

A large, solid orange geometric shape, resembling a stylized 'L' or a corner, is positioned on the left side of the cover. It starts from the top-left corner and extends diagonally down to the bottom-left, then continues horizontally to the right.

IPCC 5. ASSESSMENT REPORT

**WORKING GROUP 1
THE PHYSICAL SCIENCE BASIS**

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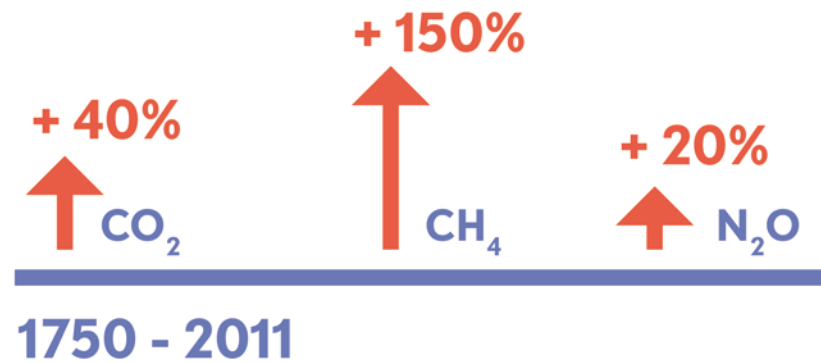
OBSERVED CHANGES



SINCE 1950, CHANGES HAVE BEEN OBSERVED THROUGHOUT THE CLIMATE SYSTEM.

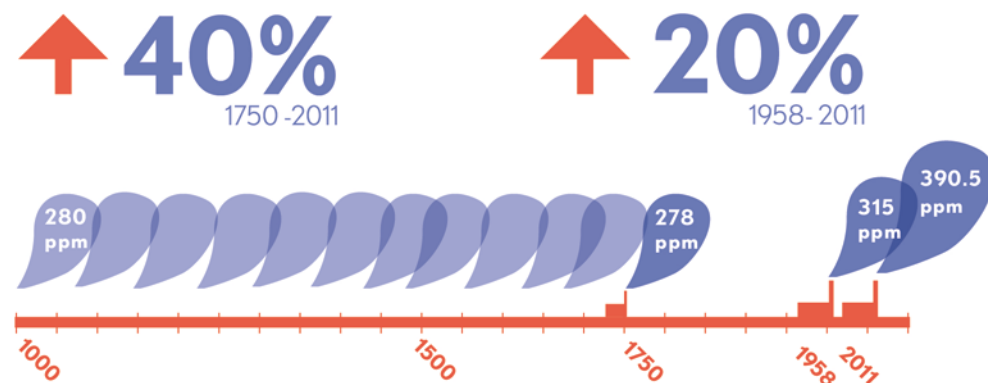
The atmosphere and ocean have warmed, the extent and volume of snow and ice have diminished, and sea level has risen. Many of these observed changes are unusual or unprecedented on time scales of decades to millennia.

CONCENTRATIONS OF GREENHOUSE GASES HAVE INCREASED SINCE 1750.



Since pre-industrial times.

CO₂ CONCENTRATIONS HAVE INCREASED IN THE ATMOSPHERE.

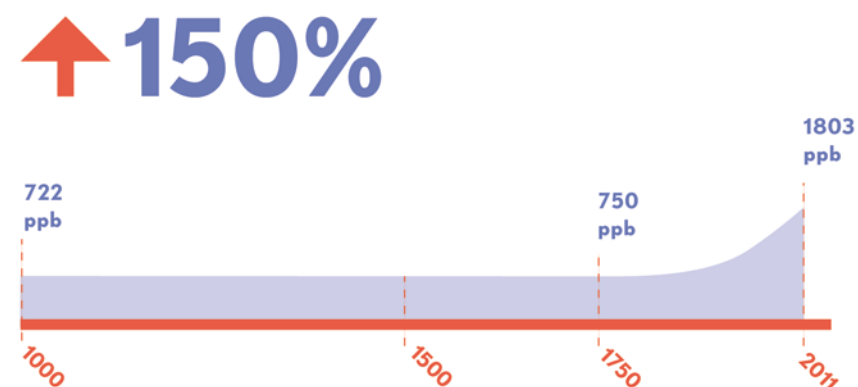


TOP PRODUCERS OF CO₂:

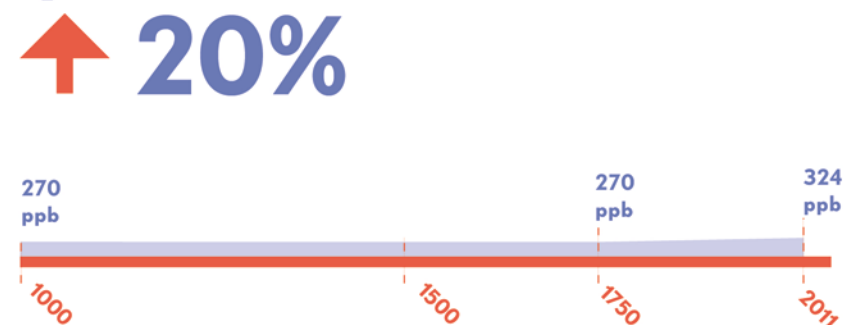
- 1. Fossil fuels**
(375 PgC since 1750; includes cement production)
- 2. Deforestation**
(180 PgC since 1750)

PgC = Billion tonnes of carbon

METHANE CONCENTRATIONS HAVE INCREASED



N₂O CONCENTRATIONS HAVE INCREASED



Present-day concentrations of CO₂, methane (CH₄), and nitrous oxide (N₂O) substantially exceed the range of concentrations recorded in ice cores during the past 800,000 years.

