

The AR6 WG I Report: Main conclusions, climate extremes, and global and regional findings

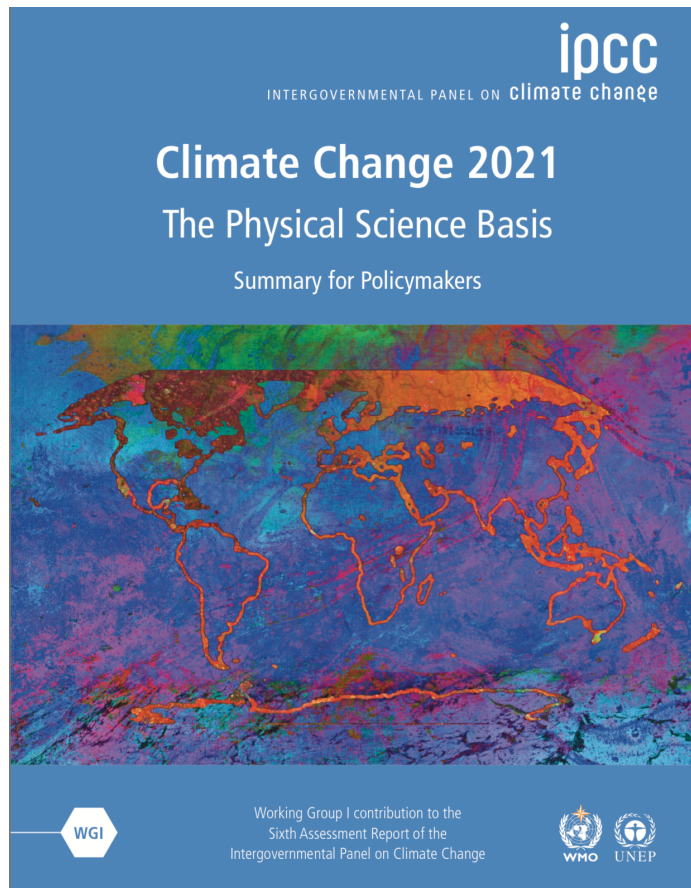
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Swiss NGO DRR Platform
October 8, 2021

