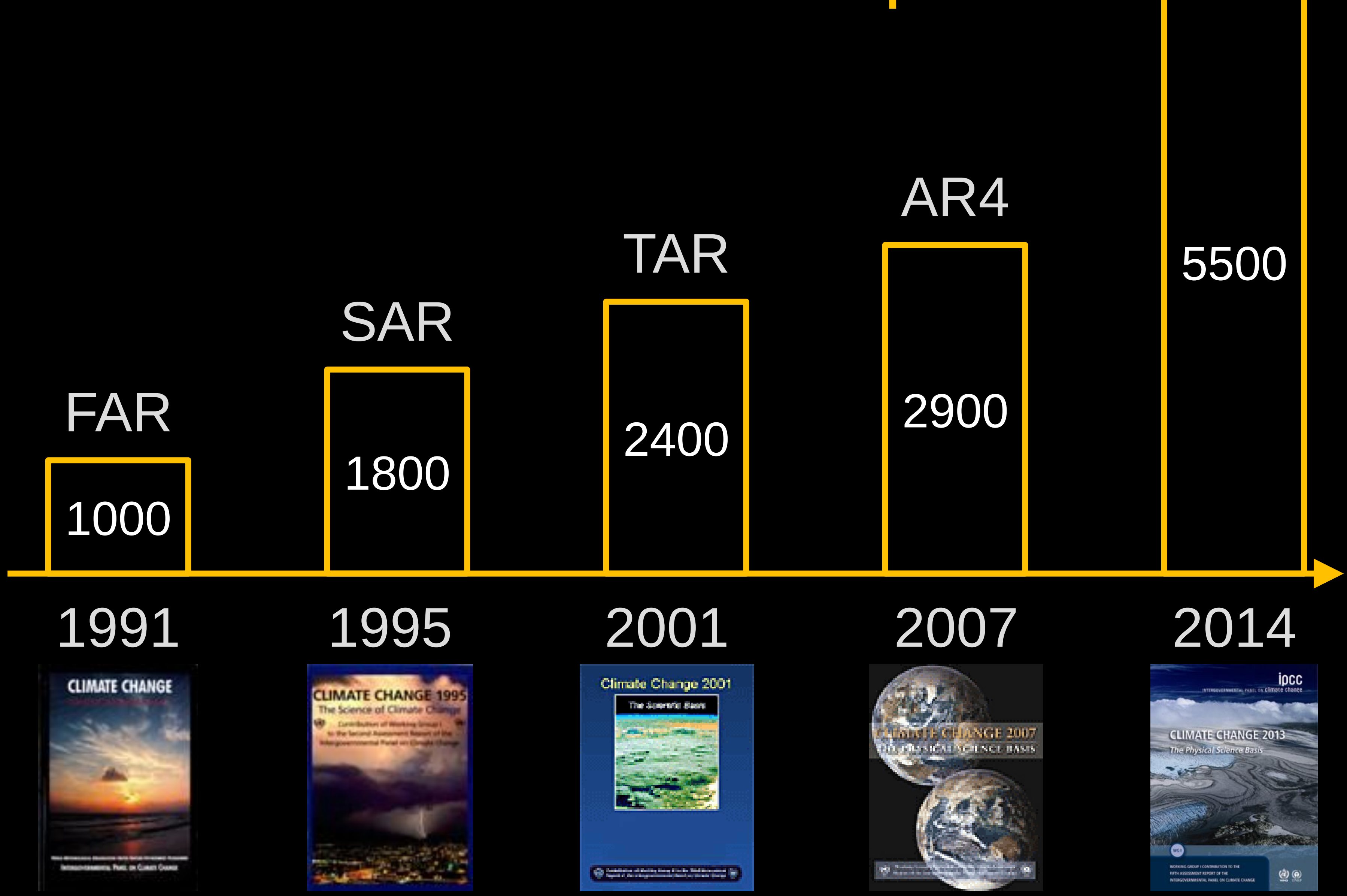
Cédric Ringenbach

Le changement climatique

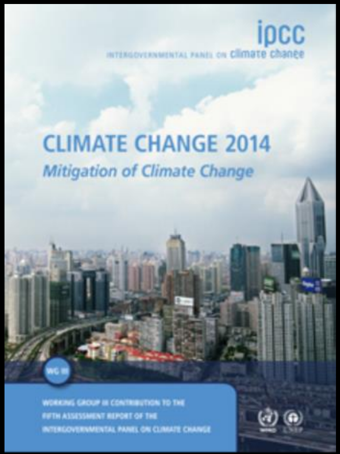
Assessment Reports

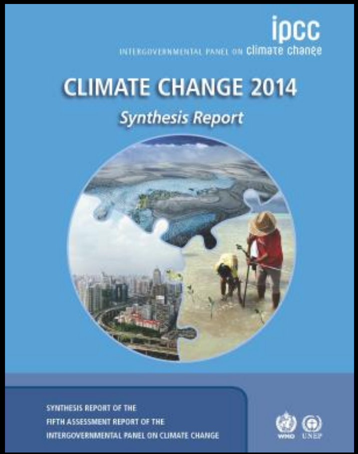


3 Working Groups

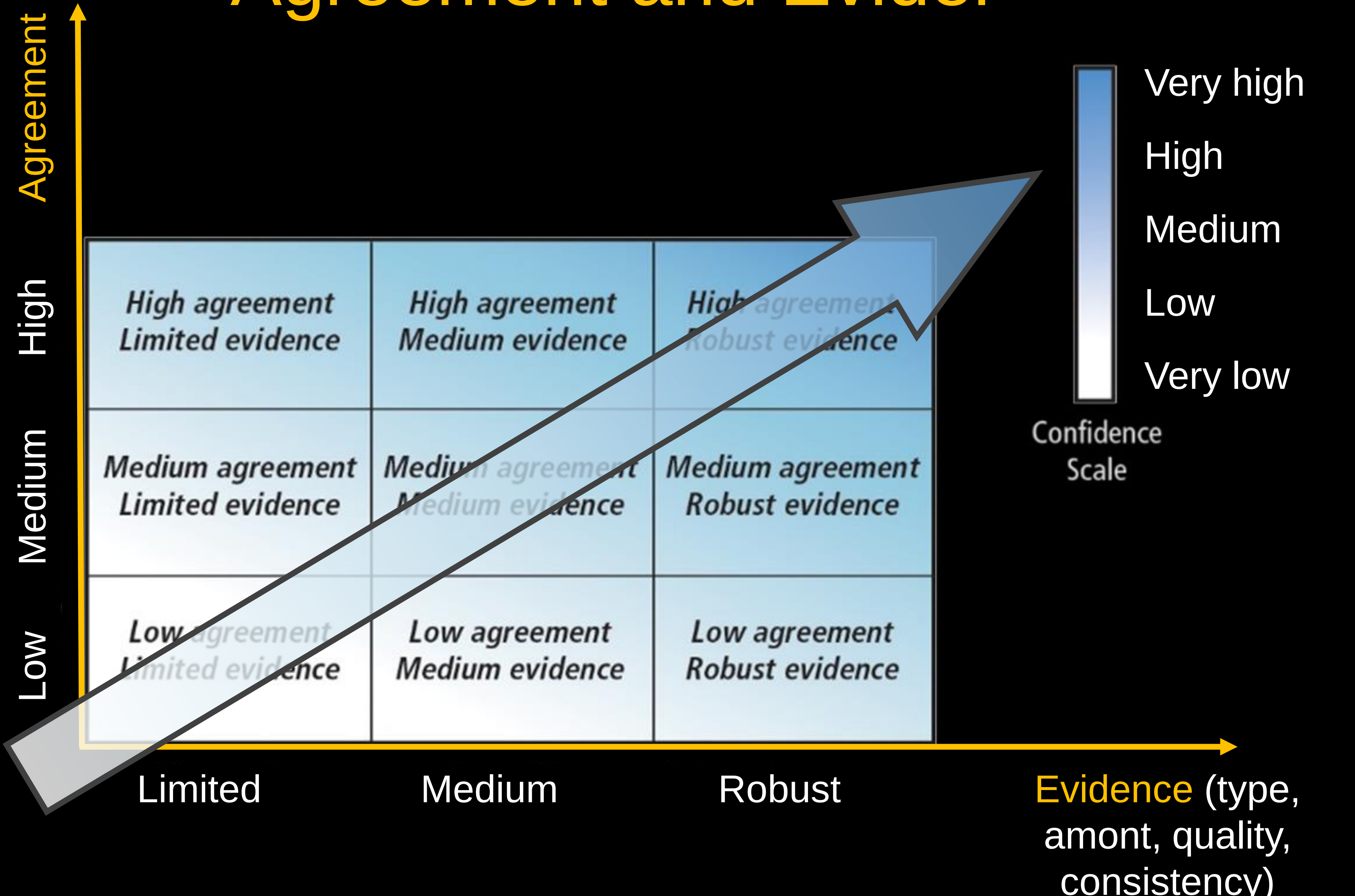
- WGI : "The Physical Science Basis"
- WGII : "Impacts, Adaptation and Vulnerability"
- WGIII : "Mitigation of Climate Change"

- Synthesis Report





Agreement and Evidence



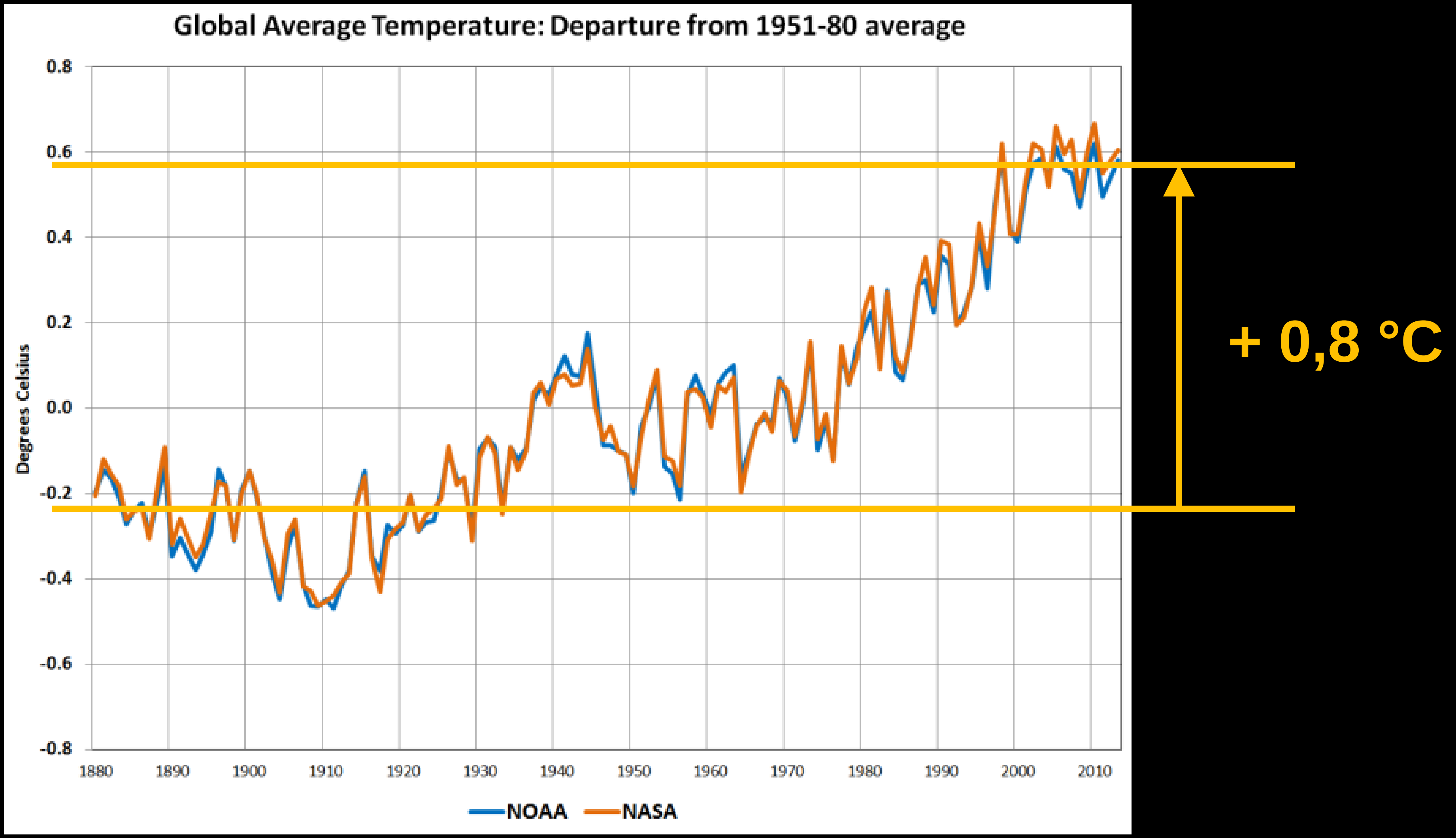
Assessed likelihood

Virtually certain	99–100% probability
Extremely likely	95–100% probability
Very likely	90–100% probability
Likely	66–100% probability
More likely than not	50–100% probability
About as likely as not	33–66% probability
Unlikely	0–33% probability
Very unlikely	0–10% probability
Extremely unlikely	0–5% probability
Exceptionally unlikely	0–1% probability

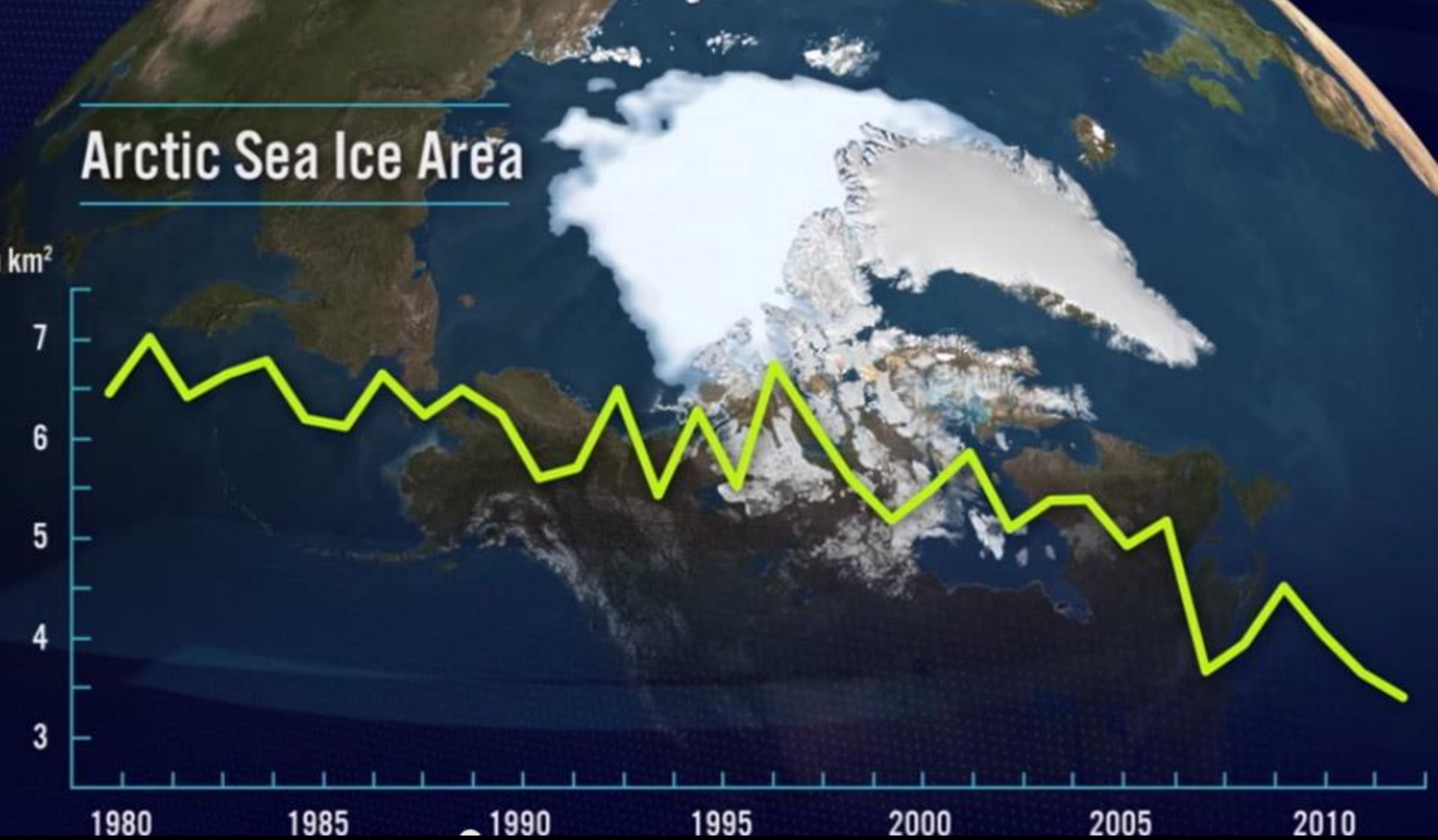
WGI :

The Physical Science Basis

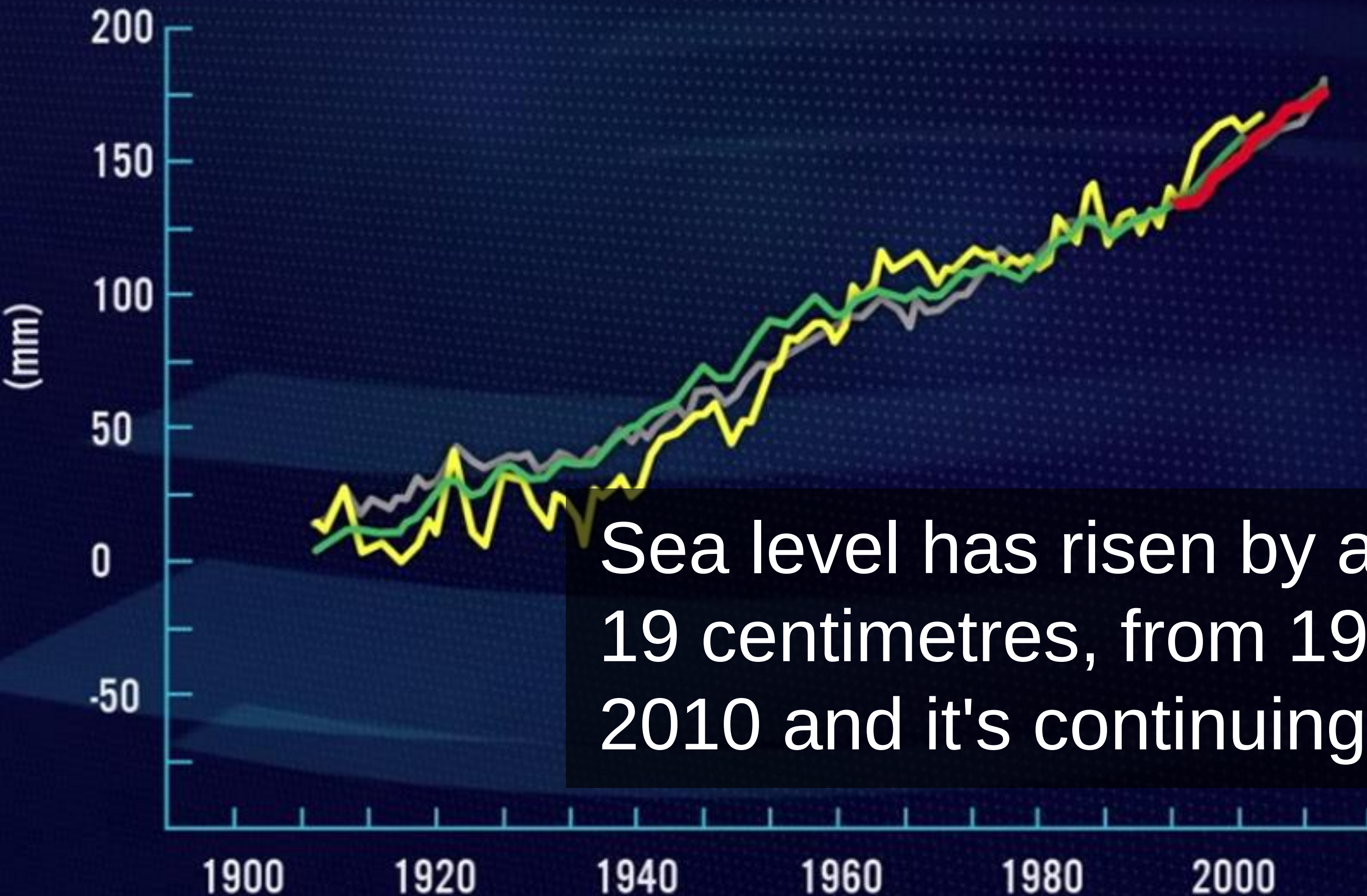
Changes in Temperature



Arctic Sea Ice Extension is showing a downward trend since 1980.

