

# **Klimaatveranderingen : urgentie nog hoger na het zesde IPCC rapport**

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**Studiedag « Hoe gaat onze natuur om met klimaatwijziging? », INBO (Instituut Natuur- en Bosonderzoek), 7 oktober 2021**

**Dank aan de Waalse regering voor zijn ondersteuning aan [www.plateforme-wallonne-giec.be](http://www.plateforme-wallonne-giec.be) & mijn ploeg aan UCLouvain**

# The Essential Truth About Climate Change in Ten Words

The basic facts of climate change, established over decades of research, can be summarized in five key points:

IT'S REAL

IT'S US

EXPERTS AGREE

IT'S BAD

THERE'S HOPE

Global warming is happening.

Human activity is the main cause.

There's scientific consensus on human-caused global warming.

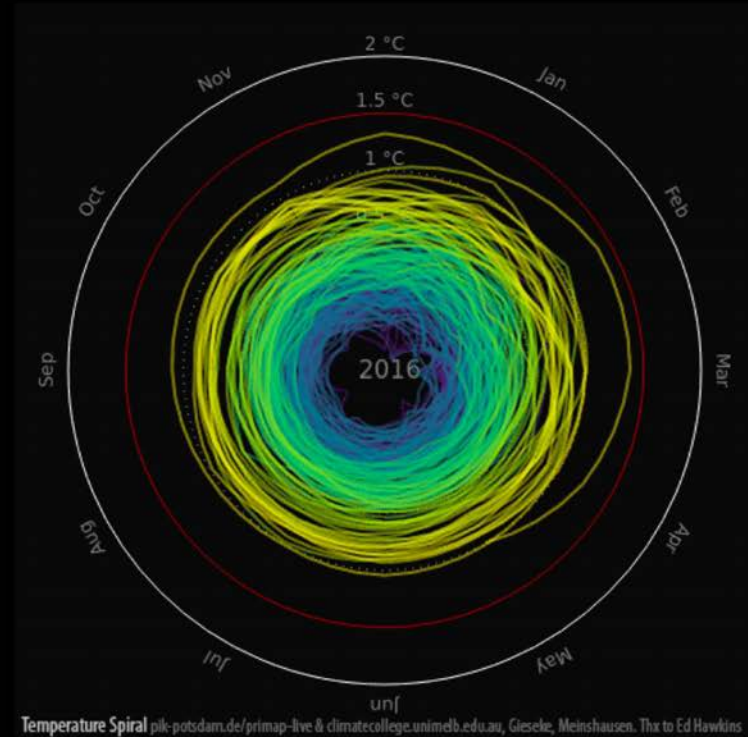
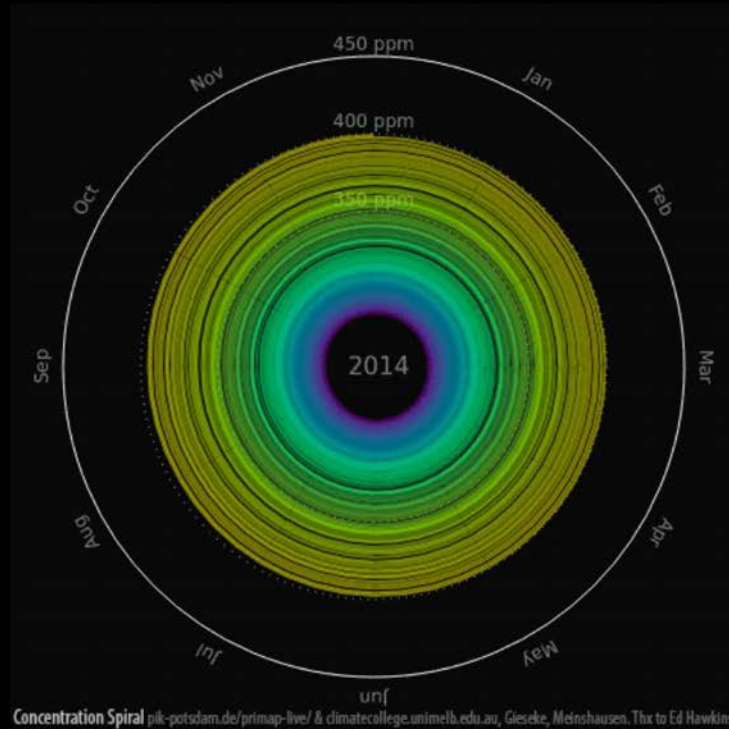
The impacts are serious and affect people.

We have the technology needed to avoid the worst climate impacts.

**Omdat we de atmosfeer gebruiken als  
vuilnisbak voor onze broeikasgassen,  
maken we de isolatielaag rond de  
planeet dikker**

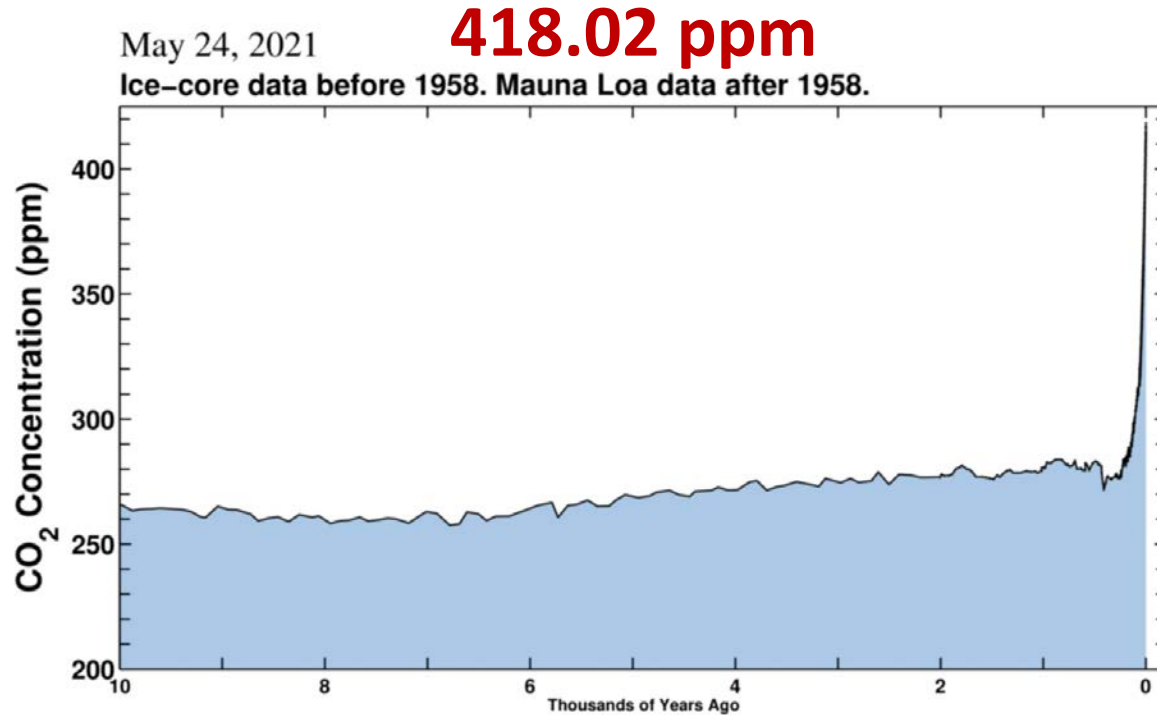
**Daarom moeten we de uitstoot naar  
NUL zo snel mogelijk verminderen**

# CO<sub>2</sub> Concentration and Temperature spirals



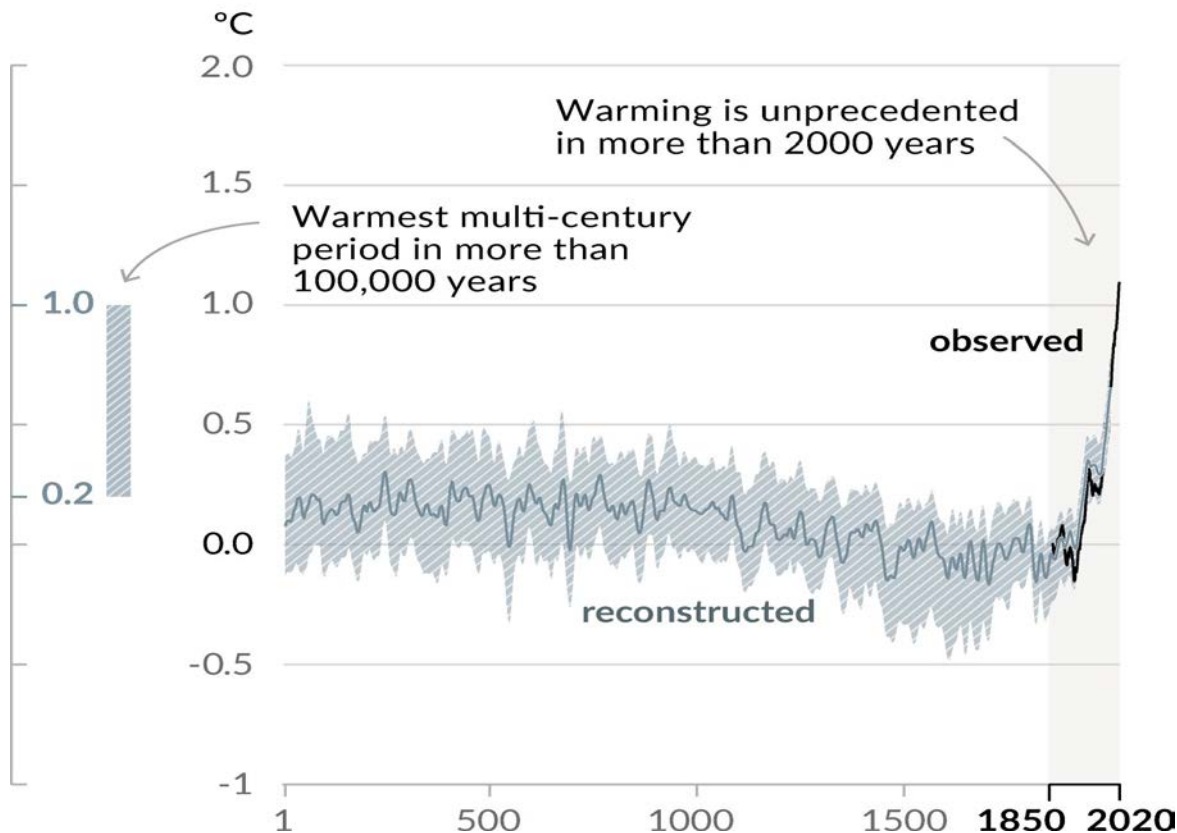
CO<sub>2</sub> Concentration since 1850 and Global Mean Temperature in °C relative to 1850 – 1900  
Graph: Ed Hawkins (Climate Lab Book) – Data: HadCRUT4 global temperature dataset  
Animation available on <http://openclimatedata.net/climate-spirals/concentration-temperature/>

# CO<sub>2</sub> Concentration 24 May 2021 (Keeling curve + last 10000 years)



Source: [scripps.ucsd.edu/programs/keelingcurve/](https://scripps.ucsd.edu/programs/keelingcurve/)

a) Change in global surface temperature (decadal average)  
as **reconstructed** (1-2000) and **observed** (1850-2020)



**Human influence  
has warmed the  
climate at a rate that  
is unprecedented in  
at least the last 2000  
years**

*Figure SPM.1*

# SIXTH ASSESSMENT REPORT

Working Group I – The Physical Science Basis

ipcc

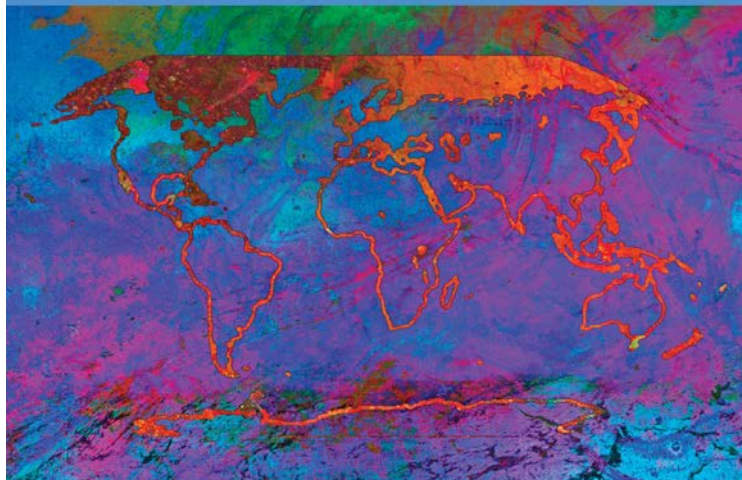
INTERGOVERNMENTAL PANEL ON climate change



