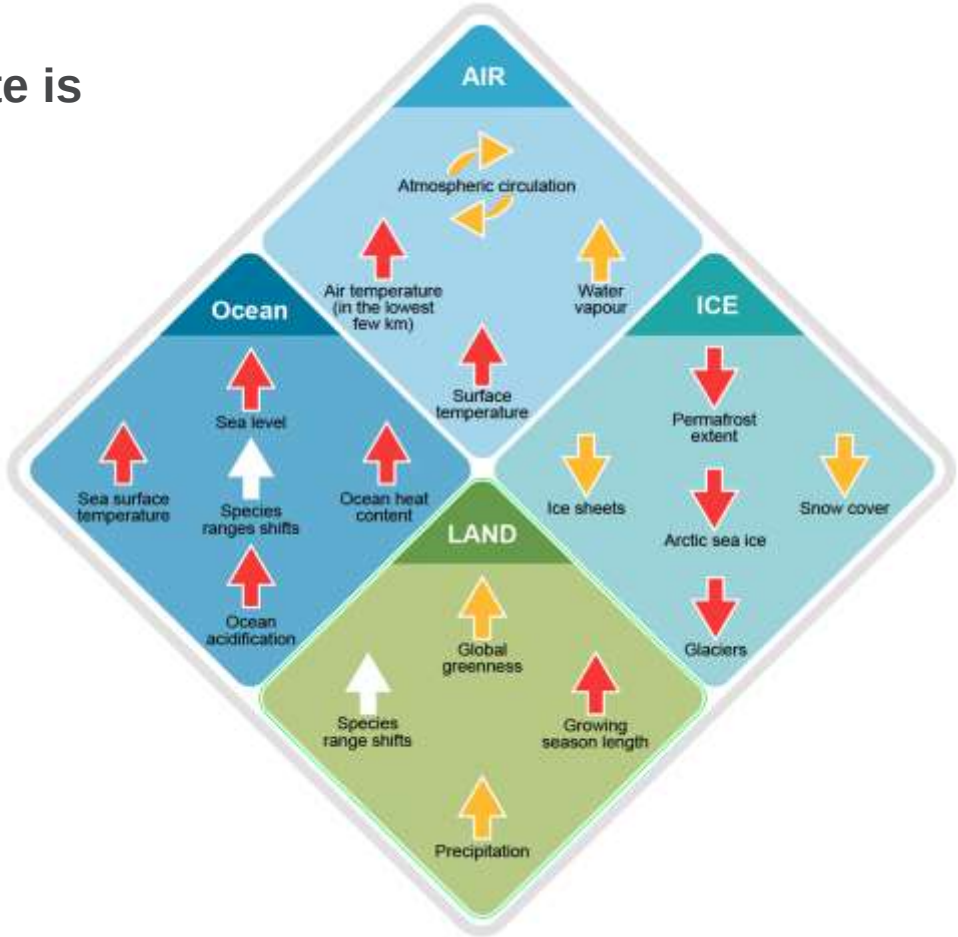



*Figure SPM.2*

# Human influence on climate is unequivocal

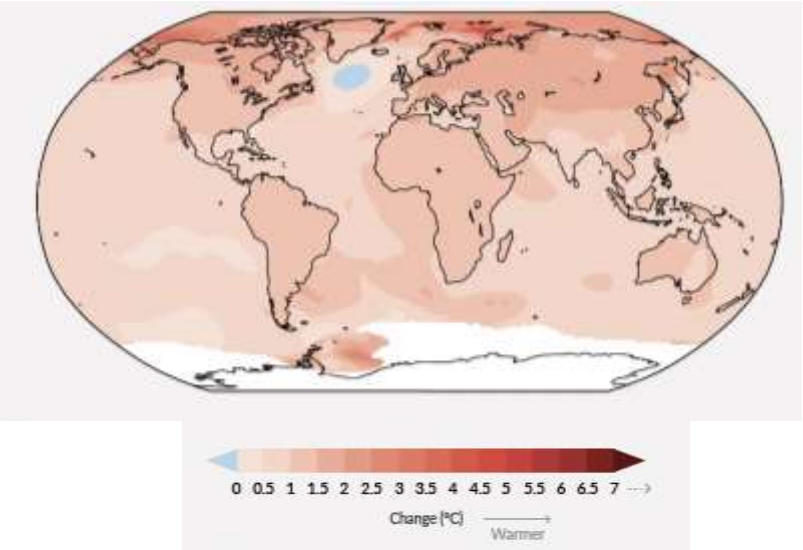



**Main driver…**

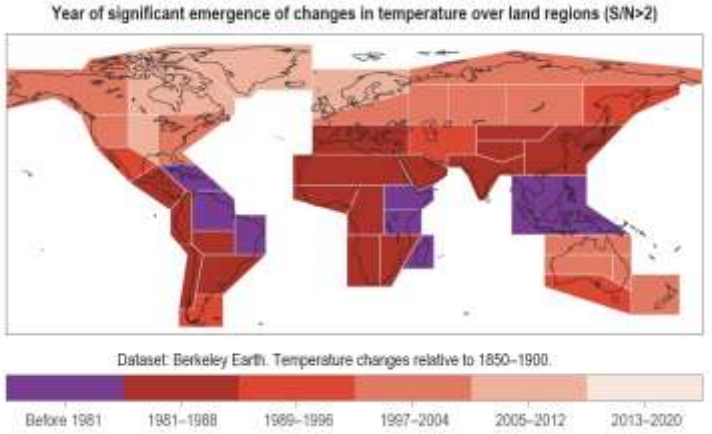
**Contributor …**

*Figure FAQ2.2*

## Surface warming is larger over land and in the Arctic

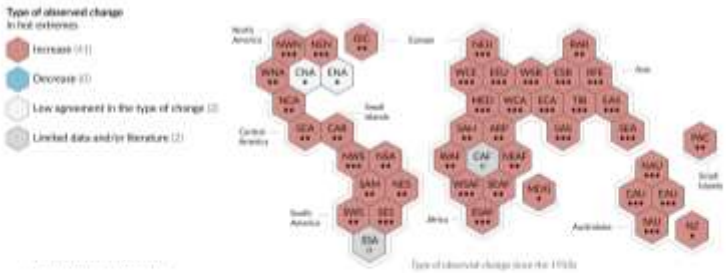



## Earlier emergence in the tropics

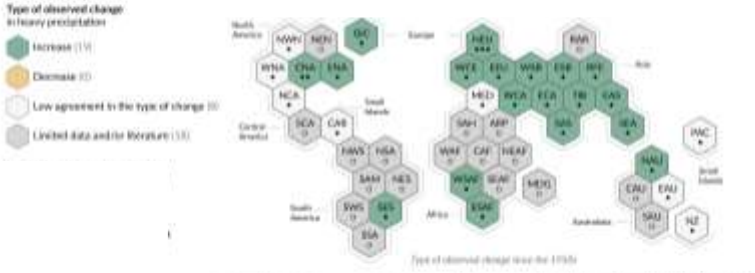


[Credit: Yoda Adaman | Unsplash]

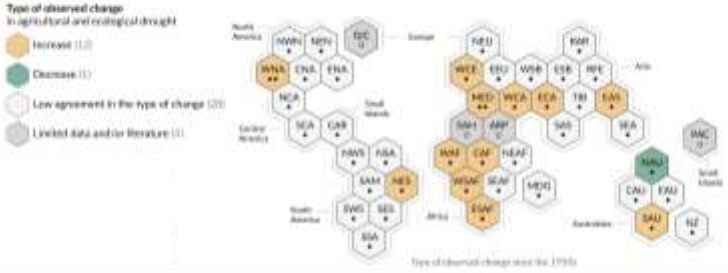
> It is indisputable that human activities are causing climate change, making extreme climate events, including heat waves, heavy rainfall, and droughts, more frequent and severe




Hot extremes




Heavy rainfall




Agricultural drought

**Every region is affected in multiple ways**

**Confidence in human contribution**
to the observed change
●●● High
●● Medium
● Low due to limited agreement
○ Low due to limited evidence

