

What does IPCC AR5 say?

IPCC as a radical inside the closet



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Plan:

- * What is IPCC?***

- * The Fifth Assessment Report (AR5)***

 - WR1: The physical basis***

 - WR2: Impacts, adaptation and vulnerability***

 - WR3: Mitigation of climate change***

What is ?

The logo for the Intergovernmental Panel on Climate Change (IPCC) is displayed. It features the lowercase letters 'ipcc' in a large, blue, sans-serif font. Below this, the full name 'INTERGOVERNMENTAL PANEL ON climate change' is written in a smaller, blue, sans-serif font. To the right of the text are the logos for the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP). The WMO logo is a blue circle with a white globe and the letters 'WMO' below it. The UNEP logo is a blue circle with a white globe and the letters 'UNEP' below it. A green triangle is positioned to the right of the UNEP logo.

- UNFCCC: United Nations Framework Convention on Climate Change (1992):

“stabilize greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system”

- IPCC: Intergovernmental Panel on Climate Change (1988), established by WMO and UNEP, produces reports on

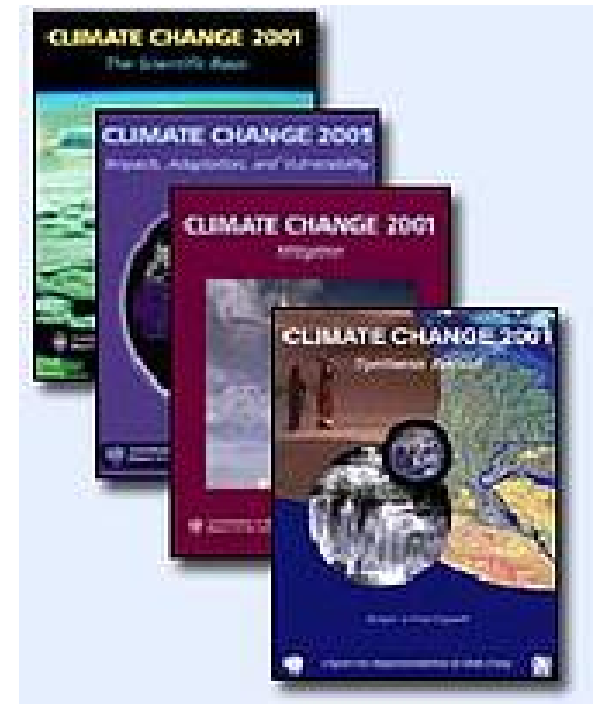
“the scientific, technical and socio-economic information relevant to understanding the scientific basis of risk of human-induced climate change, its potential impacts and options for adaptation and mitigation.”

What is ?

The logo for the Intergovernmental Panel on Climate Change (ipcc) is displayed, featuring the lowercase letters 'ipcc' in blue, with 'INTERGOVERNMENTAL PANEL ON climate change' in smaller text below. To the right of the main logo are the logos for WHO and UNEP, and a green triangular graphic element.

IPCC reports

- First Assessment Report (AR1): 1990
basis of the UNFCCC
- Supplementary Report: 1992
- AR2: 1996
- AR3: 2001
- AR4: 2007



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- **Fifth Assessment Report (AR5)**
 - WG1: The physical basis (September 2013)
 - WG2: Impacts, adaptation and vulnerability (March 2014)
 - WG3: Mitigation of climate change (April 2014)
 - Synthesis Report: November 2014



Dictionary

evidence

- Low
- Medium
- Robust

agreement

- Low
- Medium
- High

confidence

- Very low
- Low
- Medium
- High
- Very high

likelihood of an outcome or a result



exceptionally unlikely virtually certain

extremely unlikely extremely likely

very unlikely very likely

unlikely

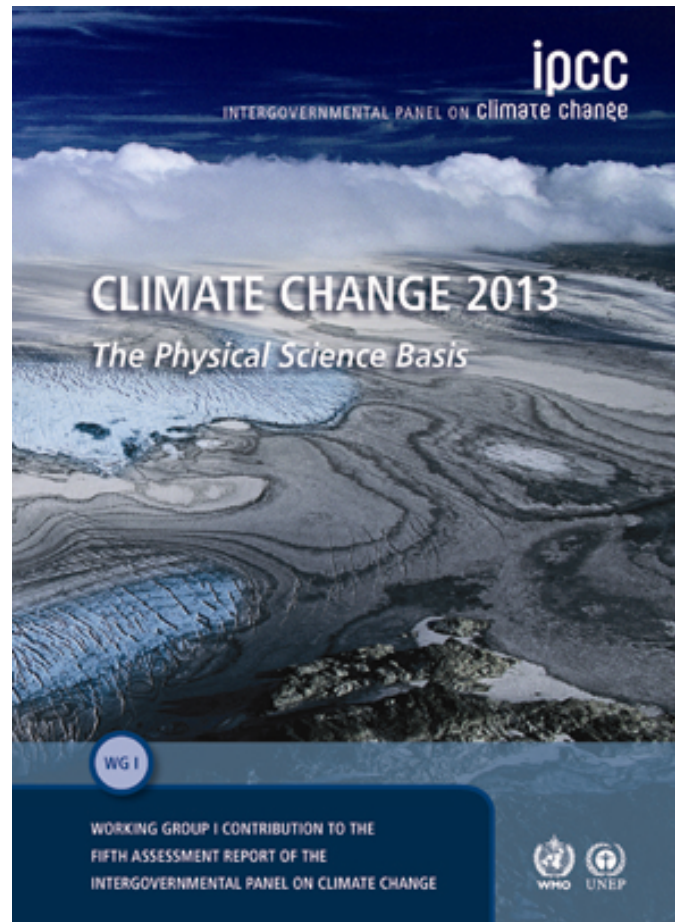
about as likely as not

likely

more unlikely than likely

more likely than not

§1. Observed changes and their causes



Human influence on the climate system is clear, and recent anthropogenic emissions of greenhouse gases are the highest in history. Recent climate changes have had widespread impacts on human and natural systems.

Warming of the climate system is unequivocal, and since the 1950s, many of the observed changes are unprecedented over decades to millennia. The atmosphere and ocean have warmed, the amounts of snow and ice have diminished, and sea level has risen.