## Climate Change 2021

### The Physical Science Basis

Summary for Policymakers

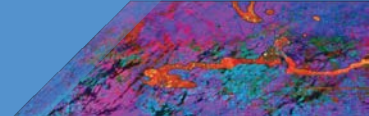


WGI

Working Group I contribution to the  
Sixth Assessment Report of the  
Intergovernmental Panel on Climate Change







## THE WGI AR6 BY THE NUMBERS:

### Author Team

**234** authors from **65**  
countries

**28%** women, **72%** men

**30%** new to the **IPCC**

### Review Process

**14,000** scientific publications  
assessed

**78,000+** review comments

**46** countries commented on Final  
Government Distribution

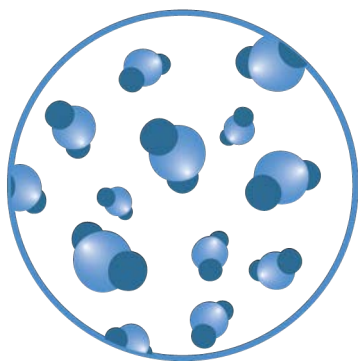


# Key messages from the latest WGI AR6 IPCC Report:

## A. The Current State of the Climate

- A.1** It is unequivocal that human influence has warmed the atmosphere, ocean and land. Widespread and rapid changes in the atmosphere, ocean, cryosphere and biosphere have occurred.
- A.2** The scale of recent changes across the climate system as a whole and the present state of many aspects of the climate system are unprecedented over many centuries to many thousands of years.
- A.3** Human-induced climate change is already affecting many weather and climate extremes in every region across the globe. Evidence of observed changes in extremes such as heatwaves, heavy precipitation, droughts, and tropical cyclones, and, in particular, their attribution to human influence, has strengthened since the Fifth Assessment Report (AR5).
- A.4** Improved knowledge of climate processes, paleoclimate evidence and the response of the climate system to increasing radiative forcing gives a best estimate of equilibrium climate sensitivity of 3°C, with a narrower range compared to AR5.

**CO<sub>2</sub>**  
concentration



**Highest**

in at least

**2 million years**

**Sea level**  
rise



**Fastest rates**

in at least

**3000 years**

**Arctic sea ice**  
area



**Lowest level**

in at least

**1000 years**

**Glaciers**  
retreat



**Unprecedented**

in at least

**2000 years**

# Progression of Understanding: Greater and Greater Certainty in Attribution

AR1 (1990): “unequivocal detection not likely for a decade”

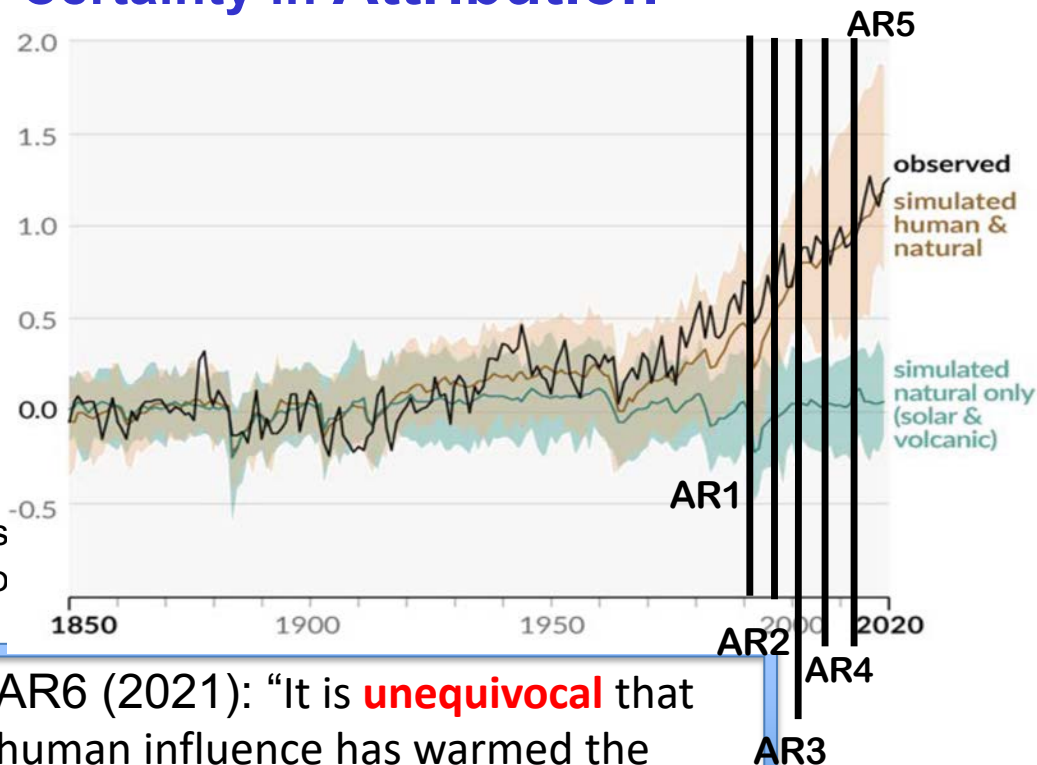
AR2 (1995): “balance of evidence suggests **discernible** human influence”

AR3 (2001): “most of the warming of the past 50 years is **likely** (odds 2 out of 3) due to human activities”

AR4 (2007): “most of the warming is **very likely** (odds 9 out of 10) due to greenhouse gases”

AR5 (2013) «It is **extremely likely** (odds 95 out of 100) that human influence has been the dominant cause... »

AR6 (2021): “It is **unequivocal** that human influence has warmed the atmosphere, ocean, and land.”



## **IPCC WGI AR6:**

**« Climate change is already affecting every inhabited region across the globe, with human influence contributing to many observed changes in weather and climate extremes »**

## Human-induced climate change is already affecting many weather and climate extremes in every region across the globe



**Extreme heat**

More frequent

More intense



**Heavy rainfall**

More frequent

More intense



**Drought**

Increase in some  
regions



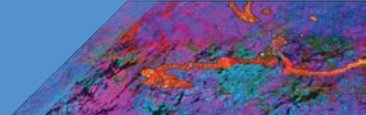
**Fire weather**

More frequent



**Ocean**

Warming  
Acidifying  
Losing oxygen



## A.3 Human-induced climate change is already affecting many weather and climate extremes in every region across the globe

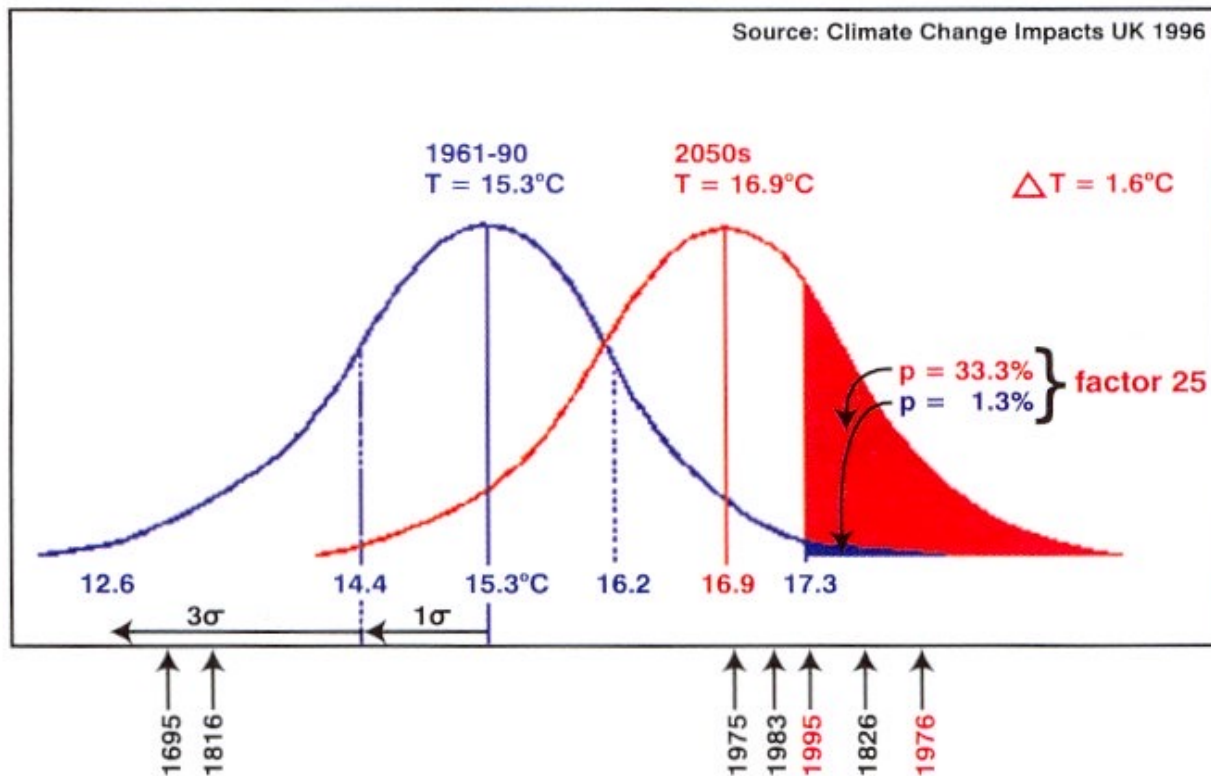
It is virtually certain that **hot extremes** (including heatwaves) have become more frequent and more intense across most land regions since the 1950s

The frequency and intensity of **heavy precipitation events** have increased since the 1950s over most land area (...) (high confidence), and human-induced climate change is likely the main driver.



# Increasing Probabilities of Extremes

Example: Summer Temperatures in Central England





# Heat waves kill (Ex: 2003 summer in EU: 70000 deaths)



Une personne âgée dans un couloir des urgences du centre hospitalier de Versailles en août 2003. | AFP PHOTO MARTIN BUREAU

# Observed changes in hot extremes since 1950

Figure SPM.3

a) Synthesis of assessment of observed change in **hot extremes** and confidence in human contribution to the observed changes in the world's regions

Type of observed change  
in hot extremes



Increase (41)



Decrease (0)



Low agreement in the type of change (2)



Limited data and/or literature (2)

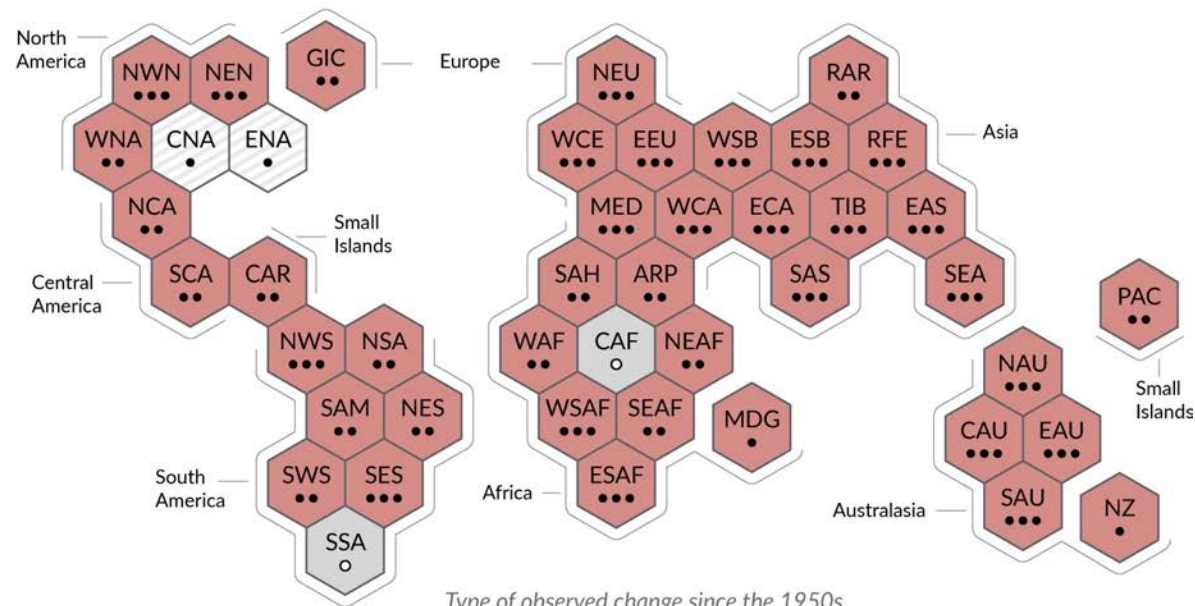
Confidence in human contribution  
to the observed change