*Hot extremes and runoff amplified in cities*

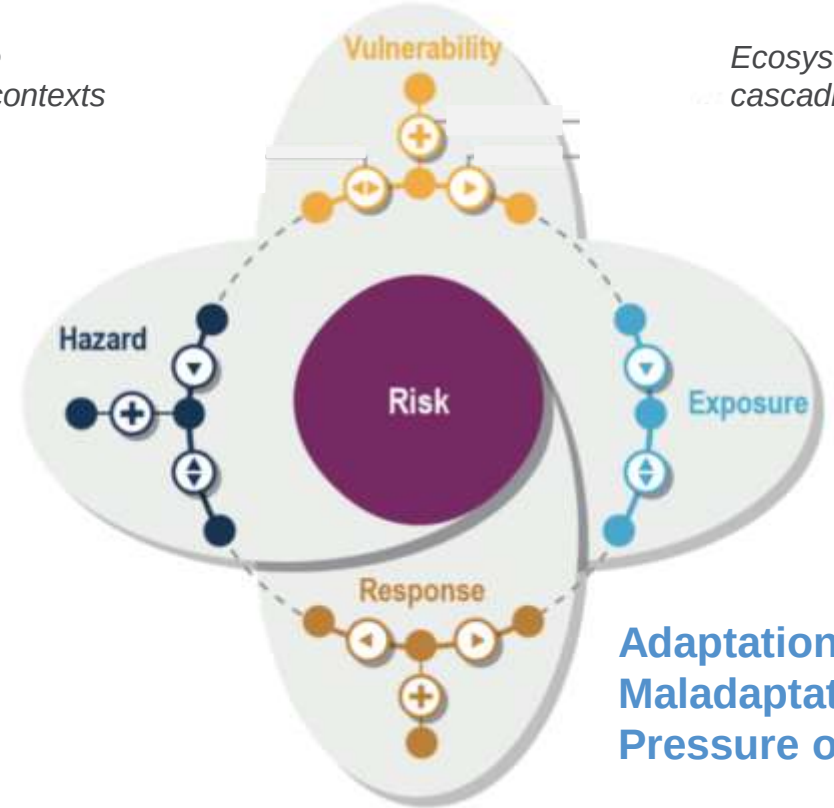
*Compound events*

*Marine heat waves*
*Acidification*
*Loss of oxygen*
*Sea level rise*

**Every region is affected in multiple ways**

*3.3-3.6 billion people in high vulnerability contexts*

*Ecosystems and societies: cascading risks*




## Climate-related risks

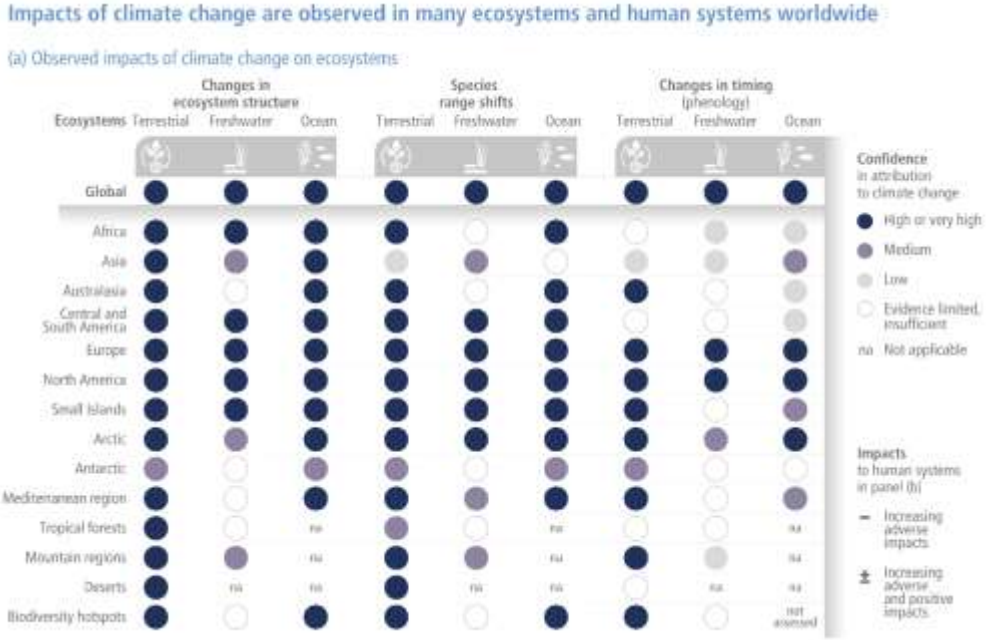
*2050 : 1 billion people on coasts*

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

## Adaptation and limits
## Maladaptation
## Pressure on land

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

# Global warming has caused dangerous and widespread disruption in nature




*Unsustainable use of natural resources, habitat fragmentation, ecosystem damage by pollutants increase ecosystem vulnerability to climate change*

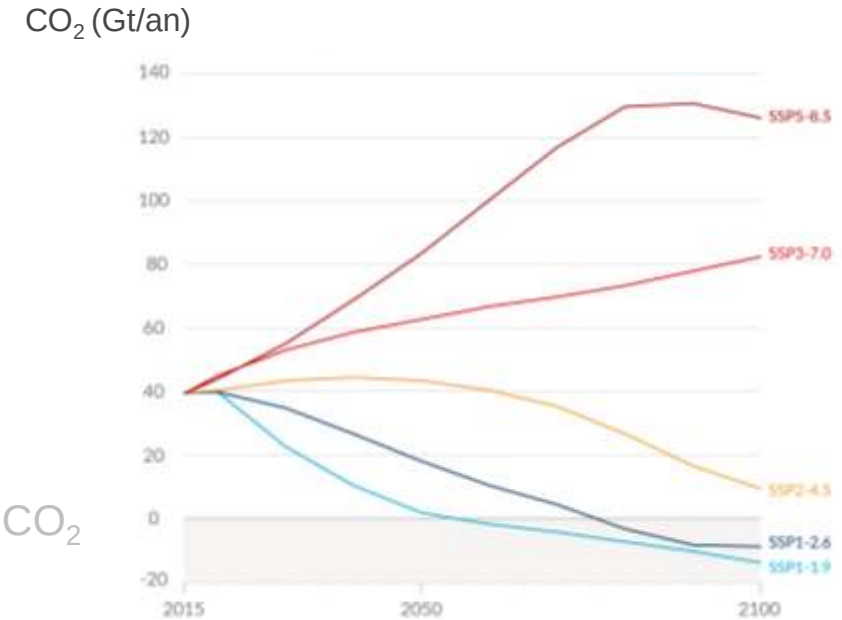
# Despite efforts to adapt, widespread impacts are observed