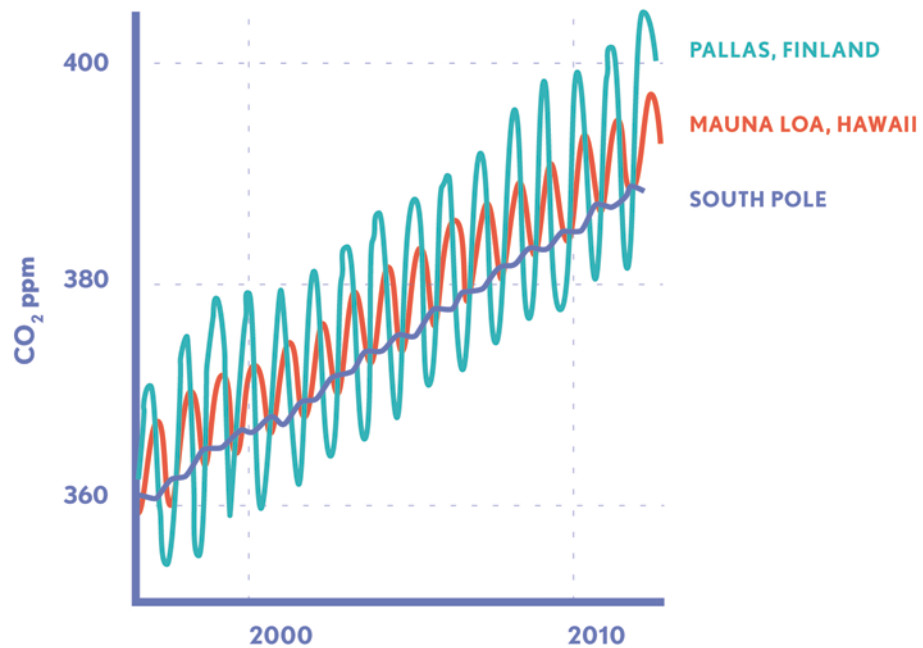
OBSERVED CHANGES: CHANGES IN THE ATMOSPHERE

GLOBAL CO₂ CONCENTRATIONS:

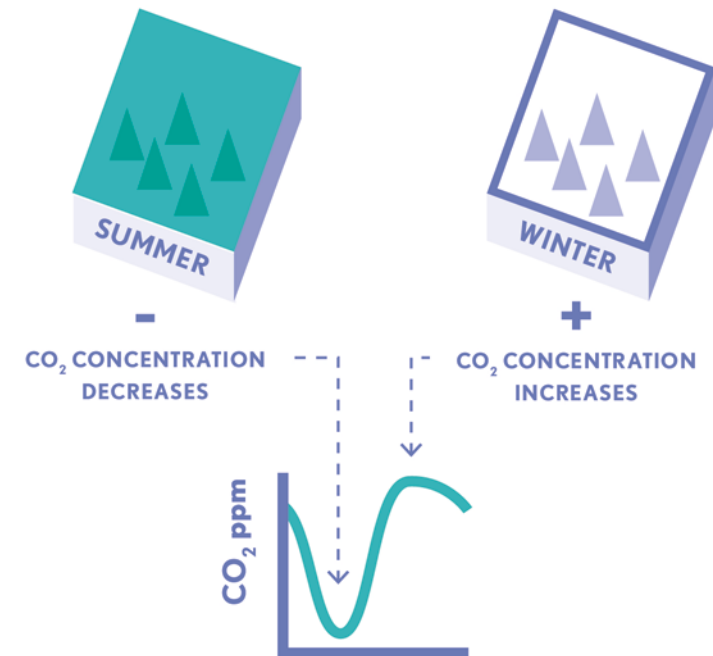
PALLAS, FINLAND

MAUNA LOA, HAWAII

SOUTH POLE

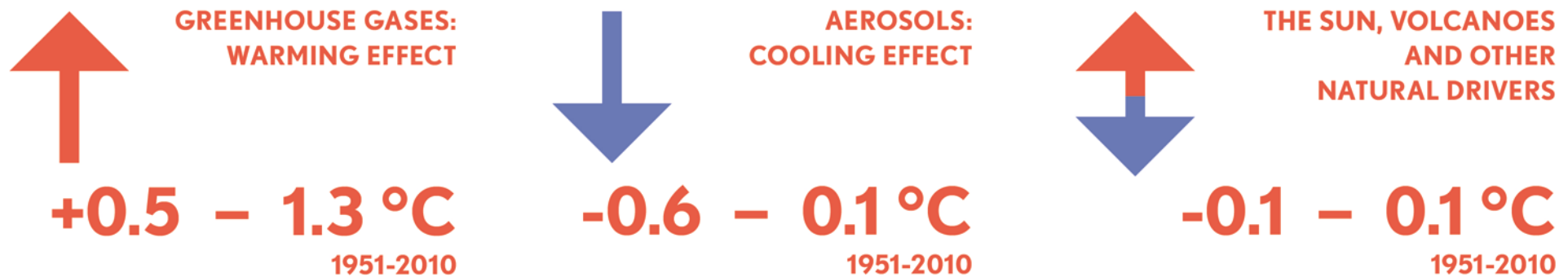


NORTHERN HEMISPHERE



In summer: Photosynthesis absorbs CO₂ temporarily from the atmosphere.