●●● High

●● Medium

● Low due to limited agreement

○ Low due to limited evidence



Type of observed change since the 1950s

**WARMER AIR**



**MORE EVAPORATION**



**MORE PRECIPITATION**

**Available  
water**

1°C  
7%

**increase =  
more water vapor**

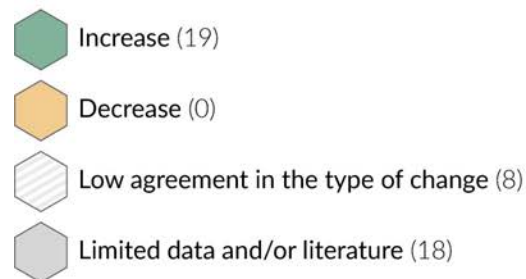
**- Temperature +**

## Observed changes in heavy precipitation since 1950

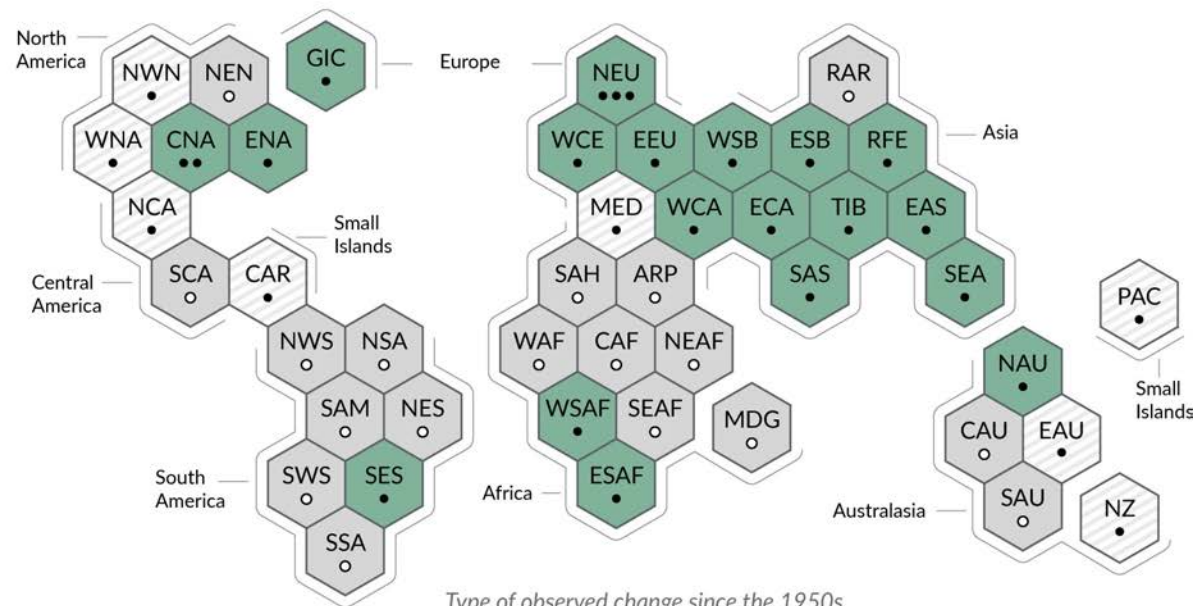
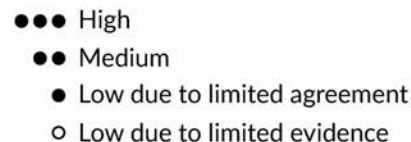
Figure SPM.3

b) Synthesis of assessment of observed change in **heavy precipitation** and confidence in human contribution to the observed changes in the world's regions

Type of observed change in heavy precipitation



Confidence in human contribution to the observed change





## Wallonia Floods, July 2021



Source:  
VRT Nieuws

## Observed changes in agricultural and ecological drought since 1950

c) Synthesis of assessment of observed change in **agricultural and ecological drought** and confidence in human contribution to the observed changes in the world's regions

Type of observed change  
in agricultural and ecological drought

● Increase (12)

● Decrease (1)

● Low agreement in the type of change (28)

● Limited data and/or literature (4)

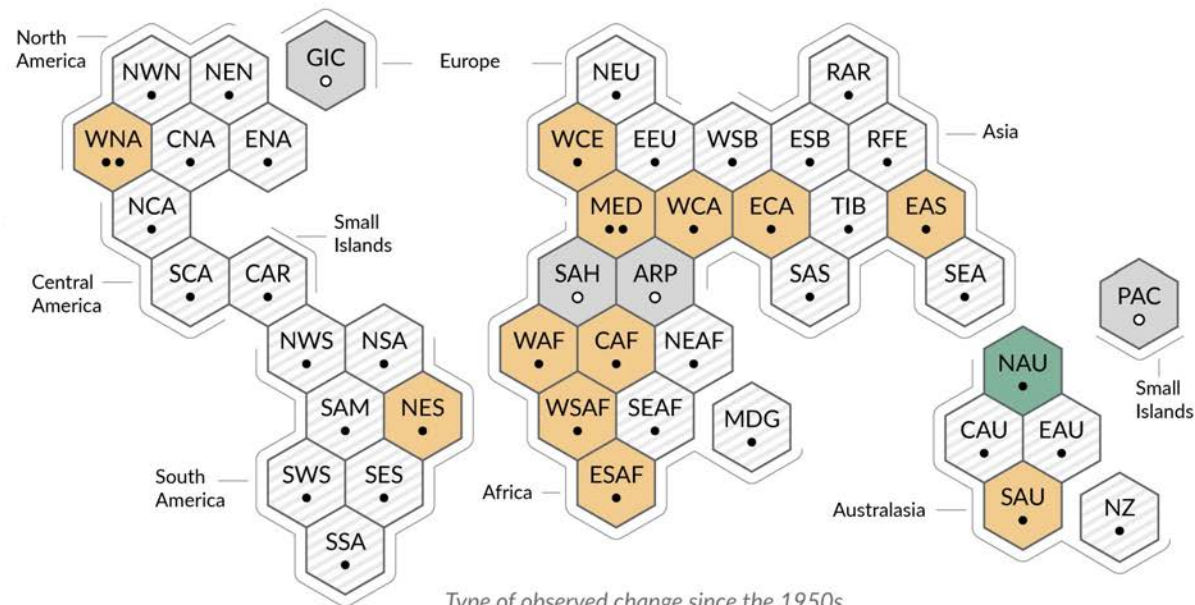
Confidence in human contribution  
to the observed change

●●● High

●● Medium

● Low due to limited agreement

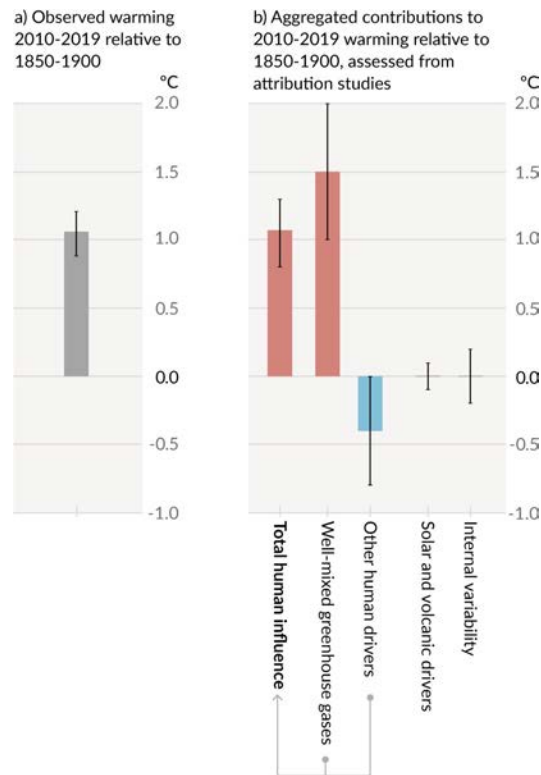
○ Low due to limited evidence



Type of observed change since the 1950s

## Observed warming is driven by emissions from human activities, with greenhouse gas warming partly masked by aerosol cooling

Figure SPM.2





# Key messages from the latest WGI AR6 IPCC Report:

## B. Possible Climate Futures

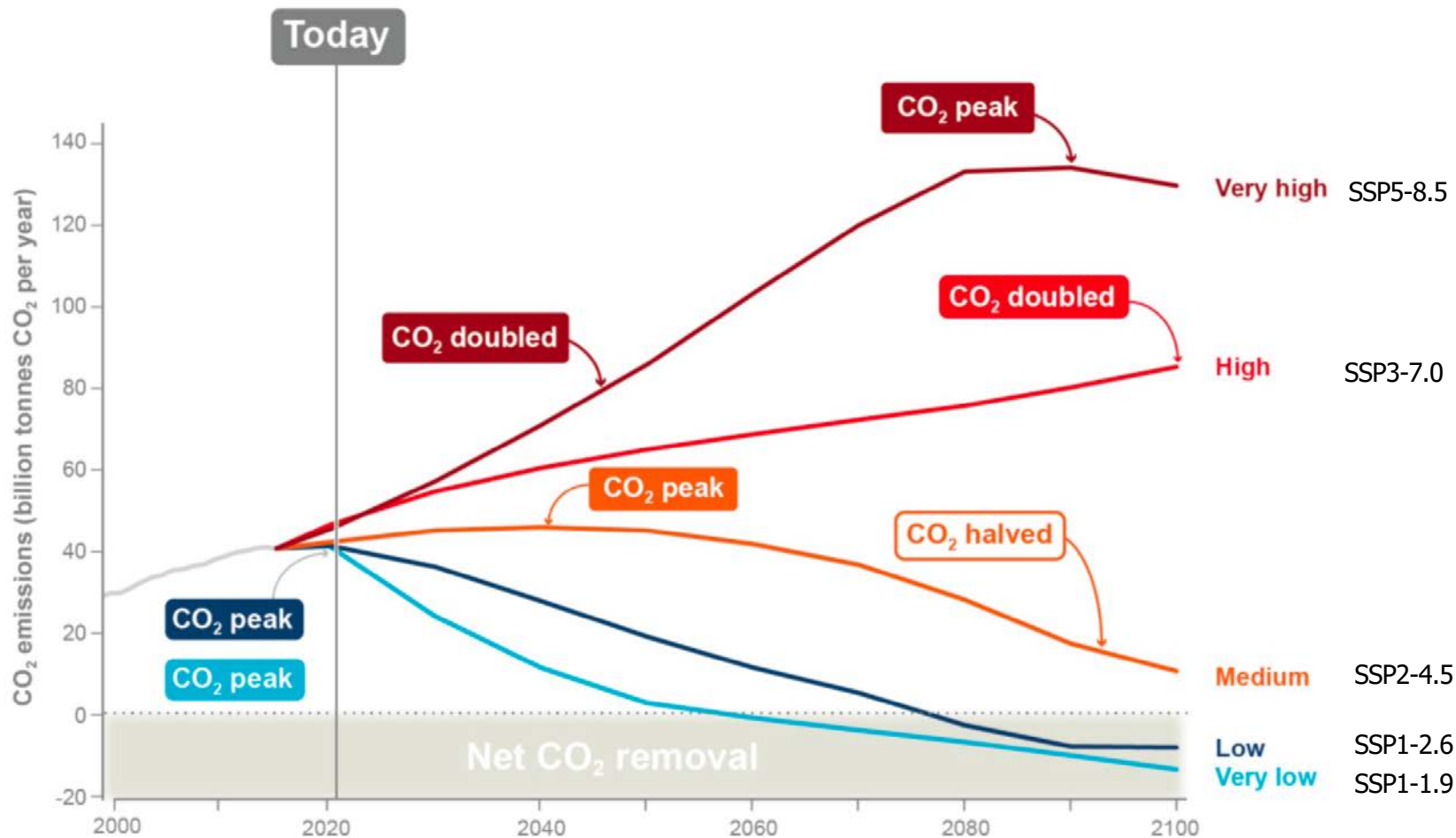
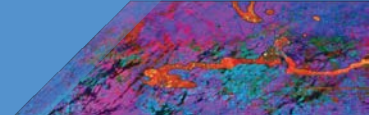
- B.1** Global surface temperature will continue to increase until at least the mid-century under all emissions scenarios considered. Global warming of 1.5°C and 2°C will be exceeded during the 21st century unless deep reductions in carbon dioxide (CO<sub>2</sub>) and other greenhouse gas emissions occur in the coming decades.
- B.2** Many changes in the climate system become larger in direct relation to increasing global warming. They include increases in the frequency and intensity of hot extremes, marine heatwaves, and heavy precipitation, agricultural and ecological droughts in some regions, and proportion of intense tropical cyclones, as well as reductions in Arctic sea ice, snow cover and permafrost.
- B.3** Continued global warming is projected to further intensify the global water cycle, including its variability, global monsoon precipitation and the severity of wet and dry events.
- B.4** Under scenarios with increasing CO<sub>2</sub> emissions, the ocean and land carbon sinks are projected to be less effective at slowing the accumulation of CO<sub>2</sub> in the atmosphere.
- B.5** Many changes due to past and future greenhouse gas emissions are irreversible for centuries to millennia, especially changes in the ocean, ice sheets and global sea level.