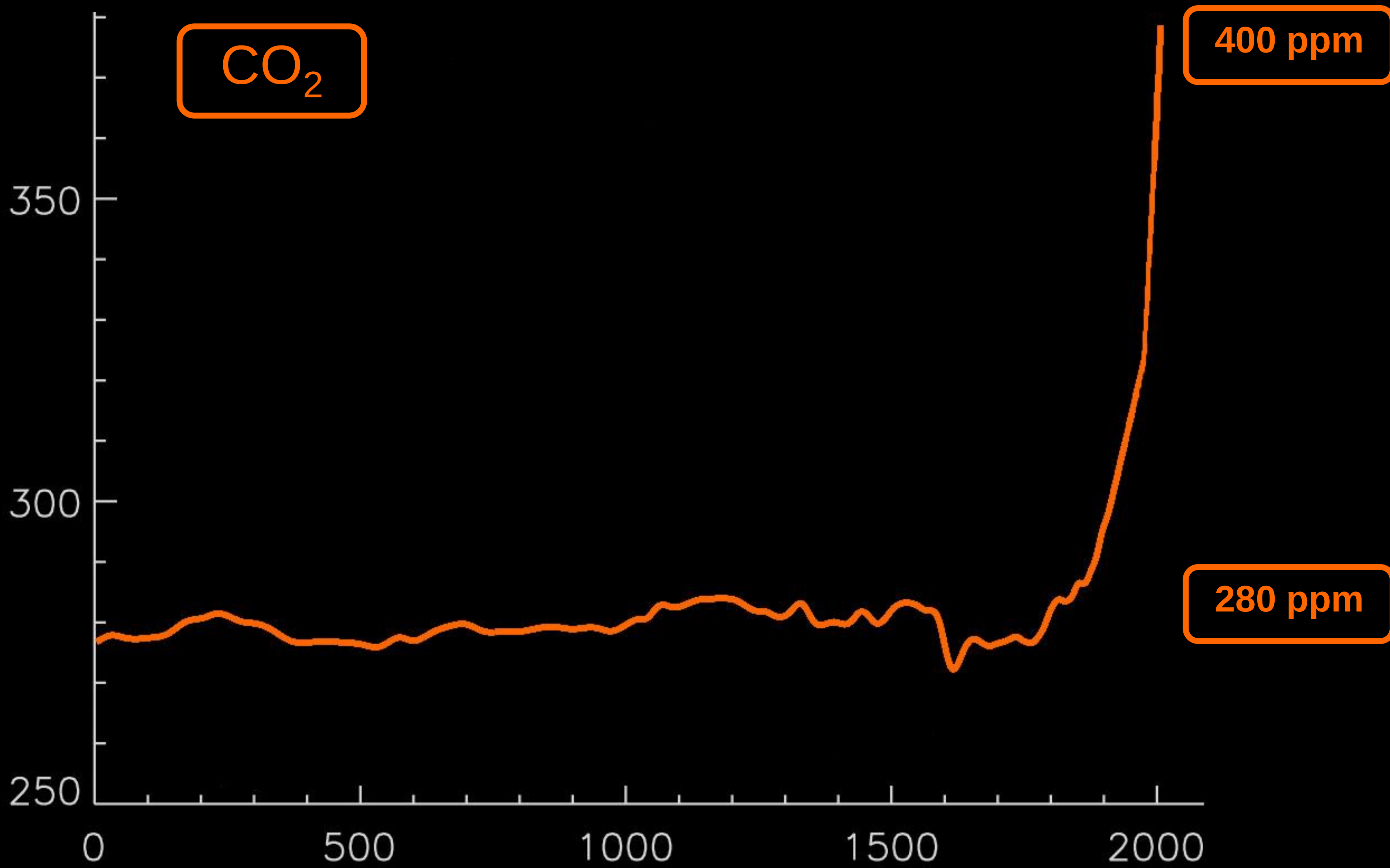


Global average sea level change

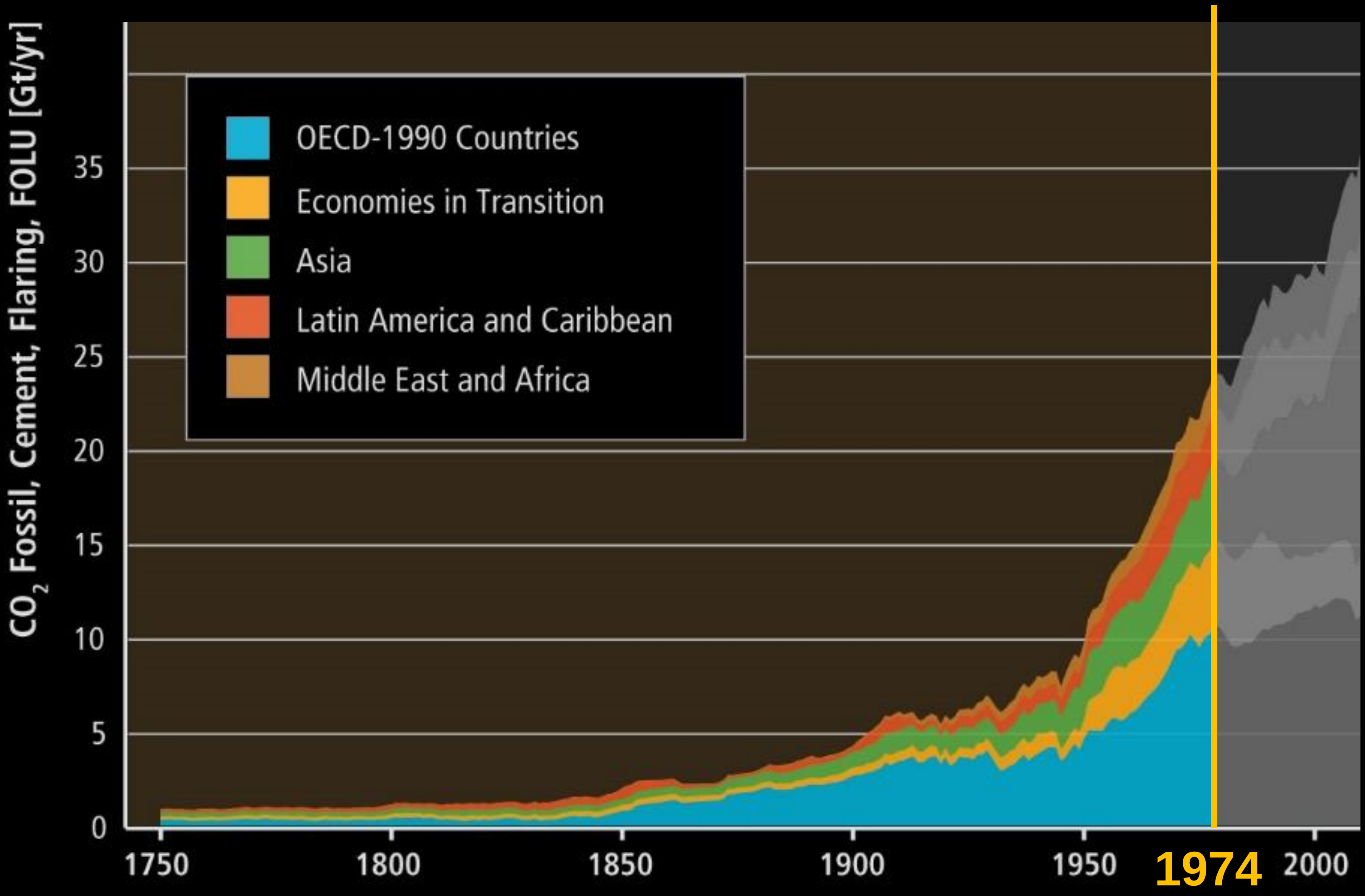


Sea level has risen by about 19 centimetres, from 1900 to 2010 and it's continuing to rise.

Evolution du CO2 depuis 2000 ans

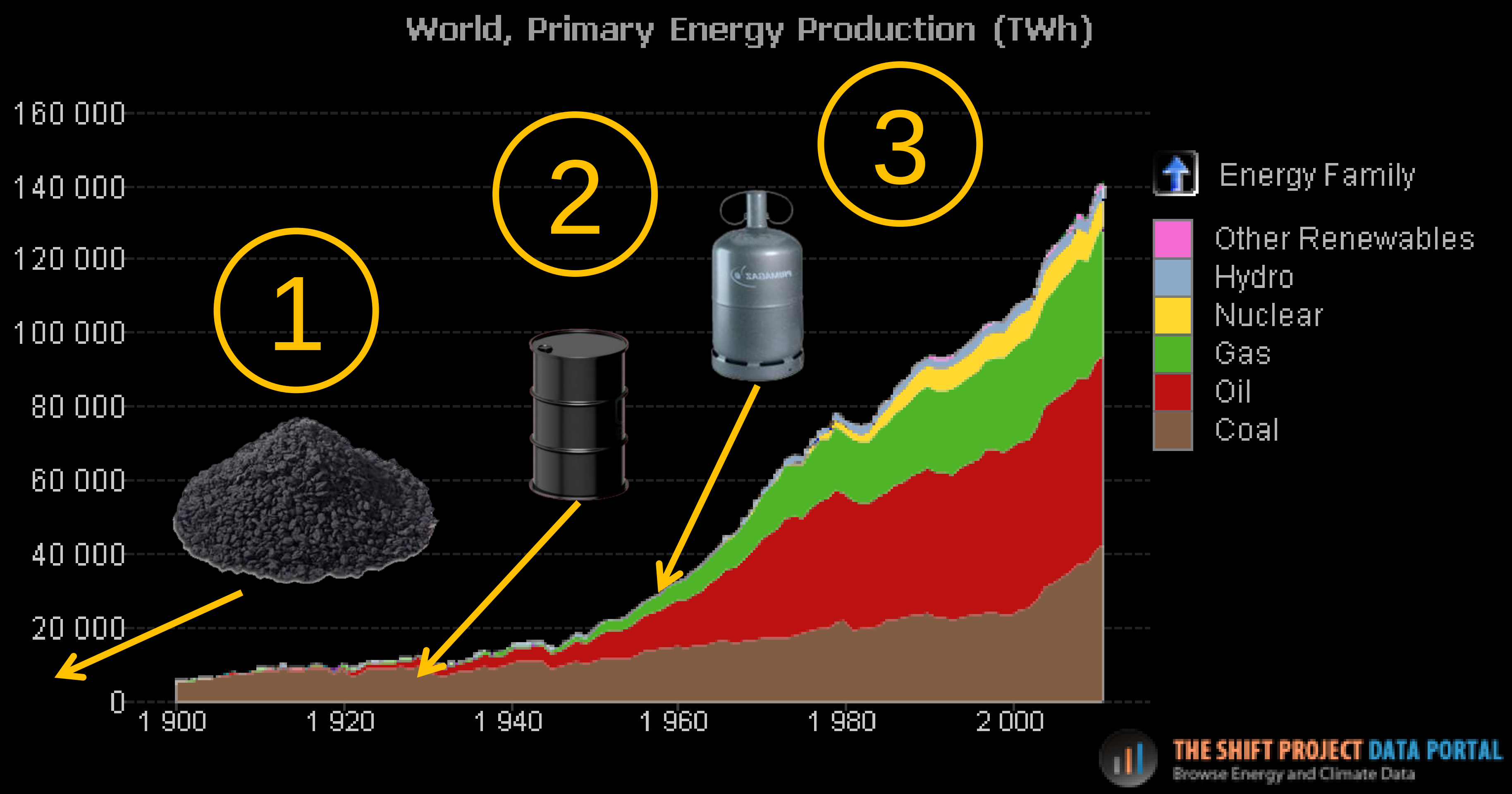


Global CO_2 emissions per regions

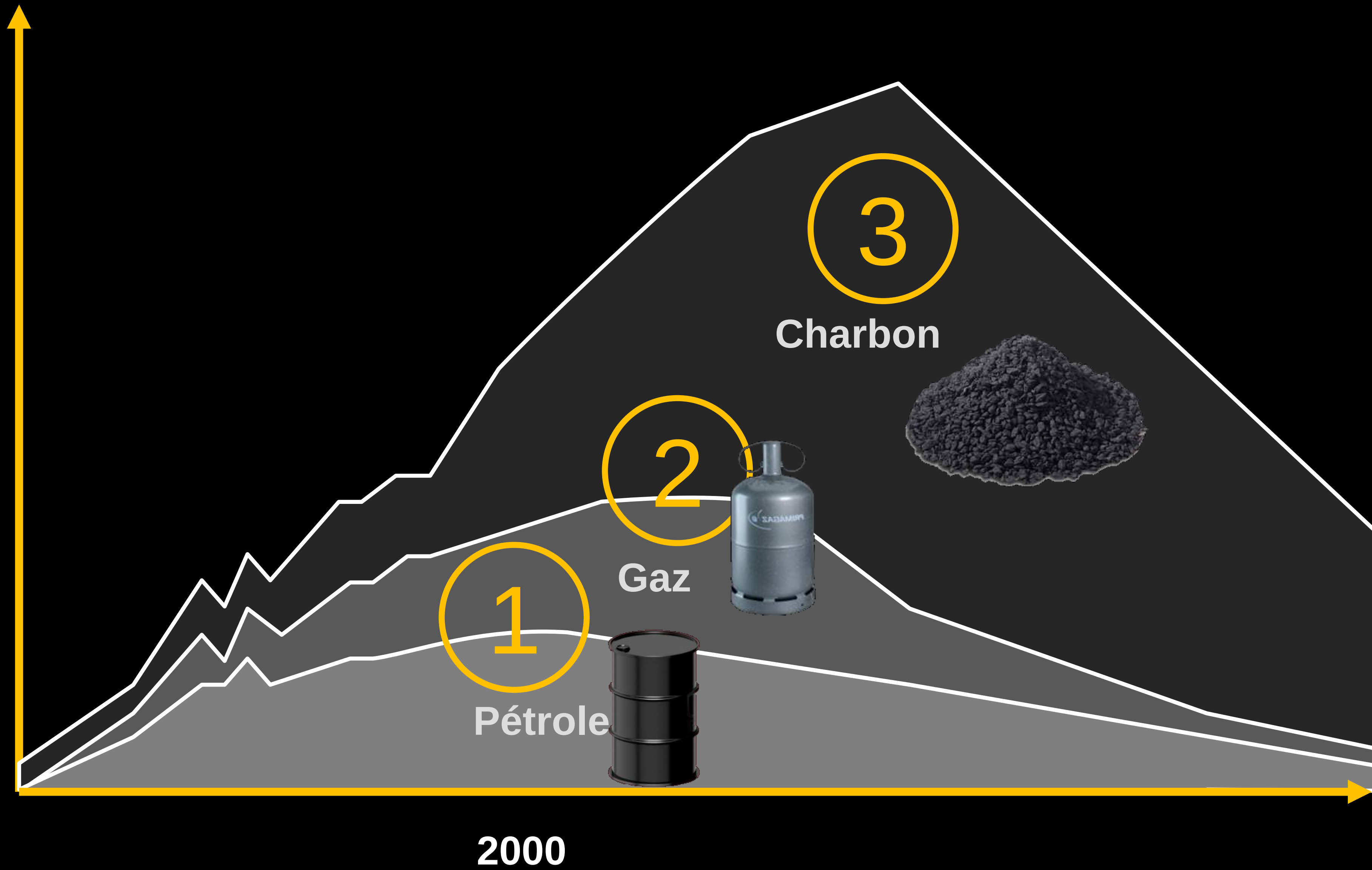


Les énergies fossiles

Démarrage

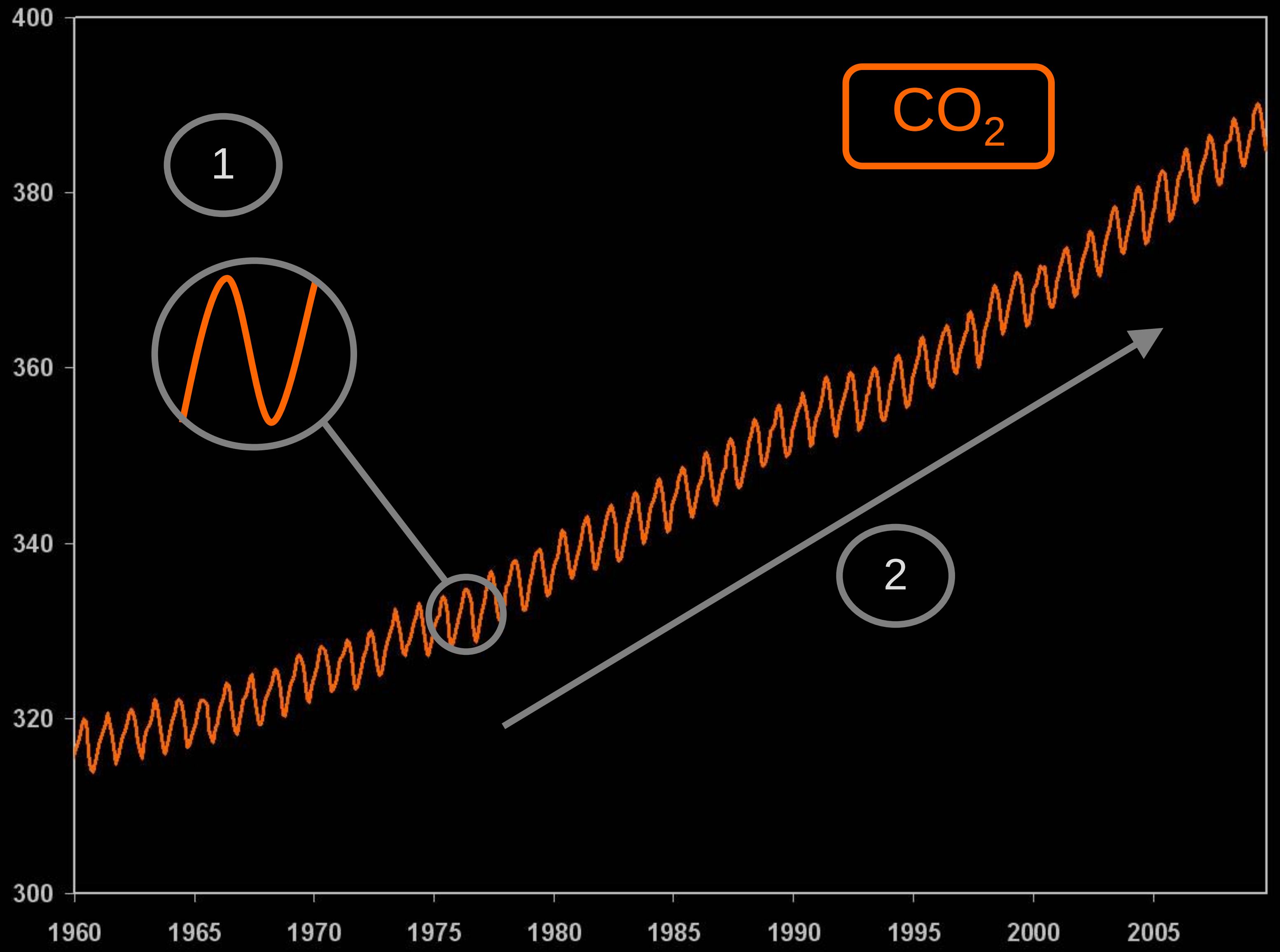

World, Primary Energy Production (TWh)
160 000
140 000
120 000
100 000
80 000
60 000
40 000
20 000
0
1 900
1 920
1 940
1 960
1 980
2 000
1
2
3
Energy Family
Other Renewables
Hydro
Nuclear
Gas
Oil
Coal
THE SHIFT PROJECT DATA PORTAL
Browse Energy and Climate Data