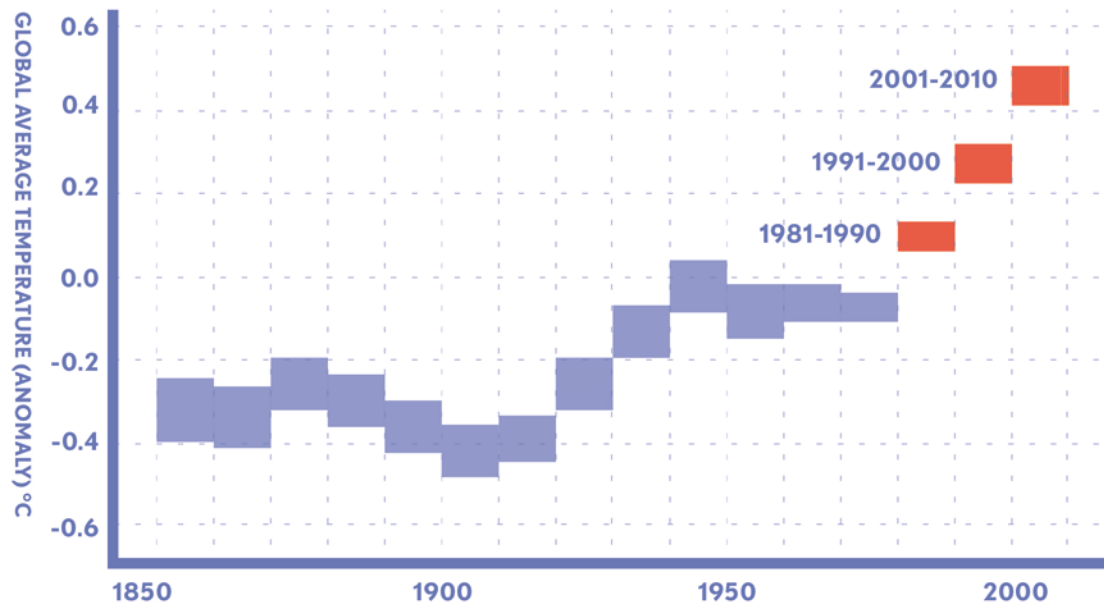
In winter: CO₂ is released from the soil.



Radiative forcing indicates the difference between radiant energy received by the earth and energy radiated back to space. A positive forcing has a warming effect on climate whereas a negative forcing has a cooling effect.

- Moreover, temperatures have fluctuated by $\pm 0,1^{\circ}\text{C}$ due to internal variability.
- Unlike other aerosols black carbon has a warming effect on climate.

EACH OF THE LAST 3 DECADES HAS BEEN WARMER THAN ALL PRECEDING DECADES SINCE 1850.



AVERAGE COMBINED LAND AND OCEAN TEMPERATURE

↑ +0,85 °C
1880-2012

OCEANS HAVE WARMED AND THE SEA LEVEL HAS RISEN.

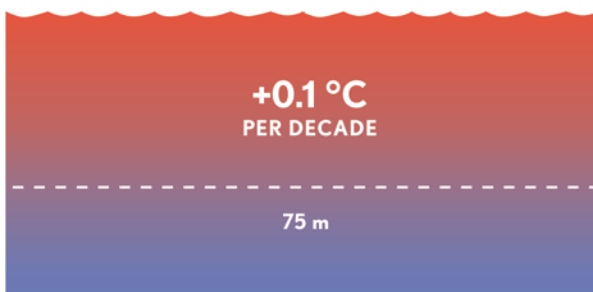


It is virtually certain that the upper ocean (0–700 m) has warmed from 1971 to 2010. Since the 1990s, when sufficient deep-ocean observations have become available to allow an assessment, the deep ocean below 3000 m depth has likely warmed.

OCEAN WARMING

OCEAN WARMING IS LARGEST NEAR THE SURFACE

and exceeds 0.1°C per decade in the upper 75 m between 1971- 2010.