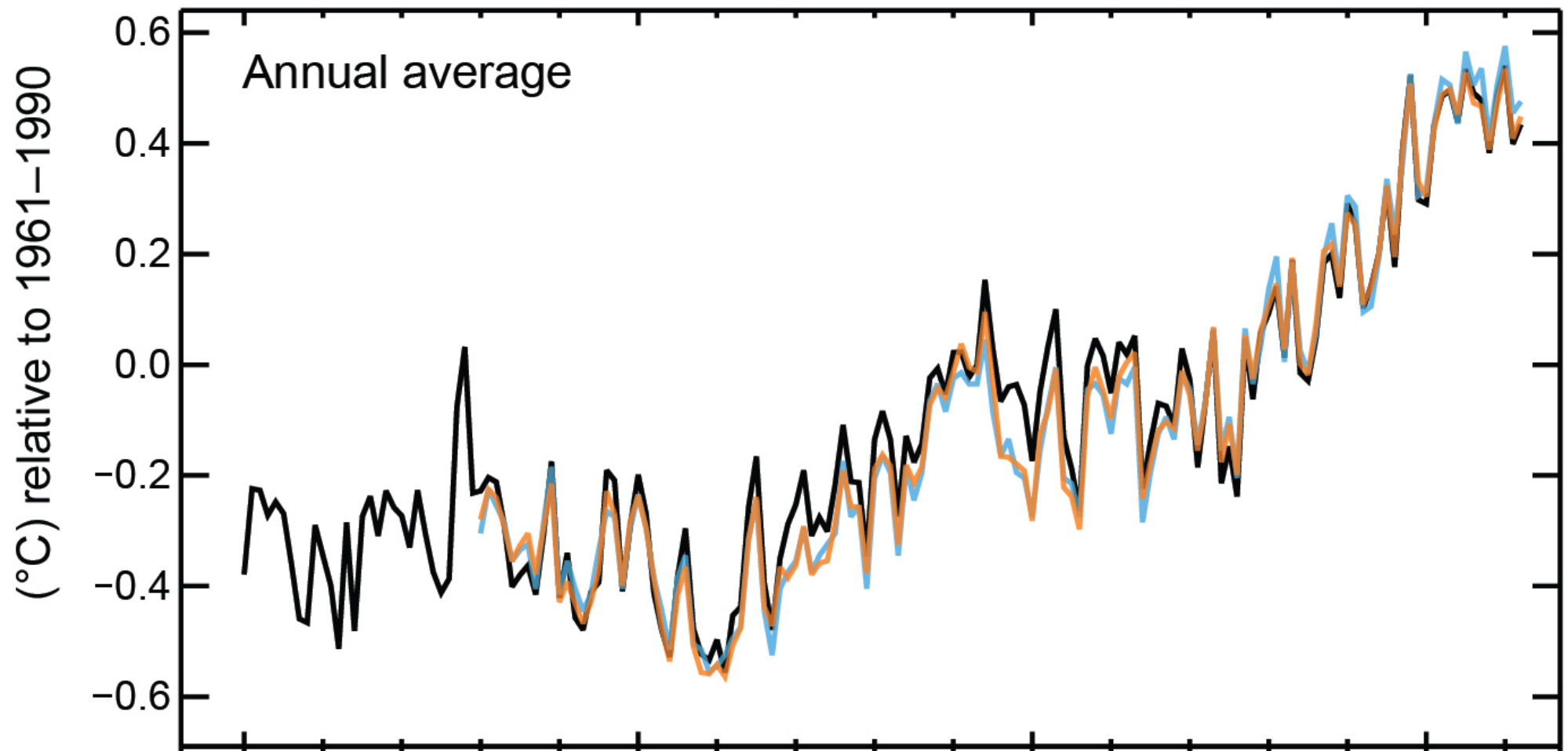
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- Each of the last three decades has been successively warmer at the Earth's surface than any preceding decade since 1850.

Observed globally averaged combined land and ocean surface temperature anomaly 1850–2012

(a)



- Ocean warming ... accounting for more than 90% of the energy accumulated between 1971 and 2010 (*high confidence*), with only about 1% stored in the atmosphere. ... the upper 75 m warmed by 0.11°C per decade over the period 1971 to 2010.
- Since the beginning of the industrial era, ... ; the pH of ocean surface water has decreased by 0.1 (*high confidence*), corresponding to a 26% increase in acidity ...
- Glaciers have continued to shrink almost worldwide (*high confidence*). Northern Hemisphere spring snow cover has continued to decrease in extent (*high confidence*). There is *high confidence* that permafrost temperatures have increased in most regions ...
- Arctic sea-ice extent decreased over the period 1979 to 2012, with a rate that was *very likely* in the range 3.5 to 4.1% per decade. Arctic sea-ice extent has decreased in every season and in every successive decade since 1979, ...
- Over the period 1901 to 2010, global mean sea level rose by 0.19 m

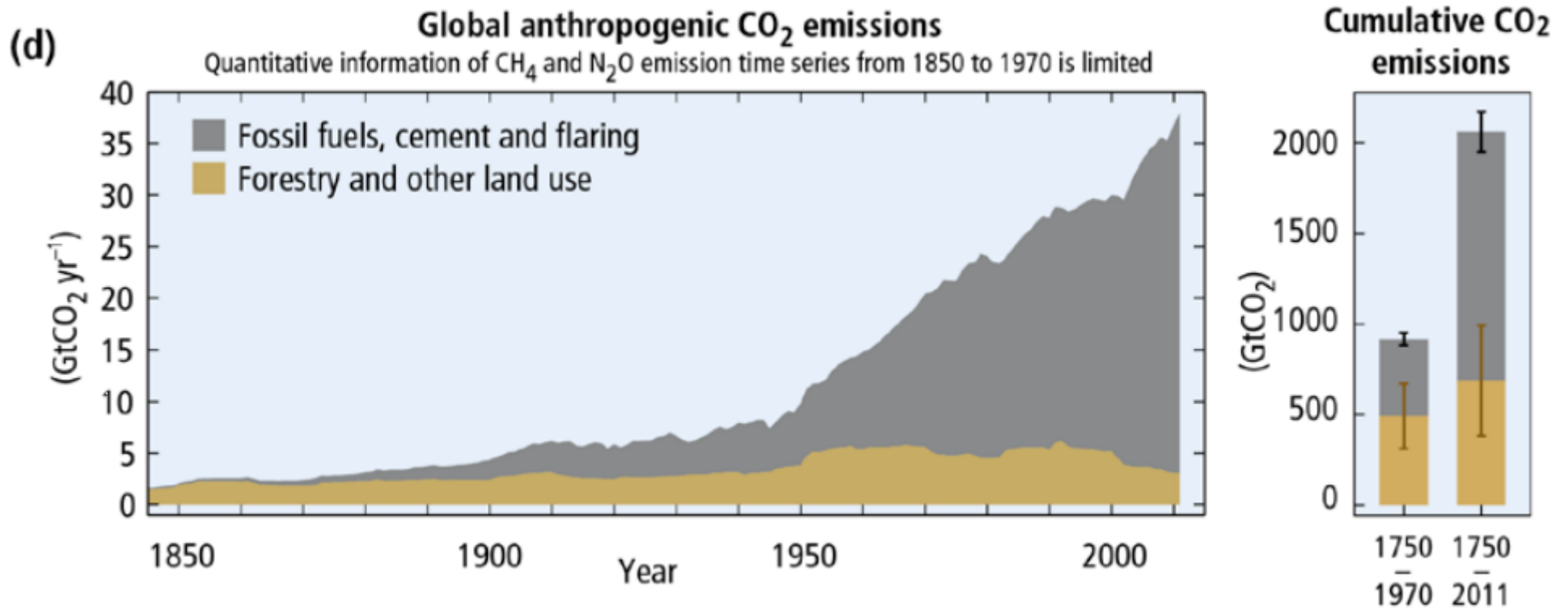
... atmospheric concentrations of carbon dioxide, methane and nitrous oxide that are unprecedented in at least the last 800,000 years. Their effects, together with those of other anthropogenic drivers, have been detected throughout the climate system and are *extremely likely* to have been the dominant cause of the observed warming since the mid-20th century.