Date du peak

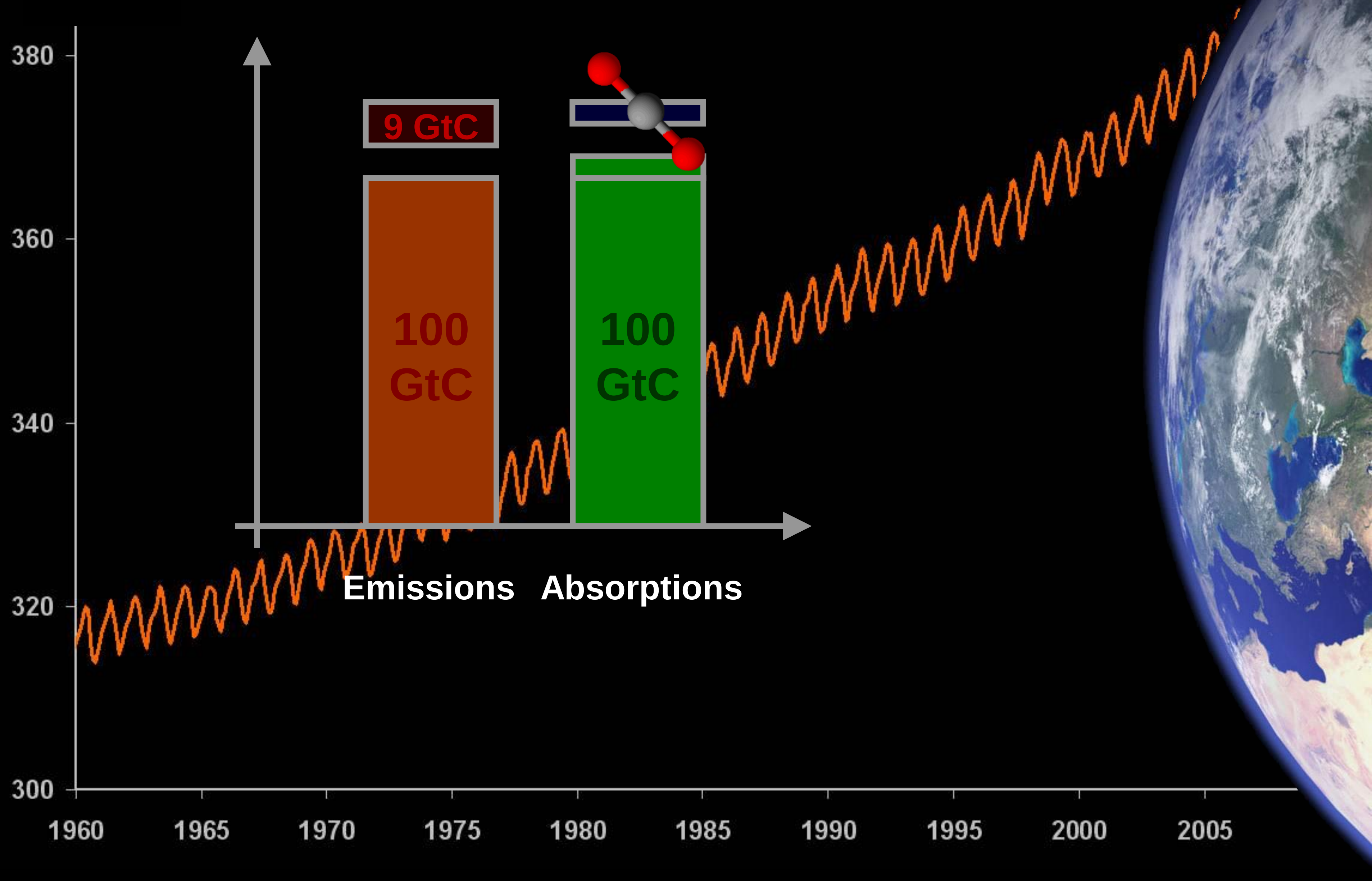


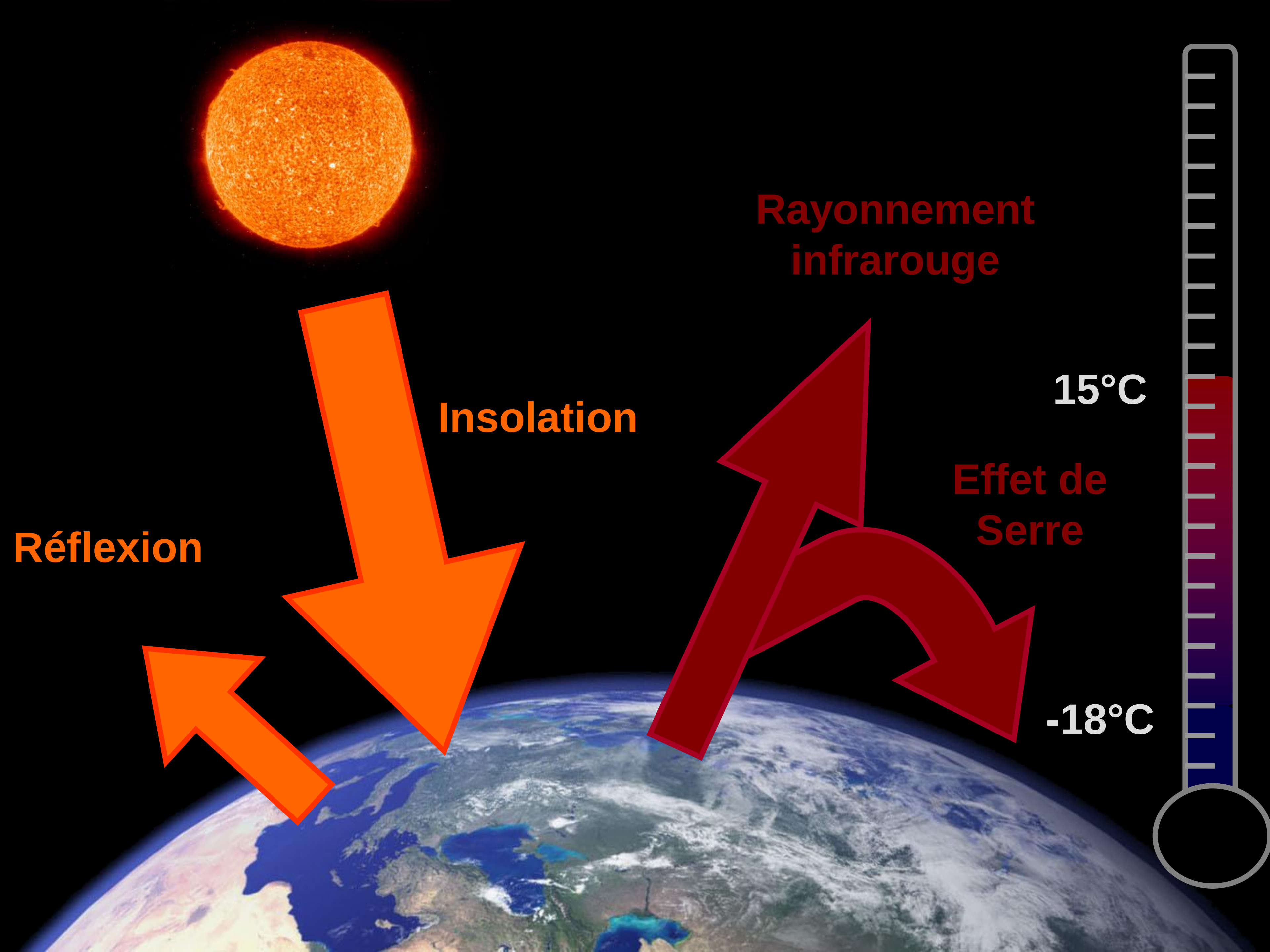
Mesure du CO_2 à Mauna Loa

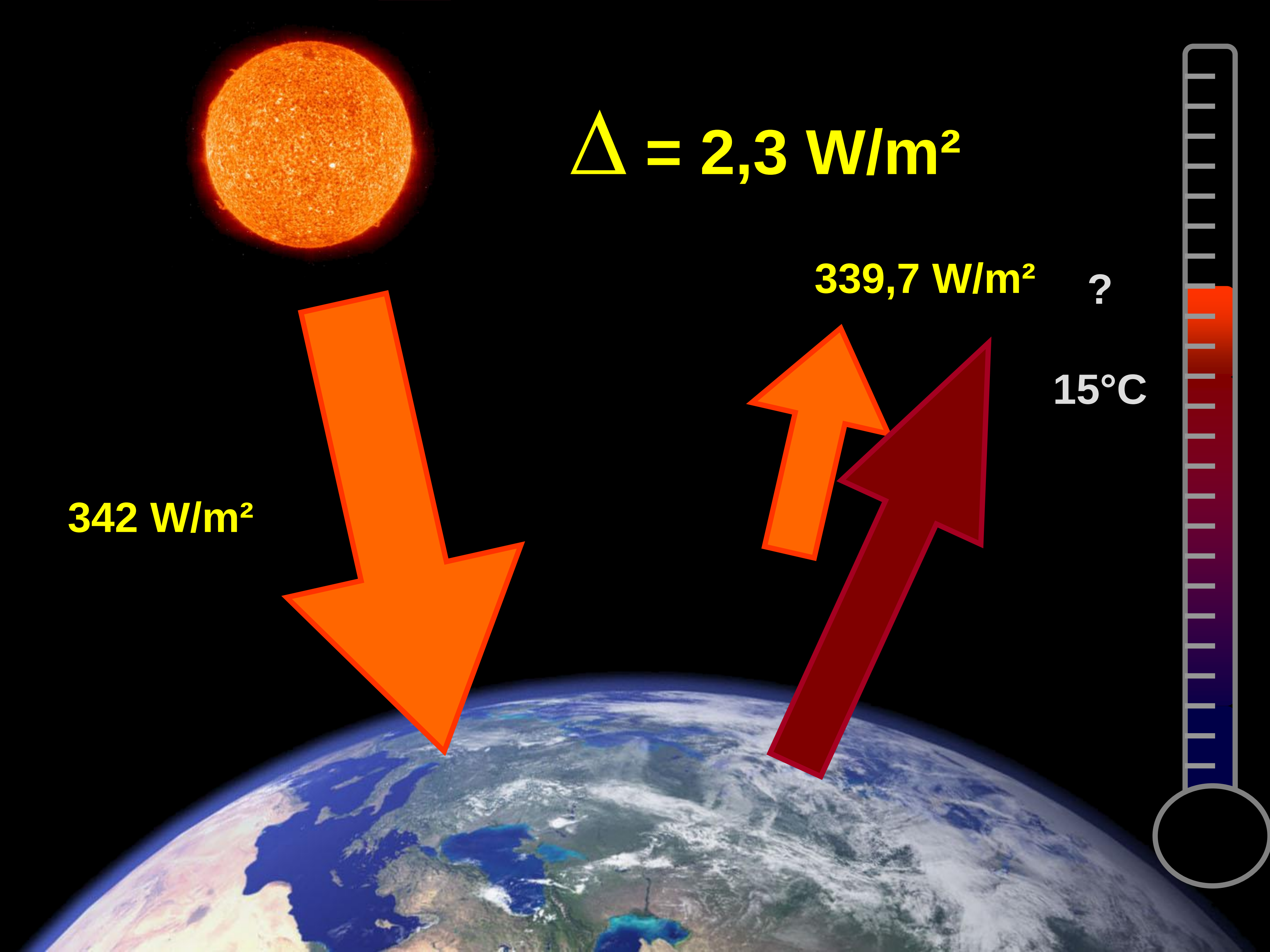
Mesures du CO_2 à Mauna Loa



Emissions naturelles et anthropiques

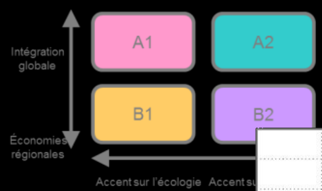



Rayonnement
infrarouge
Insolation
Effet de
Serre
Réflexion
15°C
-18°C

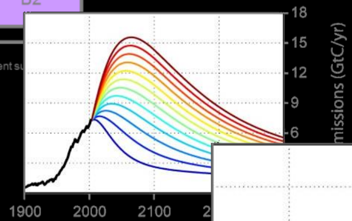


Δ = 2,3 W/m²
339,7 W/m²
?
15°C
342 W/m²

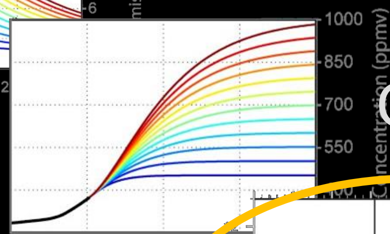
Scenarios and models



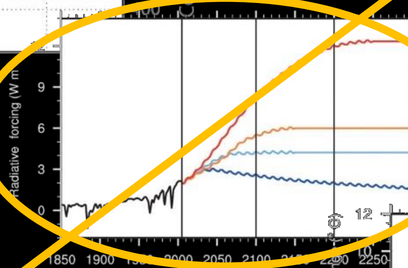
Scénarios



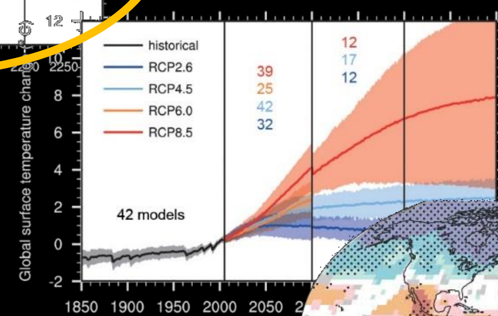
Emissions



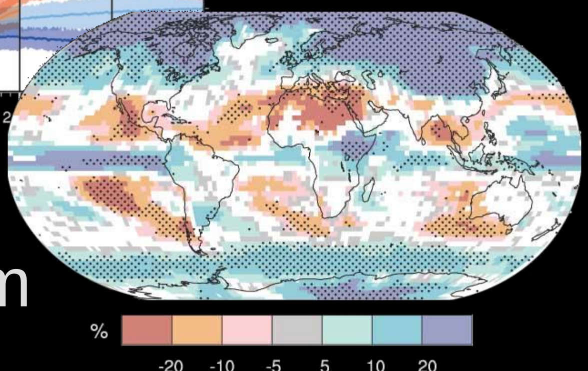
GHG Concentration



Radiative Forcing



Temperature



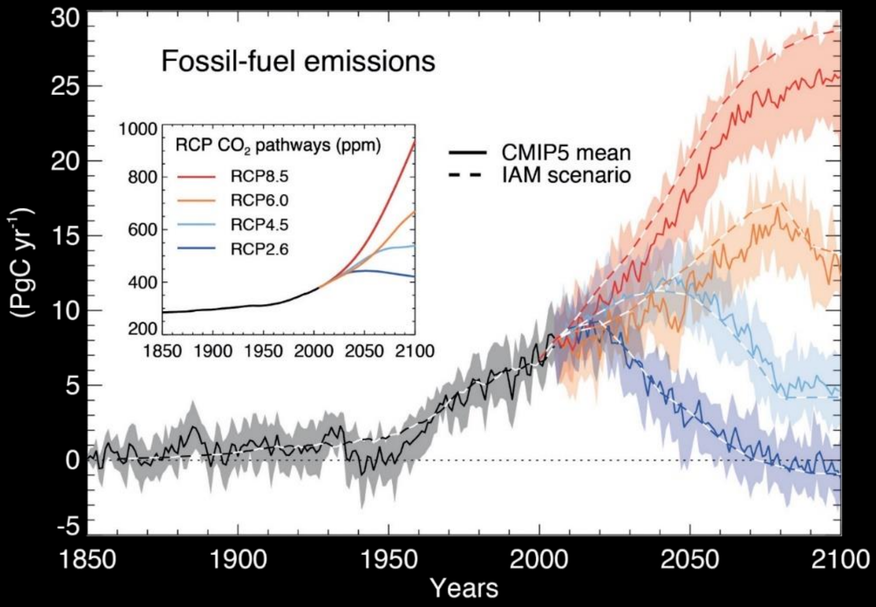
Representative
Concentration
Pathways

Consequences on Climate system

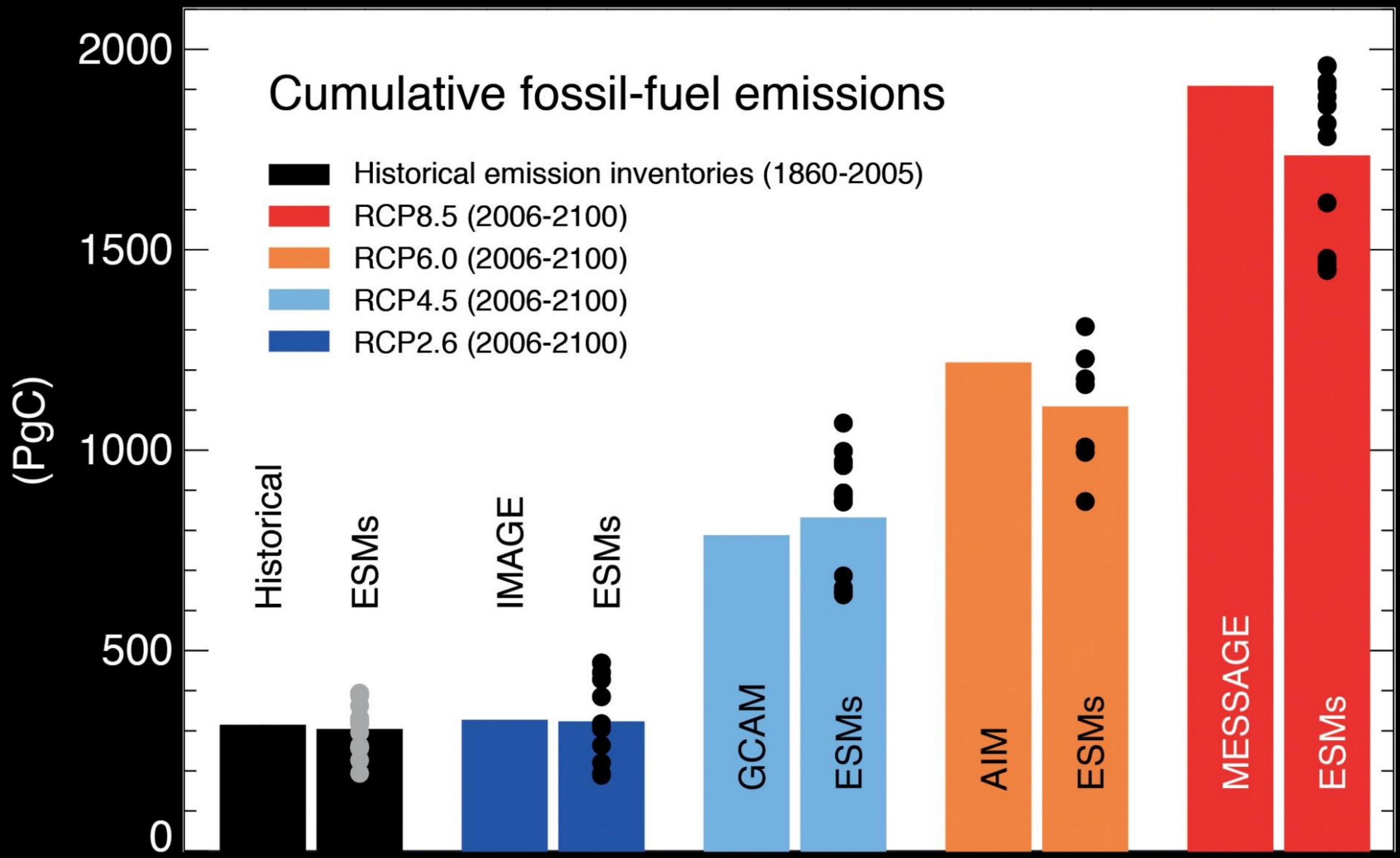
RCPs : Four scenario families

RCP are expressed in W/m² in 2100:

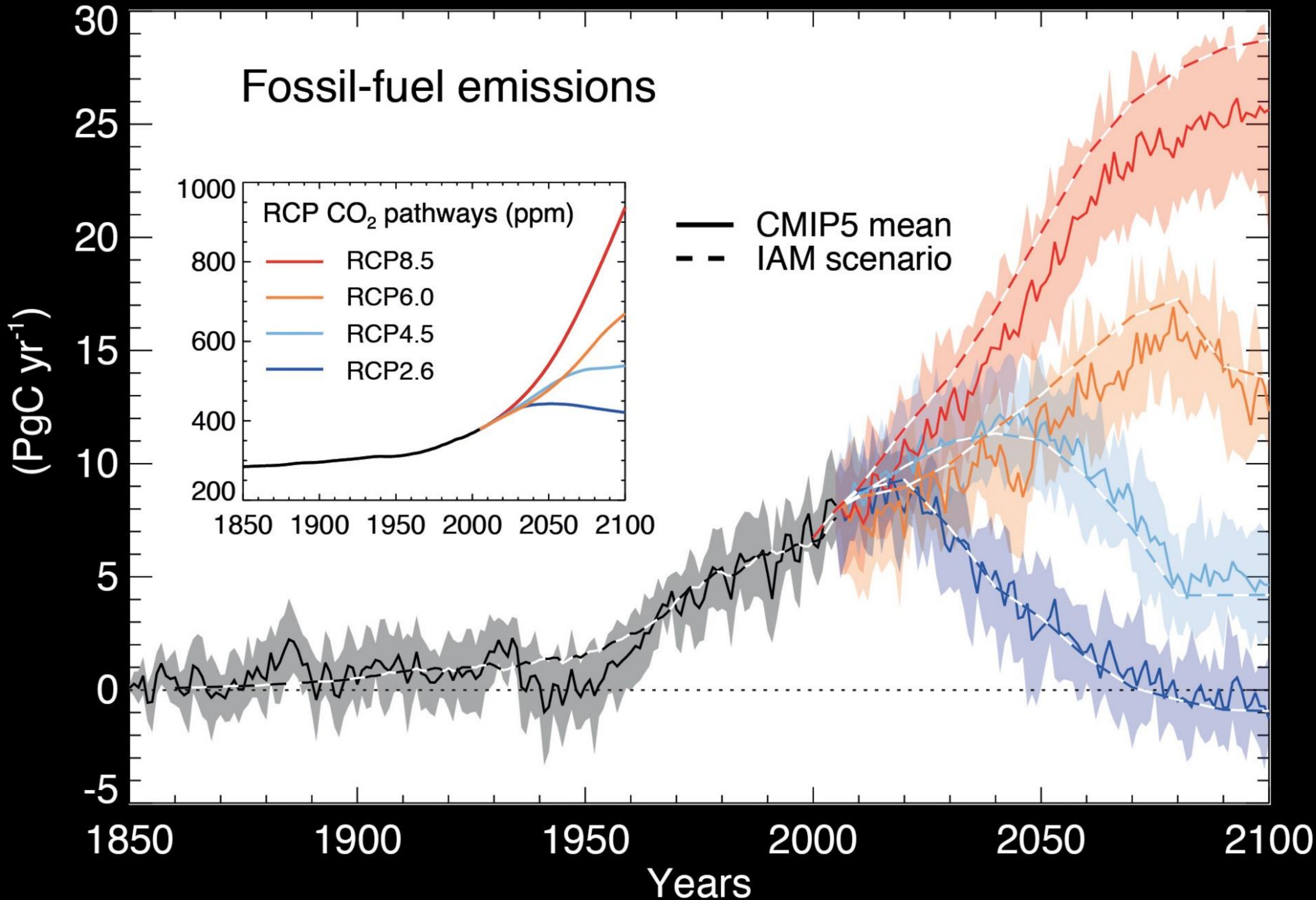
- RCP 2.6 (consistant with 2°C target)
- RCP 4.5
- RCP 6.0
- RCP 8.5 (FDM)