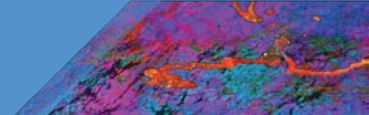
# SIXTH ASSESSMENT REPORT

Working Group I – The Physical Science Basis

ipcc

INTERGOVERNMENTAL PANEL ON climate change

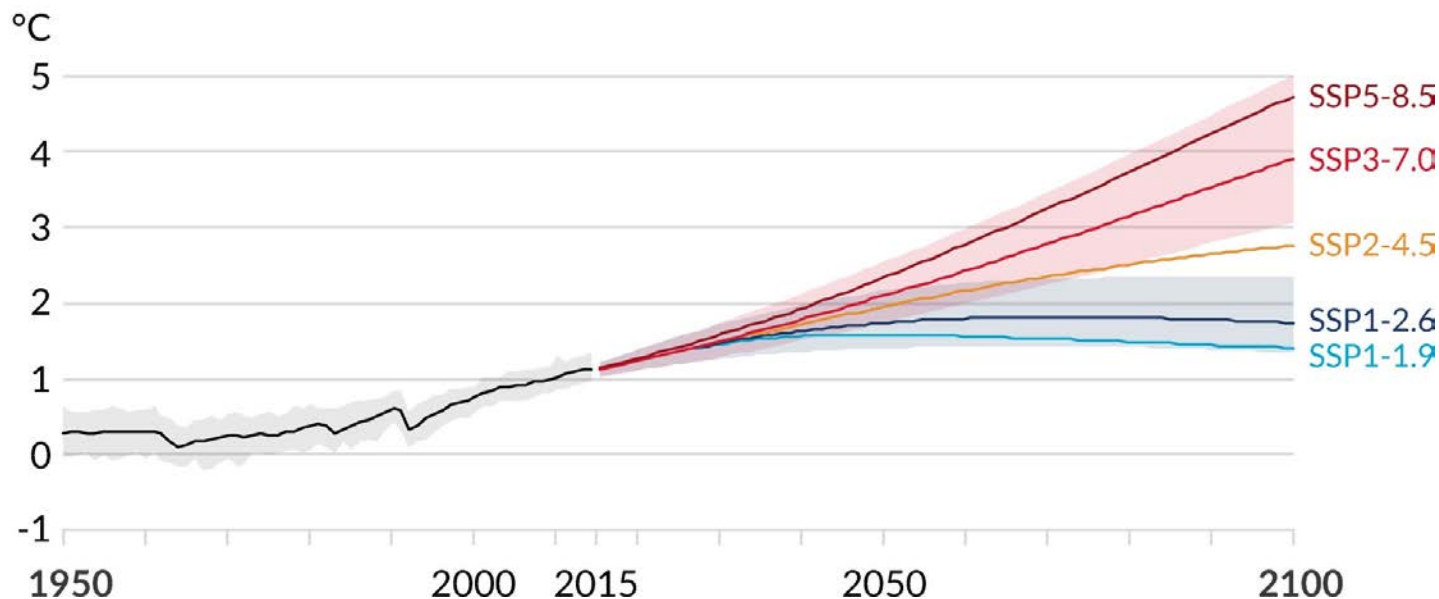




## Human activities affect all the major climate system components, with some responding over decades and others over centuries

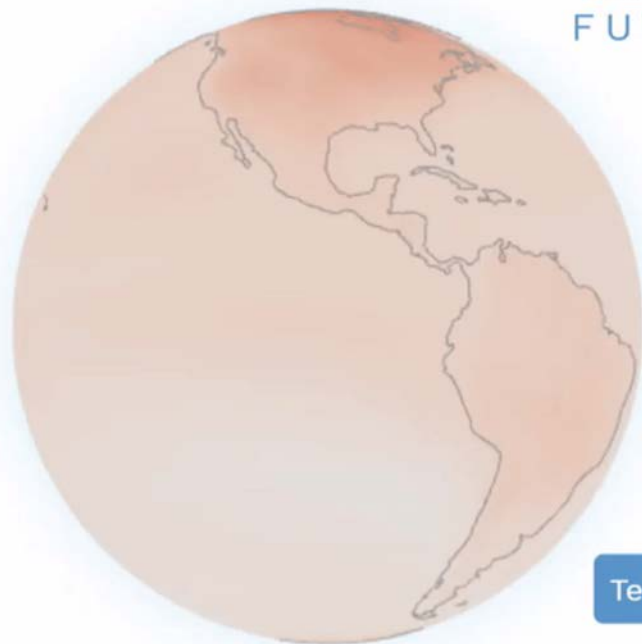
*Figure SPM.8*

a) Global surface temperature change relative to 1850-1900



## Interactive atlas

OUR POSSIBLE  
CLIMATE  
FUTURES



+1.5°C

+2°C

+3°C

+4°C

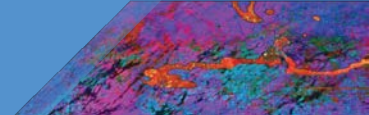
Temperature

Precipitation

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

#IPCCData

#IPCCAtlas



## Changes in global surface temperature for the five illustrative emissions scenarios considered

Table SPM.1

	Near term, 2021–2040		Mid-term, 2041–2060		Long term, 2081–2100	
Scenario	Best estimate (°C)	Very likely range (°C)	Best estimate (°C)	Very likely range (°C)	Best estimate (°C)	Very likely range (°C)
SSP1-1.9	1.5	1.2 to 1.7	1.6	1.2 to 2.0	1.4	1.0 to 1.8
SSP1-2.6	1.5	1.2 to 1.8	1.7	1.3 to 2.2	1.8	1.3 to 2.4
SSP2-4.5	1.5	1.2 to 1.8	2.0	1.6 to 2.5	2.7	2.1 to 3.5
SSP3-7.0	1.5	1.2 to 1.8	2.1	1.7 to 2.6	3.6	2.8 to 4.6
SSP5-8.5	1.6	1.3 to 1.9	2.4	1.9 to 3.0	4.4	3.3 to 5.7

**With every increment of global warming, changes get larger in regional mean temperature. Land is warming faster than the ocean, and polar regions are warming faster than the tropics**

**+1.5° C**

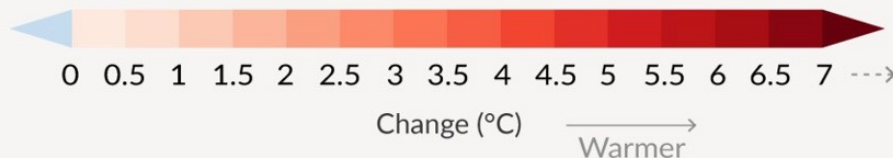
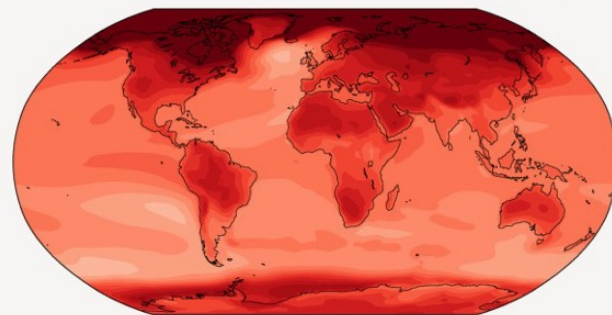
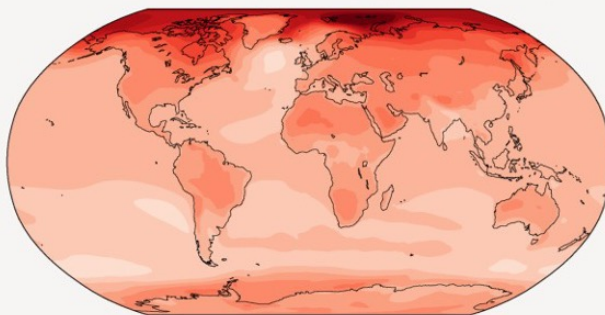
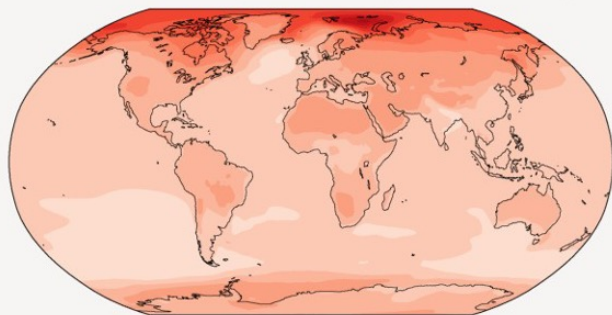
Simulated change at 1.5 °C global warming

**+2° C**

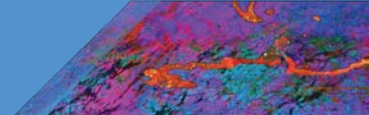
Simulated change at 2 °C global warming

**+4° C**

Simulated change at 4 °C global warming





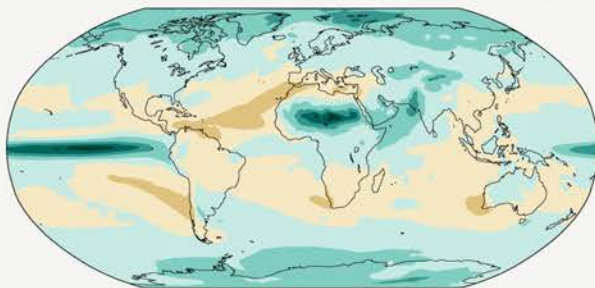


# Total annual precipitation will increase over high latitudes, the equatorial Pacific and parts of the monsoon regions, and decrease over parts of the subtropics and the tropics

## c) Annual mean precipitation change (%) relative to 1850-1900

**+1.5° C**

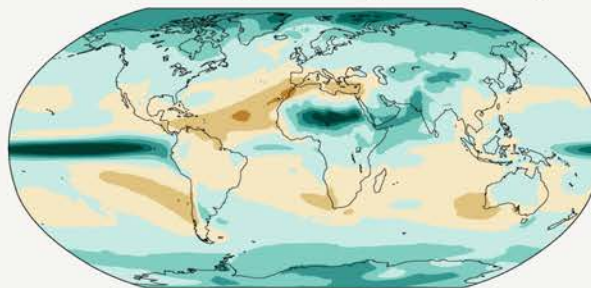
Simulated change at 1.5 °C global warming



Precipitation is projected to increase over high latitudes, the equatorial Pacific and parts of the monsoon regions, but decrease over parts of the subtropics and in limited areas of the tropics.