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

[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

# 5 illustrative pathways, future greenhouse gas emissions and pollutants




Net zero $CO_2$

$CO_2$ emissions

**very high**

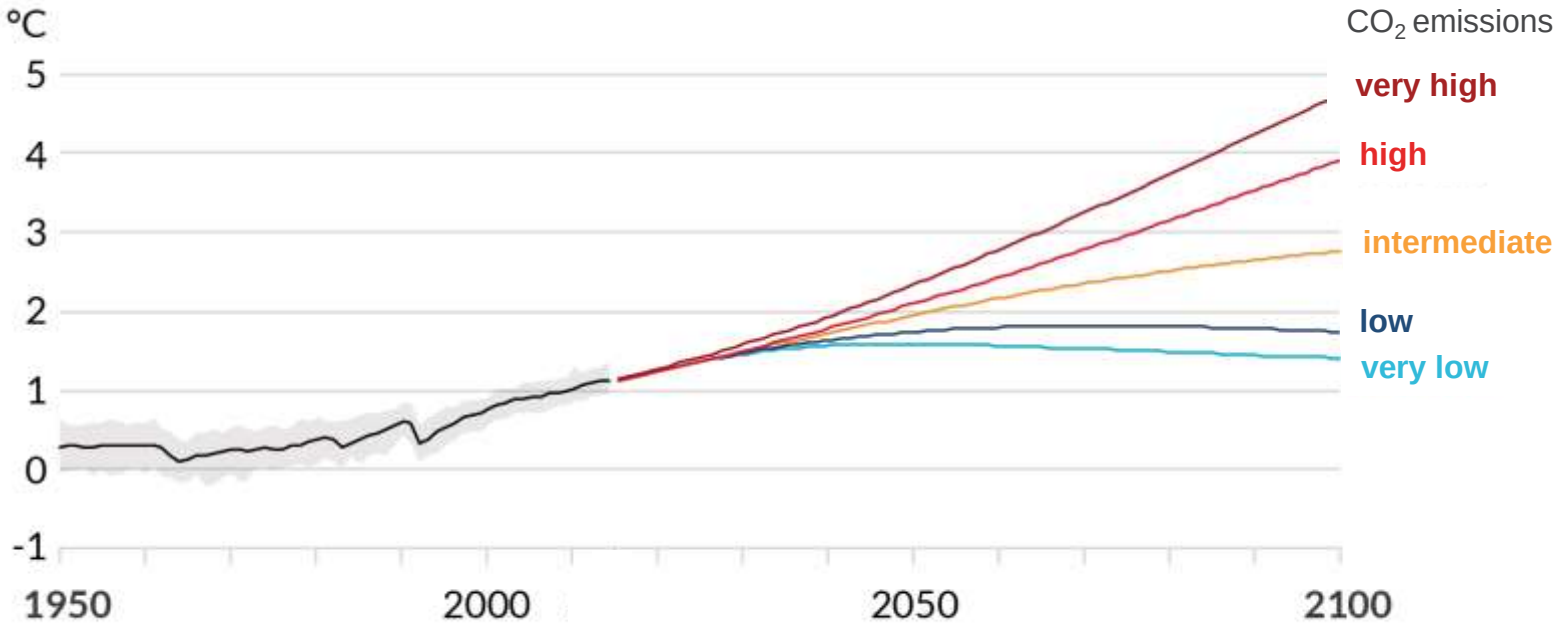
**high**

**intermediate**

**low**

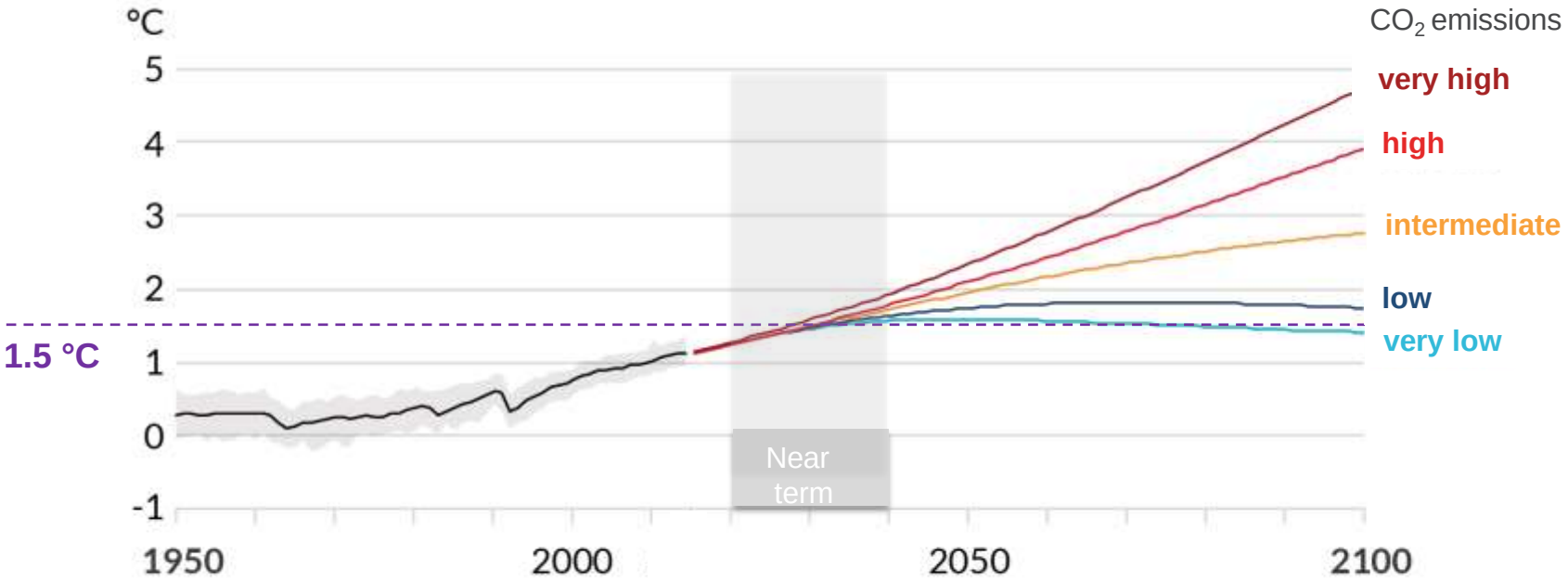
**very low**

# Future warming will depend on future emissions



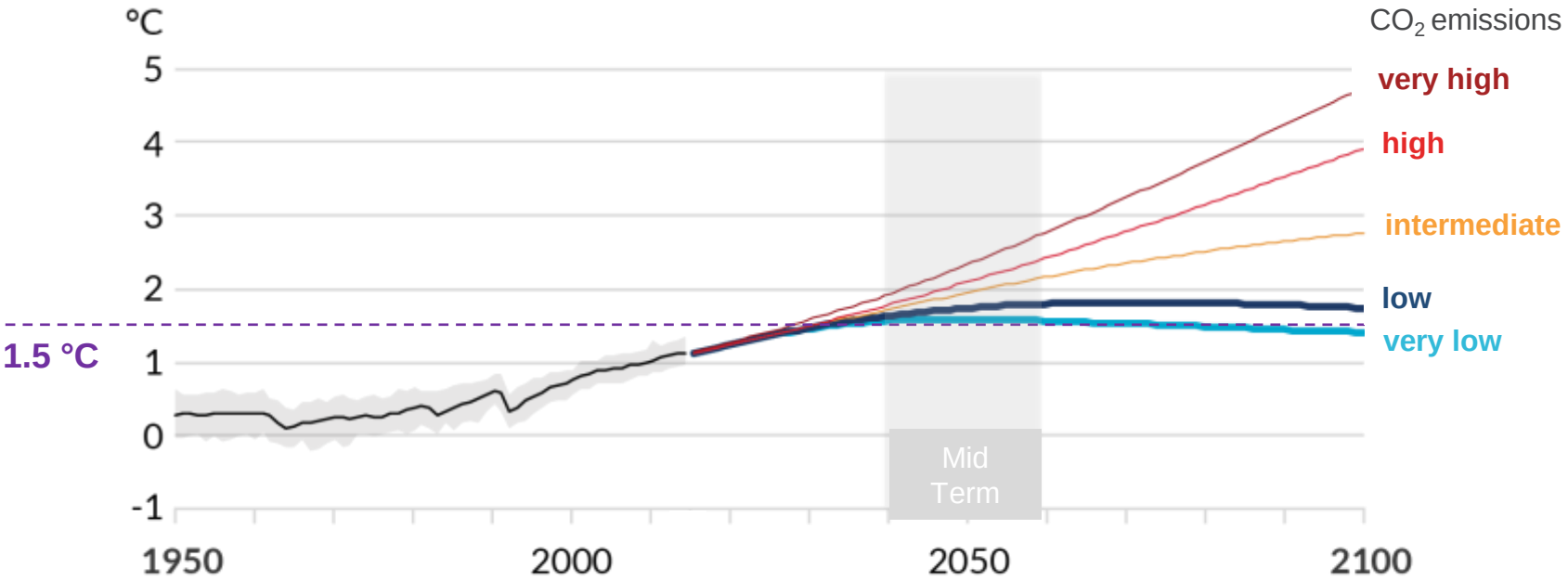

Global surface temperature change (relative to 1850-1900)

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



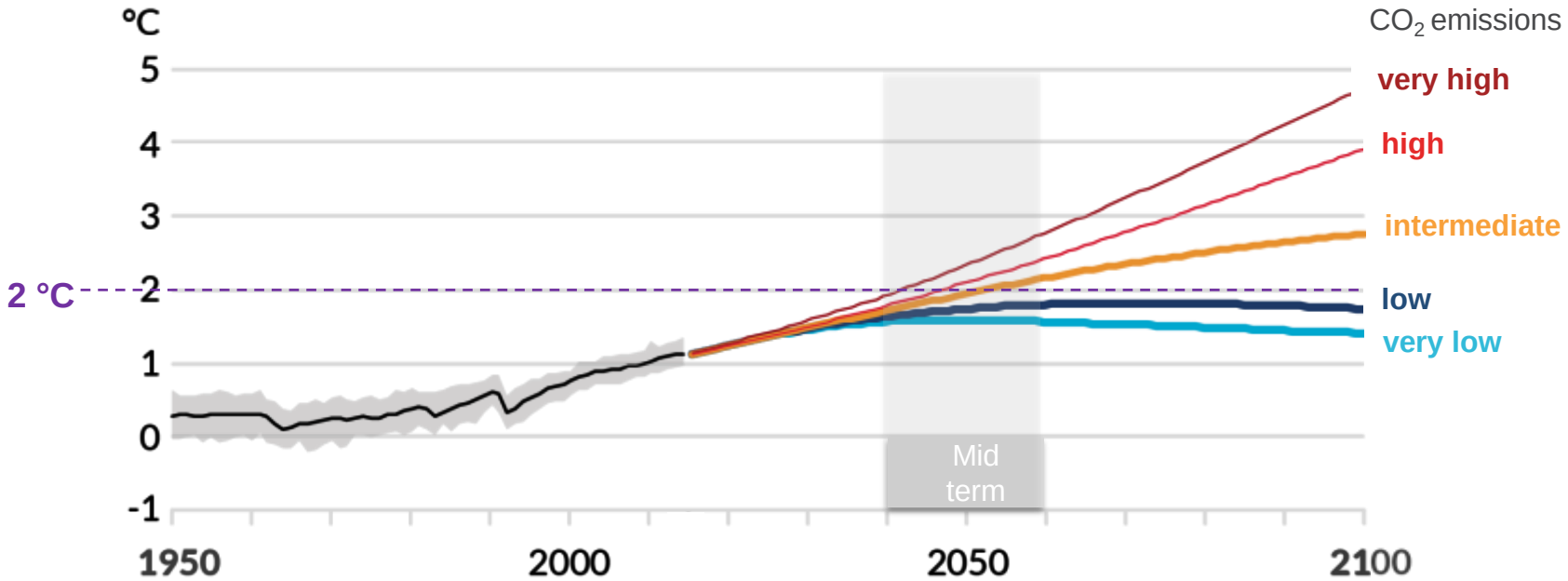

Global surface temperature change (relative to 1850-1900)

# We could reach or avoid +2°C by 2050




Global surface temperature change (relative to 1850-1900)

# Future warming depends on future emissions




Global surface temperature change (relative to 1850-1900)