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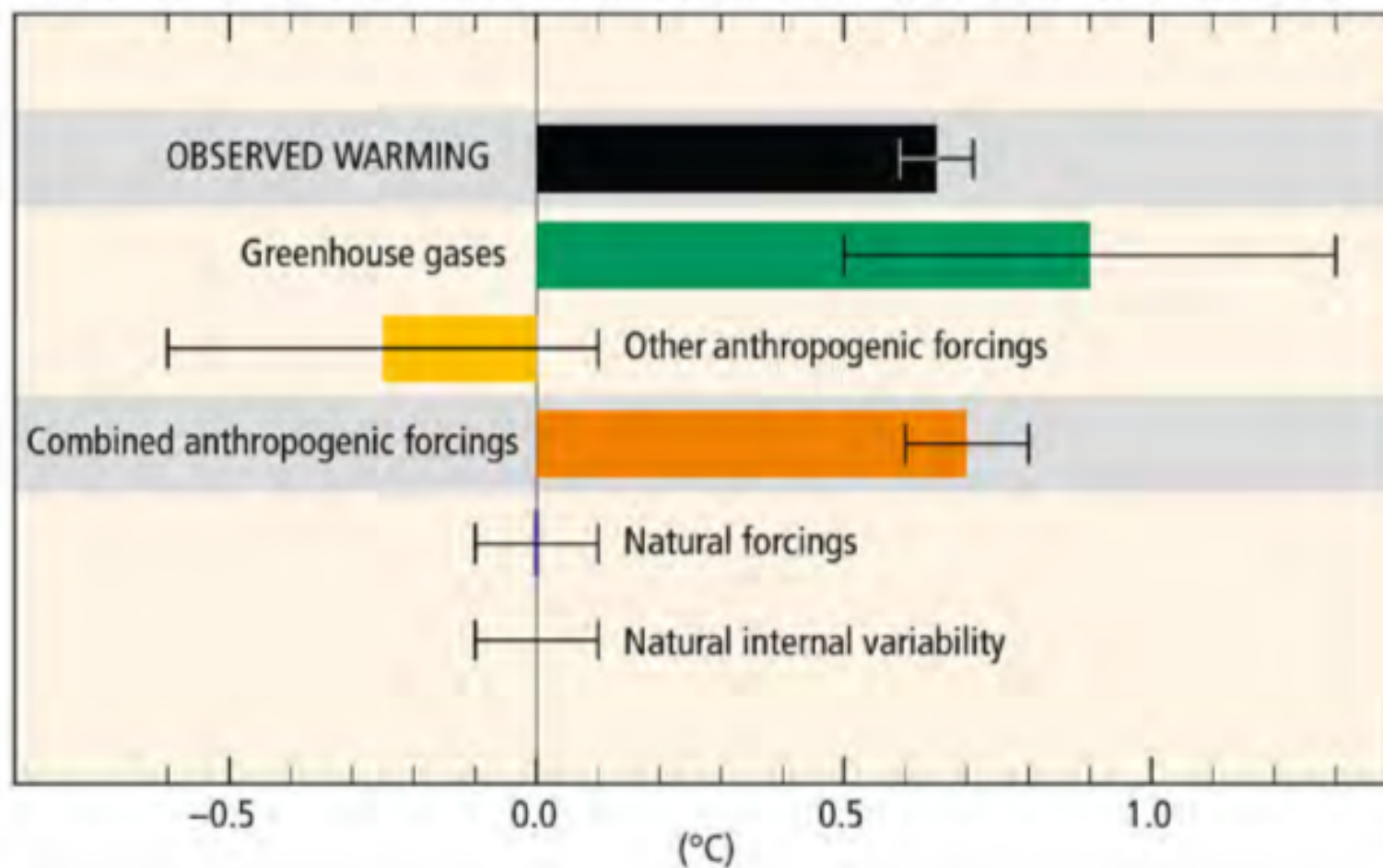


- Between 1750 and 2011, cumulative anthropogenic CO₂ emissions to the atmosphere were 2040 ± 310 GtCO₂



- Total anthropogenic greenhouse gas emissions have continued to increase over 1970 to 2010 with larger absolute increases between 2000 and 2010, ...
- ... fossil fuel combustion and industrial processes contributed about 78% of the total greenhouse gas emissions increase from 1970 to 2010, ...

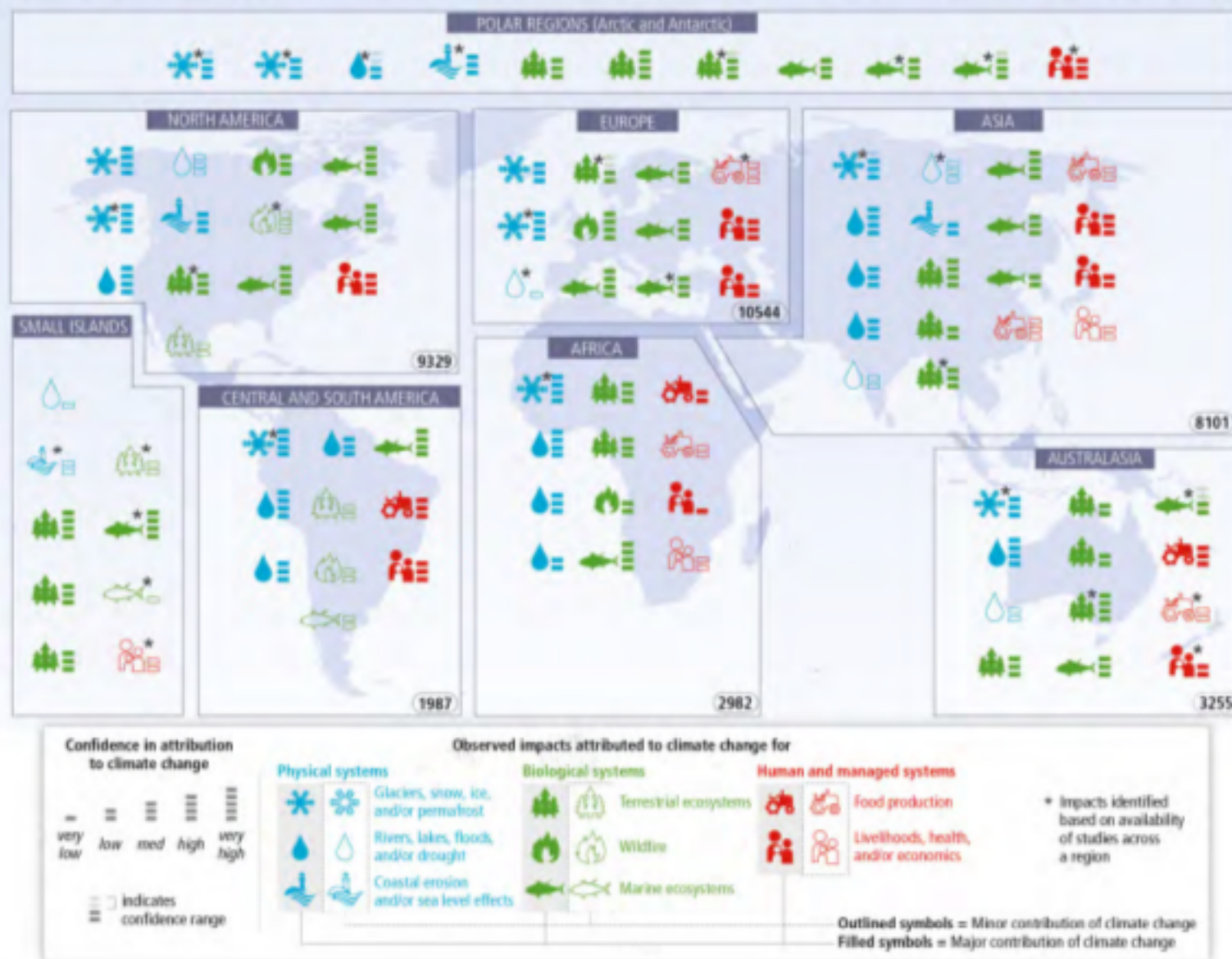
Contributions to observed surface temperature change over the period 1951-2010