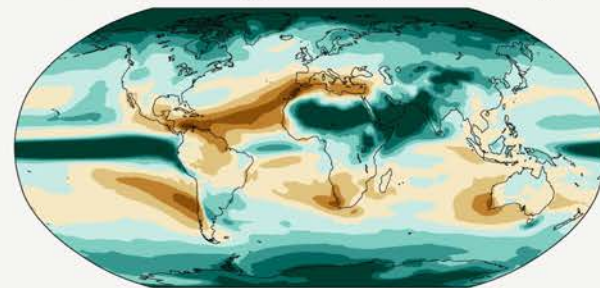
**+2° C**

Simulated change at 2 °C global warming

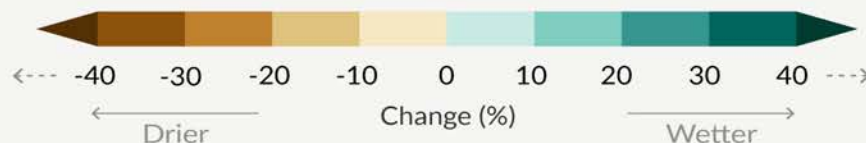


**+4° C**

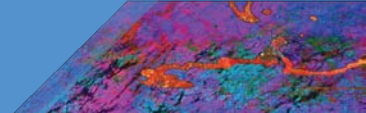
Simulated change at 4 °C global warming



Relatively small absolute changes may appear as large % changes in regions with dry baseline conditions





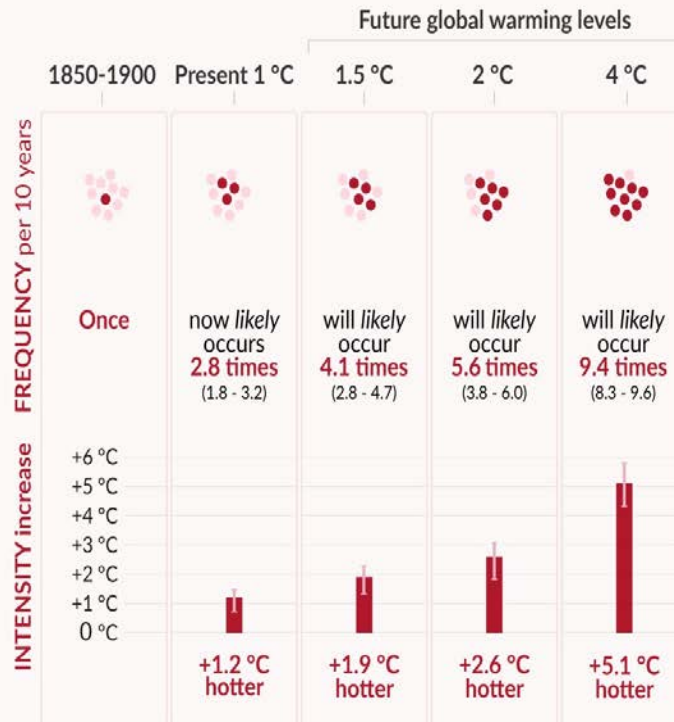


**Projected changes in hot temperature extremes are larger in frequency and intensity with every additional increment of global warming**

## Hot temperature extremes over land

### 10-year event

Frequency and increase in intensity of extreme temperature event that occurred **once in 10 years** on average in a climate without human influence



### 50-year event

Frequency and increase in intensity of extreme temperature event that occurred **once in 50 years** on average in a climate without human influence

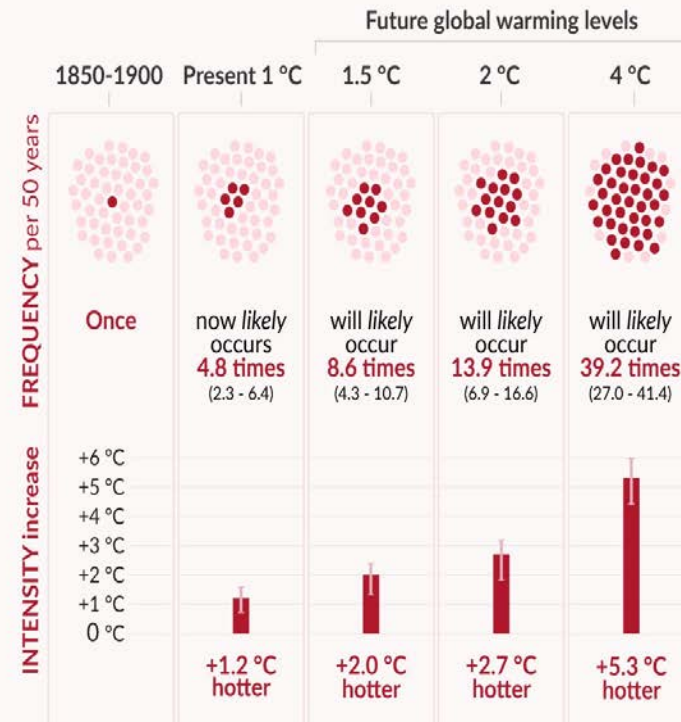


Figure SPM.6

**Projected changes in heavy 1-day precipitation events are larger in frequency and intensity with every additional increment of global warming**

Figure SPM.6

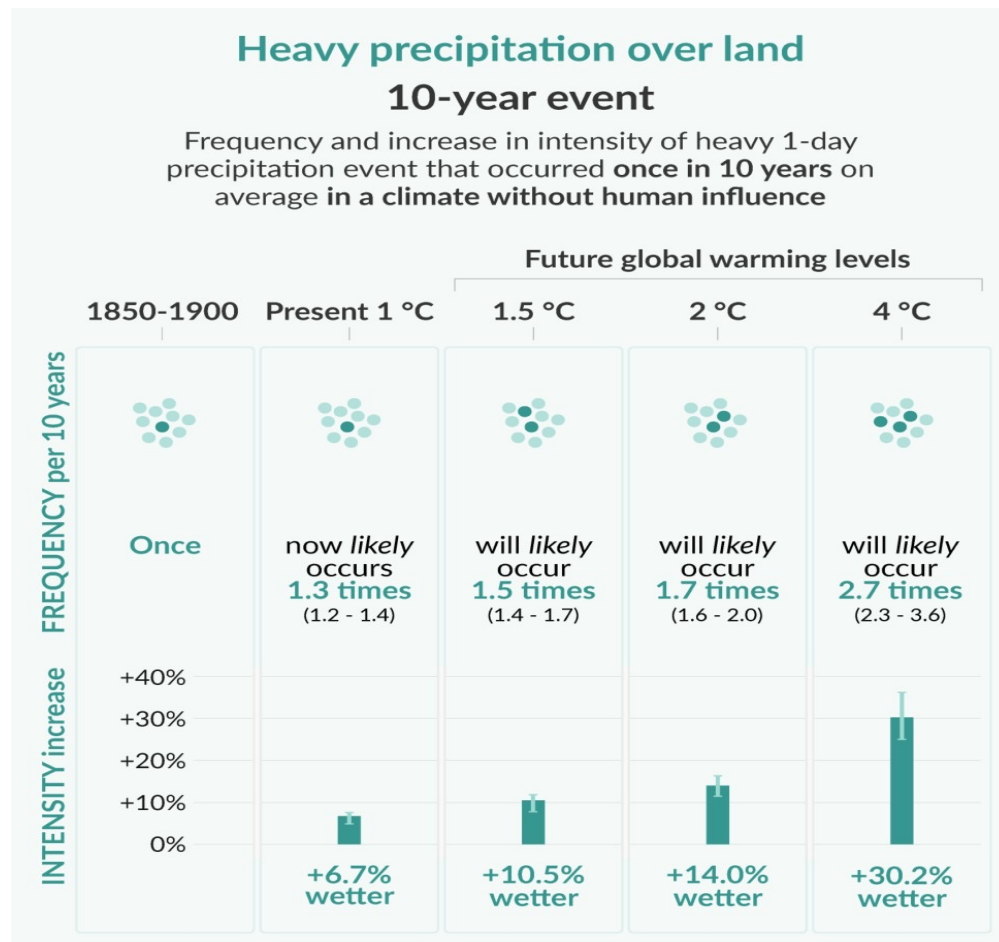
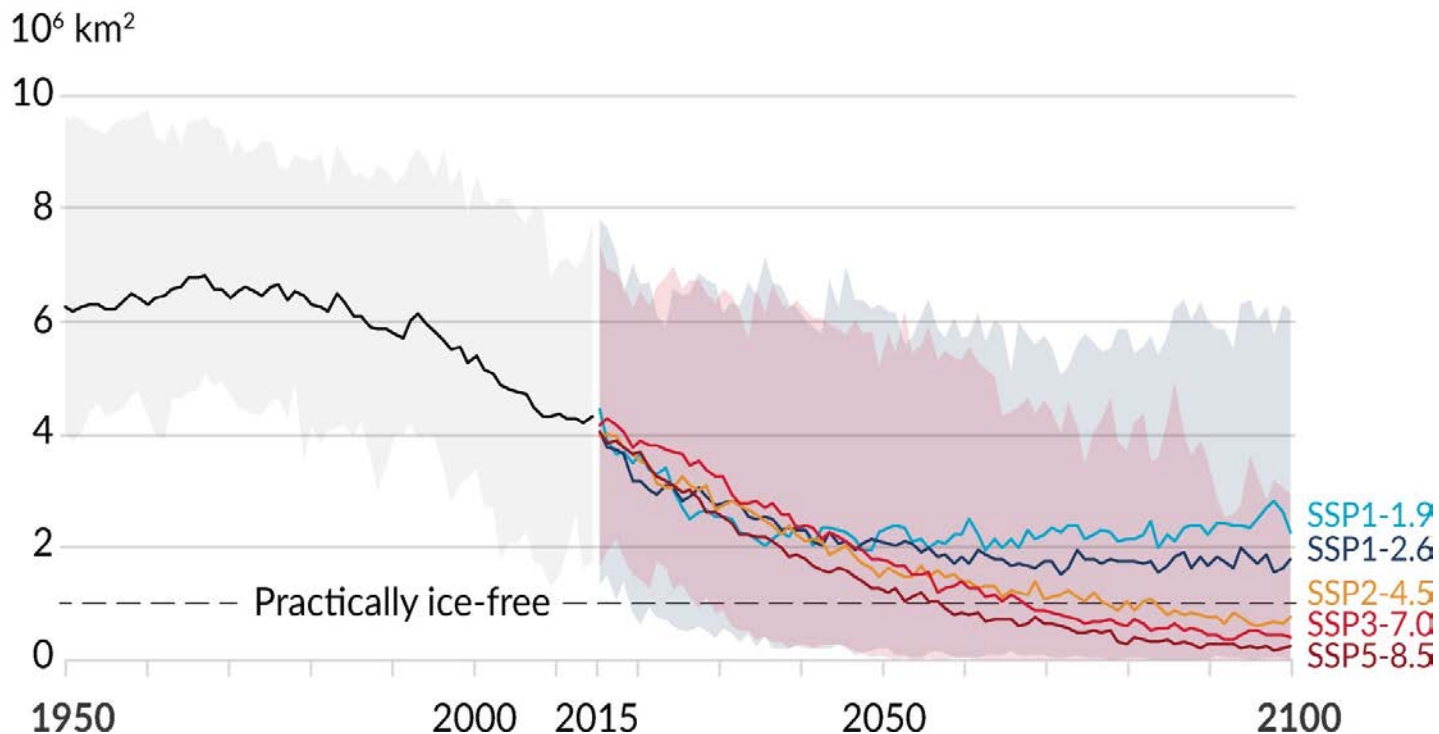