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

Change in annual mean temperature …

…+1.5°C … + 2°C …+ 4°C

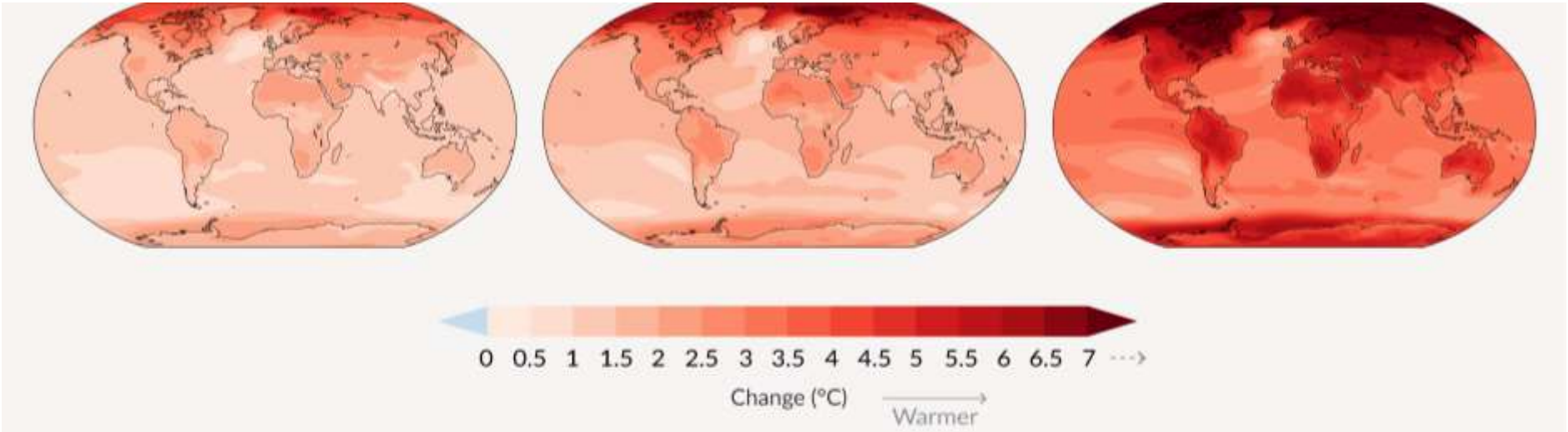



*Figure SPM.5*

# 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 …

… + 1.5°C

… + 2°C

… + 4°C

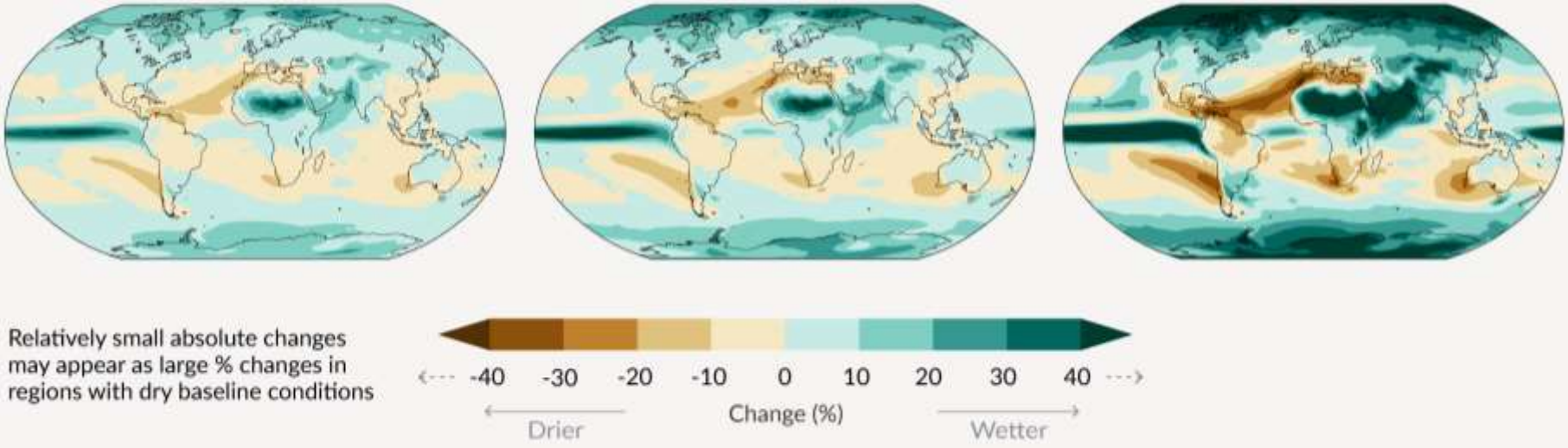



*Figure SPM.5*

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

Change in annual mean soil moisture…

… + 1.5°C

… + 2°C

… + 4°C

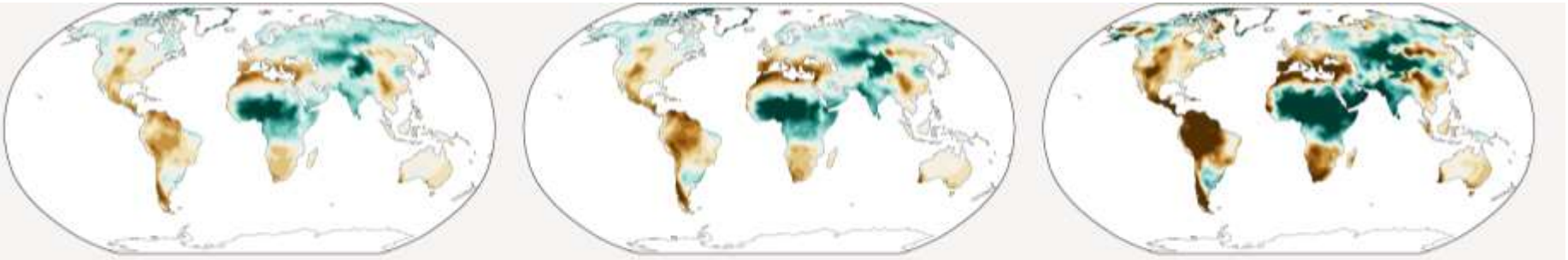
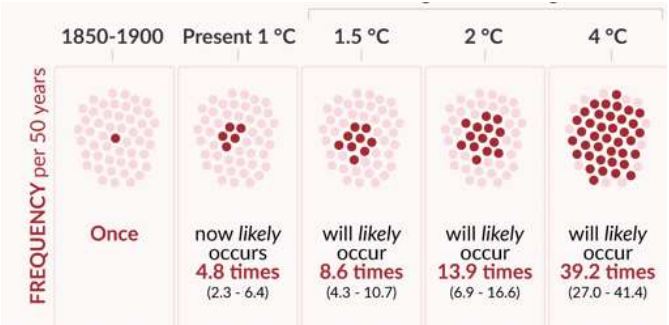