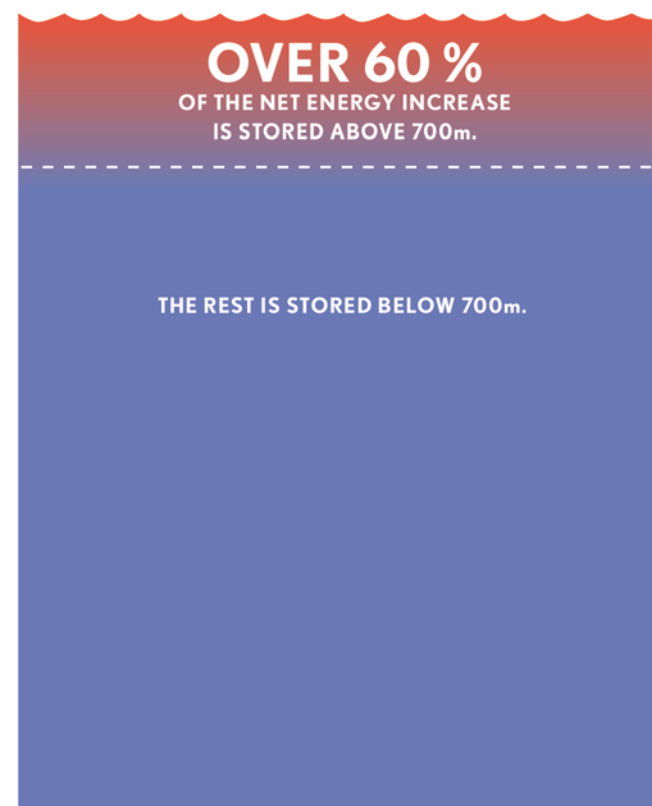
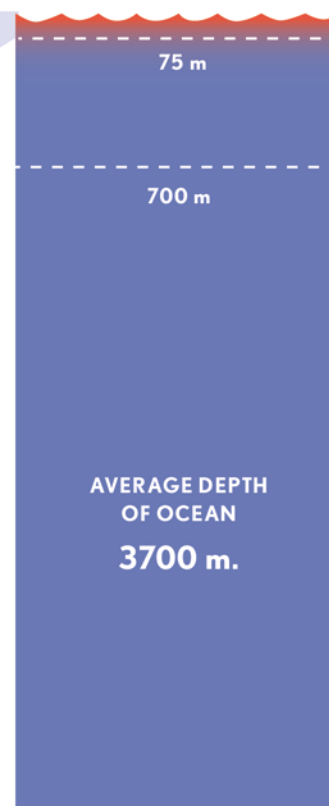
LAND, ICE, ATMOSPHERE

OCEAN

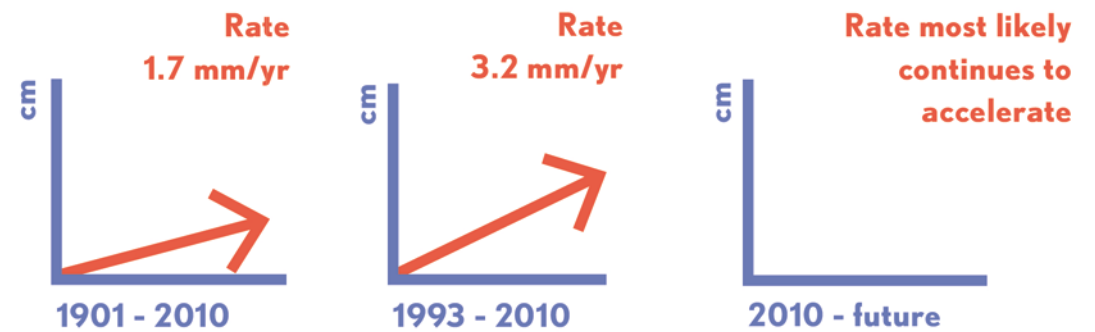
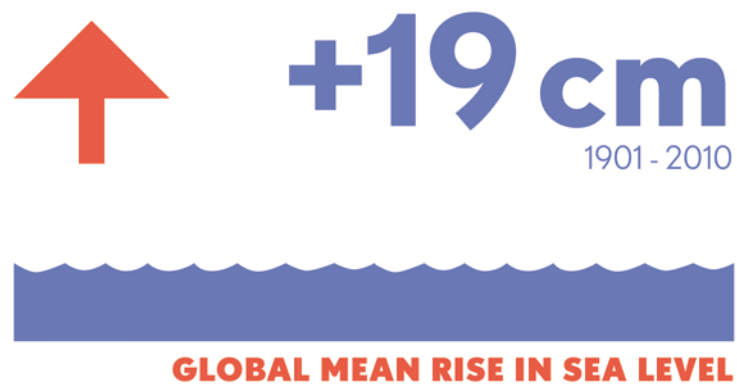
>90%

1971-2010

Over 90 % of energy gain is stored in the ocean. Ocean warming dominates the change in energy stored in the climate system.



RISE IN SEA LEVEL



The rate of global mean sea level rise has accelerated during the last two centuries.

LATE SUMMER ARCTIC SEA ICE COVER



SPRING SNOW COVER IN CONTINENTAL AREAS



There is stronger evidence that the ice sheets and glaciers worldwide are losing mass and sea ice cover is decreasing in the Arctic, while the Antarctic sea ice cover shows a small increase. Northern Hemisphere spring snow cover is decreasing and permafrost is thawing.

THE TOTAL ARCTIC SUMMER SEA ICE EXTENT HAS DECREASED FROM:

11 000 000 km² in 1900 → **6 000 000** km² in 2010

TOTAL LOSS: About 5 000 000 km²



In comparison:

Area of 6th largest country Australia: 7 692 024 km²

Area of 7th largest country India: 3 166 414 km²

SPRING SNOW COVER

-1.6%

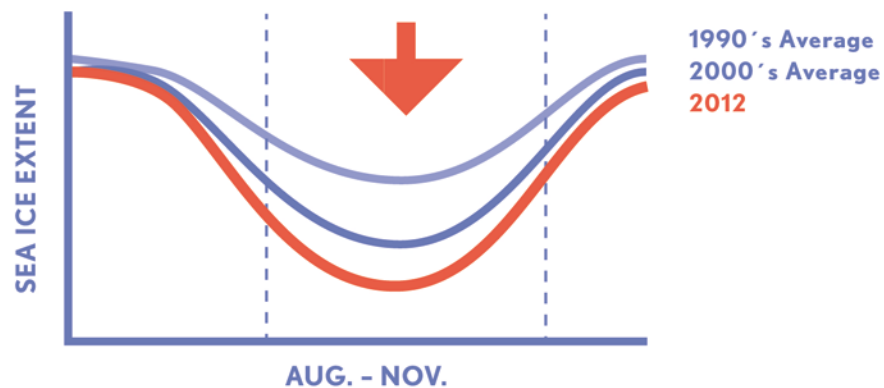
PER DECADE
SINCE 1967



MARCH AND APRIL NORTHERN HEMISPHERE SNOW COVER EXTENT

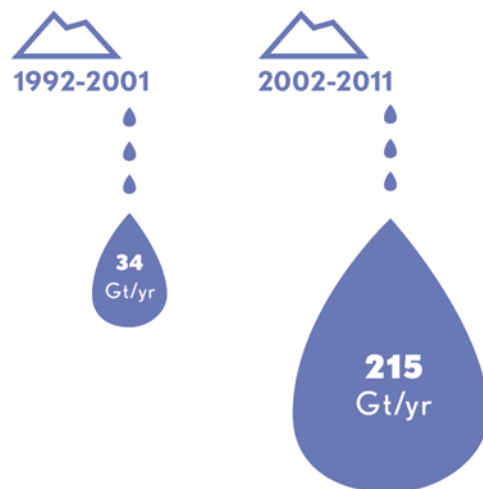
There is very high confidence that Northern Hemisphere snow cover extent has decreased since the mid- 20th century, especially in spring and early summer.

THE AVERAGE DECREASE IN DECADAL MEAN EXTENT OF ARCTIC SEA ICE HAS BEEN MOST RAPID IN SUMMER AND AUTUMN:



GREENLAND ICE SHEET

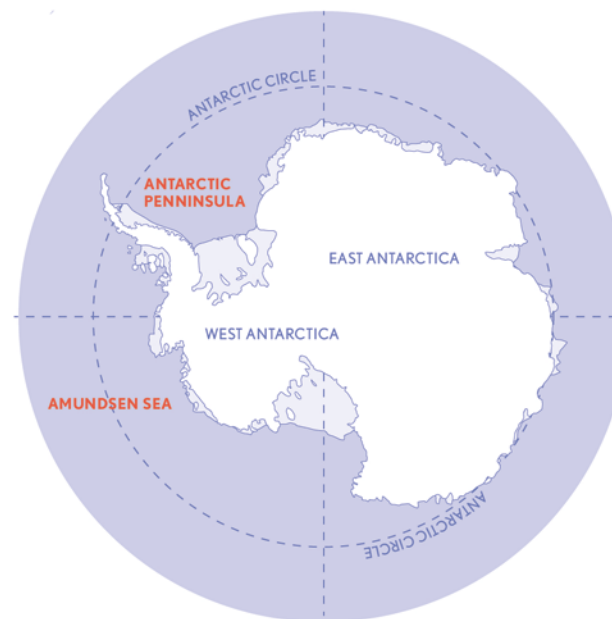
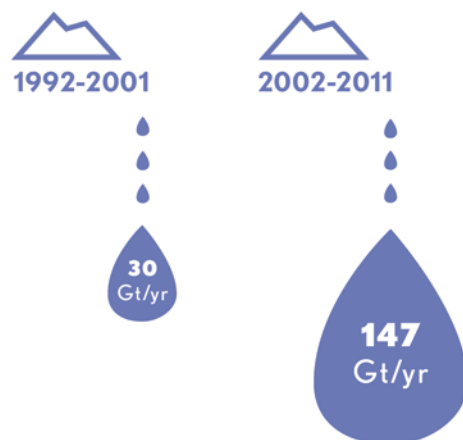
Rate of loss



ANTARCTIC ICE SHEET

Rate of loss

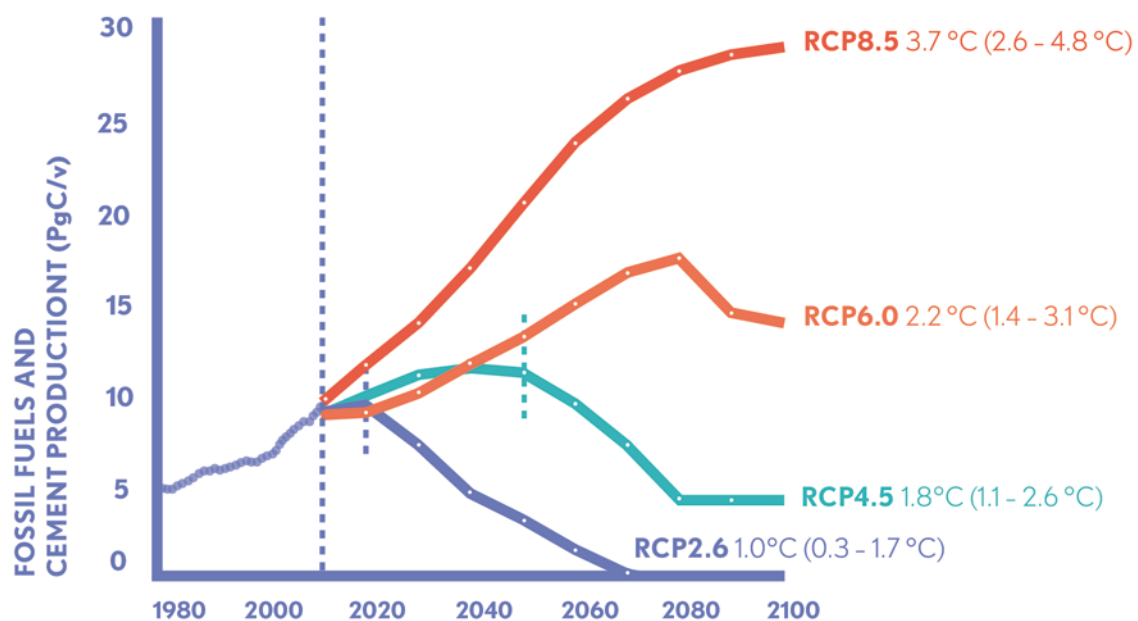
Losses are mainly from the northern Antarctic Peninsula and the Amundsen Sea sector of West Antarctica.