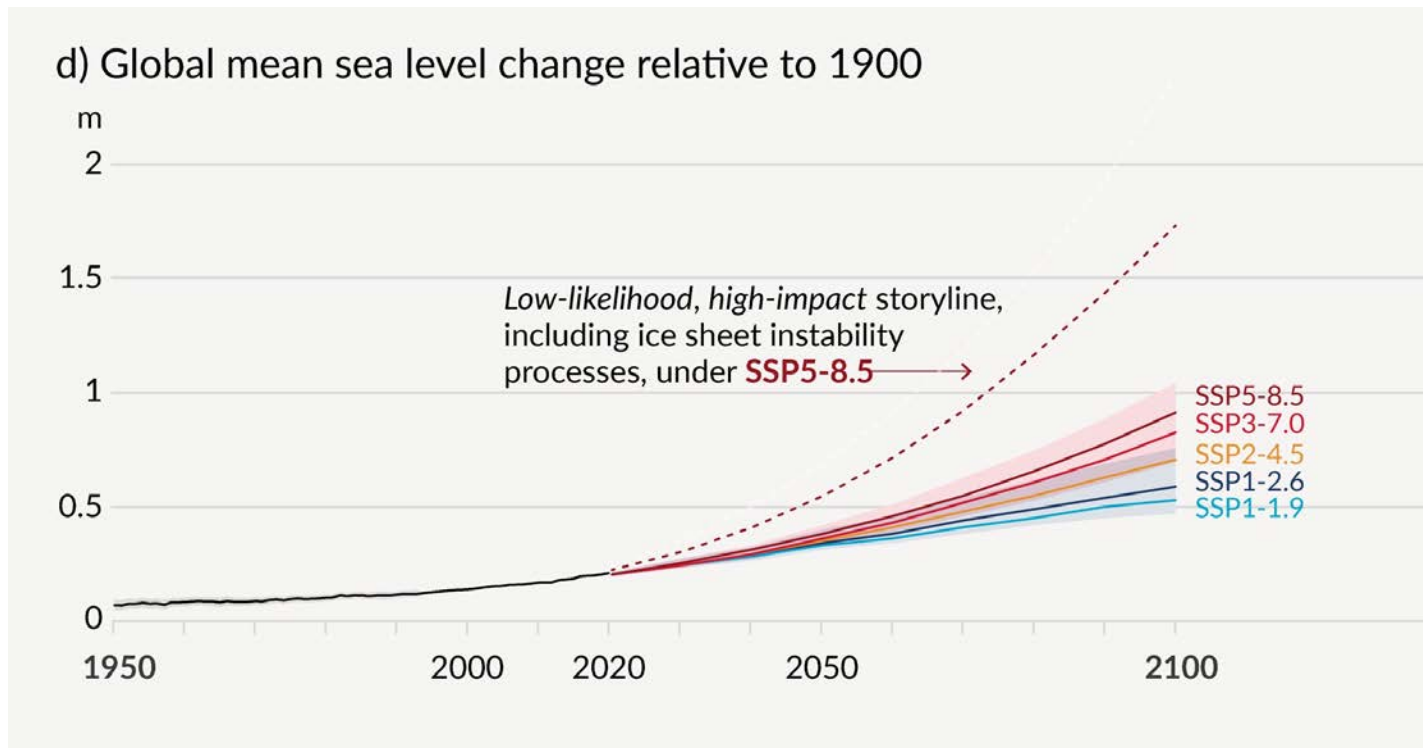
Figure SPM.8

## b) September Arctic sea ice area

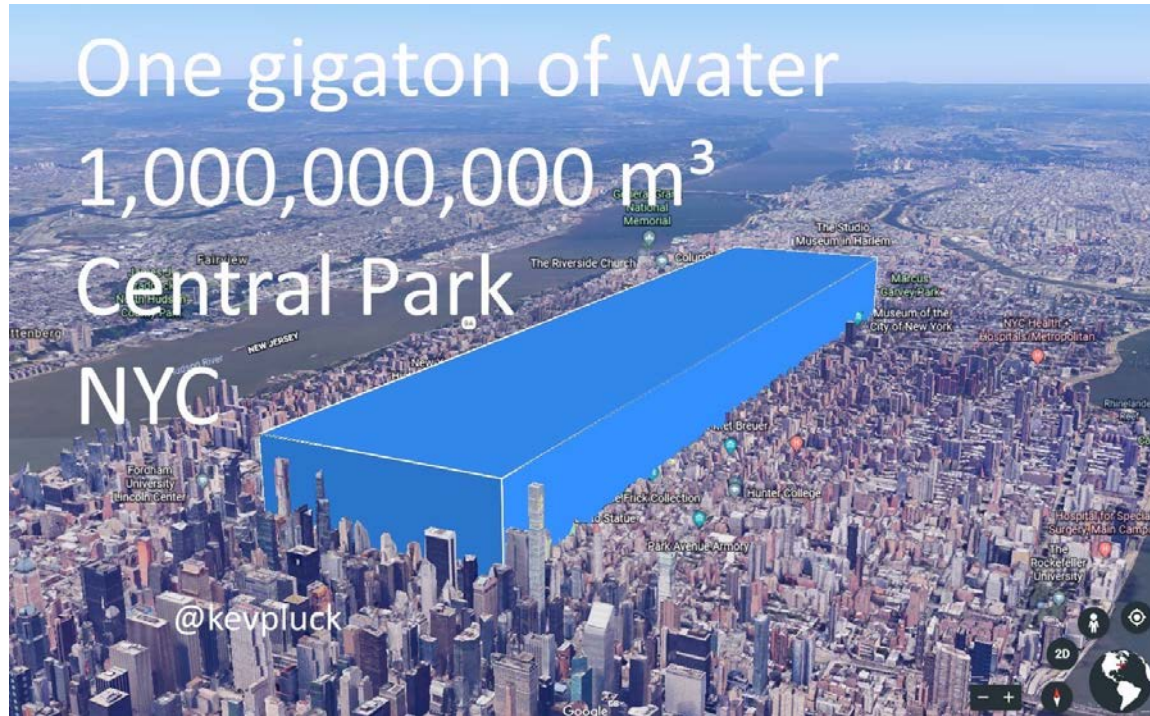


## Human activities affect all the major climate system components, with some responding over decades and others over centuries

Figure SPM.8



# The Antarctic Ice Sheet presently loses 1 Gt of water every 1.5 day

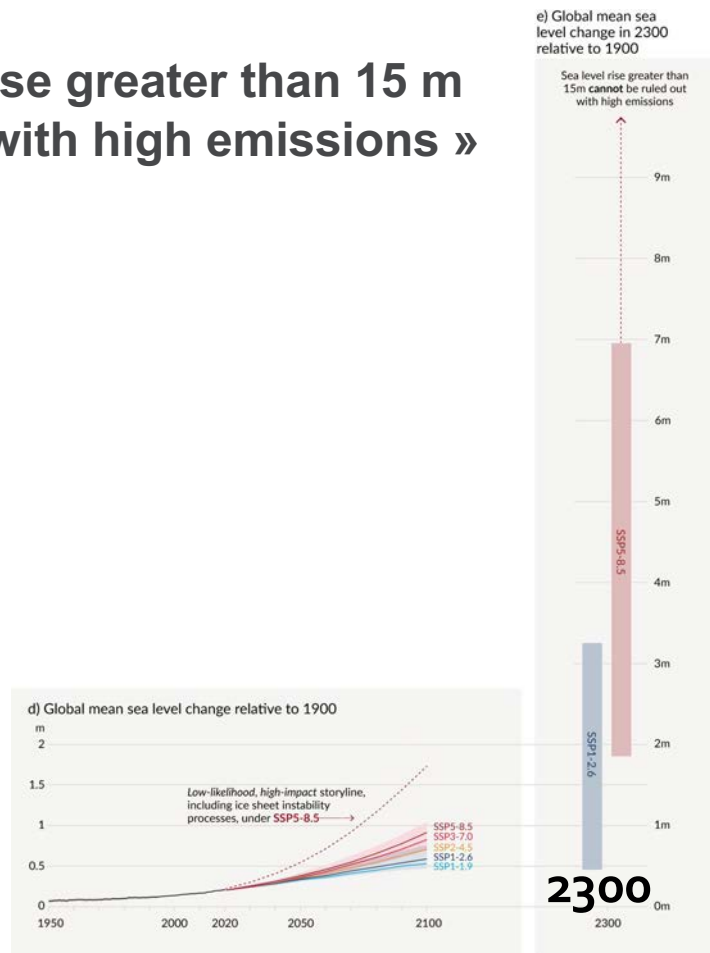


Source: @Kevpluck, June 2018



« In 2300, sea level rise greater than 15 m cannot be ruled out with high emissions »

*Figure SPM.8*



# Gent koningin der badsteden?

**Zonder maatregelen voor milieu is Antwerpen overspoeld in 3000**

BRUSSEL - Zonder nieuwe maatregelen zal ons klimaat verder opwarmen. Dan komt tegen 3000 tien procent van België onder water te staan. Daaronder uiteraard alle kuststeden, maar ook Brugge, Antwerpen en zelfs Mechelen. Gent komt aan zee te liggen. Dat blijkt uit een studie van professoren van de UCL in opdracht van Greenpeace.



Gerard Govers, professor geografie aan de Katholieke Universiteit Leuven, tekende gisteren op onze vraag het nieuwe kaartje van Vlaanderen anno 3000 uit. Een land waarin de zeespiegel volgens het rapport van Greenpeace mogelijk 8 meter gestegen is. "Je dat geval zou het grootste gedeelte

Govers. "Gent zou nog net boven water blijven, ze mogen daar al appartementjes beginnen bouwen." Gent als koningin der badsteden? Het is een grapje, volgens professor Govers is het moeilijk om nu al voorspellingen voor het volgende millennium te maken. "Dat lijkt me

meetbaar te worden en er bestaan al voorspellingen voor het jaar 2050, zelfs 2100. Maar verder hangt veel af van wat op Antarctica gaat gebeuren en dat is moeilijk te zeggen. Afwachten dus." Het rapport van Greenpeace werd gisteren overhandigd aan Bruno Tobback en Kri



The proportion of CO<sub>2</sub> emissions taken up by land and ocean carbon sinks is smaller in scenarios with higher cumulative CO<sub>2</sub> emissions

Total cumulative CO<sub>2</sub> emissions **taken up by land and oceans** (colours) and **remaining in the atmosphere** (grey) under the five illustrative scenarios from 1850 to 2100