*Figure SPM.5*

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

↑ 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**

*Figure FAQ 11.2*

[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

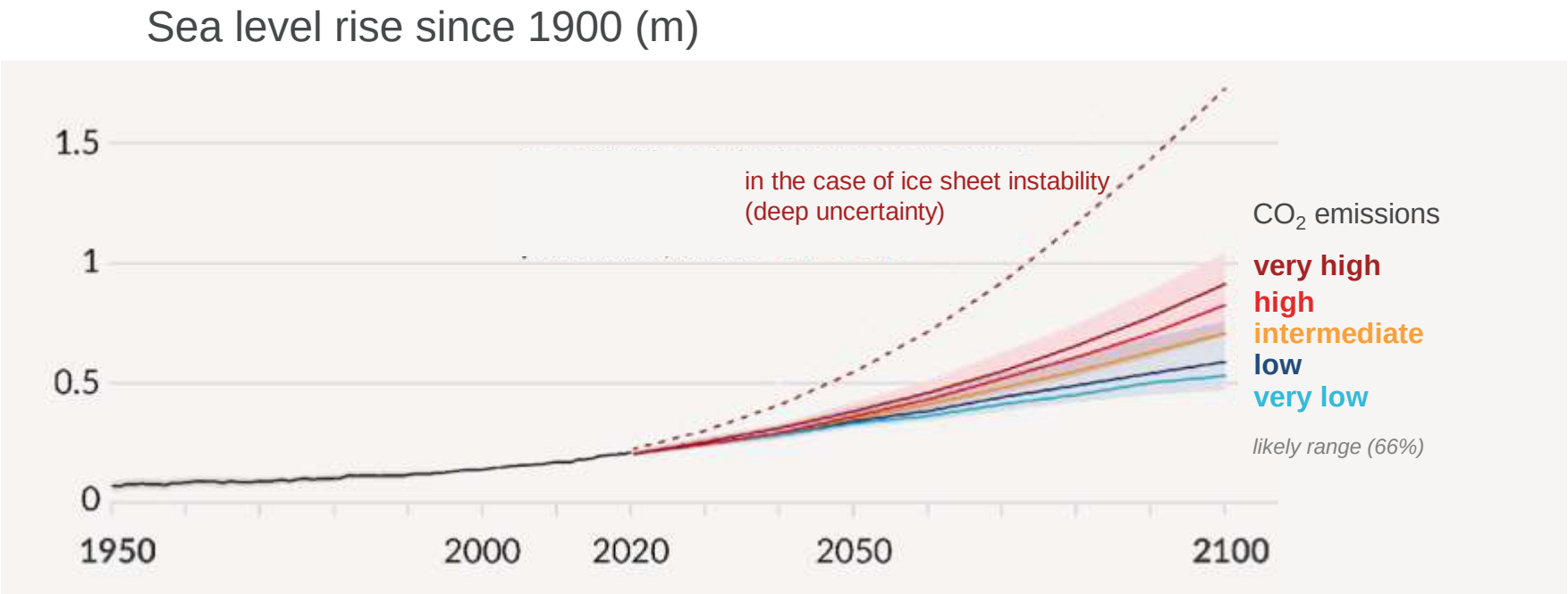
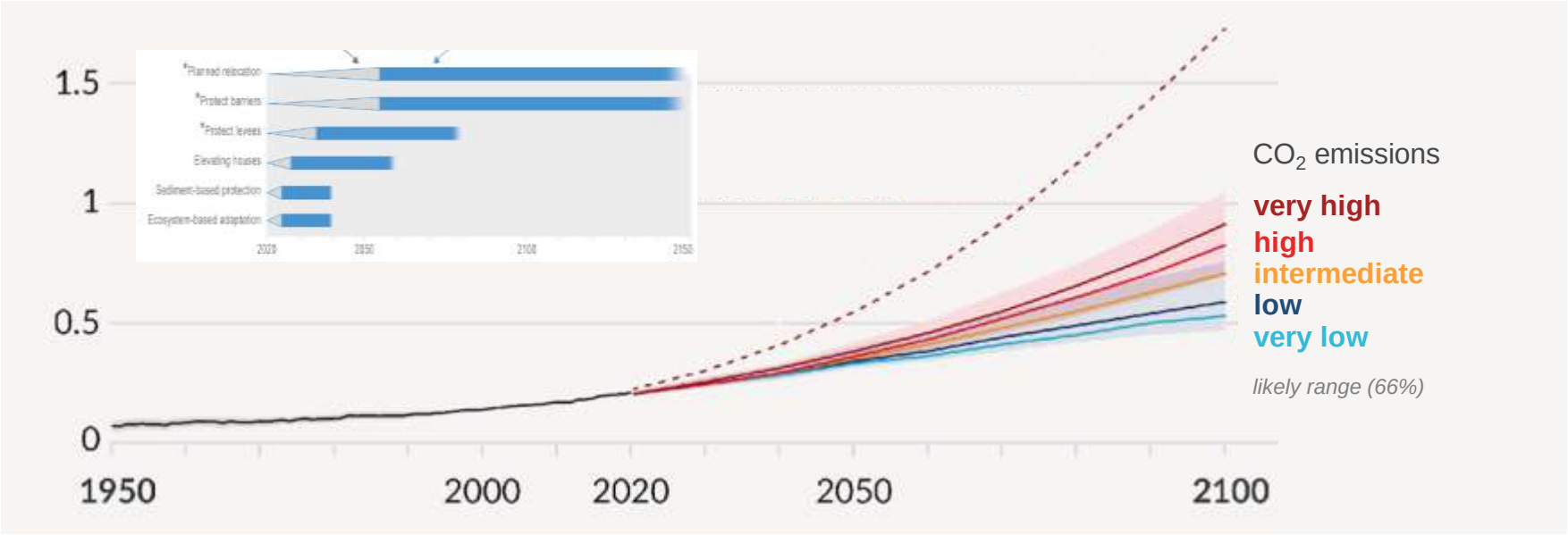



*Figure SPM.8*

# 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

# 33 climatic impact-drivers

heat & cold

rain & drought

snow & ice

wind

coasts & costal ocean

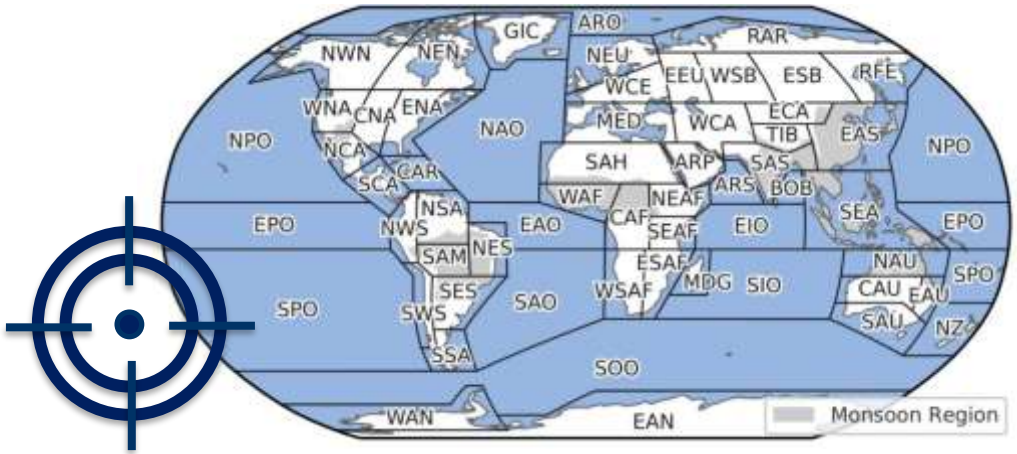
other

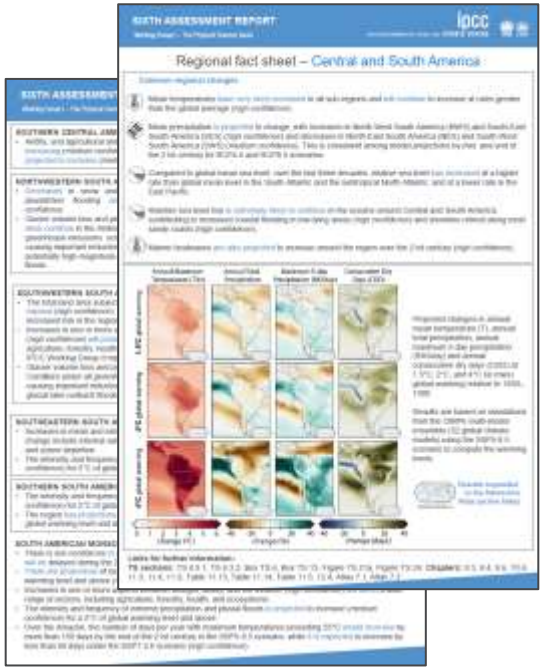
open ocean

**Thresholds**

+2°C by 2050 :
96% of regions : 10 factors or +
50% of regions : 15 factorrs or +