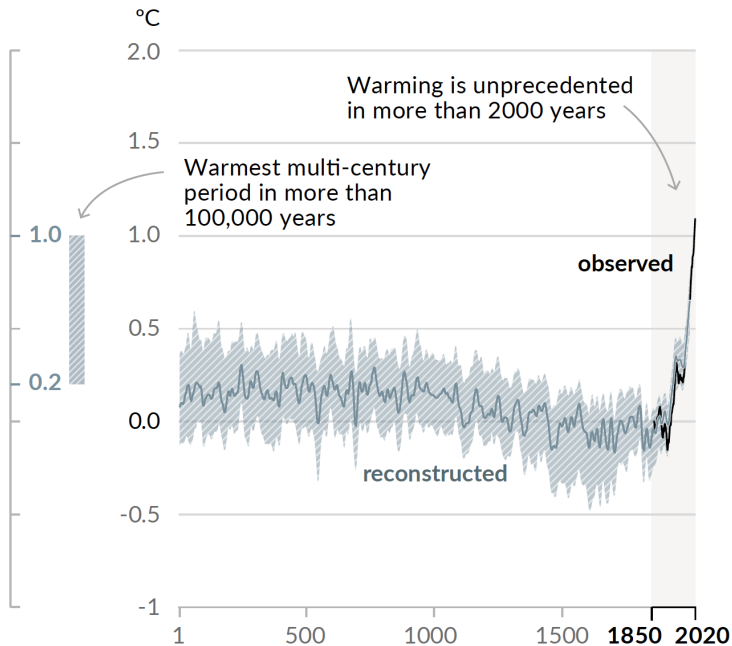
#ClimateReport #IPCC

Released on August 9, 2021: <https://www.ipcc.ch/assessment-report/ar6/>



Changes in global surface temperature relative to 1850-1900

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

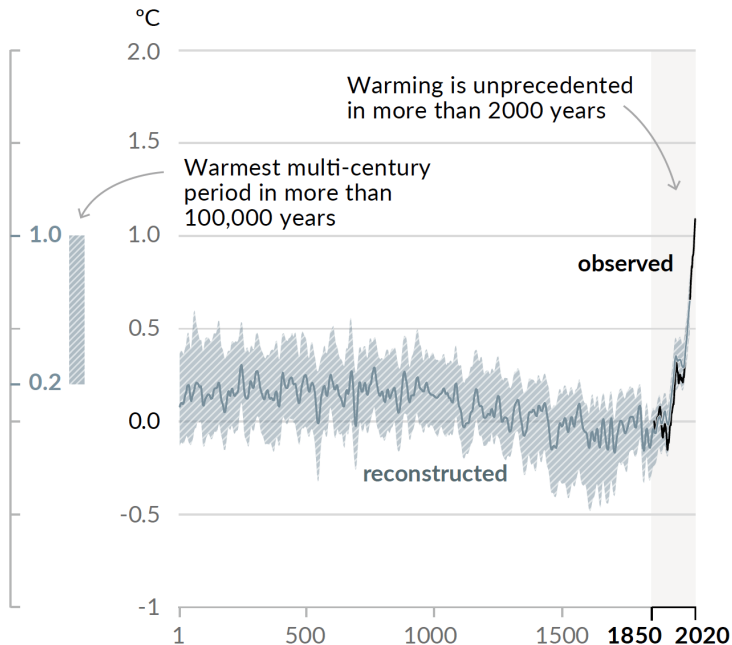


- We already had **1.1°C (1.09°C)** of global warming in 2011-2020 compared to 1850-1900

(IPCC AR6, Fig. SPM.1)

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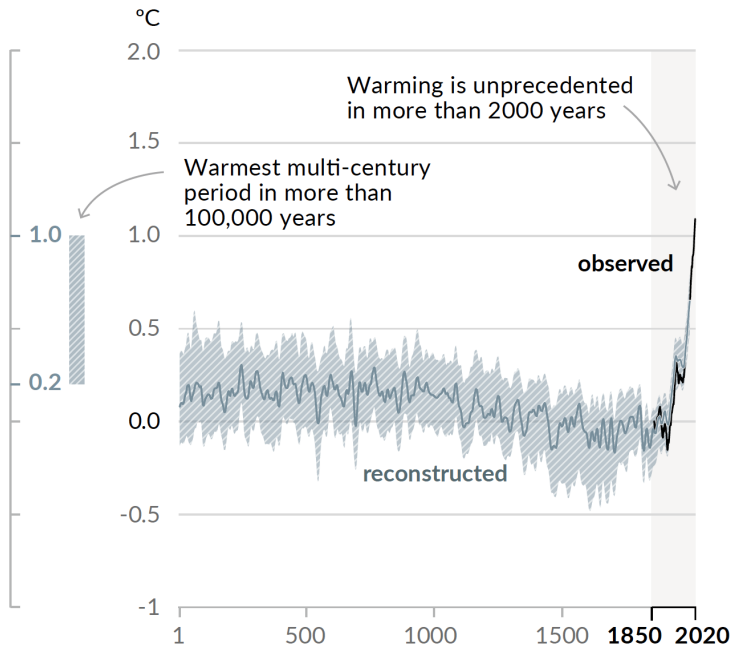


- We already had **1.1°C (1.09°C)** of global warming in 2011-2020 compared to 1850-1900
- The warming rate is **unprecedented** in more than 2000 years, the temperature level is unprecedented in more than 100'000 years

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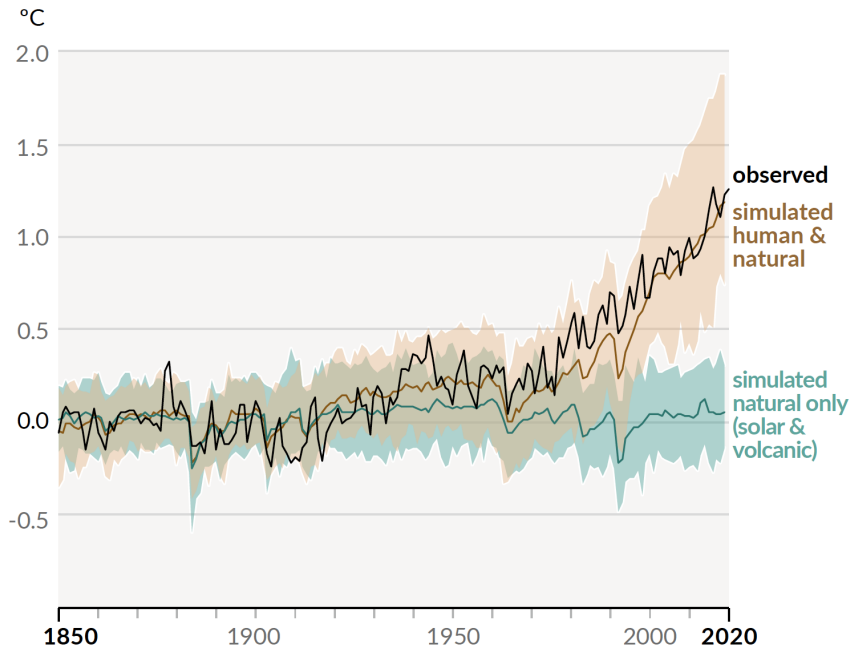