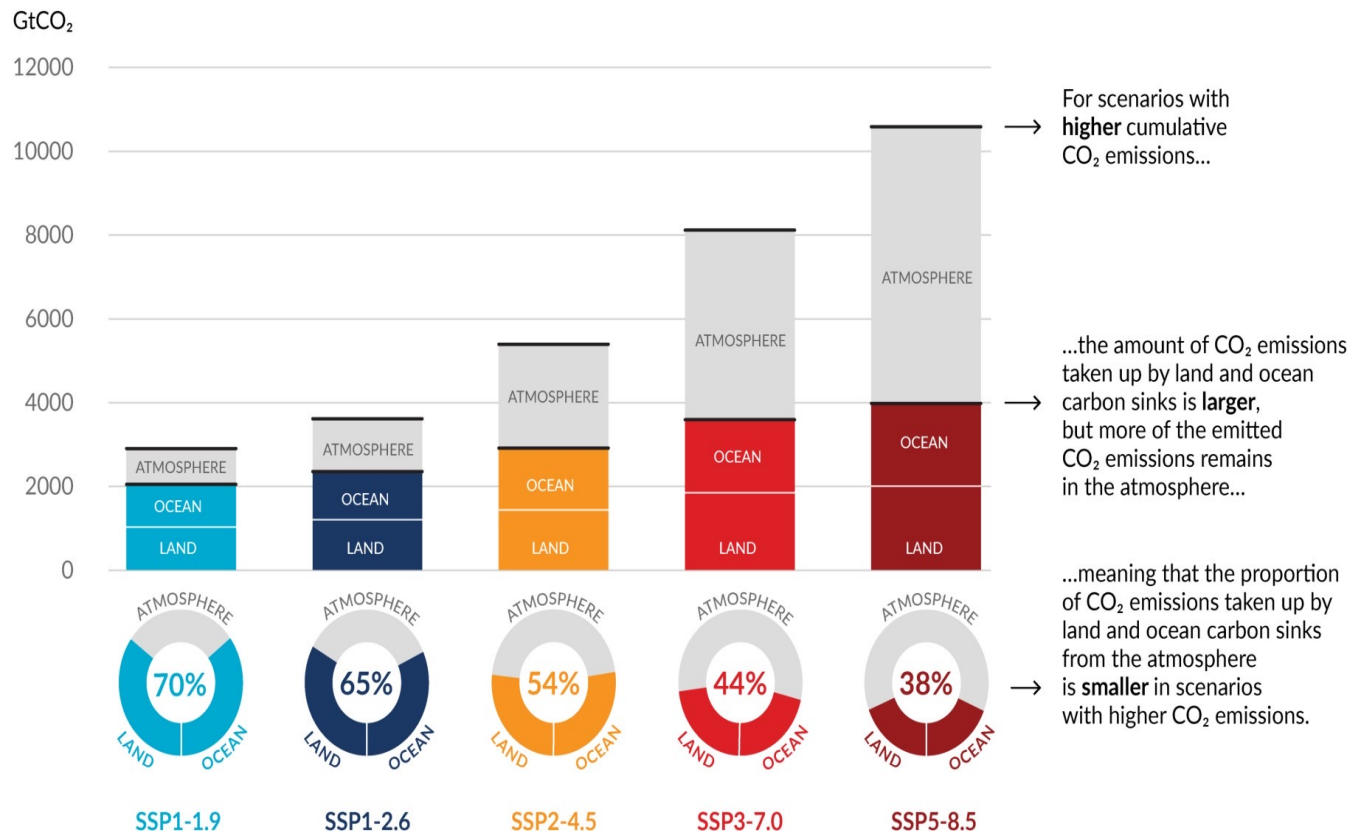


Figure SPM.7

# Key messages from the latest WGI AR6 IPCC Report:

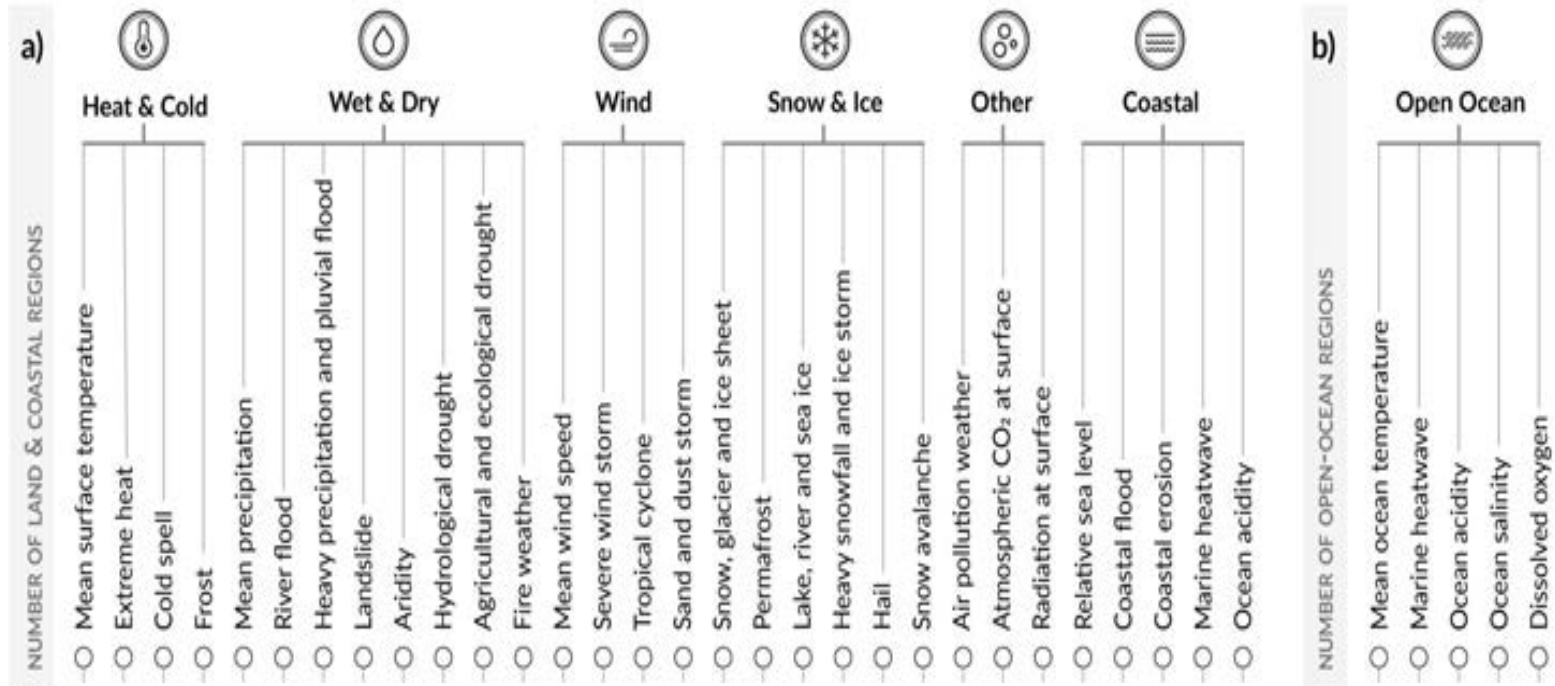
## C. Climate Information for Risk Assessment and Regional Adaptation

- C.1** Natural drivers and internal variability will modulate human-caused changes, especially at regional scales and in the near term, with little effect on centennial global warming. These modulations are important to consider in planning for the full range of possible changes.
- C.2** With further global warming, every region is projected to increasingly experience concurrent and multiple changes in climatic impact-drivers. Changes in several climatic impact-drivers would be more widespread at 2°C compared to 1.5°C global warming and even more widespread and/or pronounced for higher warming levels.
- C.3** Low-likelihood outcomes, such as ice sheet collapse, abrupt ocean circulation changes, some compound extreme events and warming substantially larger than the assessed *very likely* range of future warming cannot be ruled out and are part of risk assessment.

## Multiple climatic impact-drivers are projected to change in all regions of the world

Figure SPM.9

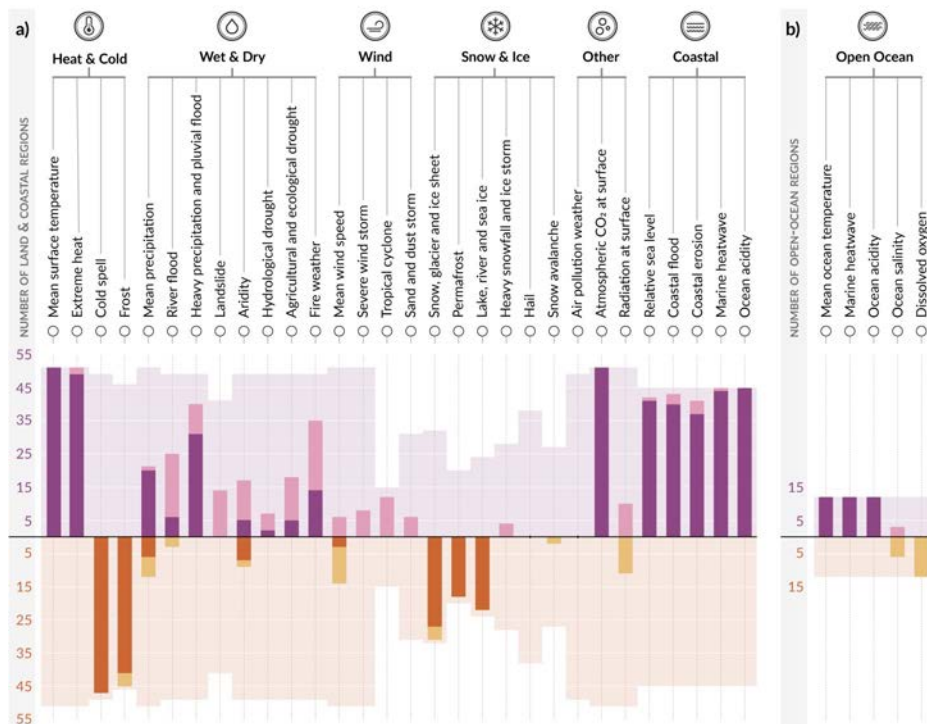
Number of land & coastal regions (a) and open-ocean regions (b) where each climatic impact-driver (CID) is projected to **increase** or **decrease** with **high confidence** (dark shade) or **medium confidence** (light shade)



# Multiple climatic impact-drivers are projected to change in all regions of the world

Figure SPM.9

Number of land & coastal regions (a) and open-ocean regions (b) where each climatic impact-driver (CID) is projected to **increase** or **decrease** with **high confidence** (dark shade) or **medium confidence** (light shade)





# Key messages from the latest WGI AR6 IPCC Report:

## D. Limiting Future Climate Change

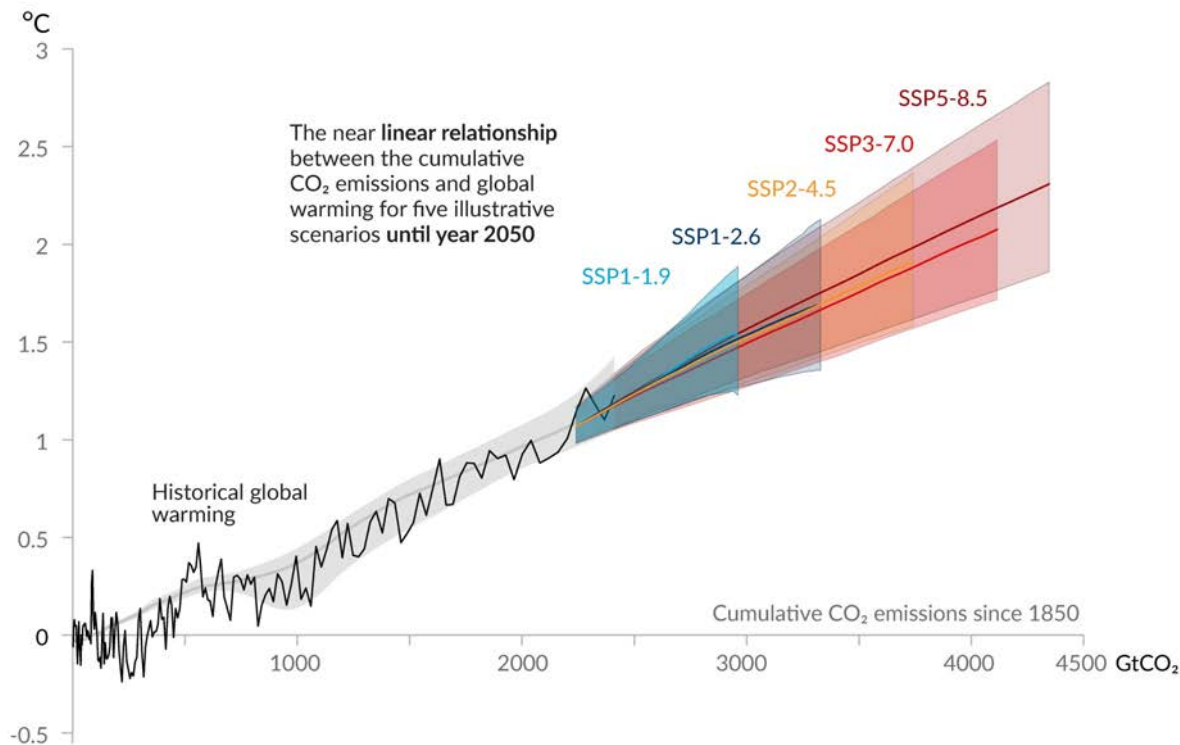
- D.1** From a physical science perspective, limiting human-induced global warming to a specific level requires limiting cumulative CO<sub>2</sub> emissions, reaching at least net zero CO<sub>2</sub> emissions, along with strong reductions in other greenhouse gas emissions. Strong, rapid and sustained reductions in CH<sub>4</sub> emissions would also limit the warming effect resulting from declining aerosol pollution and would improve air quality.
- D.2** Scenarios with low or very low greenhouse gas (GHG) emissions (SSP1-1.9 and SSP1-2.6) lead within years to discernible effects on greenhouse gas and aerosol concentrations, and air quality, relative to high and very high GHG emissions scenarios (SSP3-7.0 or SSP5-8.5). Under these contrasting scenarios, discernible differences in trends of global surface temperature would begin to emerge from natural variability within around 20 years, and over longer time periods for many other climatic impact-drivers (*high confidence*).