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- In recent decades, changes in climate have caused impacts on natural **and** human systems **on all continents** and **across the oceans**.
- ... changing precipitation or melting snow and ice are altering hydrological systems, affecting water resources in terms of quantity and quality (*medium confidence*).
- Many terrestrial, freshwater, and marine species have shifted their geographic ranges, seasonal activities, migration patterns, abundances, and species interactions ... (*high confidence*).
- ... negative impacts of climate change on crop yields have been more common than positive impacts (*high confidence*).
- Some impacts of ocean acidification on marine organisms ... (*medium confidence*)

Widespread impacts attributed to climate change based on the available scientific literature since the AR4



- ... a decrease in cold temperature extremes, an increase in warm temperature extremes, an increase in extreme high sea levels and an increase in the number of heavy precipitation events
- It is *likely* that the frequency of heat waves has increased in large parts of Europe, Asia and Australia. It is *very likely* that human influence has contributed to the observed global scale changes in the frequency and intensity of daily temperature extremes since the mid-20th century. It is *likely* that human influence has more than doubled the probability of occurrence of heat waves in some locations.
- Impacts from recent climate-related extremes, such as heat waves, droughts, floods, cyclones, and wildfires, reveal significant vulnerability and exposure of some ecosystems and many human systems to current climate variability.

§2. Future climate changes, risks and impacts



Continued emission of greenhouse gases will cause further warming and long-lasting changes in all components of the climate system, increasing the likelihood of severe, pervasive and irreversible impacts for people and ecosystems. Limiting climate change would require substantial and sustained reductions in greenhouse gas emissions which, together with adaptation, can limit climate change risks.

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Representative Concentration Pathways