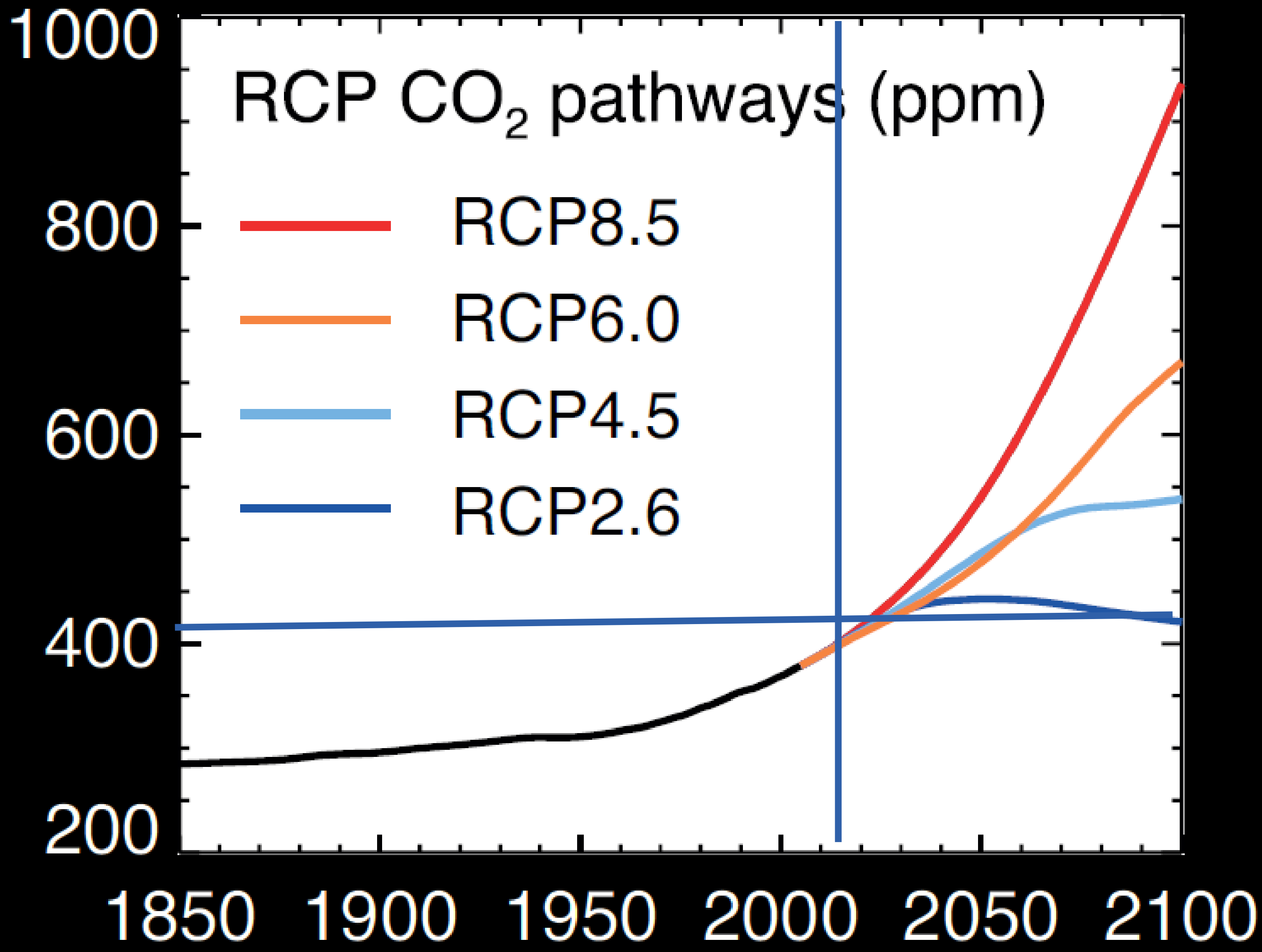
Fossil fuel emissions



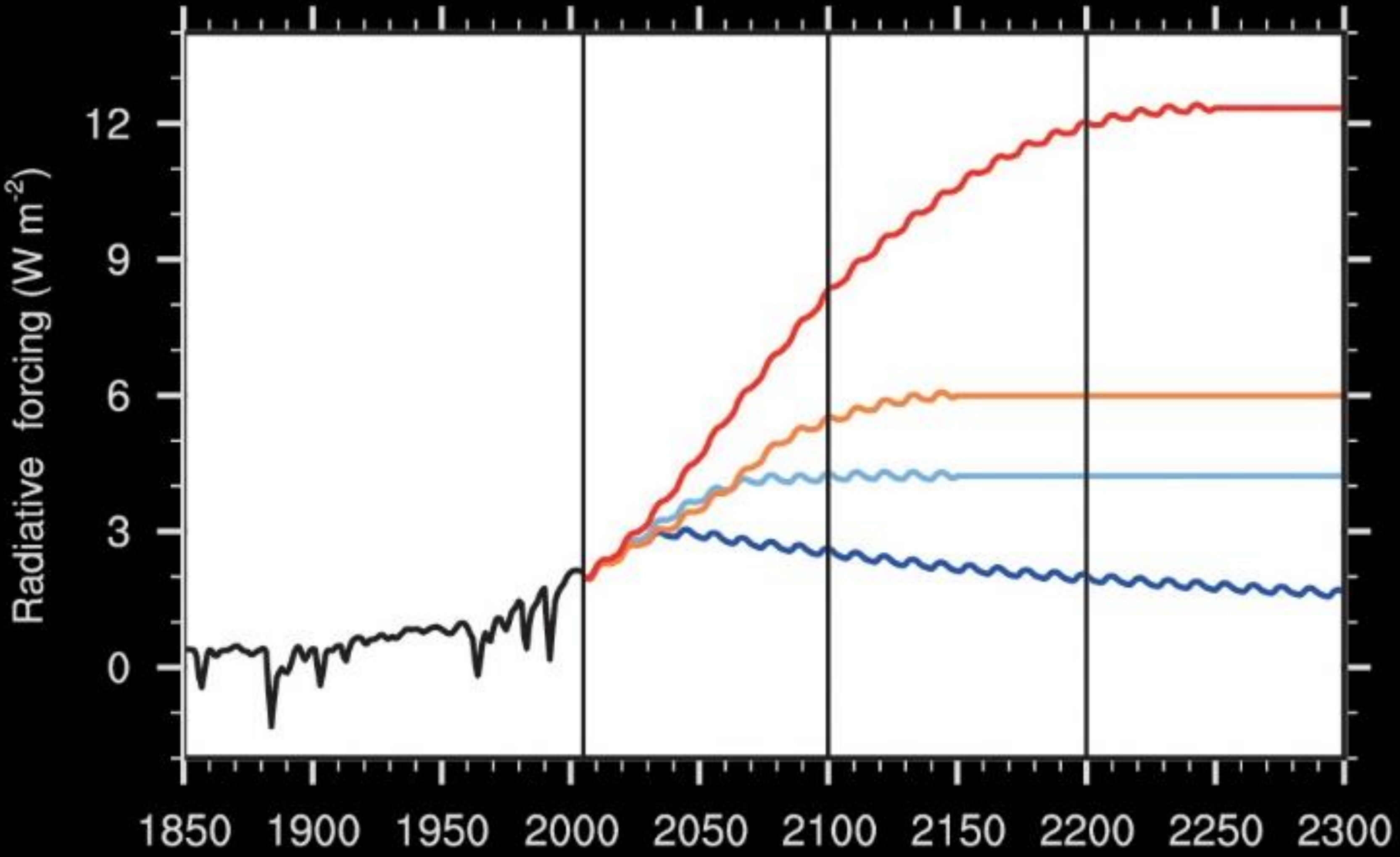
Fossil fuel emissions



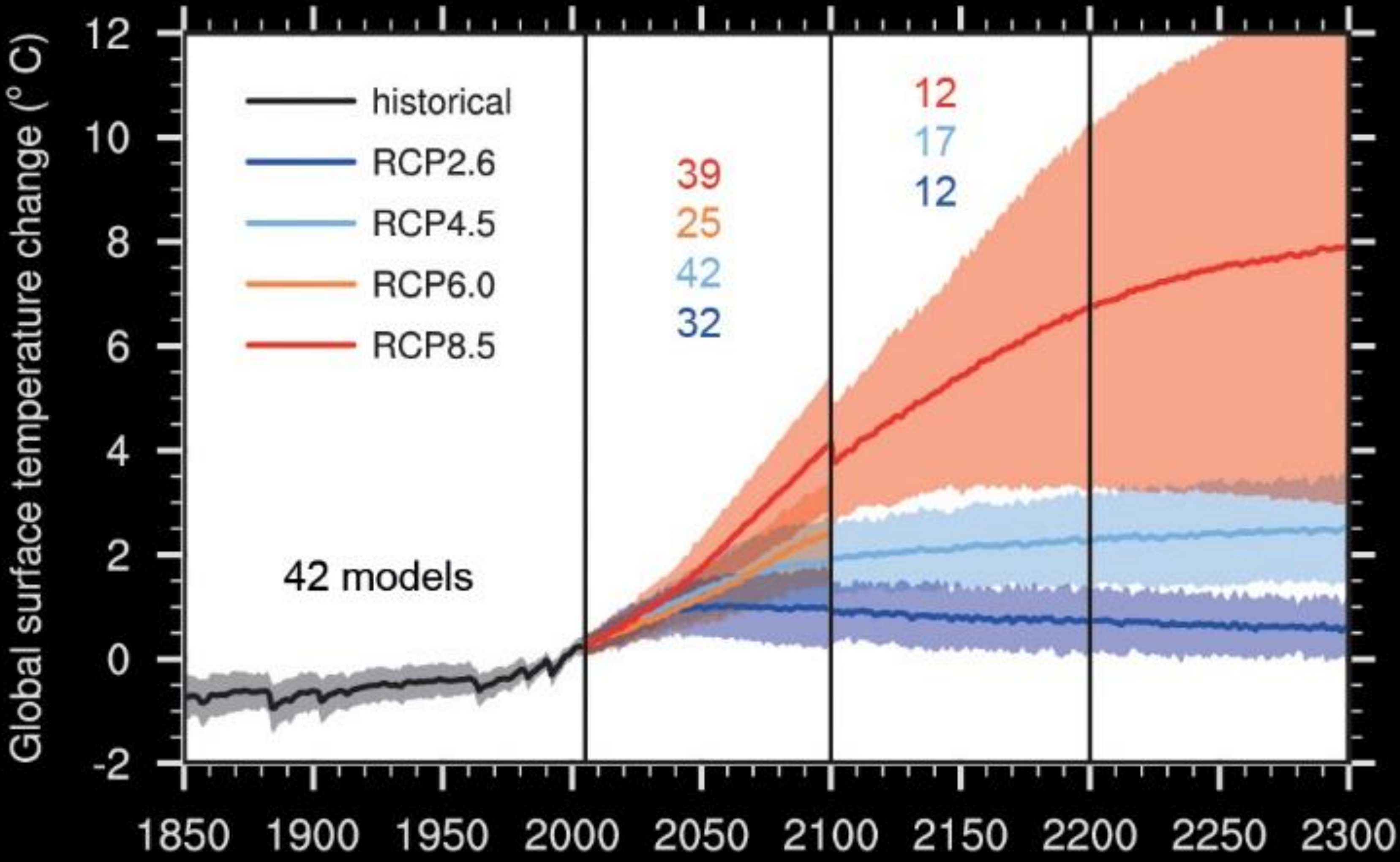
CO_2 Concentration



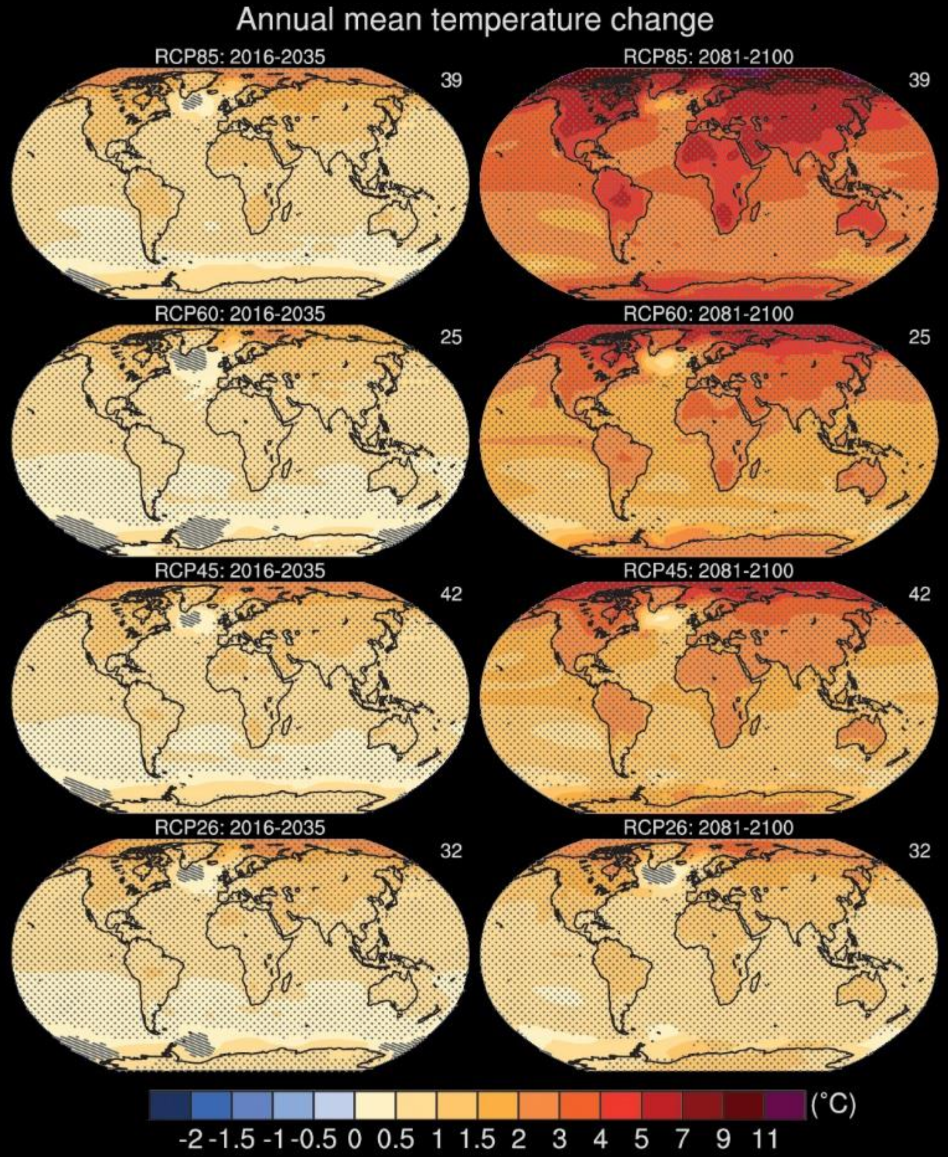
Radiative forcing projection



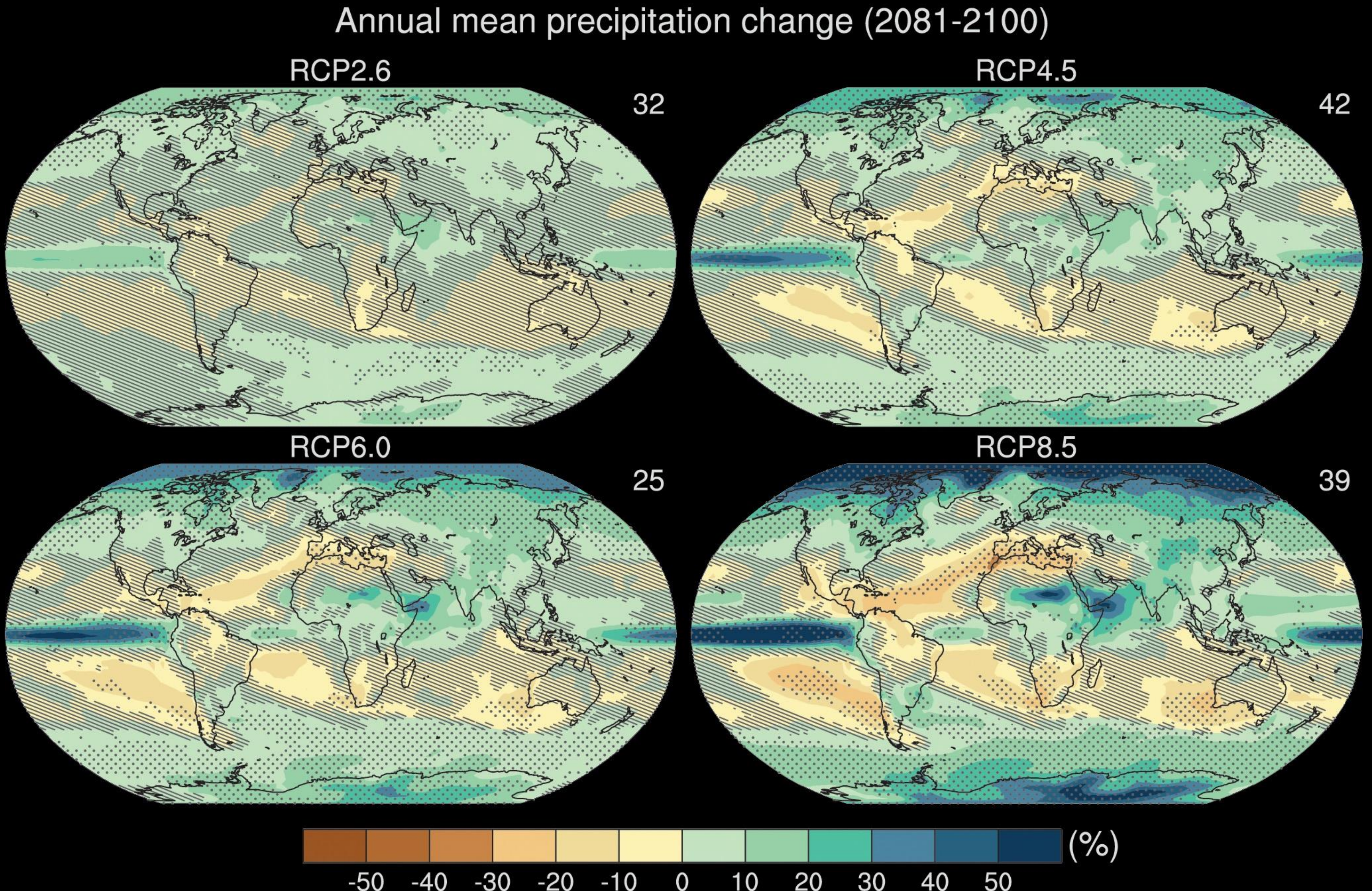
Surface temperature change



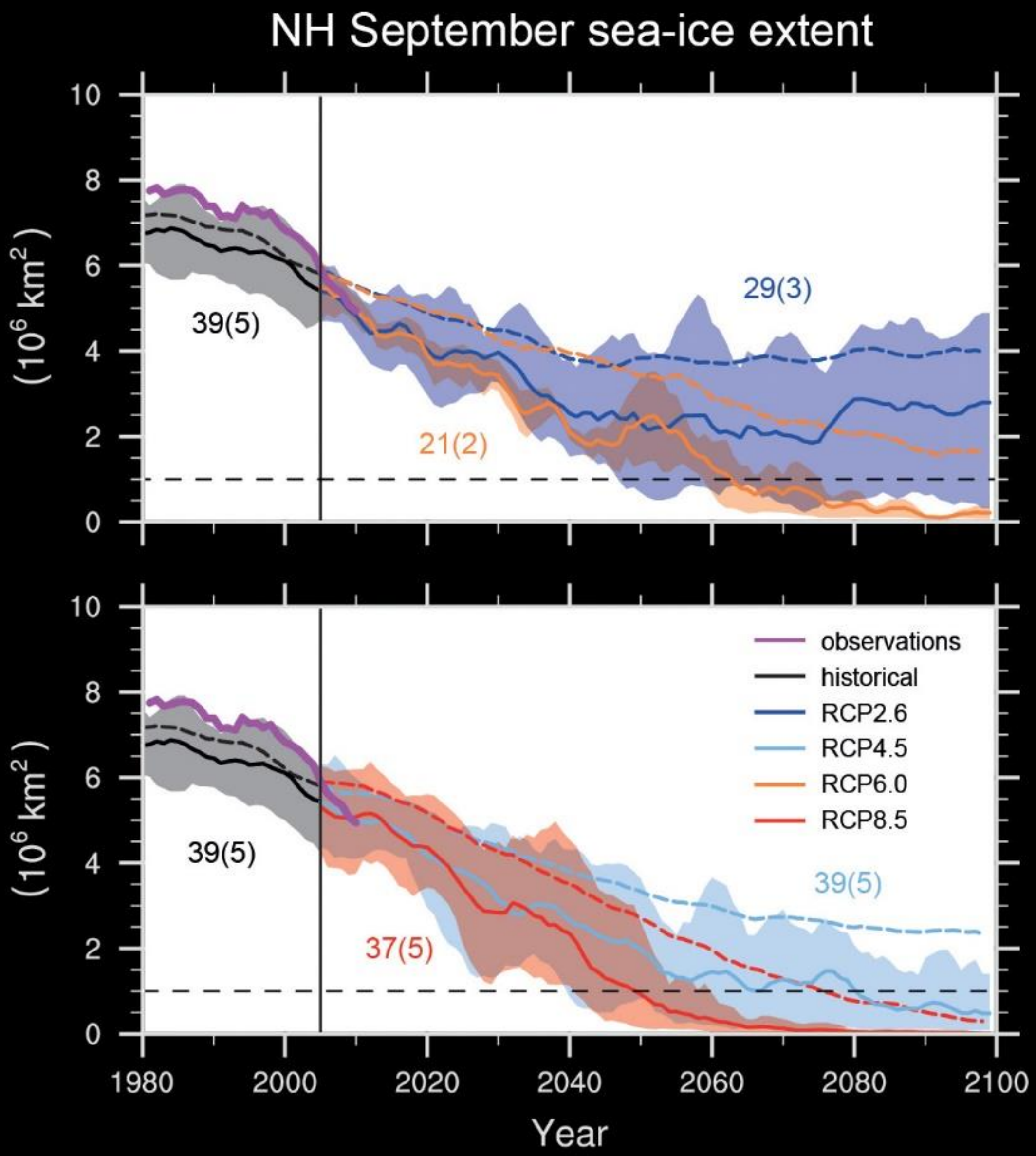
Temperature changes



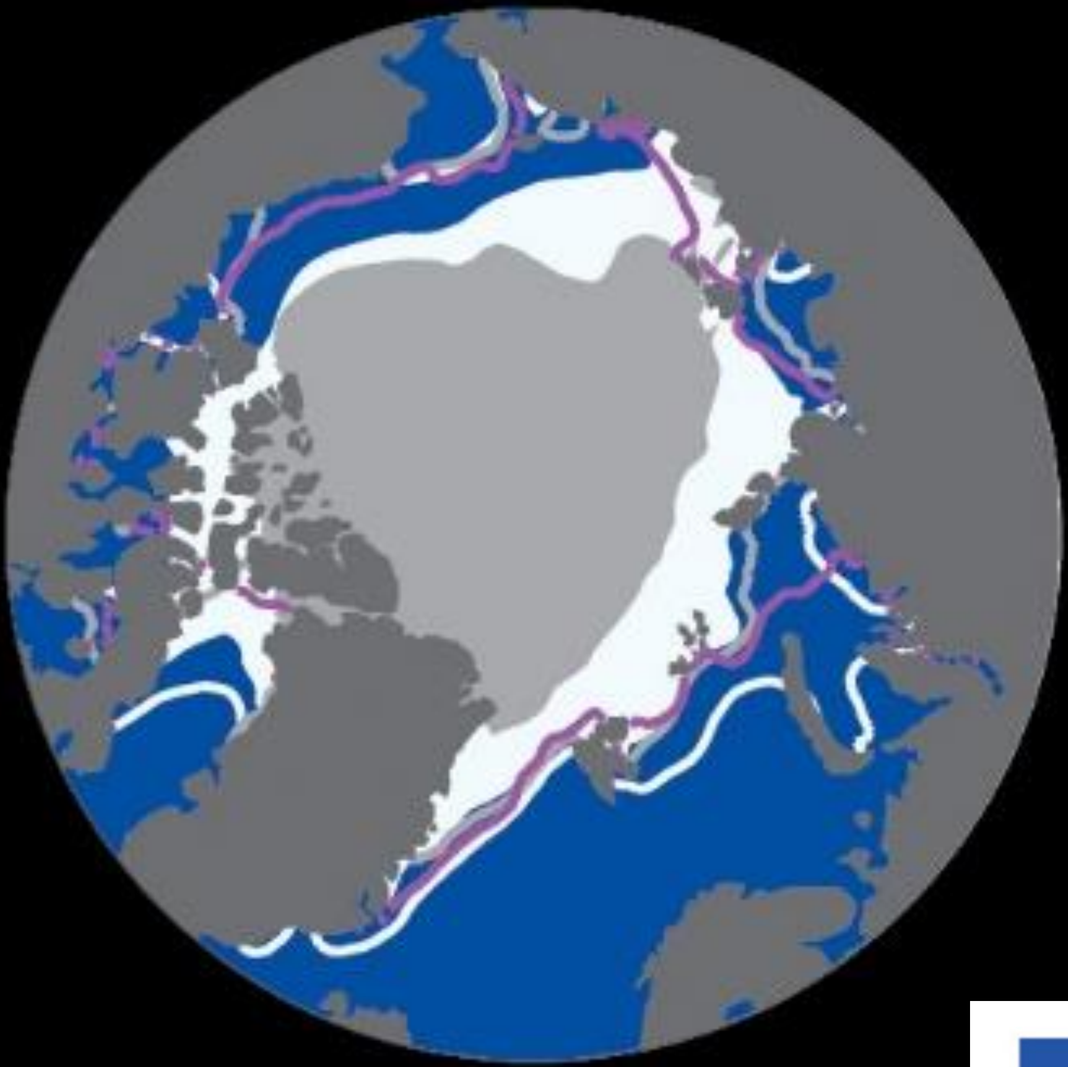
Precipitation changes



See ice extent

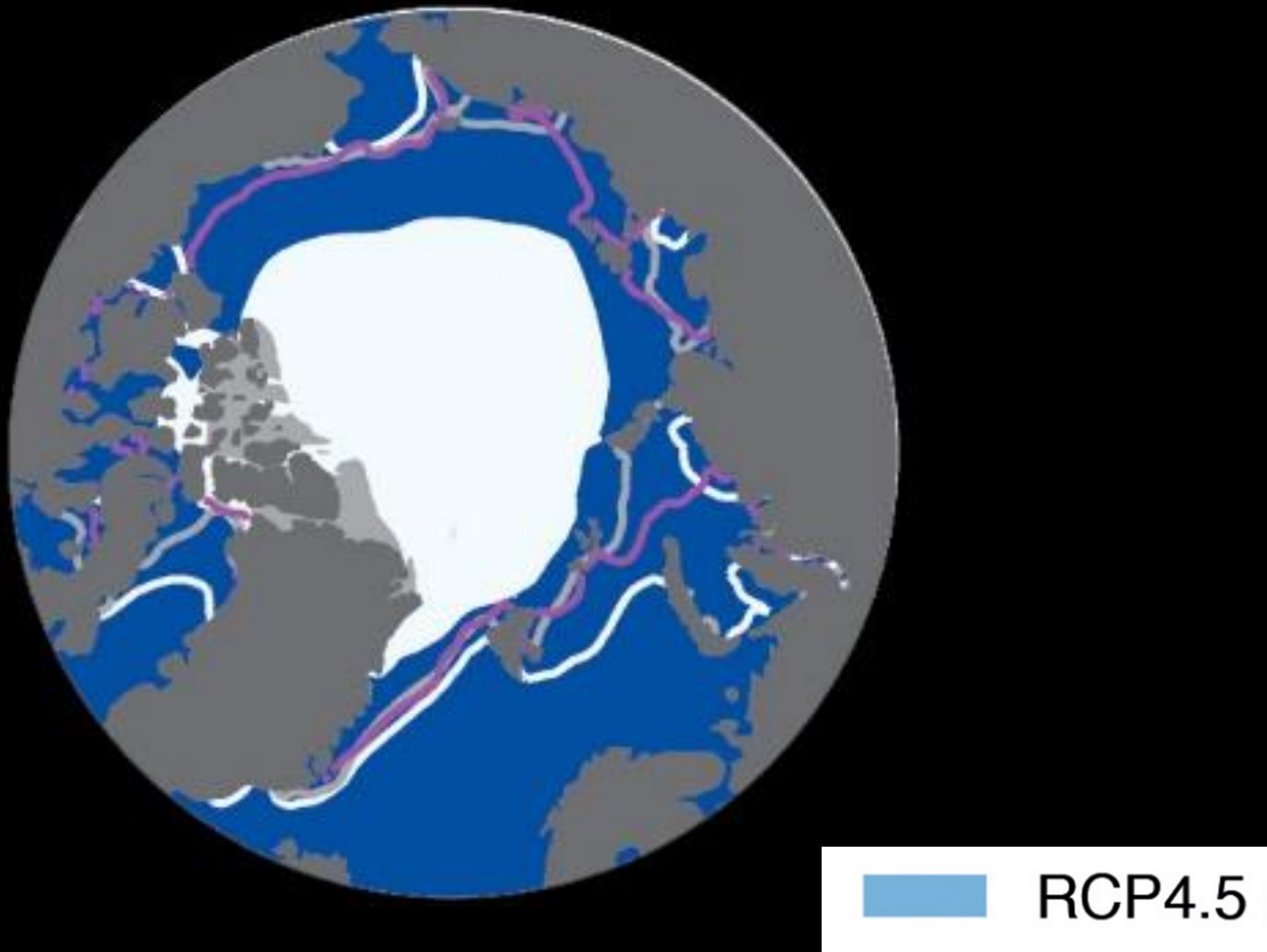


See ice extent RCP 2.6



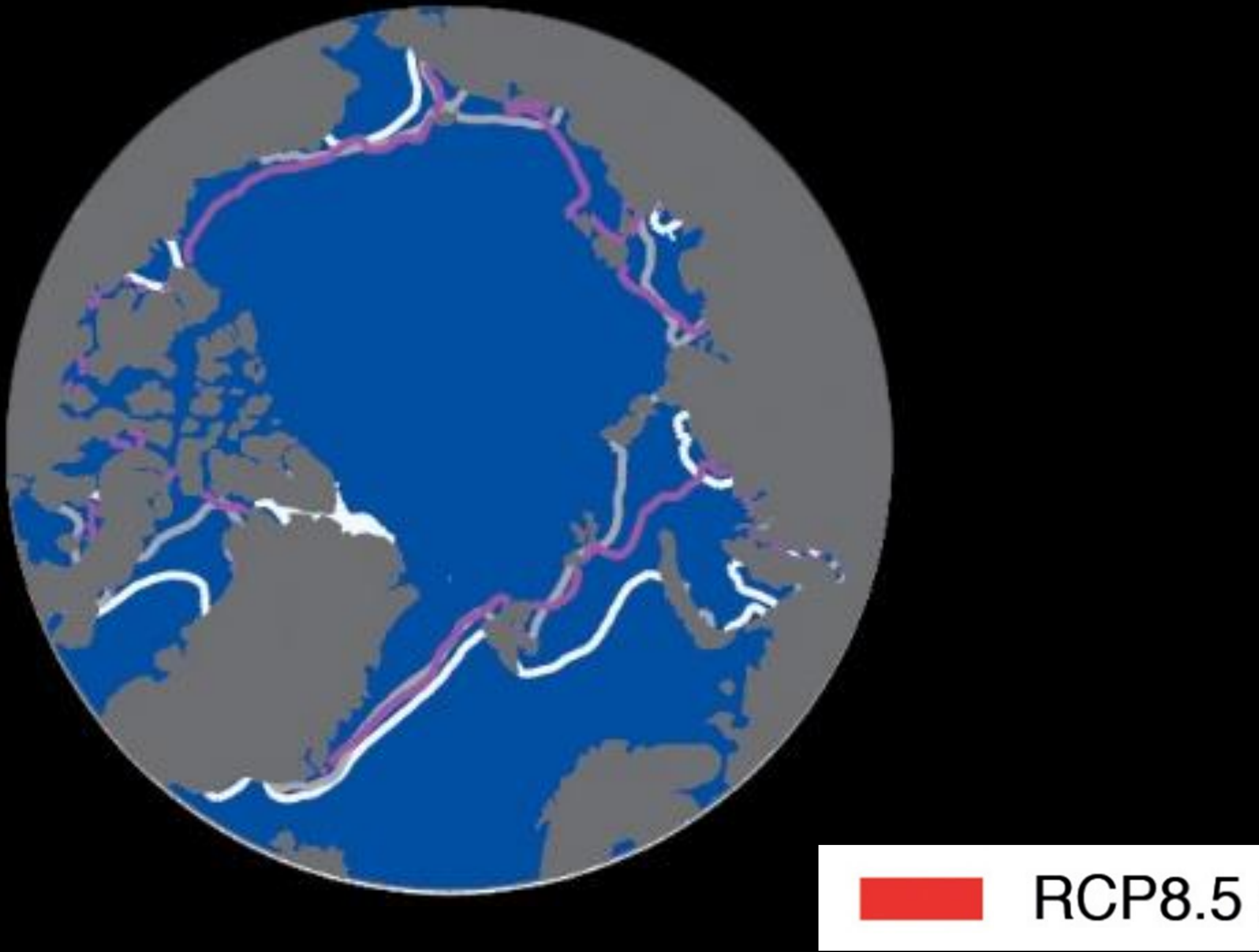
RCP2.6

See ice extent RCP 4.5

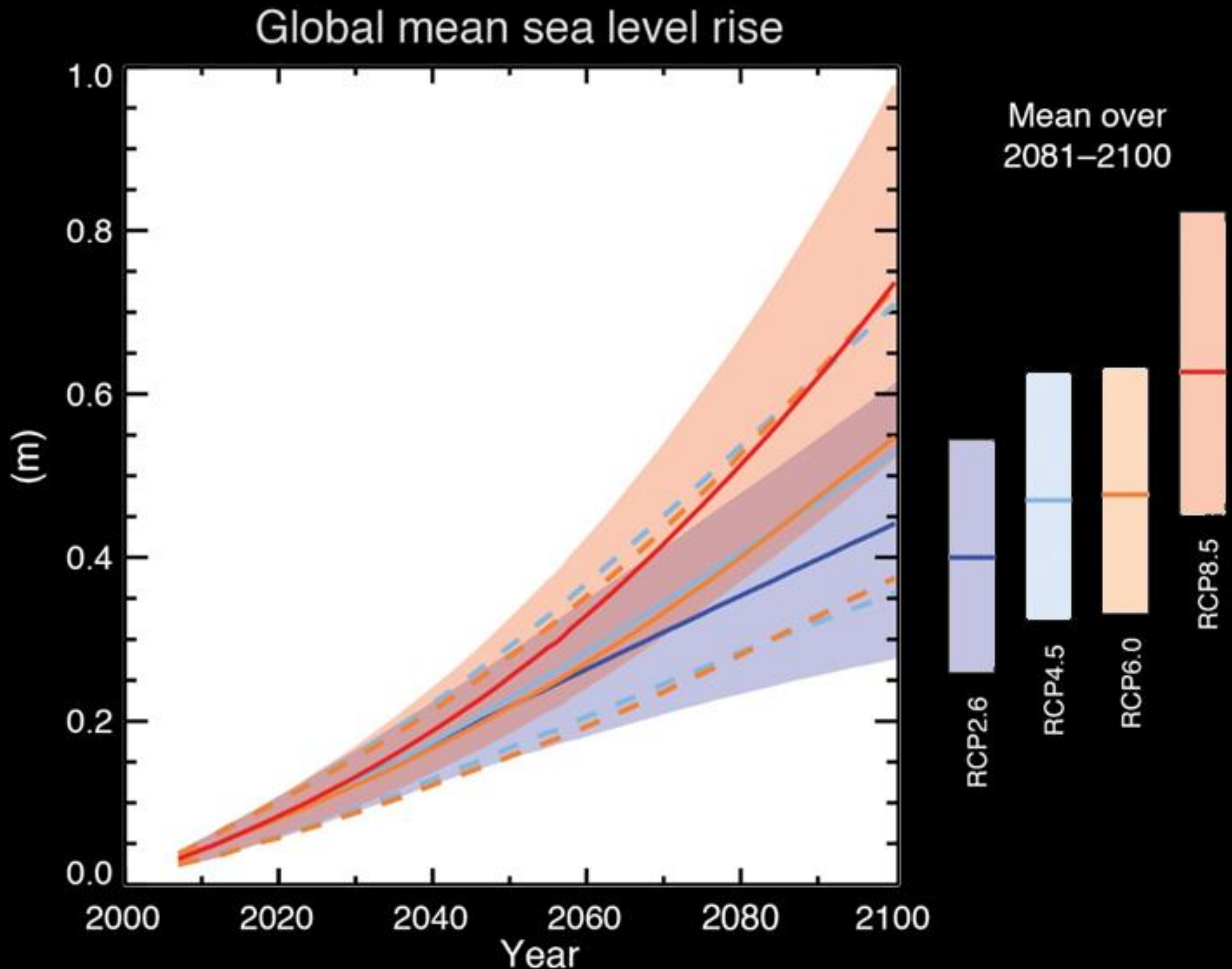


See ice extent RCP 6.0

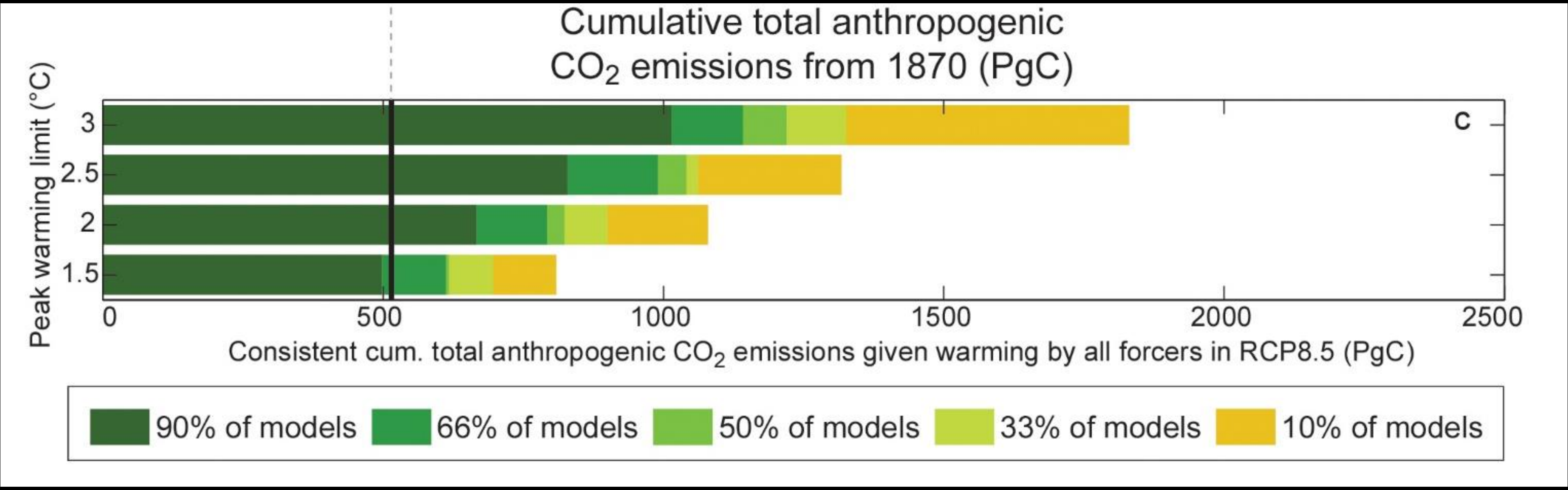
See ice extent RCP 8.5

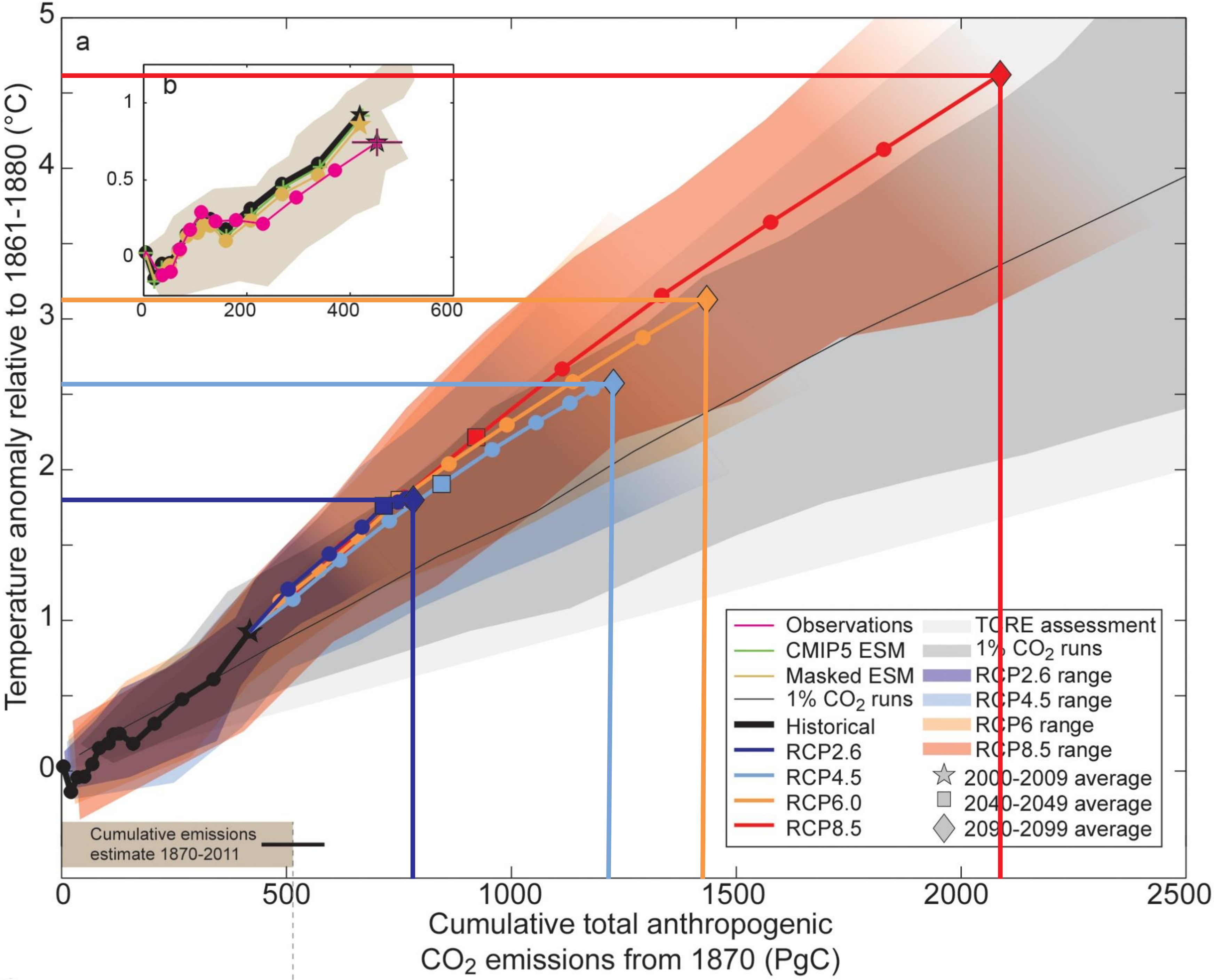


See level rise



Climate Targets and Stabilization

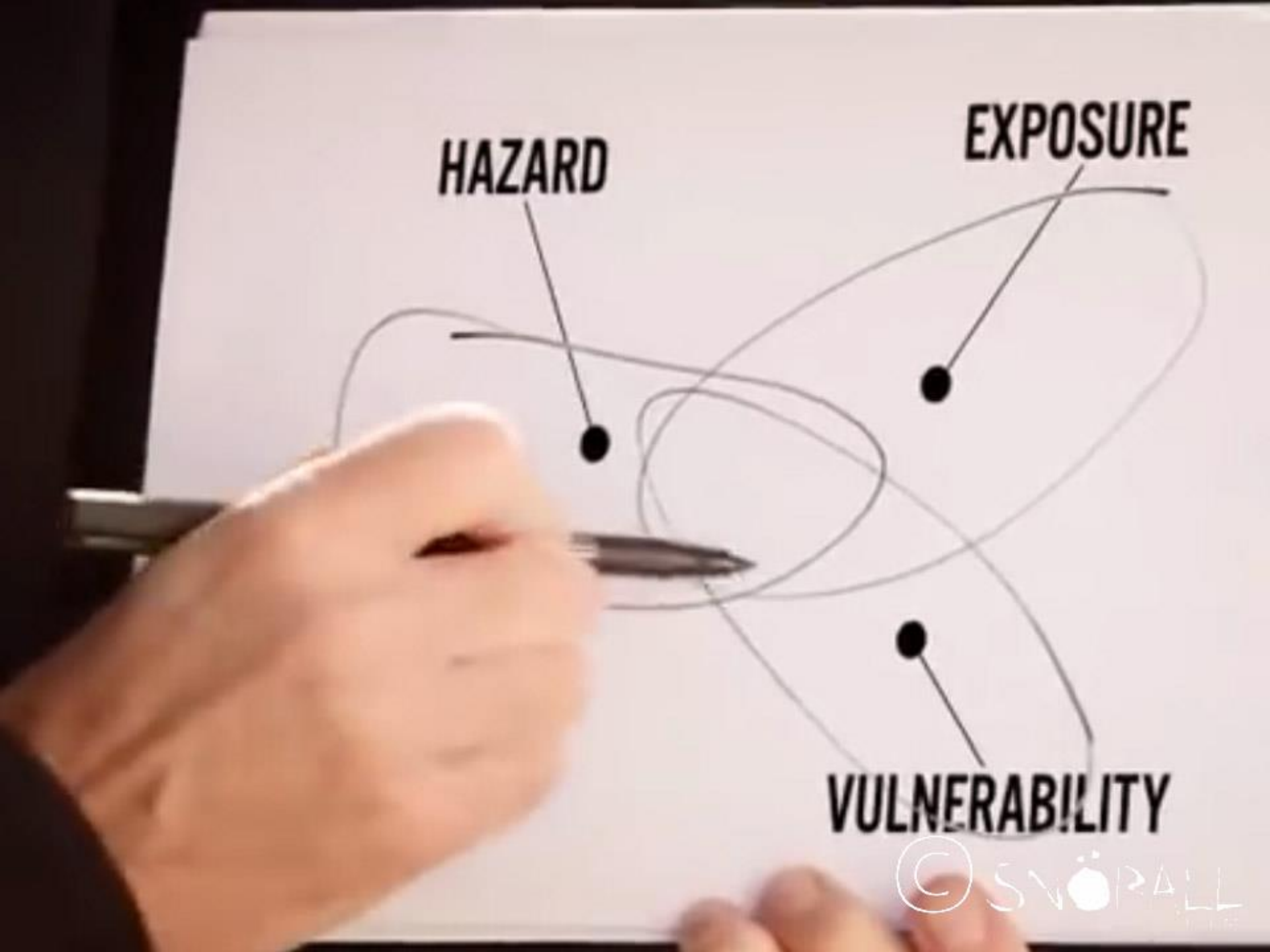



a
b
Temperature anomaly relative to 1861-1880 (°C)
Cumulative total anthropogenic
CO2 emissions from 1870 (PgC)
Observations
CMIP5 ESM
Masked ESM
1% CO2 runs
Historical
RCP2.6
RCP4.5
RCP6.0
RCP8.5
TCRE assessment
1% CO2 runs
RCP2.6 range
RCP4.5 range
RCP6 range
RCP8.5 range
2000-2009 average
2040-2049 average
2090-2099 average
Cumulative emissions
estimate 1870-2011


Model simulations tell us:
“we have a choice.”

WGII :