- We already had **1.1°C (1.09°C)** of global warming in 2011-2020 compared to 1850-1900
- The warming rate is **unprecedented** in more than 2000 years, the temperature level is unprecedented in more than 100'000 years
- The largest part of this warming is **irreversible** for several generations

(IPCC AR6, Fig. SPM.1)

Changes in global surface temperature relative to 1850-1900

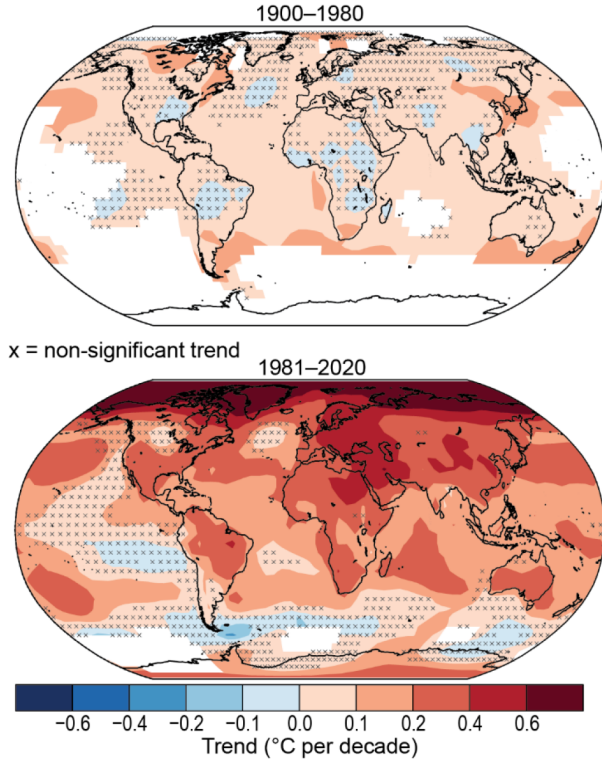
Change in global surface temperature (annual average) as **observed** and simulated using **human & natural** and **only natural** factors (both 1850-2020)



- IPCC AR6: “It is **unequivocal** that human influence has warmed the atmosphere, ocean and land”
- Best estimate of human-induced global warming until 2011-2020: 1.07°C, i.e. **~98% of observed global warming** (1.09°C)

(IPCC AR6, Fig. SPM.1)

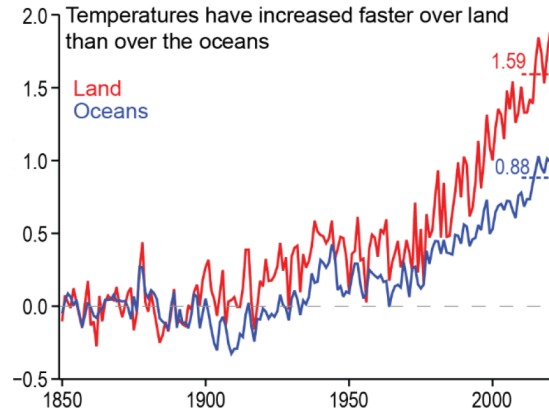
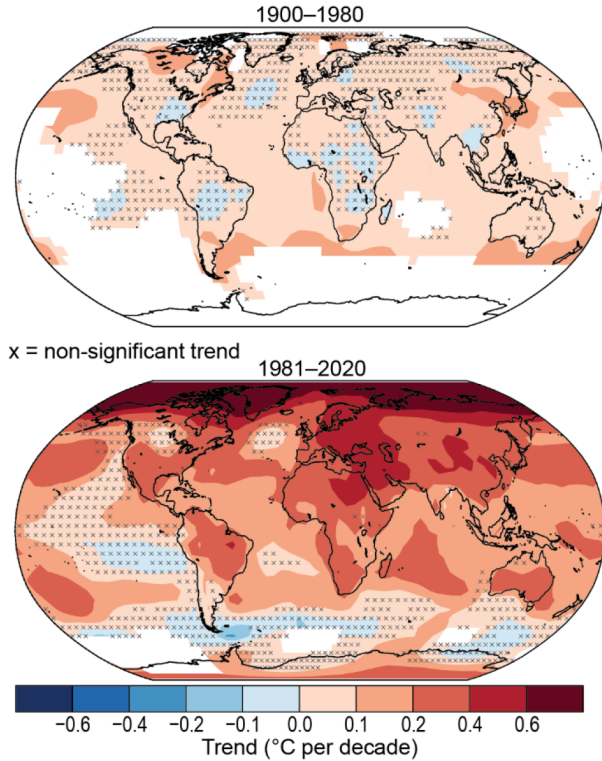
Warming accelerated after the 1970s, but
not all regions are warming equally