RCP2.6

- mitigation
- *likely* below 2°C

RCP 8.5

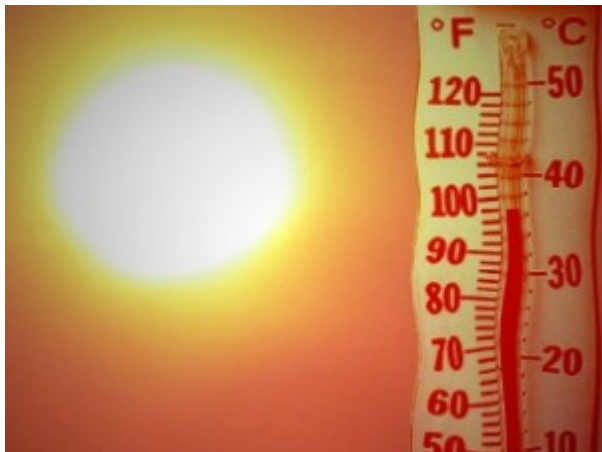
- very high greenhouse gas emissions

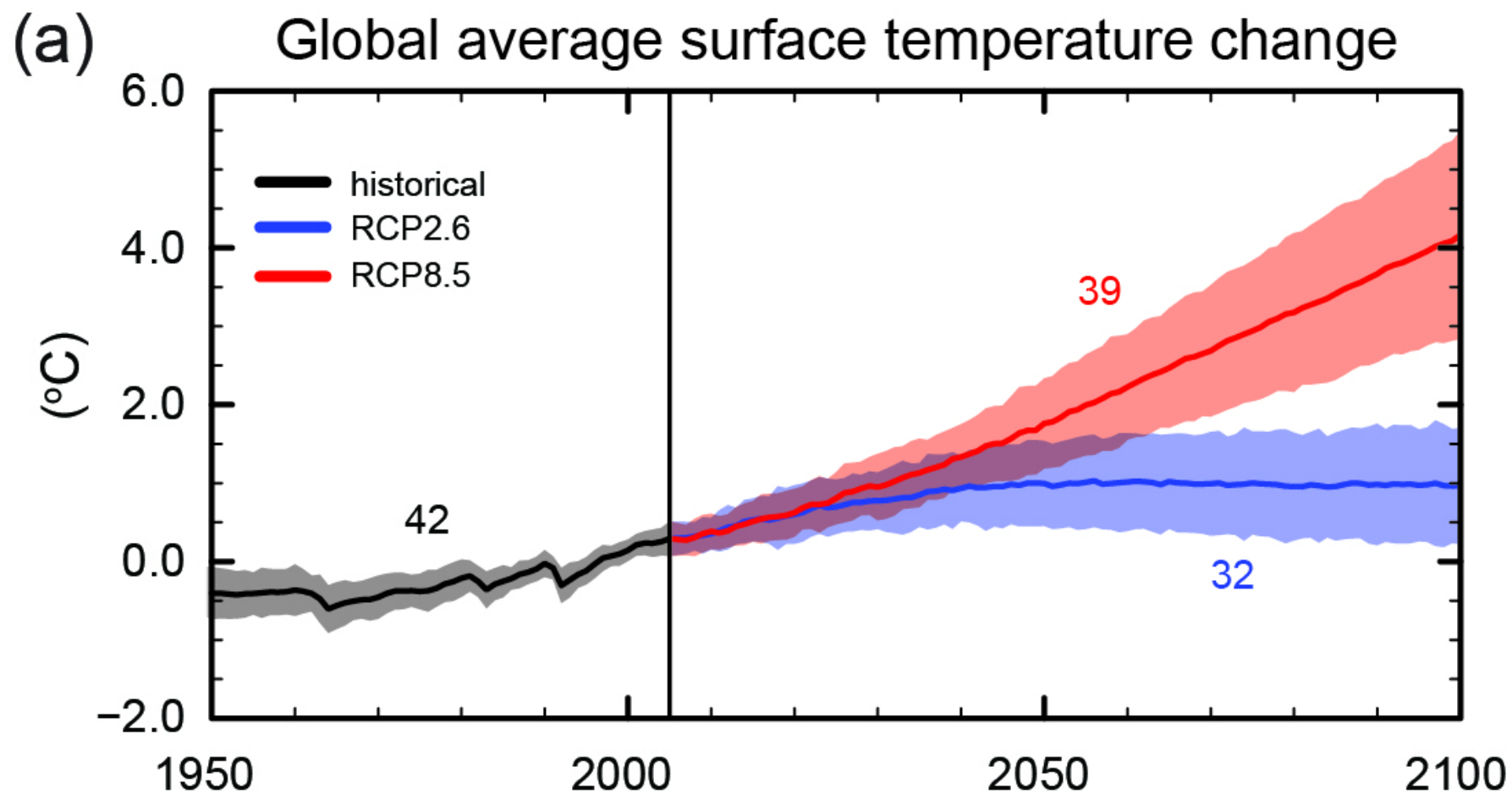
RCP4.5 and RCP6.0

- intermediate scenarios
- baseline scenarios are between RCP6.0 and RCP8.5

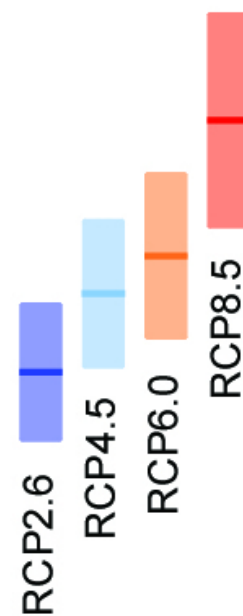
... limiting total human-induced warming to less than 2°C relative ... to the period 1861-1880 with a probability of >66% would require cumulative CO₂ emissions from all anthropogenic sources since 1870 to remain below about 2900 GtCO₂. About 1900 GtCO₂ had already been emitted by 2011.

... *very likely* that heat waves will occur more often and last longer, and that extreme precipitation events will become more intense and frequent in many regions. The ocean will continue to warm and acidify, and global mean sea level to rise.