Impacts, Adaptation and Vulnerability


HAZARD
EXPOSURE
VULNERABILITY

Victorian heat wave (2009)

- more than 300 excess deaths…
- …while intense bushfires destroyed over 2,000 buildings and led to 173 deaths.

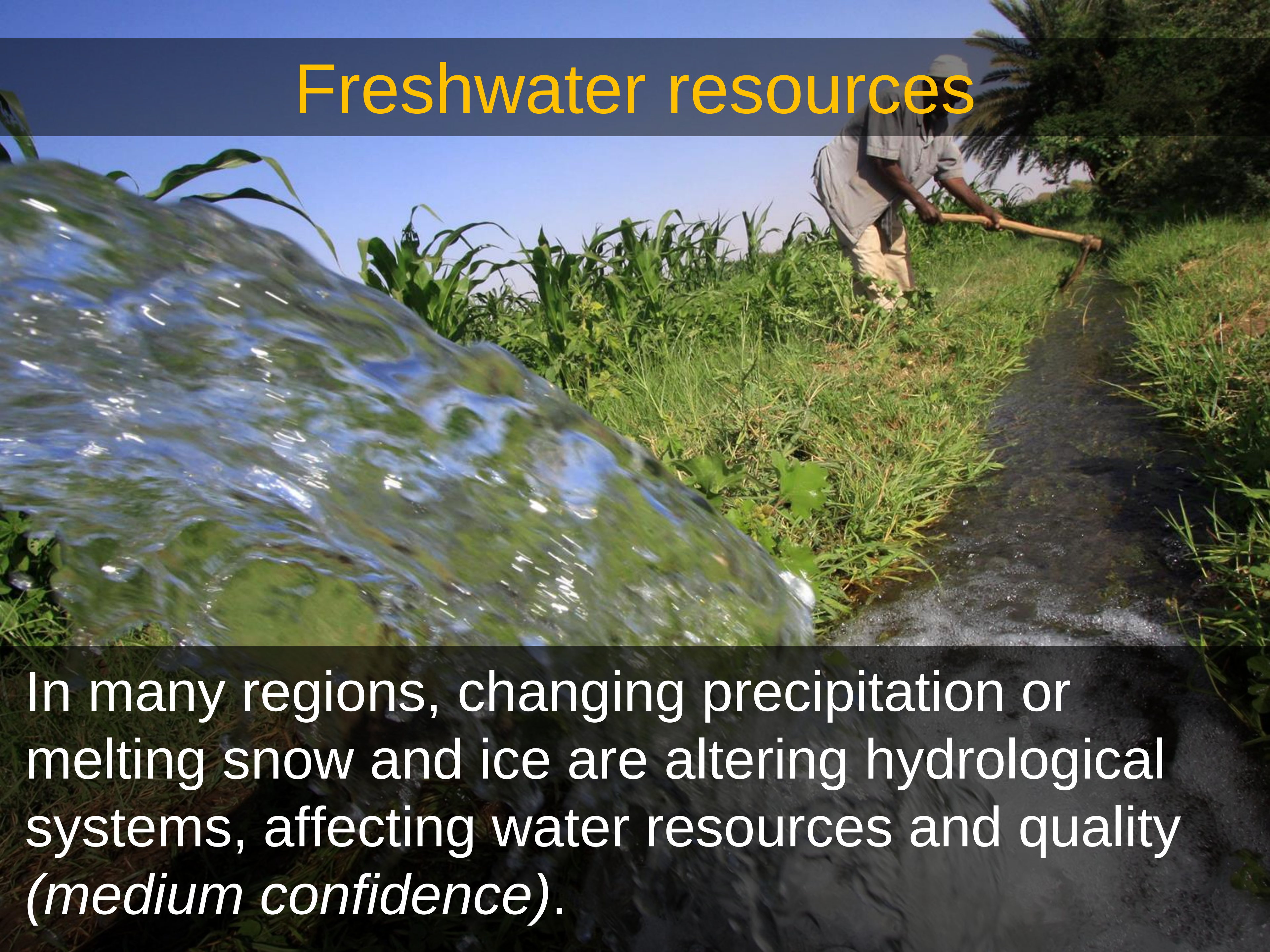
Summer 2003

- 2003 has been the hottest summer in Western and Central Europe in at least 500 years
- Consequences:
  - Damage to road and rail transport systems;
  - Reduced/interrupted operation of nuclear power plants (mostly in France);
  - High transport prices in Rhine due to low water levels;
  - Grain harvest losses of 20%;
  - 35,000 deaths in August in Central and Western Europe;
  - Decline in water quality;
  - High outdoor pollution levels.

Spring 2011

- 2011 was the hottest and driest spring in France since 1880
- This has caused :
  - Reduction in snow cover for skiing
  - 8% decline in wheat yield (AGRESTE, 2011)

Freshwater resources



In many regions, changing precipitation or melting snow and ice are altering hydrological systems, affecting water resources and quality *(medium confidence)*.

Droughts

In presently dry regions, drought frequency will *likely* increase by the end of this century under RCP 8.5 *(medium confidence)*.

Terrestrial and freshwater ecosystems

Substantial droughts and heat waves have induced tree mortality.