Temperature
observations reveal
warming acceleration
after 1970s

(IPCC AR6, Chapter 2, Fig. 2.11)

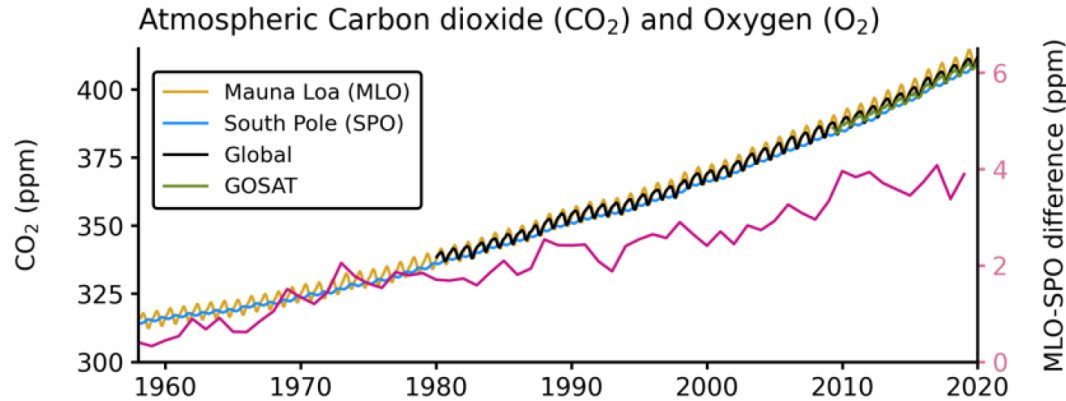
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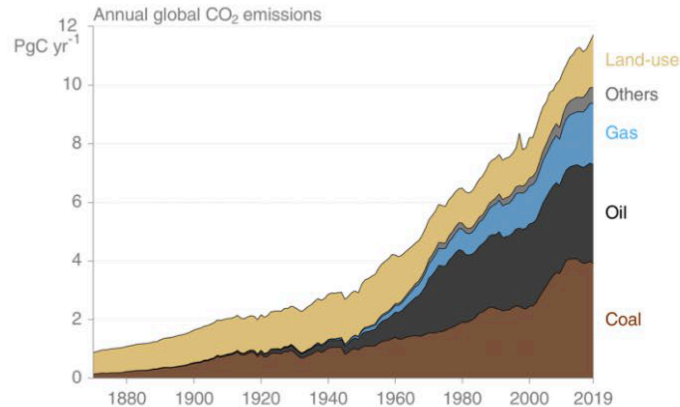
Temperature observations reveal **warming acceleration** after 1970s

Land regions are warming substantially more than the global mean: **1.6°C (1.59°C)**

(IPCC AR6, Chapter 2, Fig. 2.11)



Continuous increase of CO₂ concentrations (highest measured concentration: May 2021)