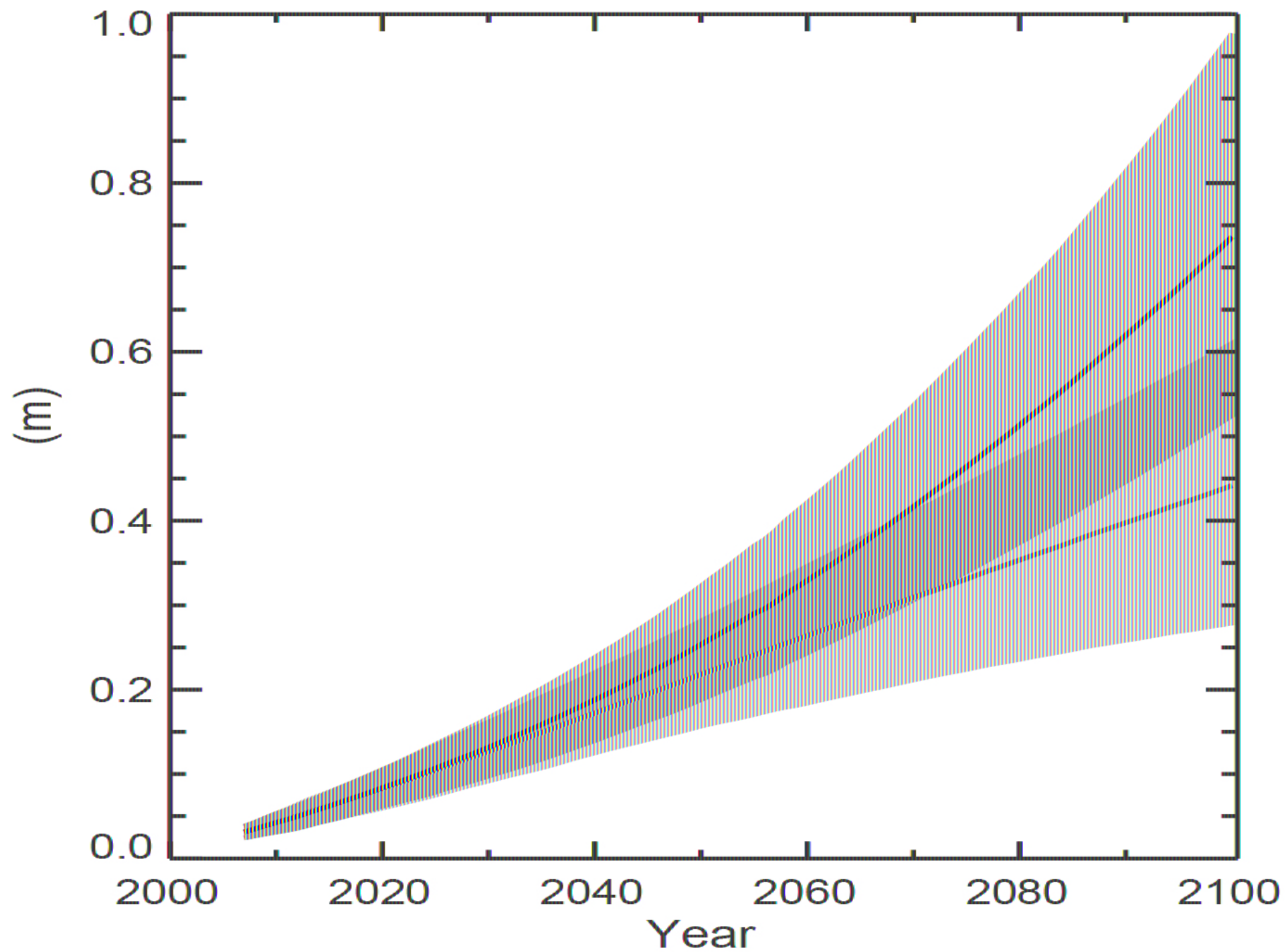




Mean over
2081–2100



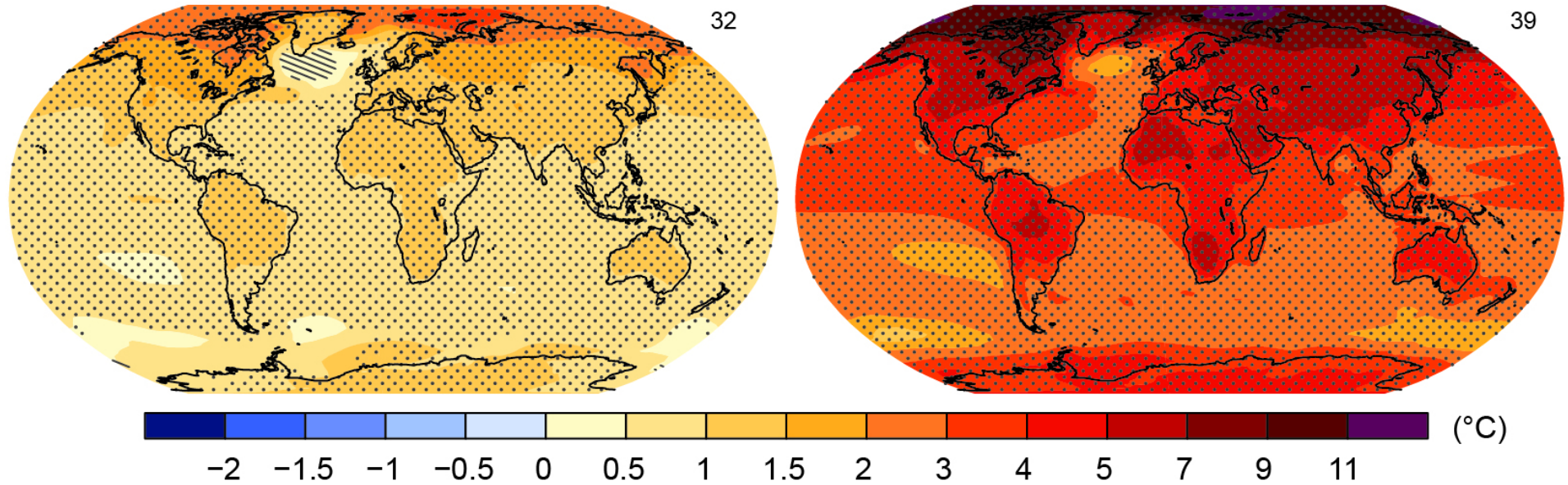
Global mean sea level rise



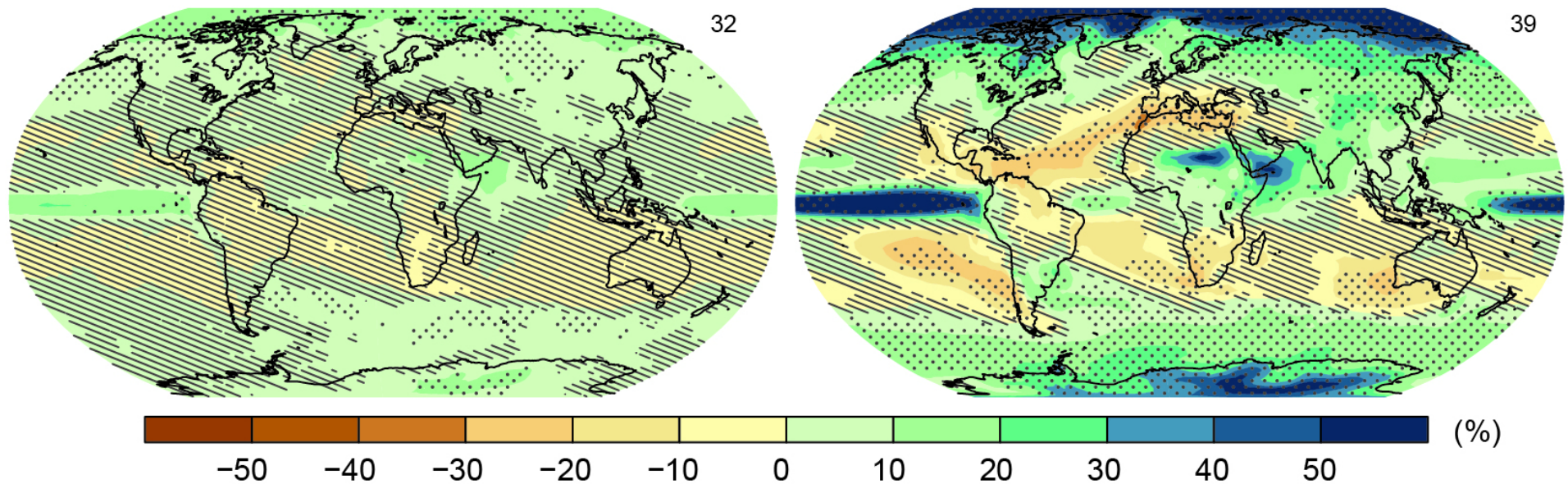
RCP 2.6

RCP 8.5

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



(b) Change in average precipitation (1986–2005 to 2081–2100)



- A nearly ice-free Arctic Ocean ... before mid-century is *likely* for RCP8.5 12 (medium confidence).
- It is *virtually certain* that near-surface permafrost extent at high northern latitudes will be reduced ... , with the area of permafrost near the surface ... projected to decrease by 37% (RCP2.6) to 81% (RCP8.5) for the multi-model average (*medium confidence*)

- Climate change will amplify existing risks and create new risks for natural and human systems. Risks are unevenly distributed and are generally greater for disadvantaged people and communities in countries at all levels of development.
- ... global marine species redistribution and marine biodiversity reduction ... will challenge ... fisheries productivity.
- For wheat, rice, and maize in tropical and temperate regions, ... negatively impact production.
- Global temperature increases of $\sim 4^{\circ}\text{C}$ or more ... pose large risks to food security globally.
- ... reduce renewable surface water and groundwater resources in most dry subtropical regions ...
- ... exacerbating health problems that already exist. ... lead to increases in ill-health in many regions and especially in developing countries ...

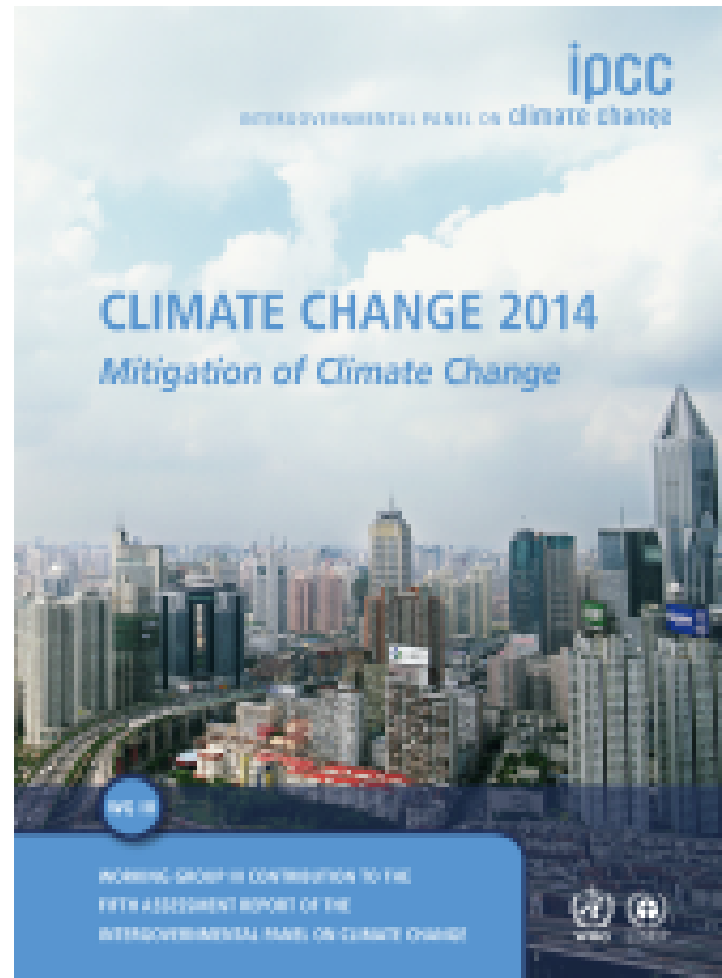
- In urban areas, climate change is projected to increase risks for people, assets, economies and ecosystems, including risks from **heat stress, storms and extreme precipitation**, inland and coastal **flooding, landslides, air pollution, drought, water scarcity, sea-level rise**, and storm surges (*very high confidence*). These risks are amplified for those lacking essential infrastructure and services or living in exposed areas.
- Rural areas are expected to experience major impacts on **water availability** and supply, **food security, infrastructure**, and agricultural incomes, including **shifts in the production areas of food and non-food crops around the world** (*high confidence*).