Terrestrial and freshwater ecosystems

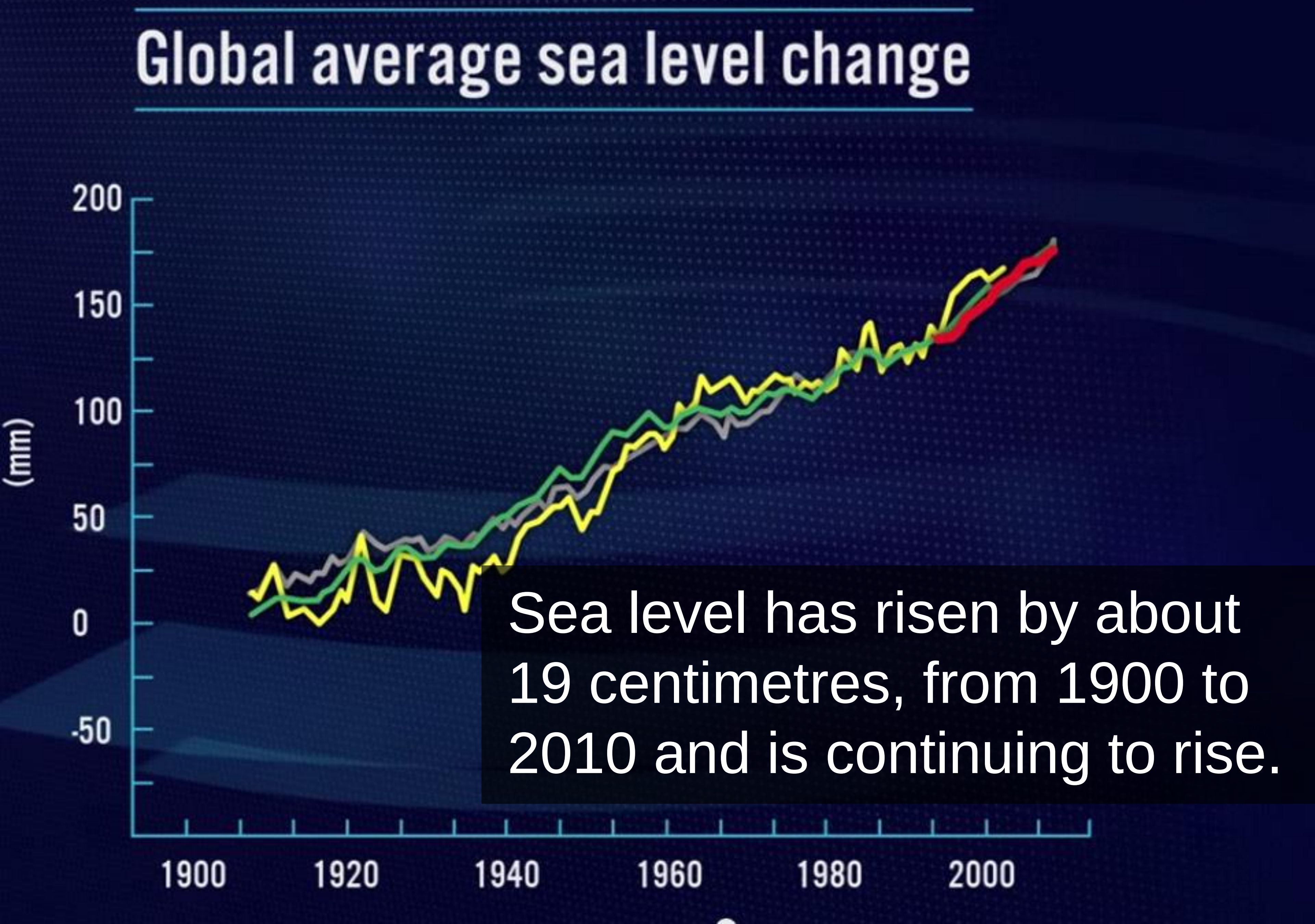
Many terrestrial plant and animal species have shifted their ranges and seasonal activities and altered their abundance in response to past climate change, and they are doing so now in many regions *(high confidence)*.

Coastal systems and low-lying areas

Due to sea-level rise coastal systems and low-lying areas will increasingly experience adverse impacts such as submergence, coastal flooding, and coastal erosion *(very high confidence)*.

Tuvalu - Crédit Photo : www.celysvet.cz

Sea level rise



Sea level has risen by about 19 centimetres, from 1900 to 2010 and is continuing to rise.

Coastal flooding

Due to sea-level rise throughout the 21st century and beyond, coastal systems and low-lying areas will increasingly experience adverse impacts such as submergence, coastal flooding, and coastal erosion *(very high confidence)*.

New York

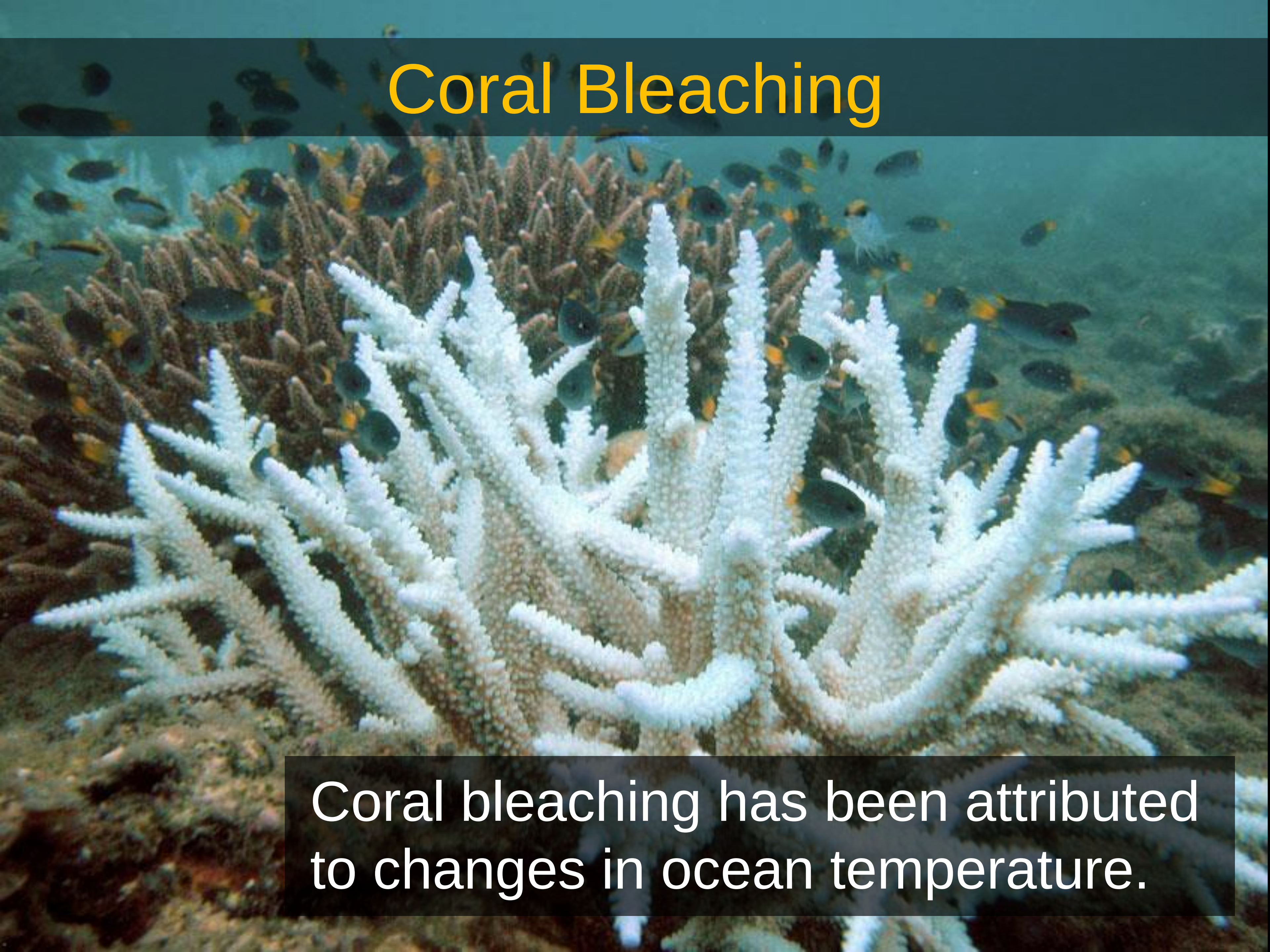

Londres

Shanghai

Tokyo


ALTA VISION
STUDIO ALTA
MITSUBISHI
MIZUHO
MIZUHO
UCカード
NOVA
STUDIO ALTA


Inland flooding

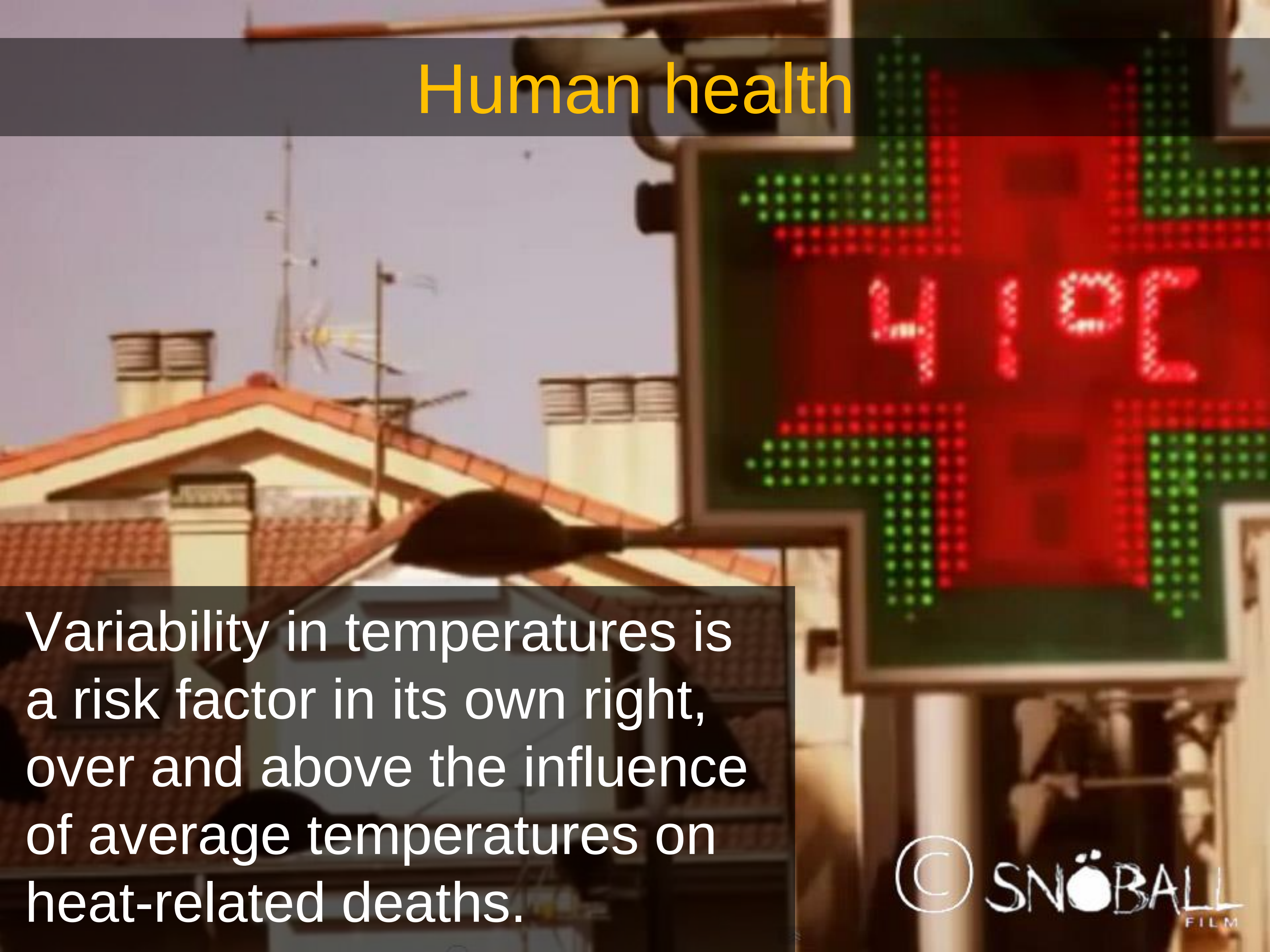

Coral Bleaching
Coral bleaching has been attributed to changes in ocean temperature.

Food production

Negative impacts of climate change on crop and terrestrial food production have been more common than positive impacts, which are evident in some high-latitude regions *(high confidence)*.

Urban areas

Rapid urbanization and growth of large cities in low- and middle-income countries have been accompanied by expansion of highly vulnerable urban communities living in informal settlements, many of which are on land exposed to extreme weather *(medium confidence)*.



Human health

Variability in temperatures is a risk factor in its own right, over and above the influence of average temperatures on heat-related deaths.

Tiger mosquito

Tiger Mosquito is a vector for the transmission of Yellow fever, Dengue fever, Paludism and Chikungunya. It is has recently settled in France.

Livelihoods and poverty

Climate-related hazards constitute an additional burden to people living in poverty, acting as a threat multiplier often with negative outcomes for livelihoods *(high confidence)*.

Livelihoods and poverty

Livelihoods of indigenous peoples in the Arctic have been altered by climate change, through impacts on food security and traditional and cultural values *(medium confidence)*.

Que signifie +4°C ?

- 5°C

Aujourd'hui

+ 4°C

WGIII :

Mitigation of Climate Change

WGIII

WGIII is about the direction Humanity is about to choose

A global issue

Need for cooperation

- Climate change is a global commons problem that implies the need for international cooperation in tandem with local, national, and regional policies on many distinct matters.
- International cooperation on climate change involves ethical considerations, including equitable effort-sharing.

Evaluation of mitigation options requires taking into account many different interests, perspectives, and challenges between and within societies.

Winners and losers

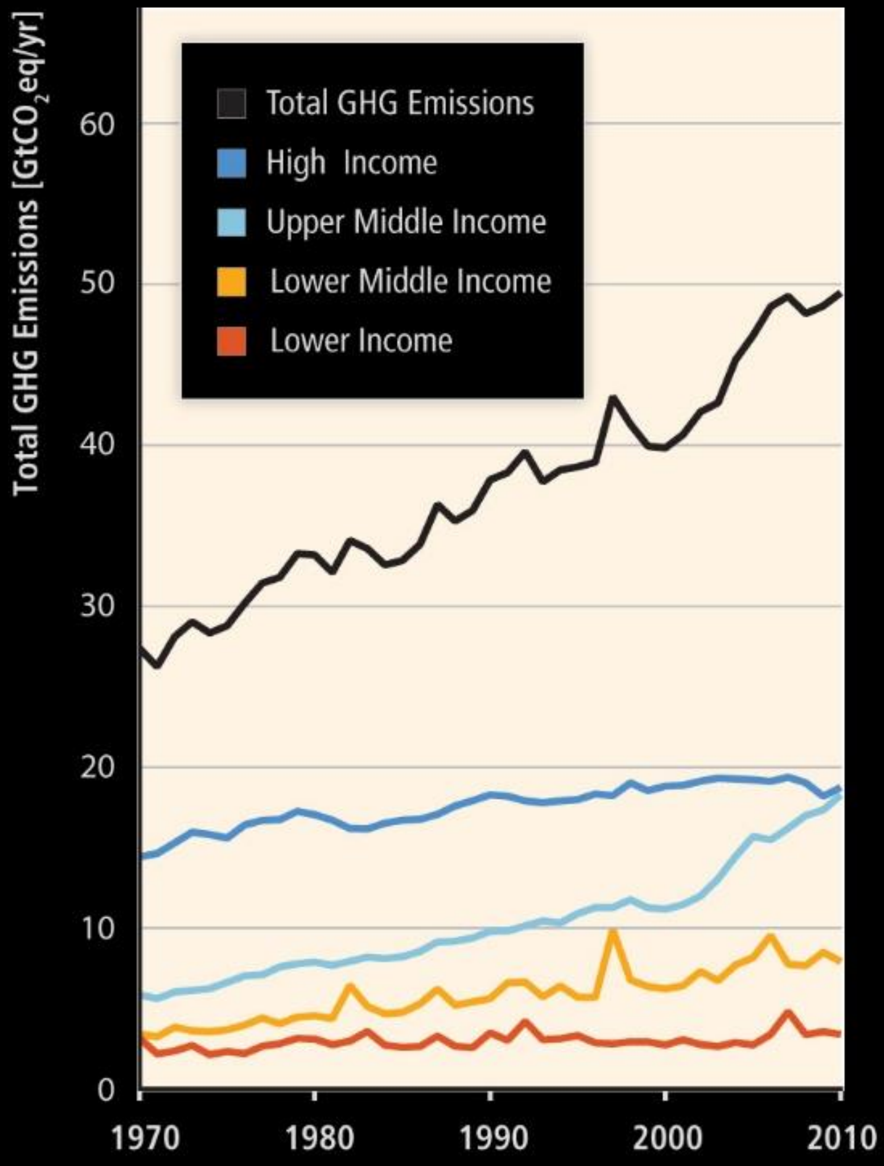
- Any approach has potential winners and losers.
  - The political feasibility of that approach will depend strongly on the distribution of power, resources, and decision-making authority among the potential winners and losers.
  - In a world characterized by profound disparities, procedurally equitable systems of engagement, decision making and governance may help enable a polity to come to equitable solutions to the sustainable development challenge.

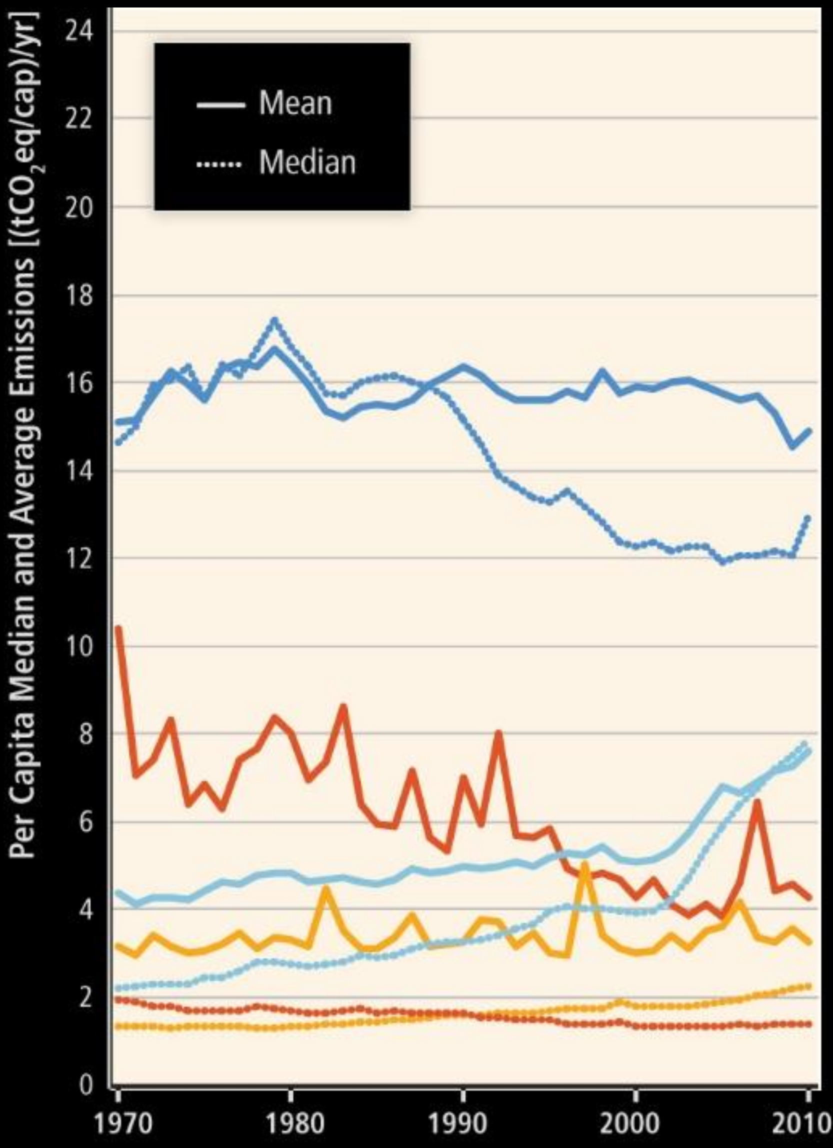
Global CO_2 and GHG emissions

• CO_2 from energy:	30 $GtCO_2$	9 GtC
• + deforestation:	36 $GtCO_2$	10 GtC
• + other GHG:	50 $GtCO_2$	13 GtC

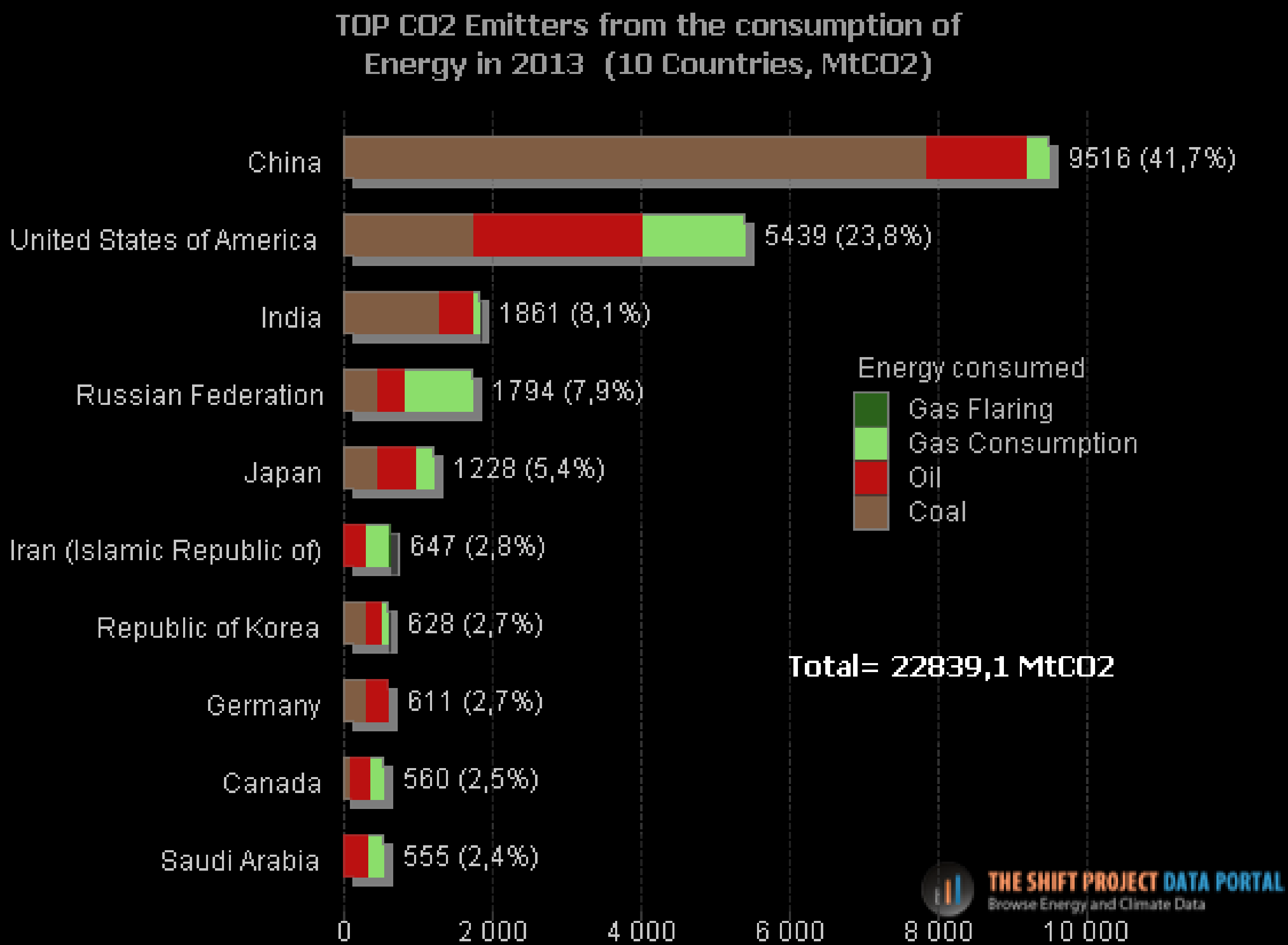
(in 2010)

Emission are highly unequal





10 countries account for 70% of CO2



Economic Growth in Assessed Scenarios

"Assumptions about economic growth range from threefold to eightfold growth in per capita income by 2100."

=> In IPCC assessed scenarios, growth is always positive !

Repères de dates

- Les conséquences du CC (augmentation de la T°, du niveau de l'eau) sont exprimées en 2100 et par rapport à l'ère préindustrielle.

- Les objectifs d'atténuation (réductions de CO_2) sont exprimés pour 2050 et (en général) par rapport à 1990.

Mitigation will take place in the South

- In order to reach atmospheric concentration levels of 430 to 530 ppm CO_2eq by 2100, the majority of mitigation relative to baseline emissions over the course of century will occur in the non-OECD countries *(high confidence)*.
- This is to “attempt to cost-effectively allocate emissions reductions across countries and over time”.
- In these scenarios, emissions peak earlier in the OECD countries than in the non-OECD countries.