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



# Climate risks will depend on the level of global warming

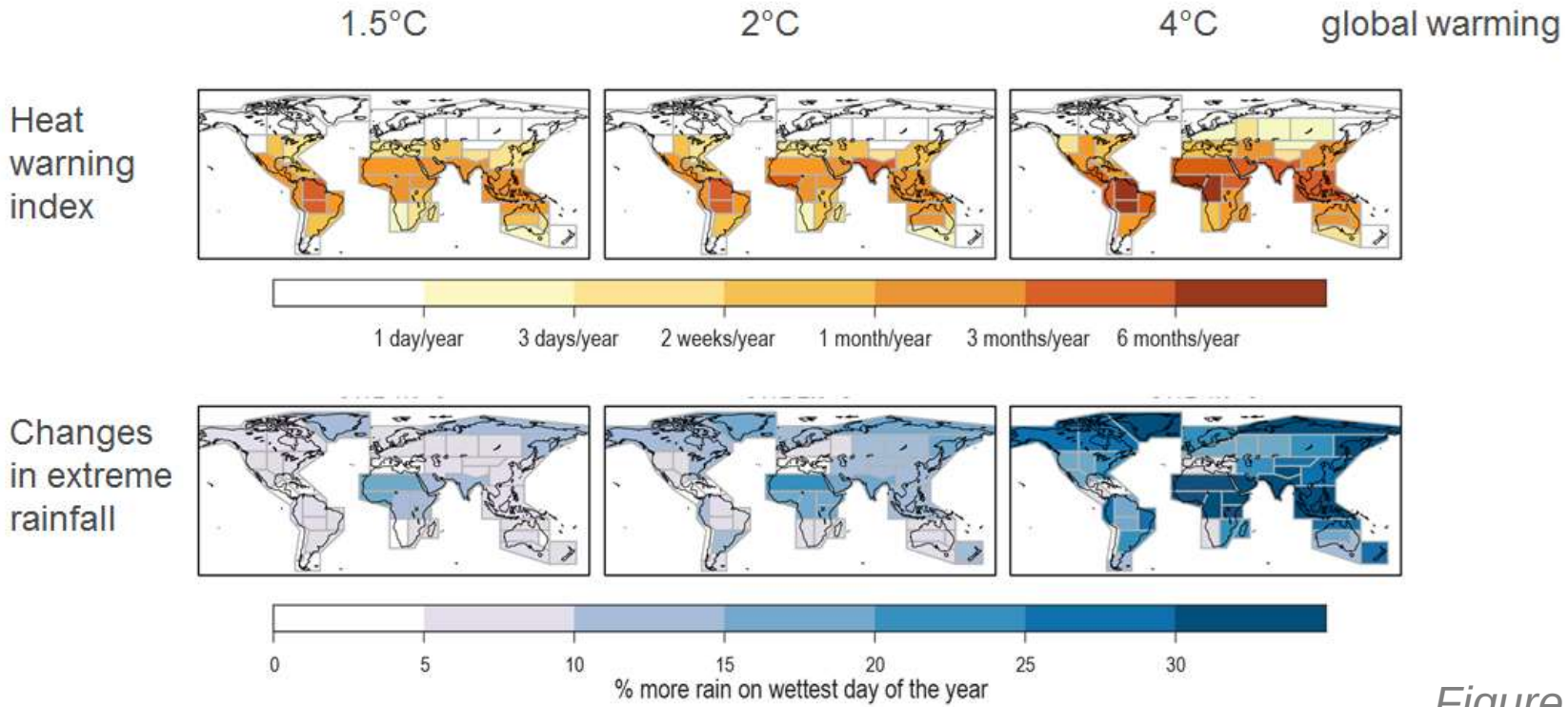
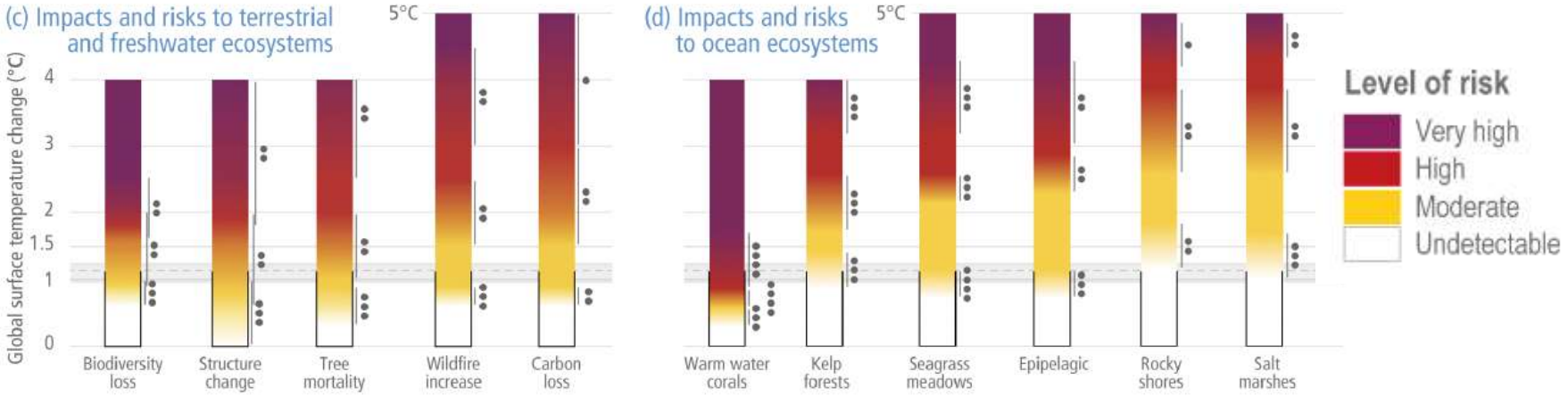
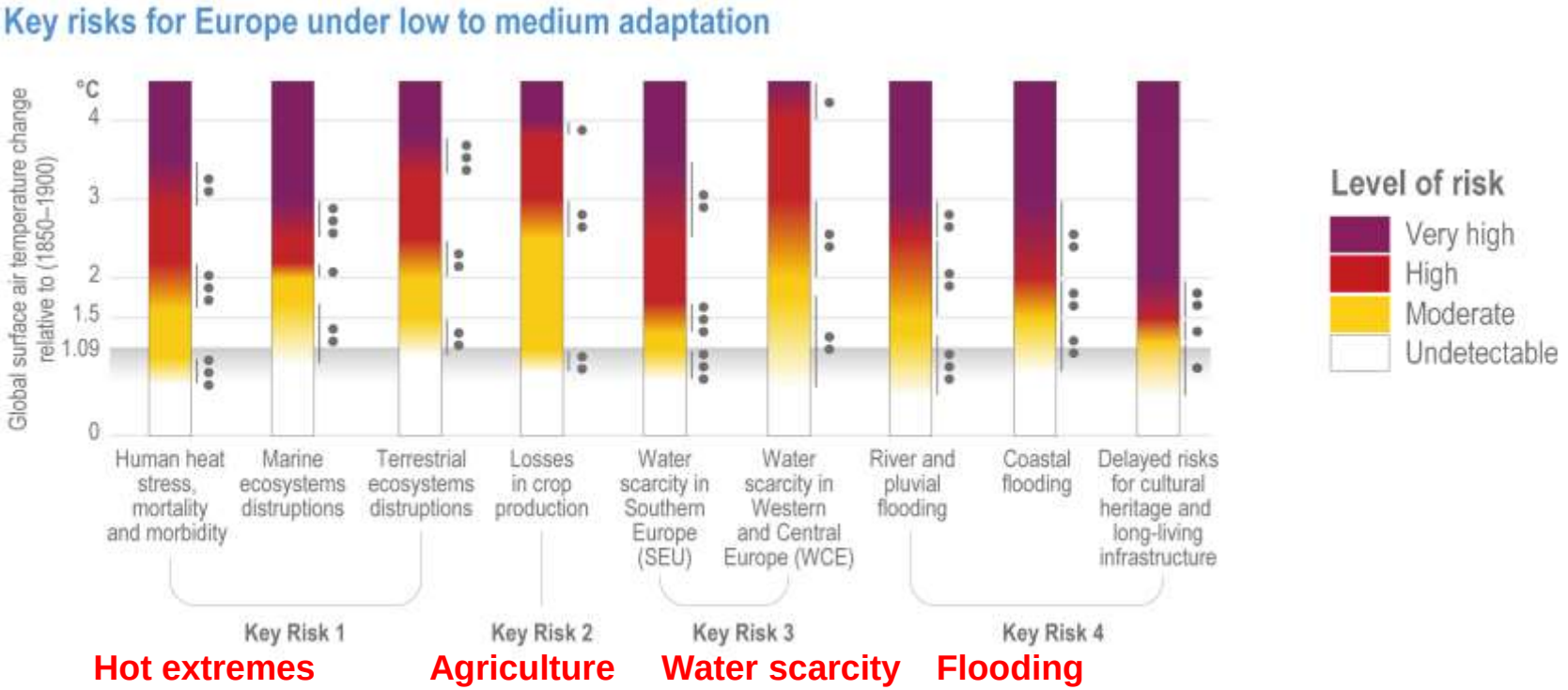



*Figure TS.6*

# 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



# Feasible adaptation options can reduce near-term risks

*Food security*
*Water management*
*Urban transformation*
*Coastal risk management*

| System transitions | Climate responses[1] 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 |
| Energy systems | Improve water use efficiency |
| | Resilient power systems |
| | Energy reliability |
| Cross-sectoral | Health and health systems adaptation |
| | Livelihood diversification |
| | Planned relocation and resettlement |
| | Human migration[3] |
| | Disaster risk management |
| | Climate services, including Early Warning Systems |
| | Social safety nets |