- slow down economic growth, make poverty reduction more difficult, further erode food security, and prolong existing and create new poverty traps, the latter particularly in urban areas and emerging hotspots of hunger (*medium confidence*)
- ... increase displacement of people (*medium evidence, high agreement*)



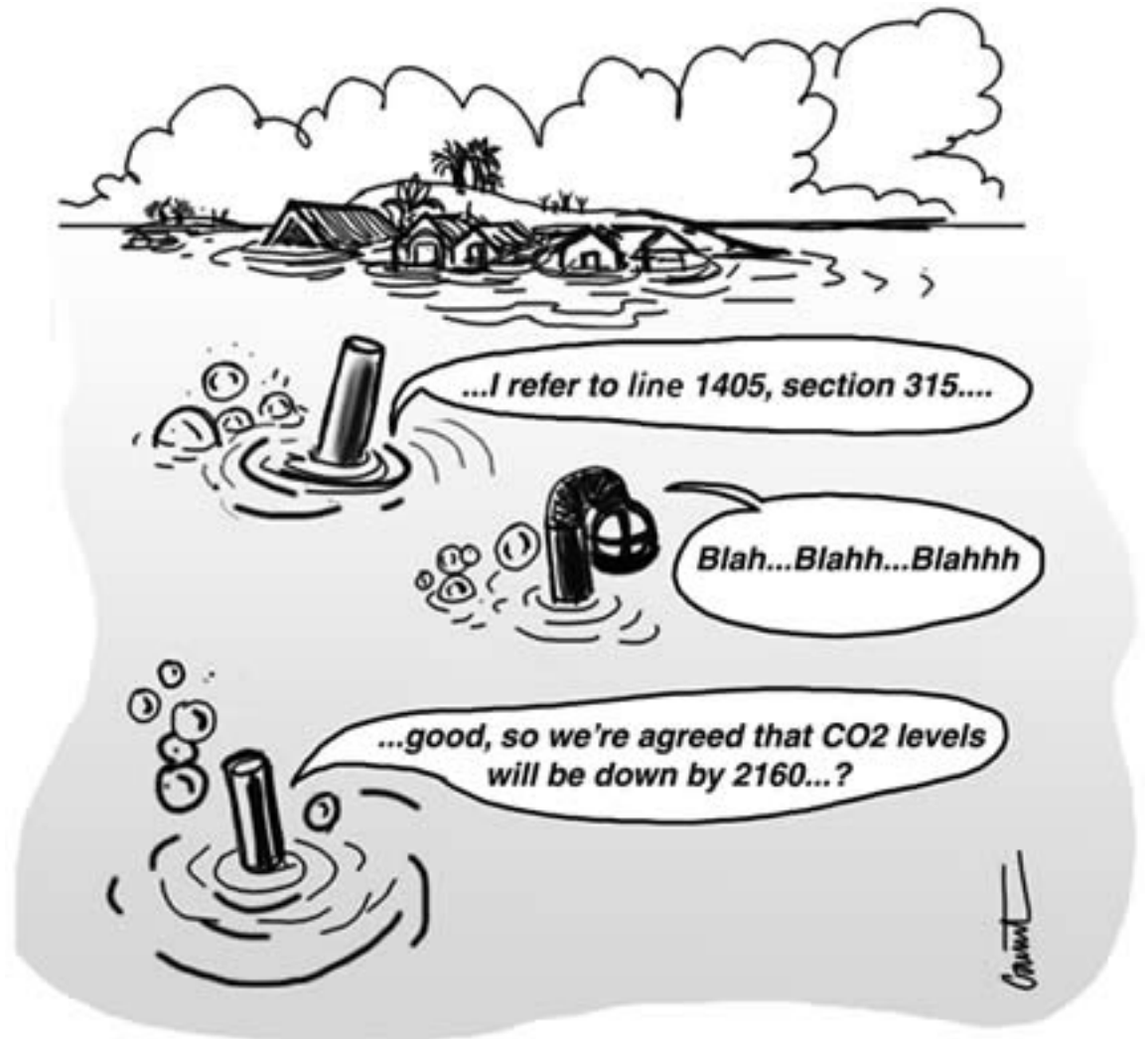
- Warming will continue beyond 2100 under all RCP scenarios except RCP2.6.
- Stabilisation of global average surface temperature does not imply stabilisation for all aspects of the climate system. Shifting biomes, soil carbon, ice sheets, ocean temperatures and associated sea-level rise all have their own intrinsic long timescales which will result in changes lasting hundreds to thousands of years after global surface temperature is stabilised.

§3. Future pathways for adaptation, mitigation and sustainable development



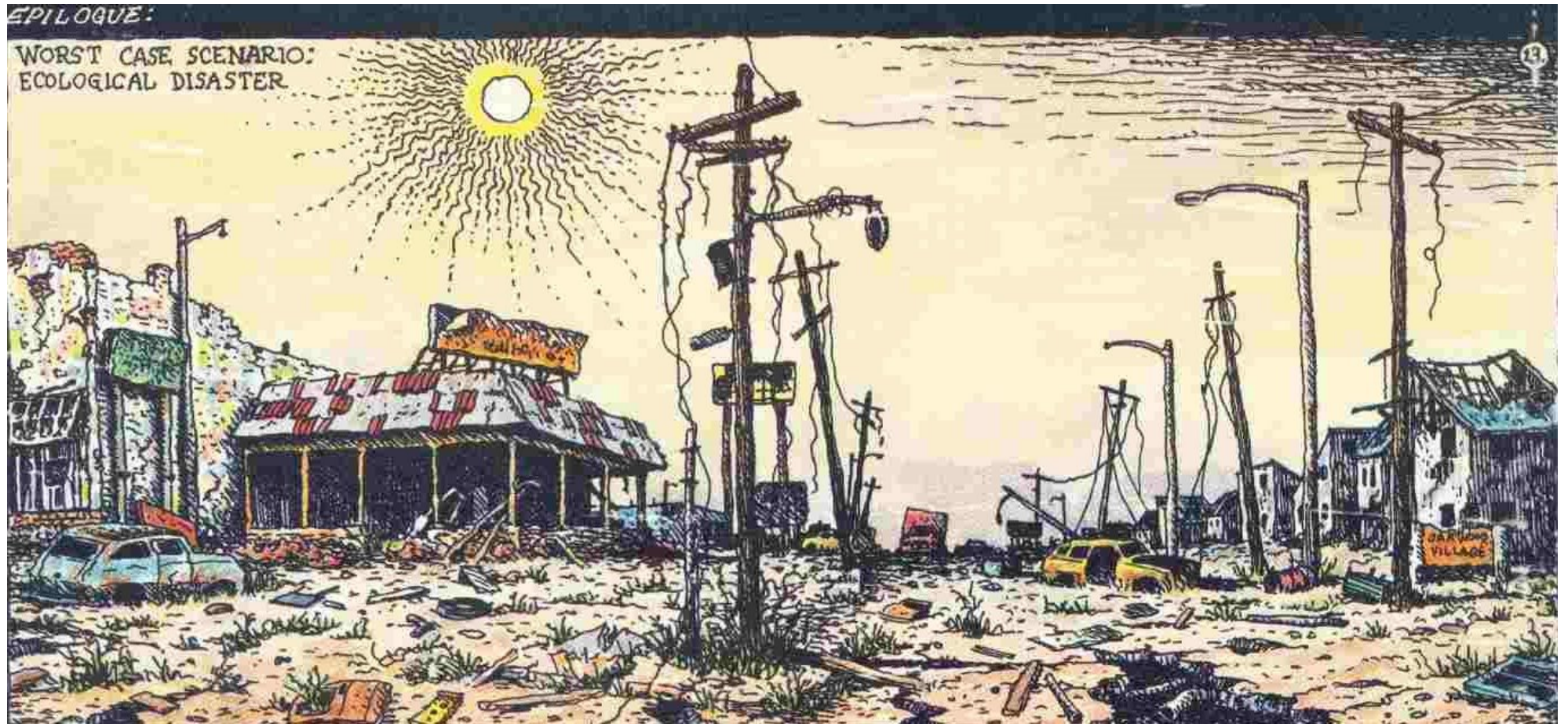
Effective decision making to limit climate change and its effects can be informed by a wide range of analytical approaches for evaluating expected risks and benefits, recognizing the importance of governance, ethical dimensions, equity, value judgments, economic assessments and diverse perceptions and responses to risk and uncertainty.