Effort sharing

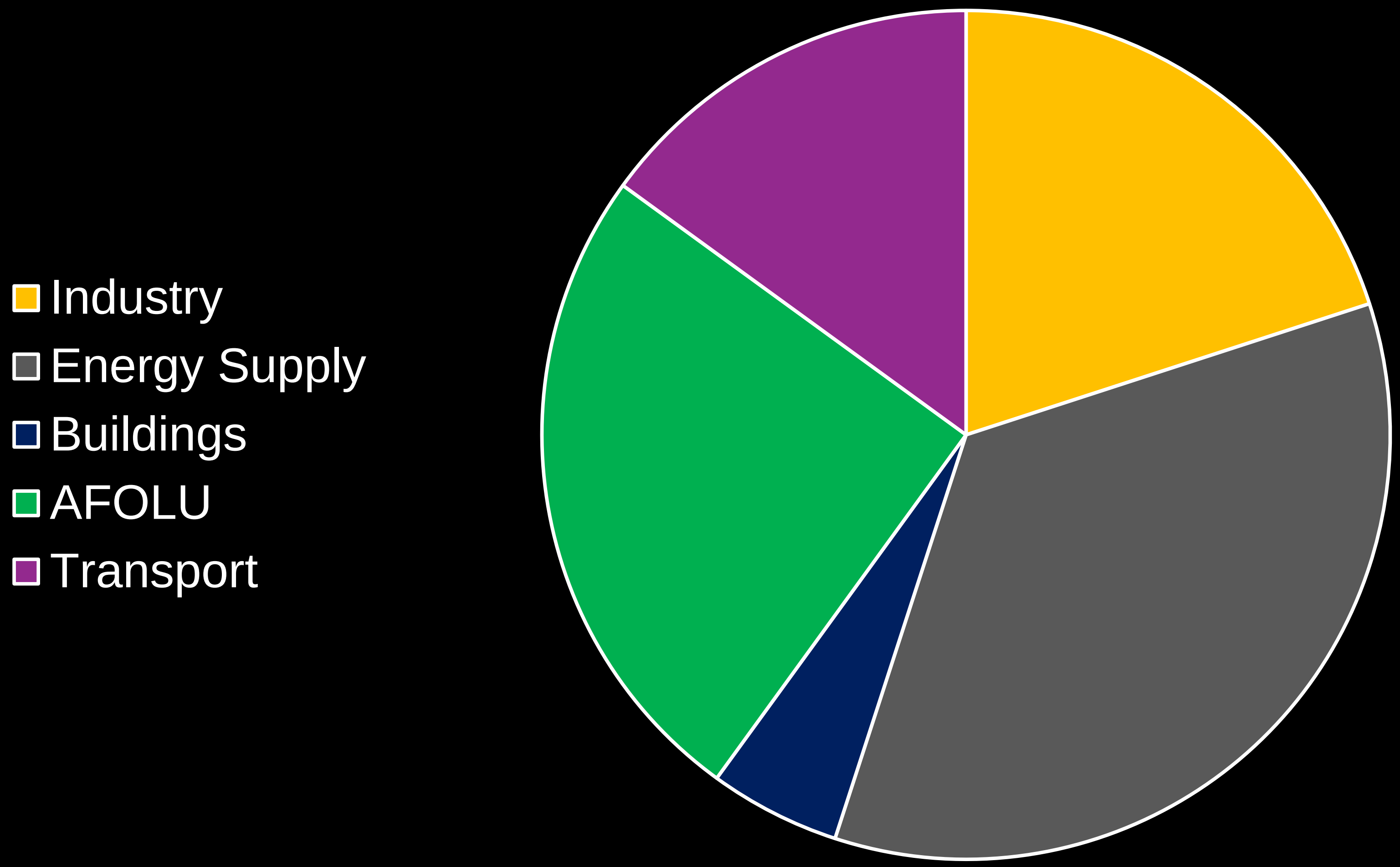
- The majority of mitigation investments over the course of century will occur in the non-OECD countries.
- The financial transfers to ameliorate this asymmetry could be in the order of hundred billions of USD per year before mid-century.

Now or never

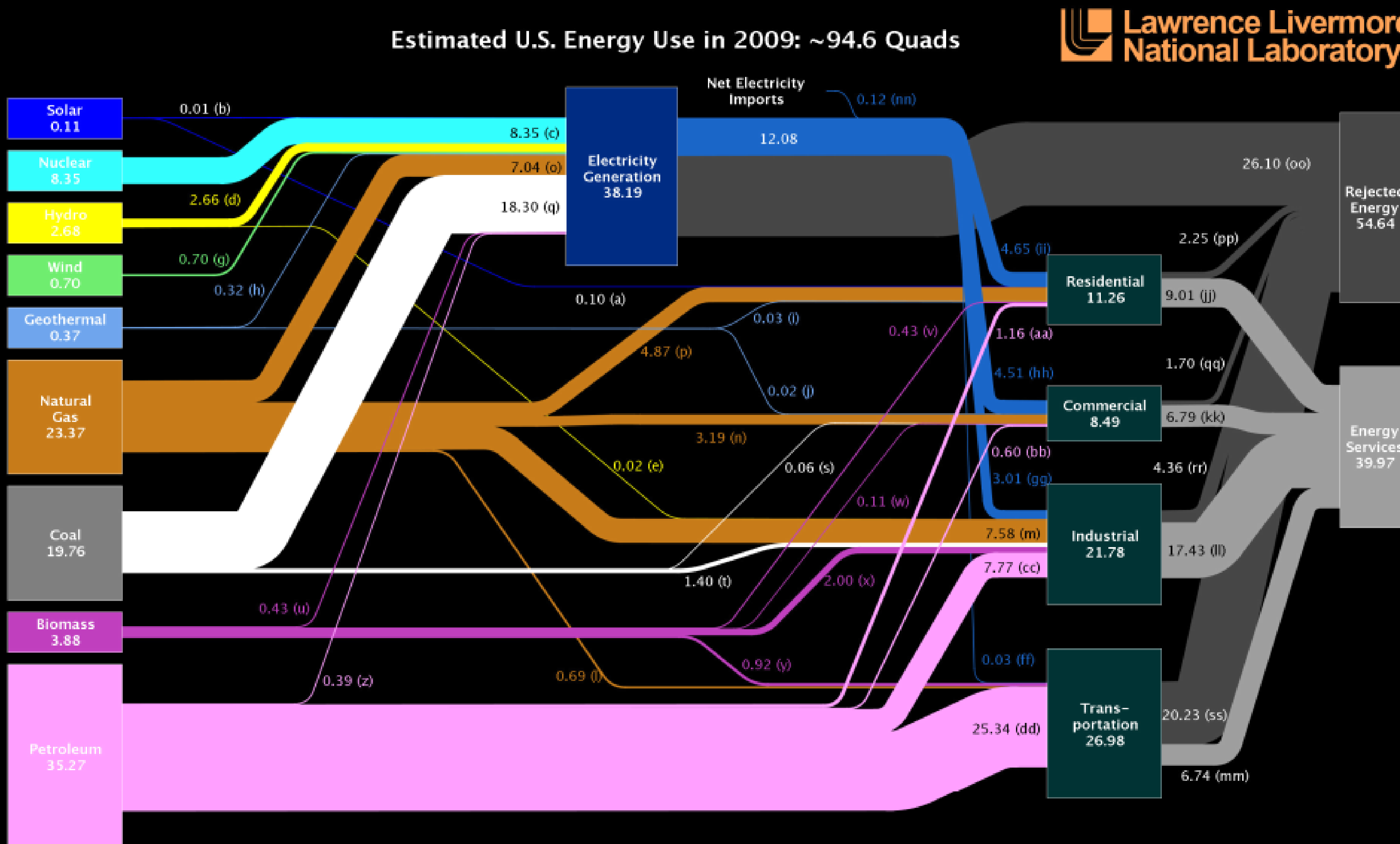
- Delays in mitigation through 2030 or beyond could substantially increase mitigation costs in the decades that follow and the second-half of the century *(high confidence)*.

A sectorial approach

Direct GHG emissions per sectors

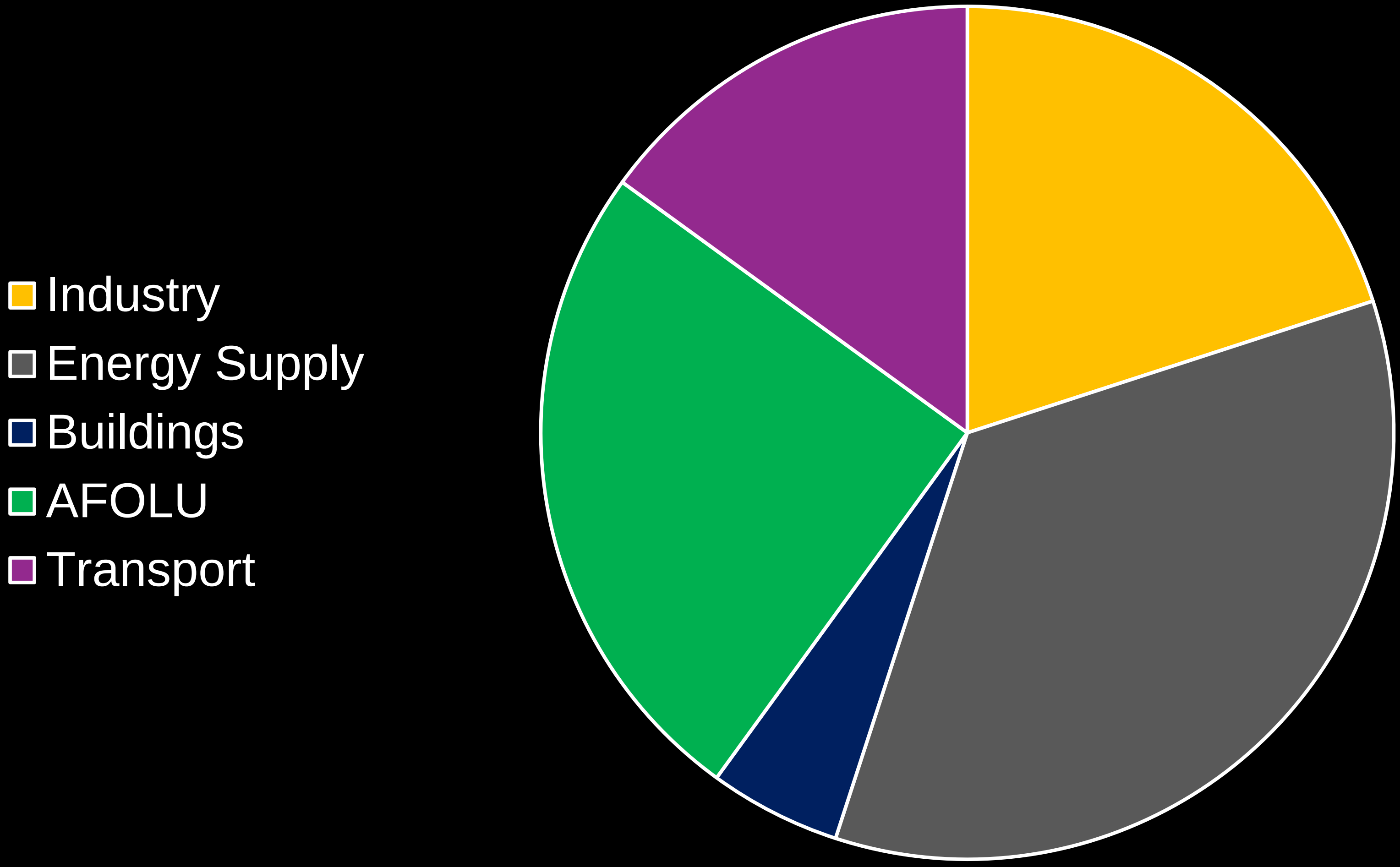


Primary VS Final Energy

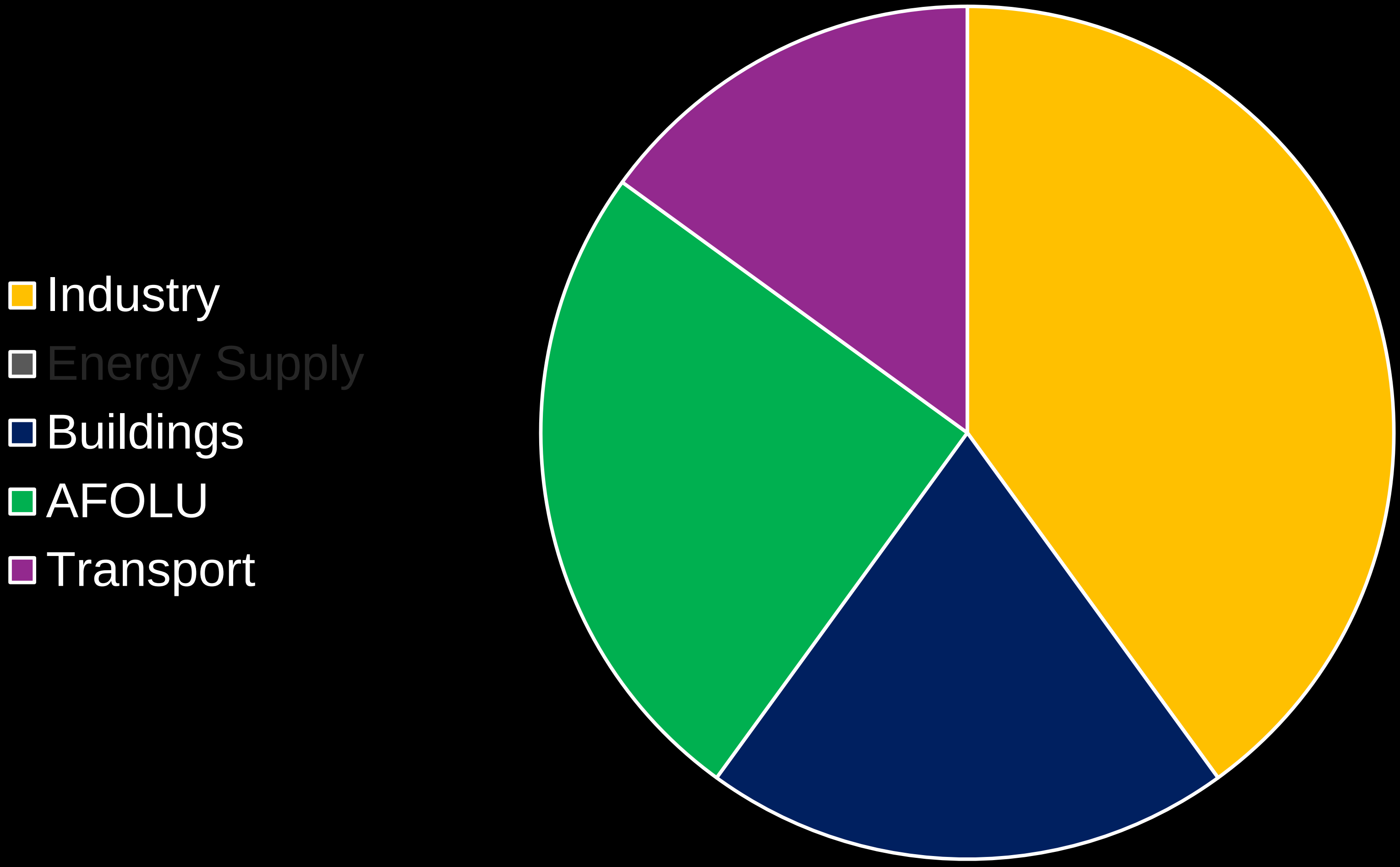


Source: LLNL 2010. Data is based on DOE/EIA-0384(2009), August 2010. If this information or a reproduction of it is used, credit must be given to the Lawrence Livermore National Laboratory and the Department of Energy, under whose auspices the work was performed. Distributed electricity represents only retail electricity sales and does not include self-generation. EIA reports flows for non-thermal resources (i.e., hydro, wind and solar) in BTU-equivalent values by assuming a typical fossil fuel plant "heat rate." The efficiency of electricity production is calculated as the total retail electricity delivered divided by the primary energy input into electricity generation. End use efficiency is estimated as 80% for the residential, commercial and industrial sectors, and as 25% for the transportation sector. Totals may not equal sum of components due to independent rounding. LLNL-MI-410527

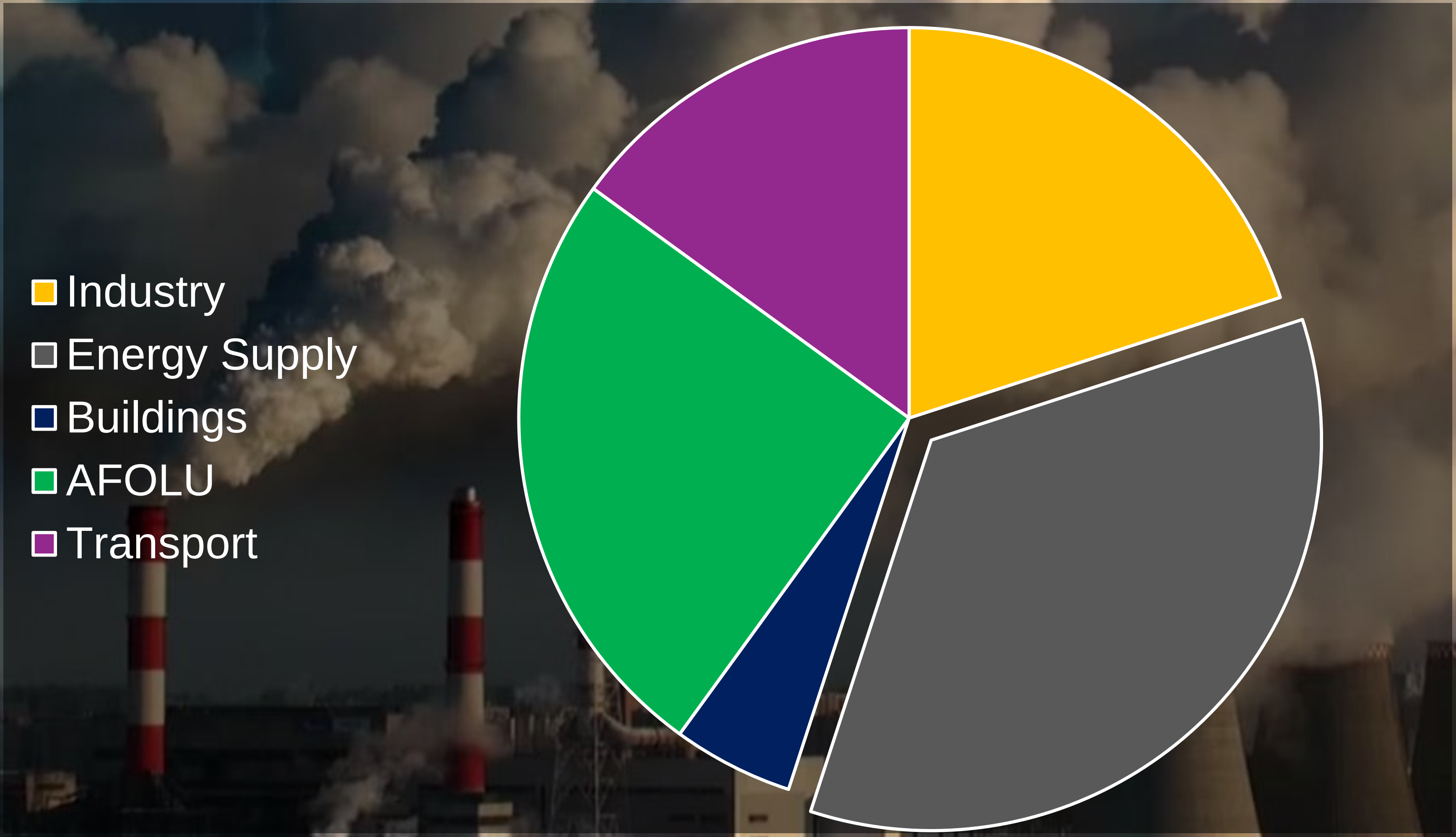
Direct GHG emissions per sectors



Indirect GHG emissions per sectors



Energy Supply



The energy supply sector offers a multitude of options to reduce GHG emissions

- Energy efficiency improvements
- Fugitive emission reductions
- Fossil fuel switching
- Low GHG energy supply technologies
  - – renewable energy (RE),
  - – nuclear power,
  - – CCS

A Fundamental transformation is needed

- The stabilization of greenhouse gas concentrations at low levels requires a fundamental transformation of the energy supply system.
- Improving the energy efficiencies of fossil power plants and/or the shift from coal to gas will not by themselves be sufficient to achieve this.

Decarbonizing electricity

- In integrated modelling studies, decarbonizing electricity generation is a key component of cost-effective mitigation strategies;
- In most scenarios, it happens more rapidly than the decarbonization of the building, transport, and industry sectors.

Renewable energy

Since AR4, renewable energy (RE) has become a fast growing category in energy supply, with many RE technologies having advanced substantially in terms of performance and cost, and a growing number of RE technologies has achieved technical and economic maturity *(robust evidence, high agreement)*.

Nuclear energy

- Nuclear energy is a mature low GHG emission technology but its share in world power generation has continued to decline *(robust evidence, high agreement)*.
- Barriers to an increasing use of nuclear energy include concerns about operational safety and (nuclear weapon) proliferation risks, unresolved waste management issues, as well as financial and regulatory risks *(robust evidence, high agreement)*.

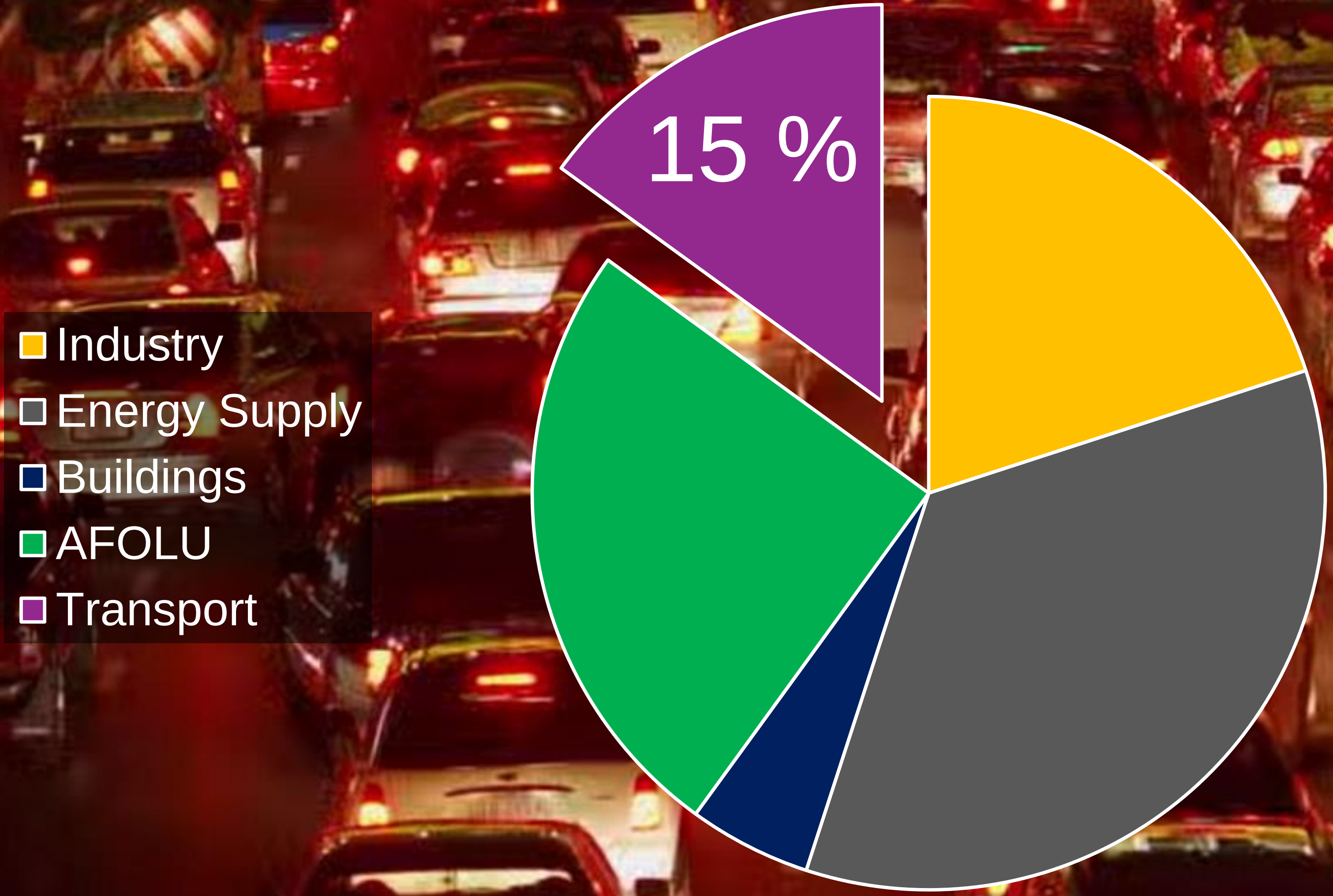
Gas

- Where natural gas is available and the fugitive emissions associated with its extraction and supply are low, near-term GHG emissions from energy supply can be reduced by replacing coal-fired with highly efficient natural gas combined cycle (NGCC) power plants or combined heat and power (CHP) plants *(robust evidence, high agreement)*.