# 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*

| System transitions | Climate responses[1] and adaptation options |
|---|---|
| Land and ocean ecosystems | Coastal defence and hardening |
| | Integrated coastal zone management |
| | Forest-based adaptation[2] |
| | Sustainable aquaculture and fisheries |
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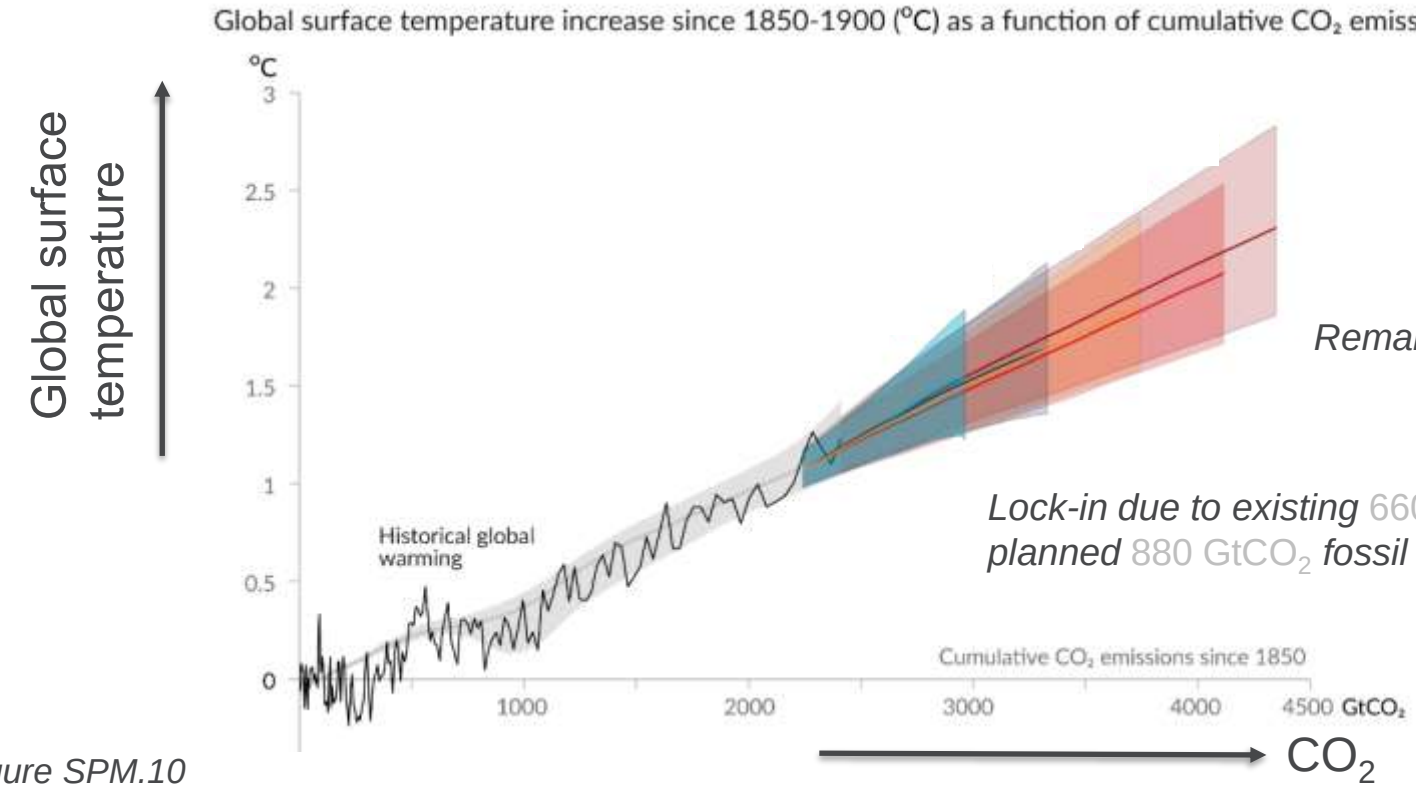
| | Human migration[3] |
| | Disaster risk management |
| | Climate services, including Early Warning Systems |
| | Social safety nets |

[Credit: Andy Mahoney | NSIDC]

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

# Every ton of $CO_2$ adds to global warming




*Remaining carbon budgets*

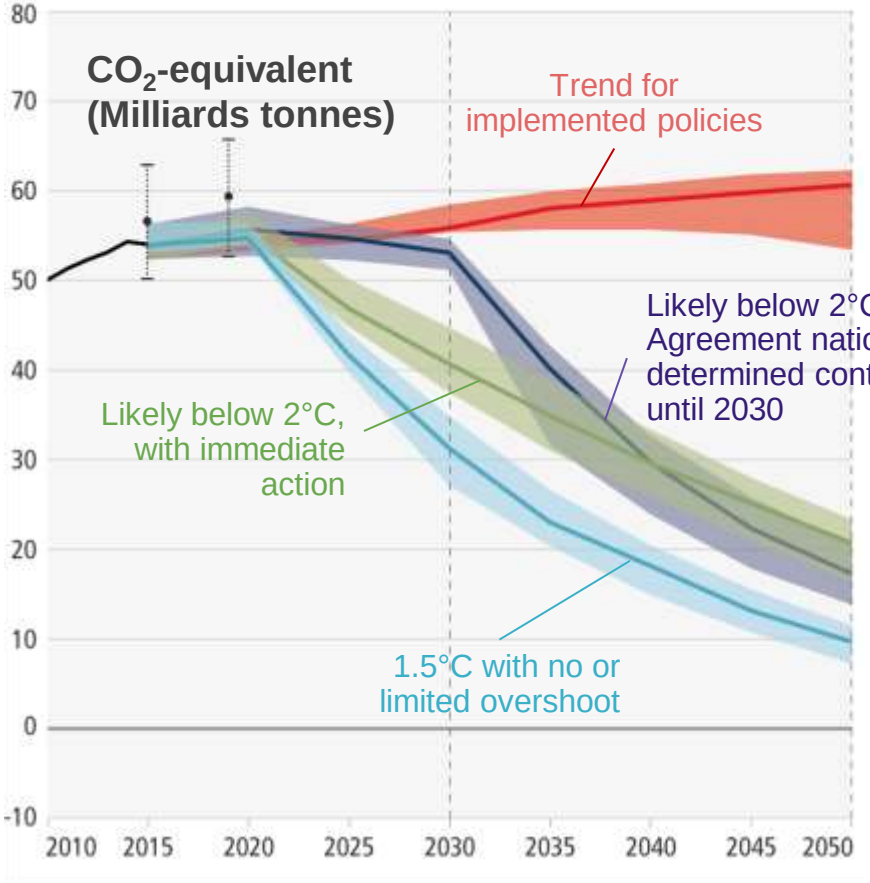
*Lock-in due to existing 660 $GtCO_2$ and planned 880 $GtCO_2$ fossil fuel infrastructures*

*Figure SPM.10*

[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




## By 2030…

### Limiting warming close to 1,5 °C

- $CO_2$-equivalent : - 43% by 2030

### Limiting warming well below 2°C

- $CO_2$-equivalent: - 27% by 2030

*Costs of action : 0.05 to 0.15% of annual GDP*

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INTERGOVERNMENTAL PANEL ON climate change
WMO UNEP