FUTURE OUTLOOK

REPRESENTATIVE CONCENTRATION PATHWAYS (RCP)

For the Fifth Assessment Report of IPCC, the scientific community has defined a set of four new greenhouse gas scenarios, referred to as the Representative Concentration Pathways (RCP).



RCP 8.5

Emissions of greenhouse gases continue to grow at current rate

RCP 6.0

RCP 4.5

RCP 2.6

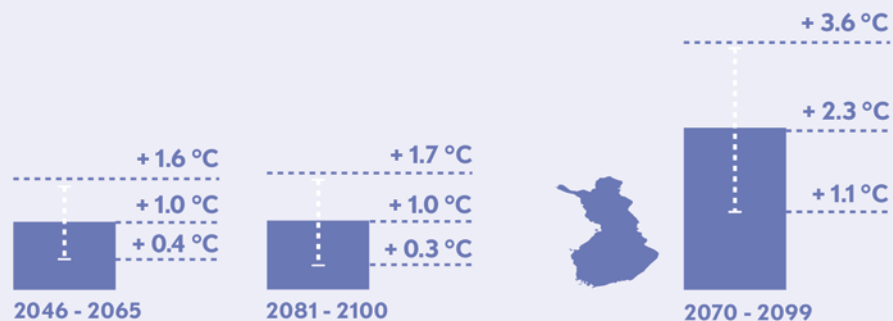
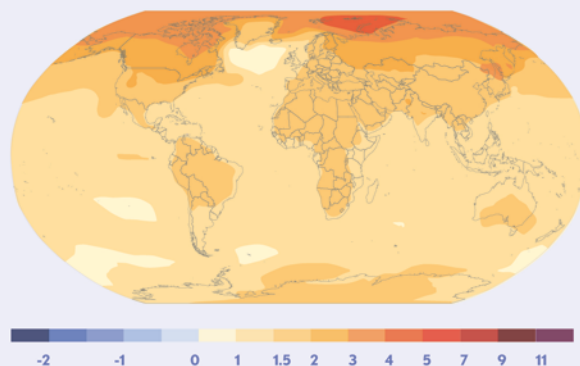
Substantial reductions of greenhouse gas emissions

RCP 2.6

Substantial reductions of greenhouse gas emissions

CHANGE IN AVERAGE TEMPERATURE PREDICTED BY MODELS:

2081-2100



PROJECTED GLOBAL AVERAGE

AVERAGE SURFACE TEMPERATURE INCREASE FINLAND

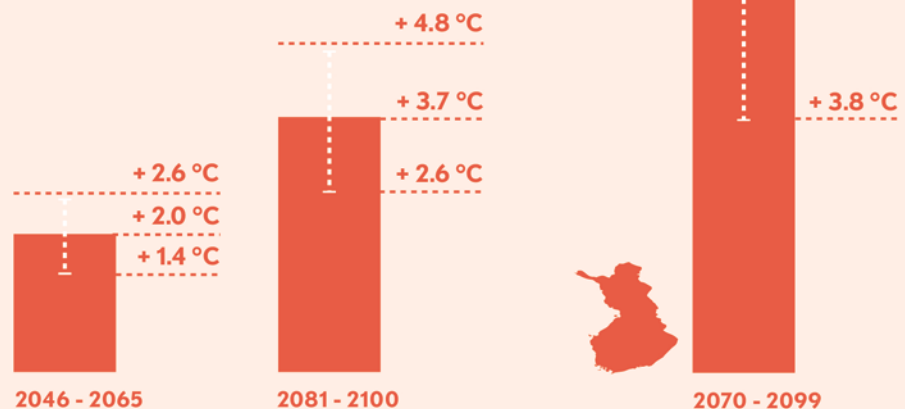
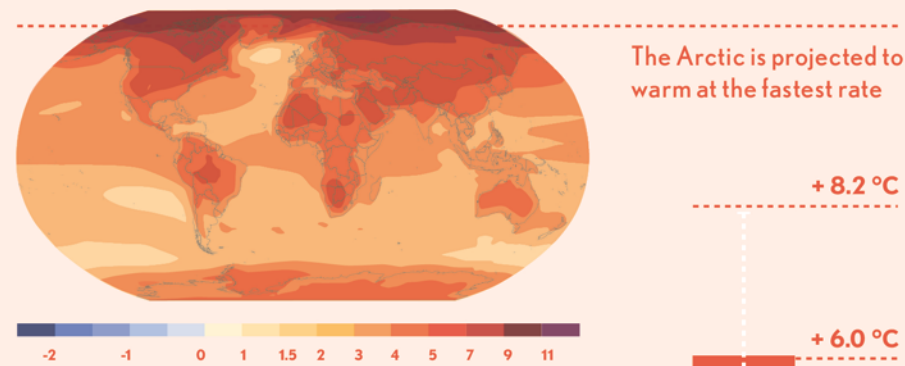
ANOMALIES CALCULATED WITH RESPECT TO 1986-2005.
FINLAND, ANOMOLIES CALCULATED WITH RESPECT TO 1971-2000.