- Mitigation and adaptation raise issues of equity, justice, and fairness.
- Effective mitigation will not be achieved if individual agents [e.g., individual, community, company, country] advance their own interests independently.



EPILOGUE:

WORST CASE SCENARIO:
ECOLOGICAL DISASTER



Without additional mitigation efforts beyond those in place today, and even with adaptation, warming by the end of the 21st century will lead to high to very high risk of **severe, widespread, and irreversible** impacts globally (*high confidence*).

The risks associated with temperatures at or above 4°C include

- substantial species extinction,
- global and regional food insecurity,
- consequential constraints on common human activities,
- and limited potential for adaptation in some cases
(*high confidence*).

Characteristics of adaptation pathways

- Adaptation can reduce the risks of climate change impacts, but there are limits to its effectiveness, especially with greater magnitudes and rates of climate change.
- A first step towards adaptation to future climate change is reducing vulnerability and exposure to present climate variability (*high confidence*). Integration of adaptation into planning, including policy design, and decision making can promote synergies with development and disaster risk reduction. Building adaptive capacity is crucial for effective selection and implementation of adaptation options (*high agreement, robust evidence*).

Characteristics of adaptation pathways

- Indigenous, local, and traditional knowledge systems and practices, including indigenous peoples' holistic view of community and environment, are a major resource for adapting to climate change, but these have not been used consistently in existing adaptation efforts.
- Common constraints on implementation arise from the following: limited financial and human resources; **limited integration or coordination of governance**; uncertainties about projected impacts; different perceptions of risks; **competing values**; absence of key adaptation leaders and advocates; and limited tools to monitor adaptation effectiveness.

Characteristics of mitigation pathways

There are multiple mitigation pathways that are likely to limit warming to below 2°C relative to pre-industrial levels. These pathways would require substantial emissions reductions over the next few decades and near zero emissions of CO₂ and other long-lived GHGs by the end of the century. Implementing such reductions poses substantial technological, economic, social, and institutional challenges ...



Characteristics of mitigation pathways

- baseline scenarios: 3.7 – 4.8 °C
 - 2.5 – 7.8 °C when including climate uncertainty
- less than 2°C means:
 - 450 ppm CO₂-eq
 - 40% to 70% greenhouse gas emission cut by 2050
 - zero emission by 2100
- limited evidence
 - 430 ppm CO₂-eq
 - less than 1.5°C with a probability more than 50%
 - 70-95% cut by 2050



Estimated global emissions levels in 2020 based on the Cancún Pledges are not consistent with cost-effective mitigation trajectories that are at least about as likely as not to limit warming to below 2°C relative to pre-industrial levels, but they do not preclude the option to meet this goal (*high confidence*).

- ... bioenergy with carbon dioxide capture and storage (BECCS) and afforestation in the second half of the century. The availability and scale of these and other Carbon Dioxide Removal (CDR) technologies and methods are uncertain and CDR technologies are, to varying degrees, associated with challenges and risks.
- ... annualized reduction of consumption growth by 0.04 to 0.14 (median: 0.06) percentage points over the century ...
- Solar Radiation Management (SRM) ... is untested and is not included in any of the mitigation scenarios. If it were deployed, SRM would entail numerous uncertainties, side-effects, risks, shortcomings and has particular governance and ethical implications. SRM would not reduce ocean acidification. If it were terminated, there is *high confidence* that surface temperatures would rise very rapidly impacting ecosystems susceptible to rapid rates of change.

§4. Adaptation and mitigation

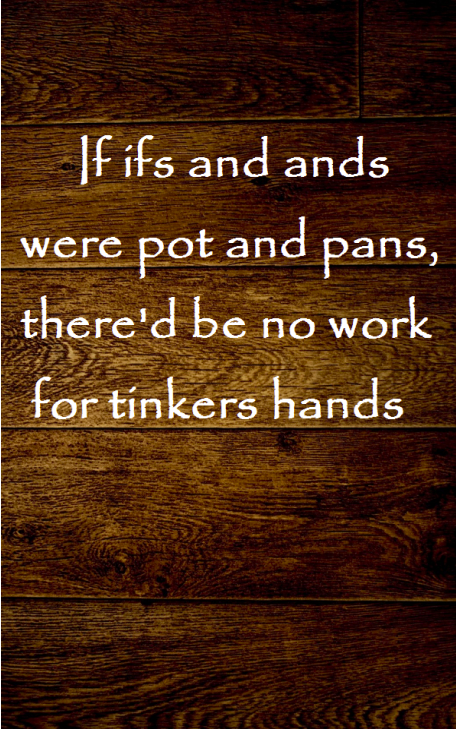
- Adaptation and mitigation responses are underpinned by common enabling factors. These include effective institutions and governance, innovation and investments in environmentally sound technologies and infrastructure, sustainable livelihoods, and behavioral and lifestyle choices.
- Mitigation can be more cost-effective if using an integrated approach that combines measures to reduce energy use and the GHG intensity of end-use sectors, decarbonize energy supply, reduce net emissions and enhance carbon sinks in land-based sectors.

In scenarios reaching 450 ppm CO₂-eq concentrations by 2100, global CO₂ emissions from the energy supply sector ... are characterized by reductions of 90% or more below 2010 levels between 2040 and 2070. In the majority of low-concentration stabilization scenarios ... the share of low-carbon electricity supply increases from the current share of approximately 30% to more than 80% by 2050, and fossil fuel power generation without CCS is phased out almost entirely by 2100.



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- In principle, mechanisms that set a carbon price, including cap and trade systems and carbon taxes, can achieve mitigation in a cost-effective way, but have been implemented with diverse effects due in part to national circumstances as well as policy design. The short-run effects of cap and trade systems have been limited as a result of loose caps or caps that have not proved to be constraining (*limited evidence, medium agreement*).
- Regulatory approaches and information measures are widely used and are often environmentally effective (*medium evidence, medium agreement*).



If ifs and ands
were pot and pans,
there'd be no work
for tinkers hands

Sector-specific mitigation policies have been more widely used than economy-wide policies. ... Although theoretically more cost-effective, administrative and political barriers may make economy wide policies harder to implement.