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**

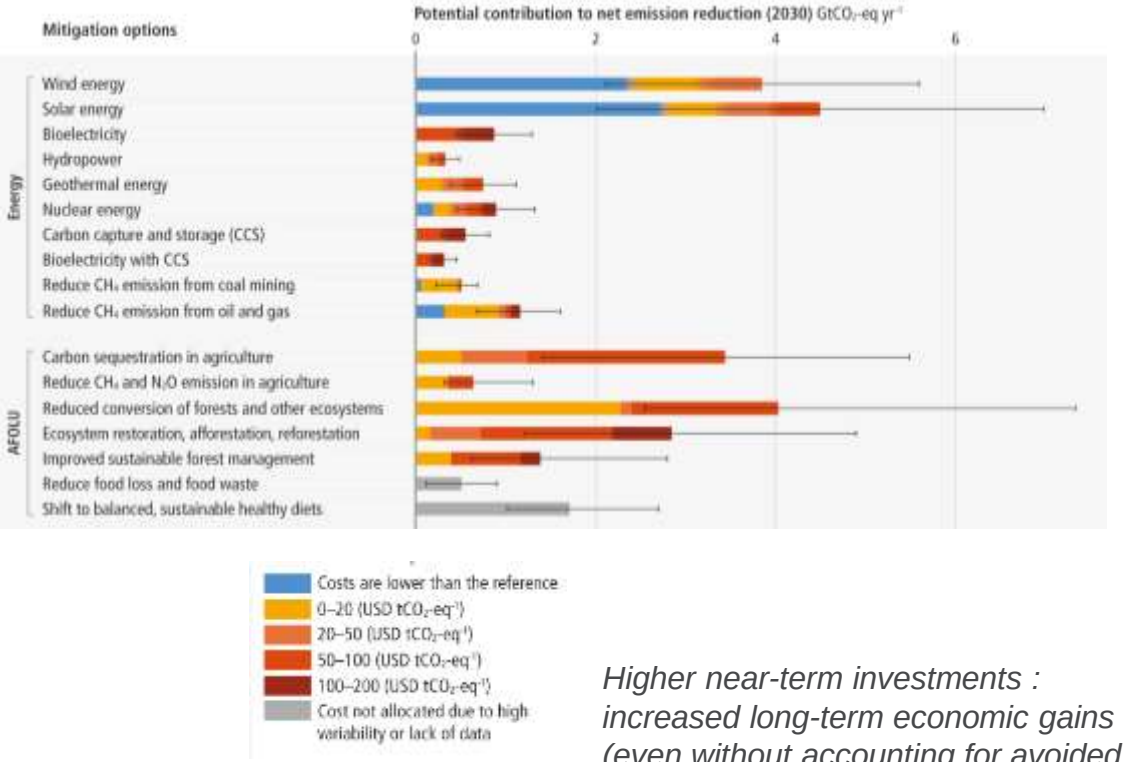
**Industry**

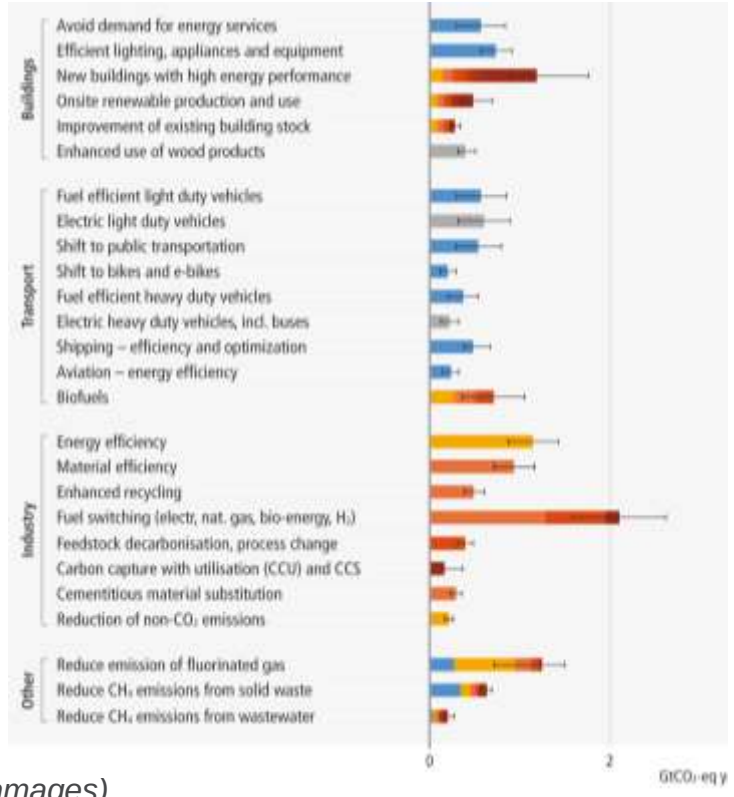
**Urban**

**Buildings**

**Transport**

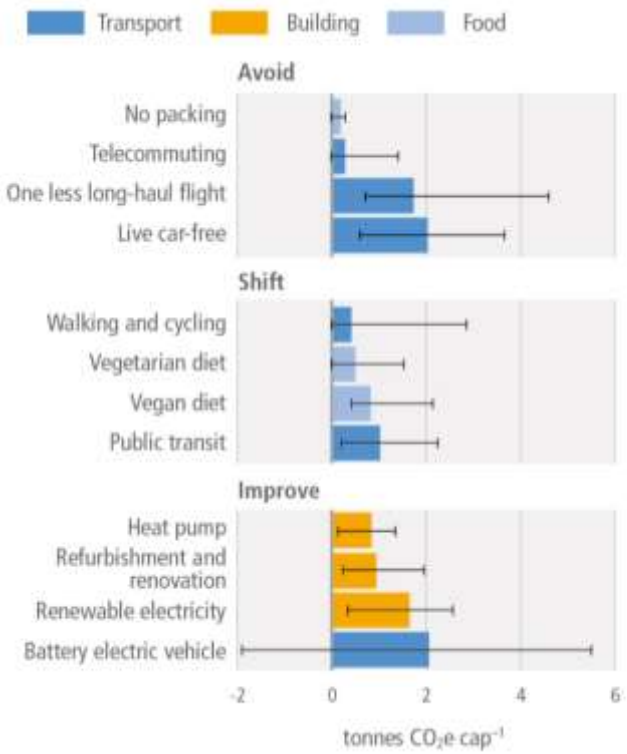
# There are feasible options to reduce greenhouse gas emissions in all sectors




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

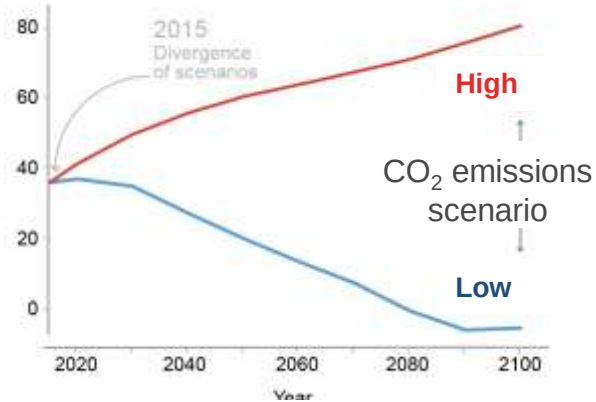
# … and strategies that can support low carbon lifestyles



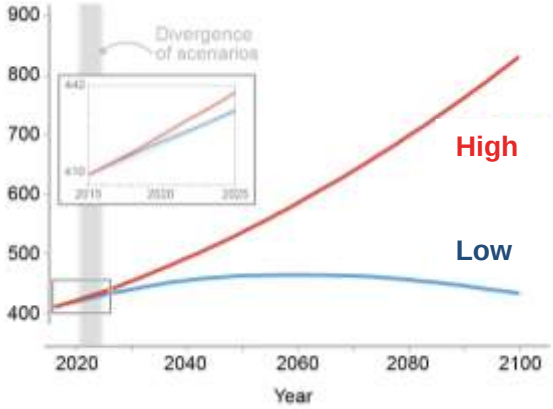

*with health and wellbeing benefits*

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

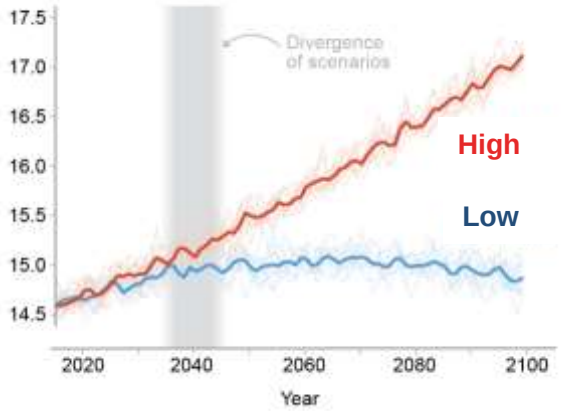
$CO_2$ emissions (billion tonnes of CO2 per year)



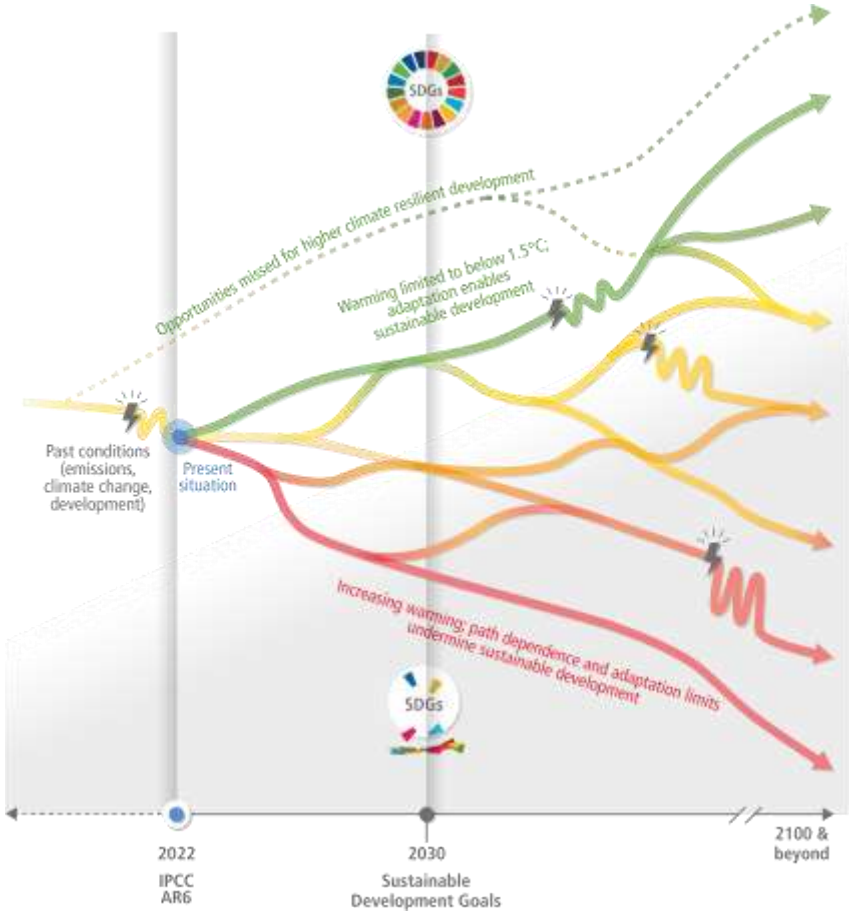

$CO_2$ concentration in the atmposphere (ppm)




Global surface temperature (ºC)

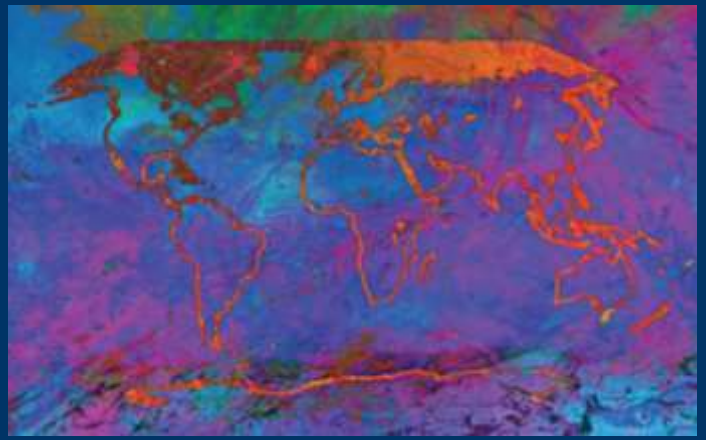



*FAQ4.2, Figure 1*




## 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

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