RCP 8.5

Emissions of greenhouse gases continue to grow at current rate

CHANGE IN AVERAGE TEMPERATURE PREDICTED BY MODELS:

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PROJECTED GLOBAL AVERAGE

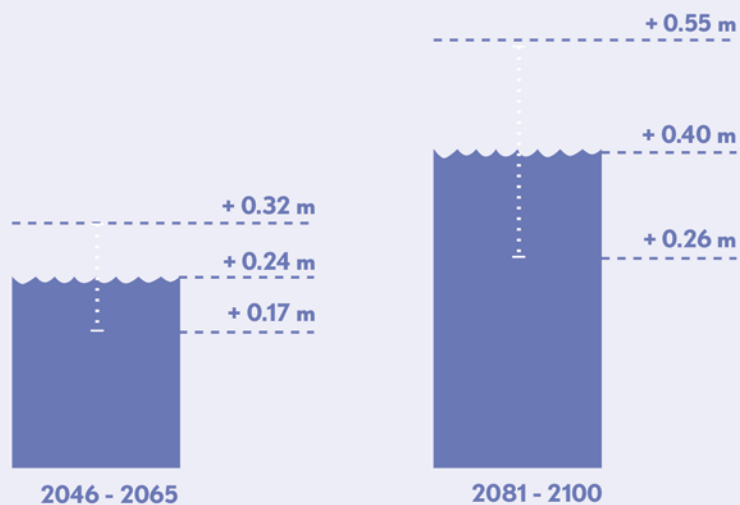
AVERAGE SURFACE TEMPERATURE INCREASE FINLAND

ANOMALIES CALCULATED WITH RESPECT TO 1986-2005.
FINLAND, ANAMOLIES CALCULATED WITH RESPECT TO 1971-2000.

RCP 2.6

Substantial reductions of greenhouse gas emissions

GLOBAL MEAN SEA LEVEL RISE (m) FROM 1986-2005.



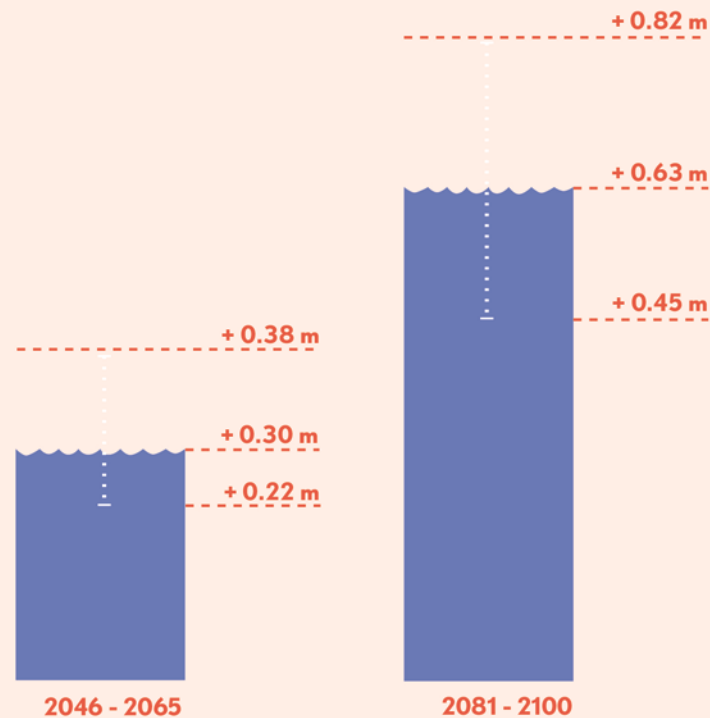
Sea level rise continues long after the rise in temperatures has stabilized, as changes in the ocean occur slowly.

ANOMALIES CALCULATED WITH RESPECT TO 1986-2005.

RCP 8.5

Emissions of greenhouse gases continue to grow at current rate

GLOBAL MEAN SEA LEVEL RISE (M) FROM 1986-2005.



ANOMALIES CALCULATED WITH RESPECT TO 1986-2005.

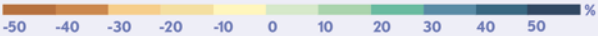
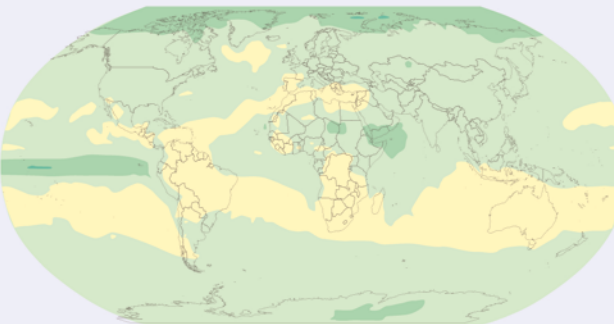
Future estimates include a calculated best estimate and a confidence interval.

Based on IPCC Assessment Report 5, Working Group 1.