CCS

- Carbon dioxide Capture and Storage (CCS) technologies could reduce the specific CO_2eq lifecycle emissions of fossil fuel power plants *(medium evidence, medium agreement)*.
- CCS needs support or a high carbon price.
- Barriers to large-scale deployment of CCS include concerns about the operational safety and long-term integrity of CO_2 storage, as well as risks related to transport and the required upscaling of infrastructure *(limited evidence, medium agreement).*

Transport



Emissions have inscreased

- Since AR4, emissions in the transport sector have grown in spite of more efficient vehicles (road, rail, watercraft, and aircraft) and policies being adopted *(robust evidence, high agreement).*

A high mitigation potential

- Low-carbon fuels,
- Uptake of improved vehicle
- Engine performance technologies,
- Behavioural change leading to avoided journeys and modal shifts,
- Investments in related infrastructure,
- Changes in the built environment.

Energy density

- The required energy density of fuels makes the transport sector difficult to decarbonize, and integrated and sectoral studies broadly agree that opportunities for fuel switching are low in the short term but grow over time *(medium evidence, medium agreement).*

Engine designs

- Energy efficiency measures through improved vehicle and engine designs have the largest potential for emission reductions in the short term *(high confidence)*.

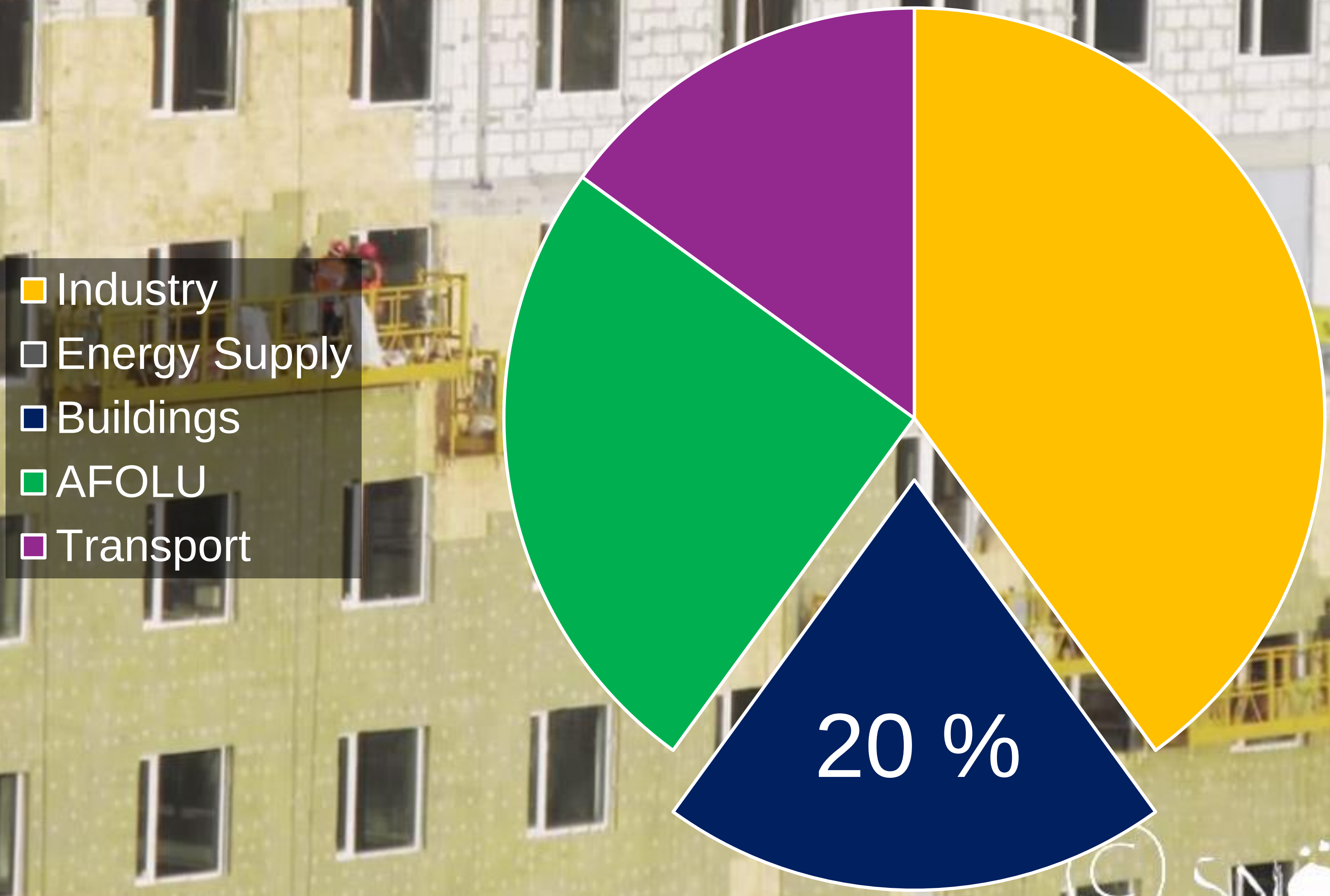
Transport mode

- Shifts in transport mode and behaviour, impacted by new infrastructure and urban (re)development, can contribute to the reduction of transport emissions *(medium evidence, low agreement)*.

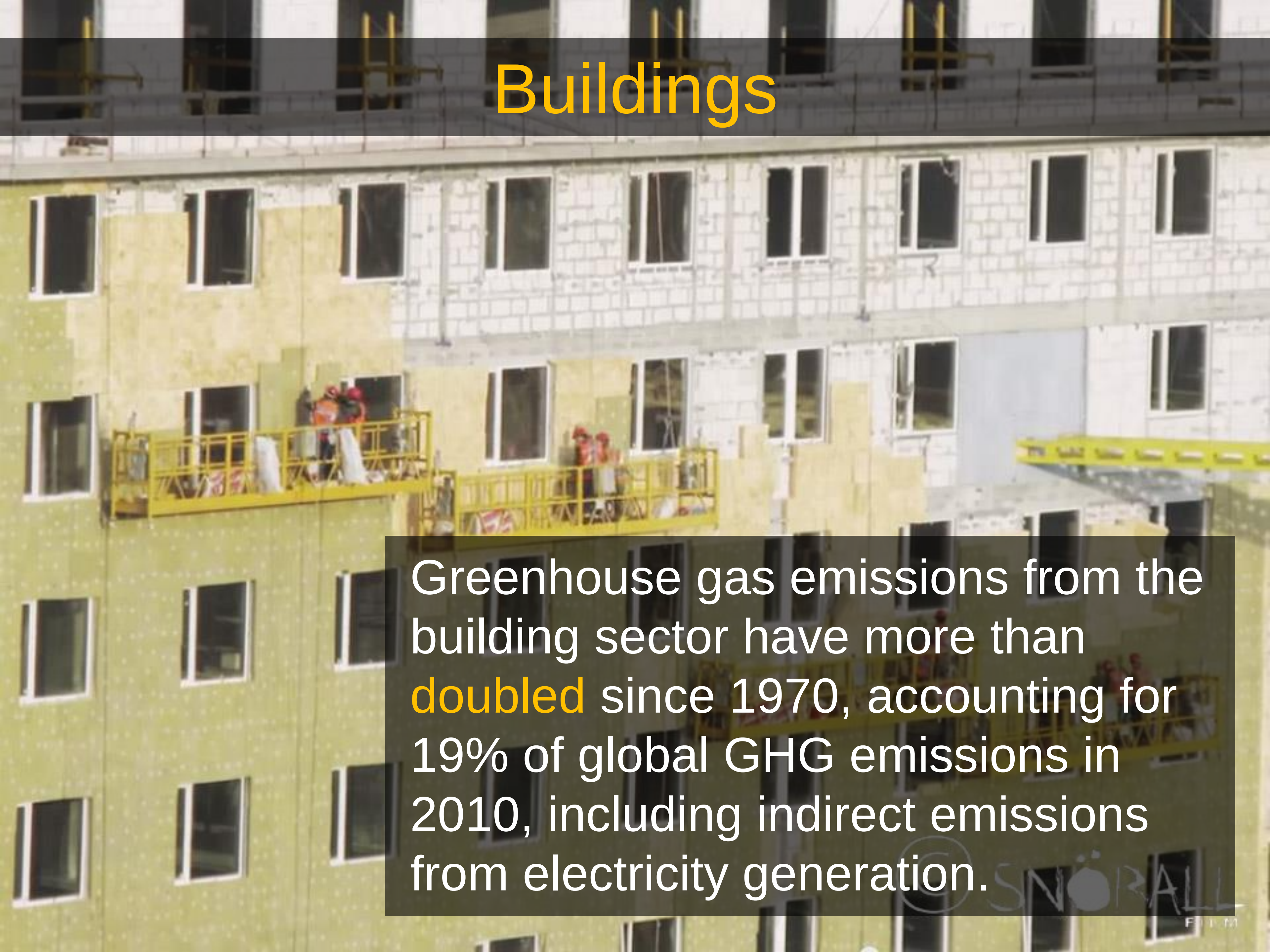
Barriers

- High investment costs needed to build low-emissions transport systems,
- Slow turnover of stock and infrastructure,
- Limited impact of a carbon price on petroleum fuels that are already heavily taxed.

Buildings



Buildings



Greenhouse gas emissions from the building sector have more than doubled since 1970, accounting for 19% of global GHG emissions in 2010, including indirect emissions from electricity generation.

Lock-in risks

Significant lock-in risks arise from the long lifespans of buildings infrastructure *(robust evidence, high agreement)*.

Potential

- Improvements in wealth, lifestyle, urbanization, and the provision of access to modern energy services and adequate housing will drive the increases in building energy demand *(robust evidence, high agreement)*.
- The recent proliferation of advanced technologies, know-how, and policies in the building sector, however, make it feasible that global total sector final energy use stabilizes or even declines by mid-century *(robust evidence, medium agreement)*.

Zero Energy Buildings

- Advances since AR4 include the widespread demonstration worldwide of very low, or net zero energy buildings both in new construction and retrofits *(robust evidence, high agreement)*.
- However, zero energy/carbon buildings may not always be the most cost-optimal solution, nor even be feasible in certain building types and locations.

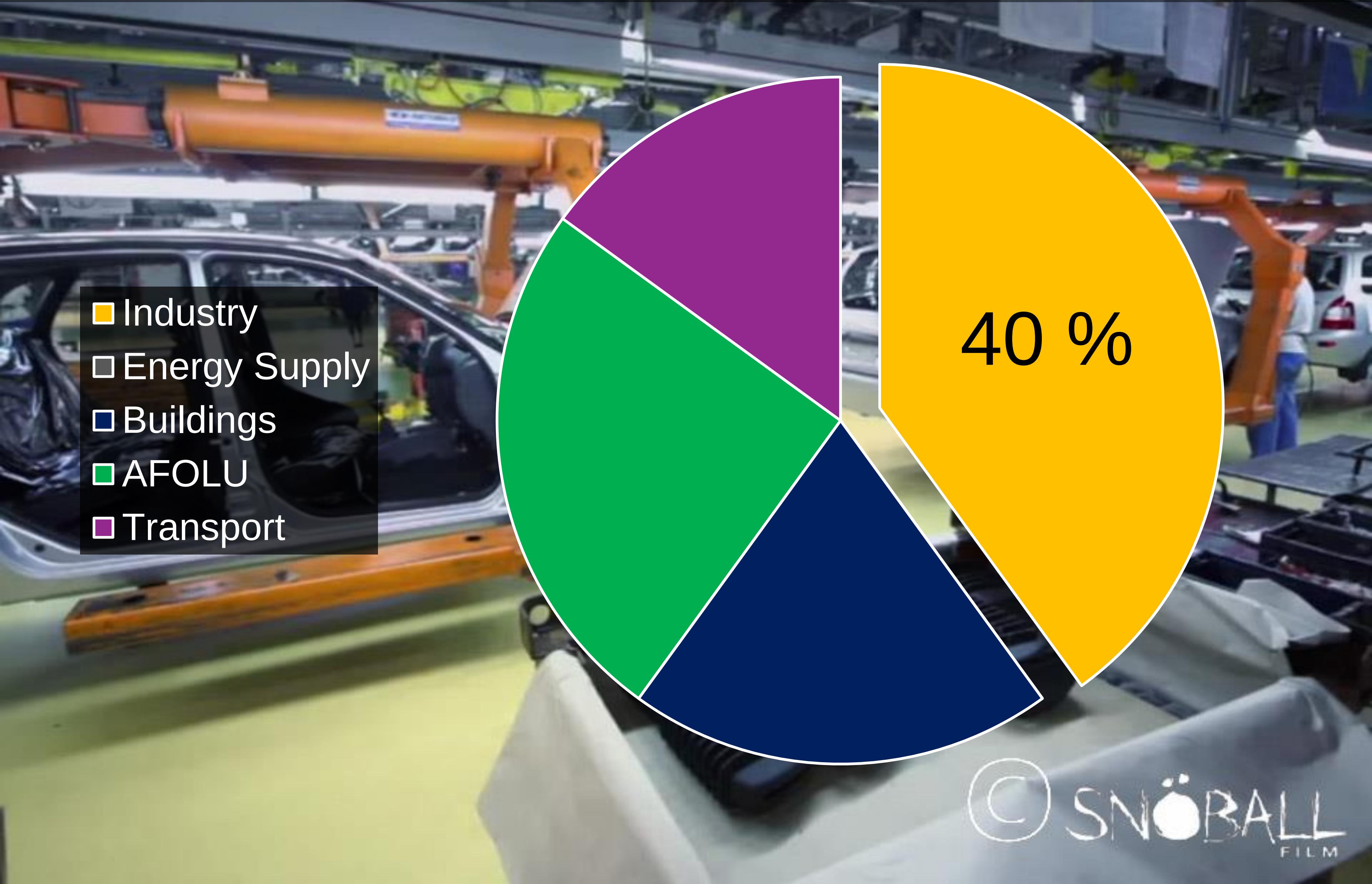
Cost effectiveness

- 25–30% efficiency improvements have been available at costs substantially lower than marginal energy supply *(robust evidence, high agreement).*

Barriers

- Especially strong barriers in this sector hinder the market uptake of cost-effective technologies and practices.
- As a consequence, programmes and regulation are more effective than pricing instruments alone
  (robust evidence, high agreement).

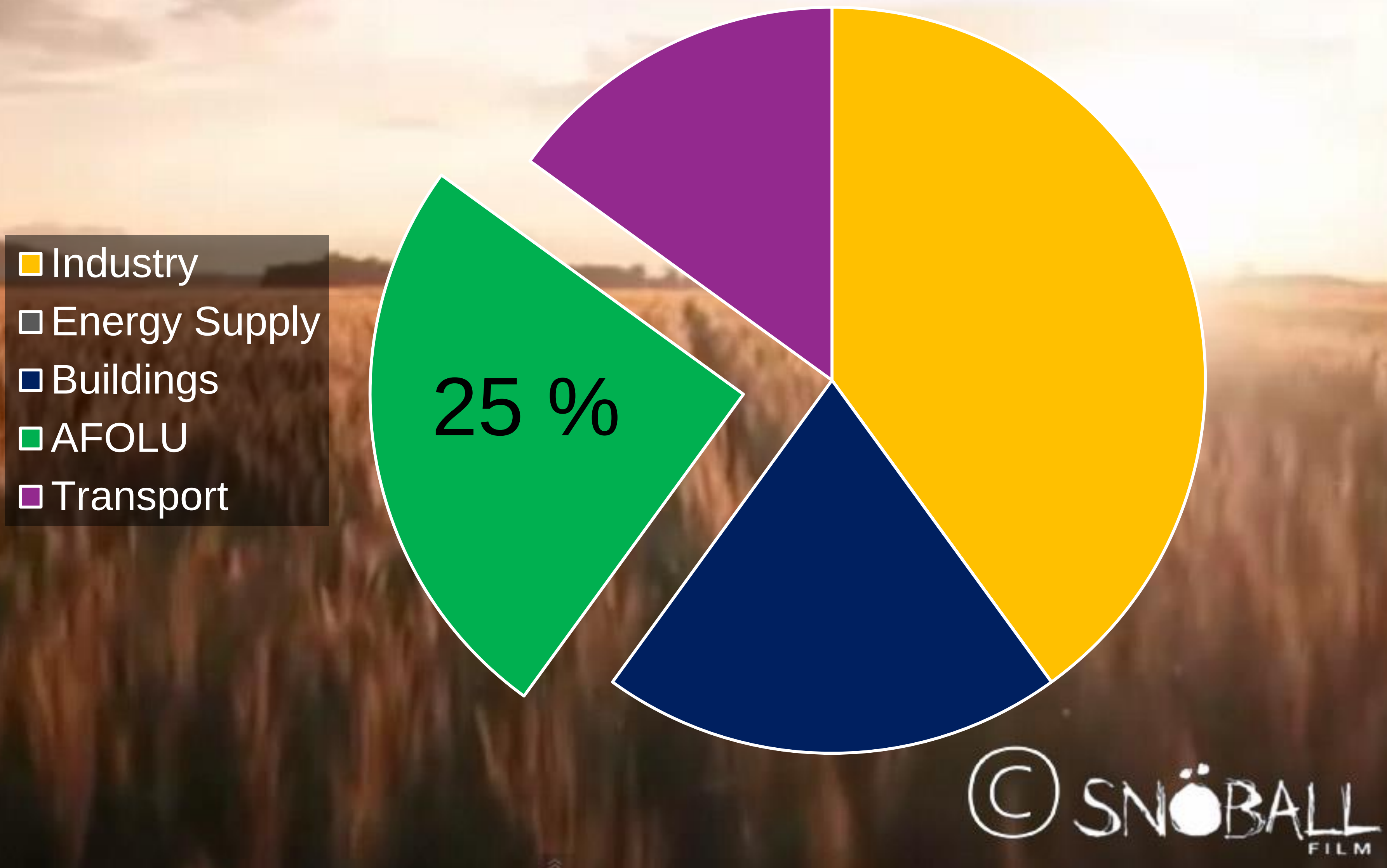
Industry


Industry
Energy Supply
Buildings
AFOLU
Transport
40 %
SNÖBALL
FILM

Industry

- The wide-scale deployment of best available technologies and in non-energy intensive industries, could reduce the energy intensity of the sector by up to 25% *(robust evidence, high agreement)*.

AFOLU


Industry
Energy Supply
Buildings
AFOLU
Transport
25 %
© SNÖBALL FILM

AFOLU

- Since AR4, emissions from the AFOLU sector have stabilized but the share of total anthropogenic emissions has decreased *(robust evidence, high agreement)*.
- Net annual baseline CO_2 emissions from AFOLU are projected to decline over time with emissions potentially less than half of what they are today by 2050, and the possibility of the terrestrial system becoming a net sink before the end of century.

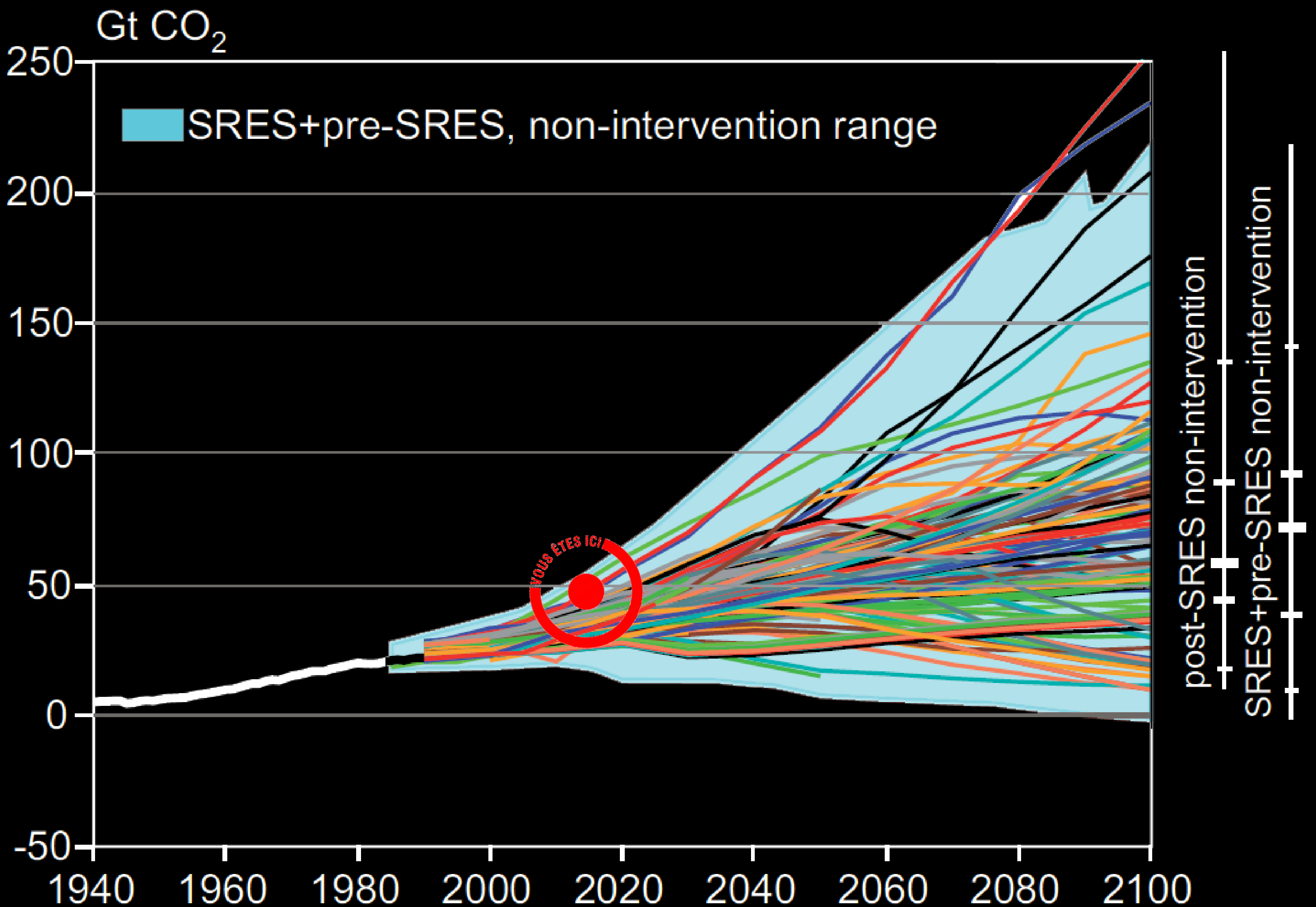
Supply side

- Reduce deforestation
- Land and livestock management
- Increase carbon stocks by sequestration in soils and biomass
- Substitution of fossil fuels by biomass for energy production

Demand side

- Dietary change
- Waste reduction in the food supply chain.

Vous êtes ici !



Merci !