## Every tonne of CO<sub>2</sub> emissions adds to global warming

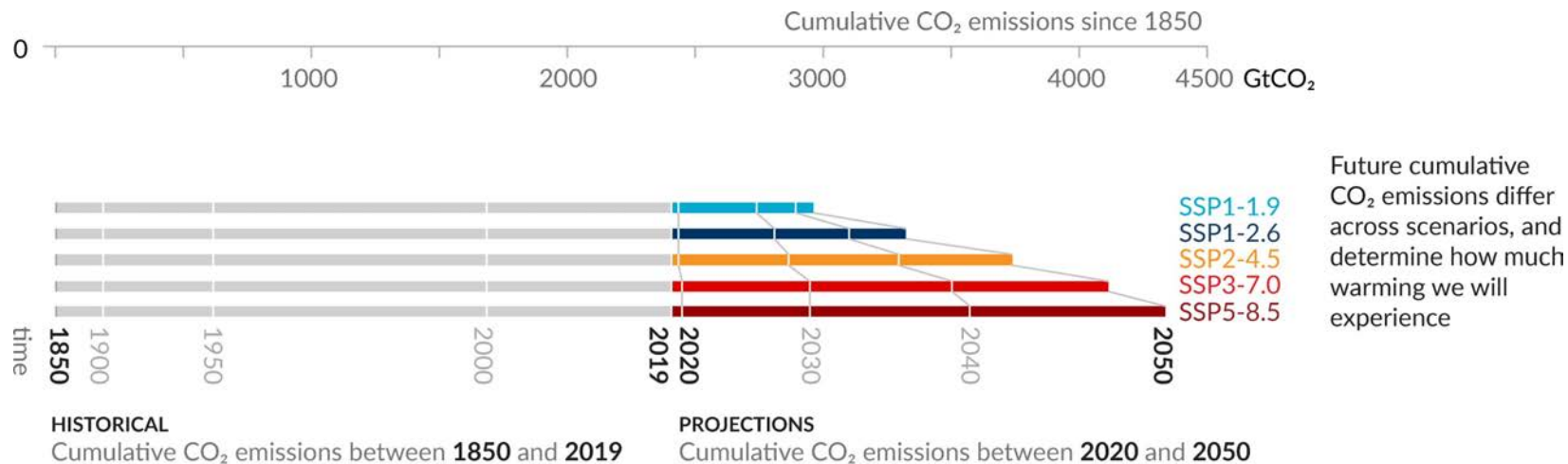
Figure SPM.10

Global surface temperature increase since 1850-1900 (°C) as a function of cumulative CO<sub>2</sub> emissions (GtCO<sub>2</sub>)



## Every tonne of CO<sub>2</sub> emissions adds to global warming

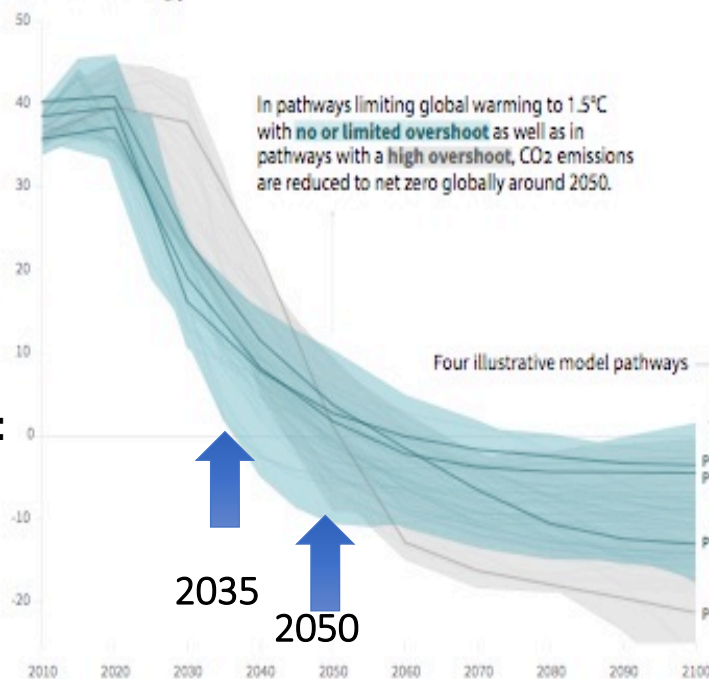
Figure SPM.10



# Emission pathways compatible with below 1.5° C warming:

## Global total net CO<sub>2</sub> emissions

Billion tonnes of CO<sub>2</sub>/yr



Net ZERO:

### Timing of net zero CO<sub>2</sub>

Line widths depict the 5-95th percentile and the 25-75th percentile of scenarios



Pathways limiting global warming to 1.5°C with no or low overshoot

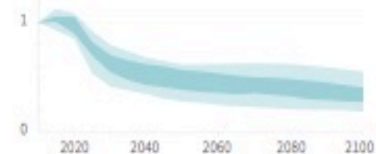
Pathways with high overshoot

Pathways limiting global warming below 2°C (Not shown above)

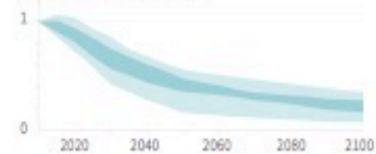
## Non-CO<sub>2</sub> emissions relative to 2010

Emissions of non-CO<sub>2</sub> forcers are also reduced or limited in pathways limiting global warming to 1.5°C with no or limited overshoot, but they do not reach zero globally.

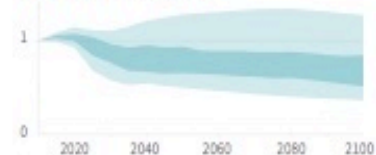
### Methane emissions



### Black carbon emissions



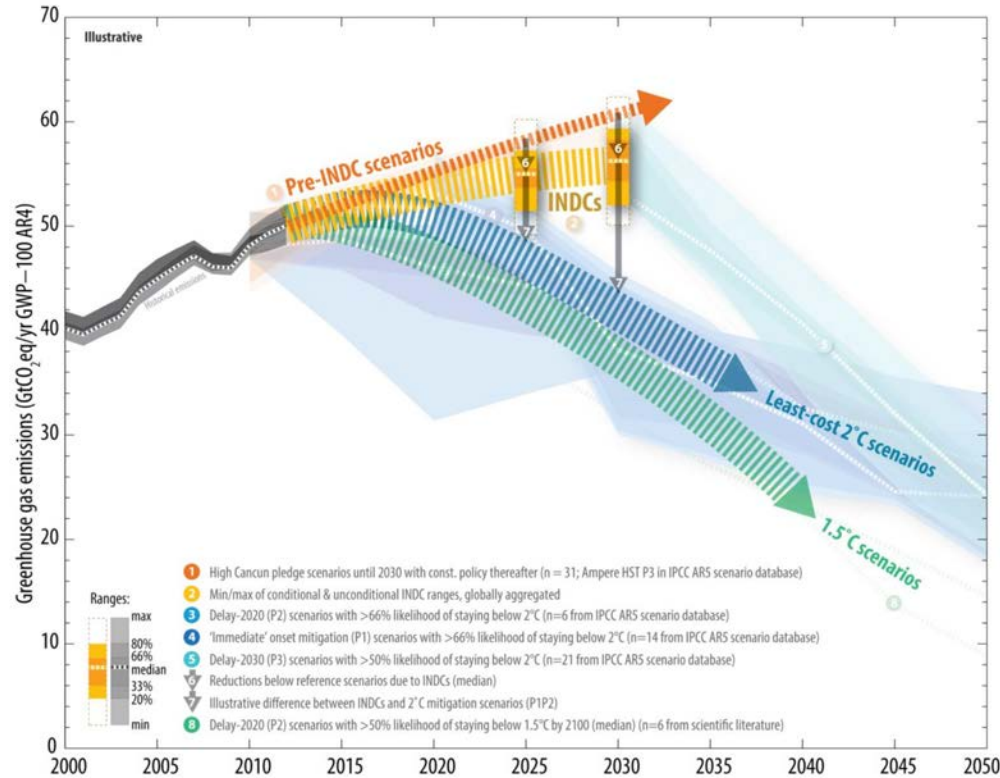
### Nitrous oxide emissions



**Feit : De huidige nationale plannen  
(NDC's) die vóór de Overeenkomst  
van Parijs zijn ingevoerd, zijn verre  
van toereikend om de 1,5° C-  
doelstelling te halen en zelfs onder de  
2° C te blijven**

Merk op dat de Overeenkomst van Parijs spreekt over  
een opwarming van 1,5 ° C en een temperatuur van "*ver  
onder de 2 ° C*", niet van 2 ° C

# Comparison of global emission levels in 2025 and 2030 resulting from the implementation of the intended nationally determined contributions (INDC)



UNFCCC, Aggregate effect of the intended nationally determined contributions: an update

<http://unfccc.int/resource/docs/2016/cop22/eng/02.pdf>





Joel Pett, USA Today



# SUSTAINABLE DEVELOPMENT GOALS



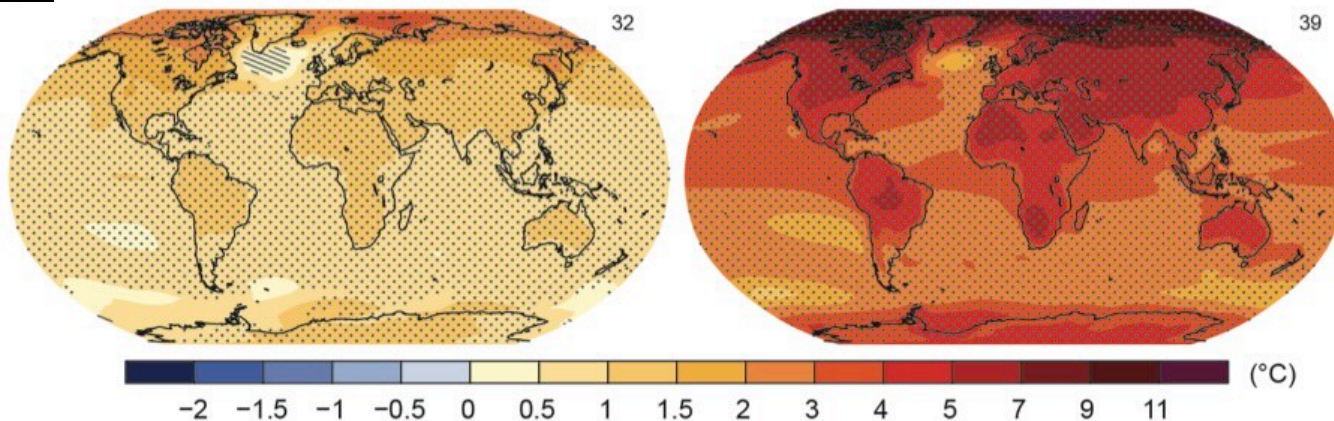
**Fact: It might become much worse,  
but the future climate is in our  
hands**

# RCP2.6

# RCP8.5

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

Fig. SPM.8



Humanity has the choice





Nature is resilient:  
look carefully

Photo: Katrien Van Der Heyden





Incredible  
resilience of  
nature, it is  
healing

Photo: Katrien Van Der Heyden

**Bij EPO  
(februari 2018)**

**Voorwoord:  
Jill Peeters**



# DAT POLITICI OVER TWINTIG JAAR NIET KOMEN JANKEN DAT ZE HET NIET WISTEN.



**DIRK DRAULANS**

(1956) is bioloog, doctor in de wetenschappen en was gastonderzoeker aan de University of Oxford. Sinds 1987 is hij journalist bij Knack.



**JEAN-PASCAL VAN YPERSELE** (1957) is fysicus en klimatoloog. Hij is hoogleraar klimatologie en milieuwetenschappen aan de UCLouvain en was ondervoorzitter van het Intergovernmental Panel on Climate Change (IPCC).

BILAGE BIJ KNACK VAN 16 SEPTEMBER 2020. MAG NIET LOS VERKOCHT WORDEN.

HET KLIMAATALARM

# HET KLIMAAT ALARM

Dirk Draulans en  
Jean-Pascal van Ypersele



**Knack**

Gratis pdf op : [www.knack.be/klimaatalarm](http://www.knack.be/klimaatalarm)

# Om meer te weten :

- [www.climate.be/vanyp](http://www.climate.be/vanyp) : my slides (under « conferences)
- [www.ipcc.ch](http://www.ipcc.ch) : IPCC
- [www.skepticalscience.com](http://www.skepticalscience.com) : answers to the merchants of doubt arguments
- [www.plateforme-wallonne-giec.be](http://www.plateforme-wallonne-giec.be) : IPCC-related in French, Newsletter, latests on SR15, basic climate science
- **Twitter: @JPvanYpersele & @IPCC\_CH**



# Ook :

- [www.wechangeforlife.org](http://www.wechangeforlife.org) :  
250 Belgians experts speak
- [www.klimaatpanel.be](http://www.klimaatpanel.be) : onze rapport op  
vraag van #YouthForClimate (14 mei 2019)
- [www.scientists4climate.be](http://www.scientists4climate.be) : Belgian  
scientists platform
- [www.climate.be/vanyp](http://www.climate.be/vanyp) : my note (in FR &  
NL) presented to the royal informers on 4  
June 2019



# Te noteren :

■ [www.climate.be/vanyp/conferences](http://www.climate.be/vanyp/conferences)

■ **Twitter: @JPvanYpersele**  
**@IPCC\_CH**