RCP 2.6

Substantial reductions of greenhouse gas emissions

CHANGE IN PRECIPITATION: BETWEEN 2081-2100



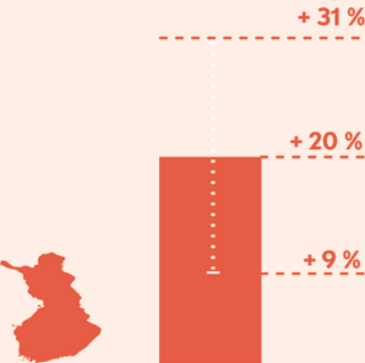
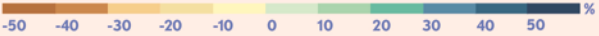
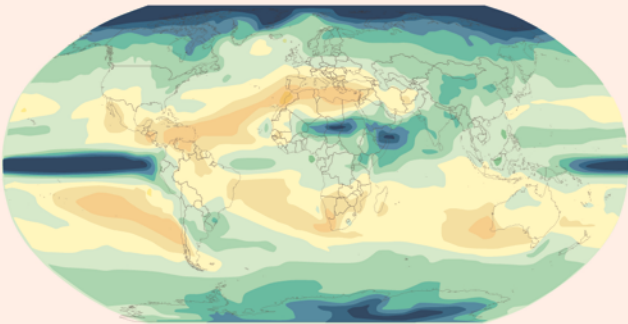
AVERAGE INCREASE IN PRECIPITATION: BETWEEN 2070-2099

ANOMALIES CALCULATED WITH RESPECT TO 1986-2005.
FINLAND, ANAMOLIES CALCULATED WITH RESPECT TO 1971-2000.

RCP 8.5

Emissions of greenhouse gases continue to grow at current rate

CHANGE IN PRECIPITATION: BETWEEN 2081-2100



AVERAGE INCREASE IN PRECIPITATION: BETWEEN 2070-2099

ANOMALIES CALCULATED WITH RESPECT TO 1986-2005.
FINLAND, ANAMOLIES CALCULATED WITH RESPECT TO 1971-2000.

RCP 2.6

Substantial reductions of greenhouse gas emissions

DECREASE IN NORTHERN HEMISPHERE SPRING SNOW COVER BY 2100.



DECREASE IN ARCTIC SEA ICE EXTENT 2081-2100.



DECREASE IN MOUNTAIN GLACIER VOLUME BY 2100.



DECREASE IN NEAR-SURFACE PERMAFROST AREA BY 2100.

ANOMALIES CALCULATED WITH RESPECT TO 1986-2005.



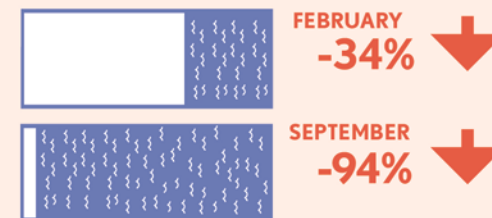
RCP 8.5

Emissions of greenhouse gases continue to grow at current rate

DECREASE IN NORTHERN HEMISPHERE SPRING SNOW COVER BY 2100.



DECREASE IN ARCTIC SEA ICE EXTENT 2081-2100.

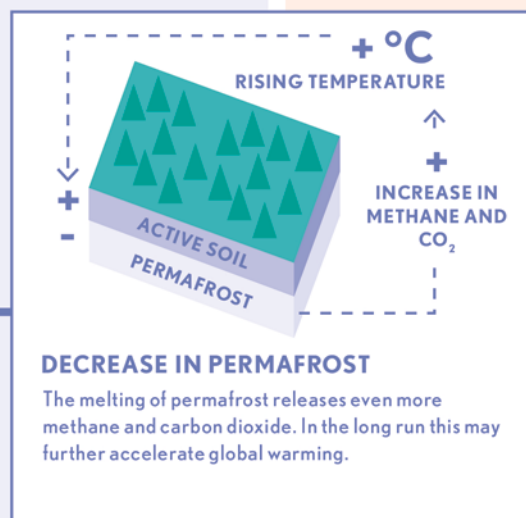


DECREASE IN MOUNTAIN GLACIER VOLUME BY 2100.



DECREASE IN NEAR-SURFACE PERMAFROST AREA BY 2100.

ANOMALIES CALCULATED WITH RESPECT TO 1986-2005.



FUTURE OUTLOOK:

Continued emissions of greenhouse gases would cause further warming.
Limiting climate change would require substantial and sustained reductions of CO₂ emissions.

CLIMATE CHANGE IN A NUTSHELL

CONCENTRATIONS OF CO₂ AND OTHER GREENHOUSE GASES HAVE INCREASED IN THE ATMOSPHERE.



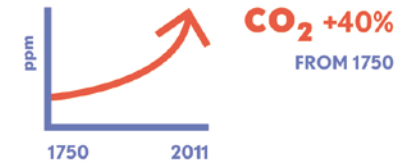
CAUSES:

- Burning of fossil fuels
- Deforestation and other land use
- Cement production



2011 CO₂ CONCENTRATIONS:

390 ppm



AS A RESULT



SEA LEVEL &
OCEAN TEMPERATURE



ATMOSPHERE



CRYOSPHERE



OCEAN
ACIDIFICATION



INCREASE IN
HOT DAYS/ NIGHTS



SNOW COVER



INCREASE OF DROUGHT
IN WIDESPREAD AREAS



INCREASE IN HEAVY RAIN
IN WIDESPREAD AREAS



DECREASE IN
COLD DAYS/ NIGHTS



INCREASE IN INTENSE
TROPICAL CYCLONE ACTIVITY
IN MANY AREAS



INCREASE OF HEAT WAVES



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