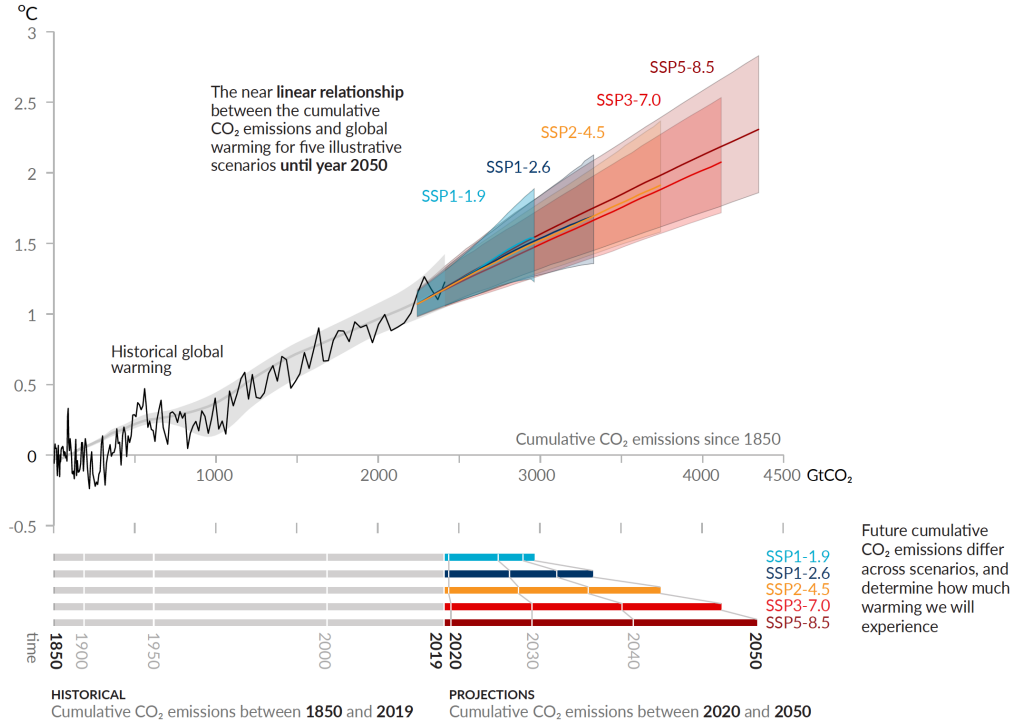
The sources of CO₂ emissions are clear

- Burning of fossil fuels
- Land use (deforestation)

(IPCC AR6, Chapter 5: Figs. 5.6 and 5.5)

Every tonne of CO₂ emissions adds to global warming

Global surface temperature increase since 1850-1900 (°C) as a function of cumulative CO₂ emissions (GtCO₂)



Direct relationship
between cumulative CO₂
emissions and global
warming

Every additional emissions
of CO₂ lead to additional
global warming

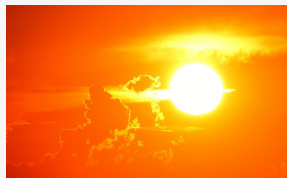
Very small remaining CO₂
budget for a stabilisation
at ca. 1.5°C (1.6°C)

(IPCC AR6, Fig. SPM.10)

Observed changes in extremes & their attribution

- Evidence of observed changes in extremes has **strengthened**
- Human-induced climate change is already affecting many weather and climate extremes in **every region** across the globe

(IPCC AR6)



Temperature
extremes



Heavy precipitation



Floods



Droughts



Storms

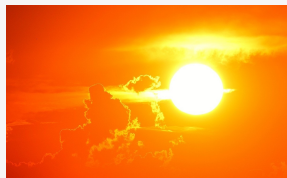


Compound
events

Observed changes in extremes & their attribution

- Evidence of observed changes in extremes has **strengthened**
- Human-induced climate change is already affecting many weather and climate extremes in **every region** across the globe
- Some **recent hot extreme events** would have been *extremely unlikely* to occur **without human influence** on the climate system

(IPCC AR6)



Temperature
extremes



Heavy precipitation



Floods



Droughts

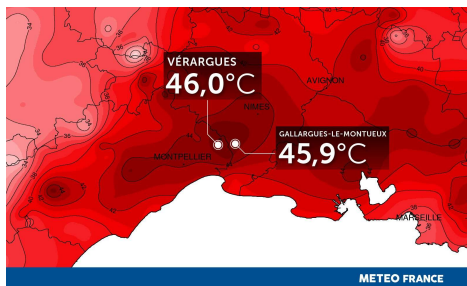


Storms



Compound
events

2019-2021: Events made more likely because of human-induced climate change



France, 2019



Australia, 2019-2020



Siberia, 2020



Canada, 2021



Western Europe, 2021

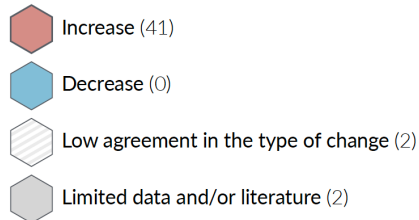


Mediterranean, 2021

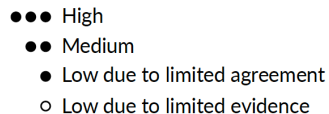
“It is *virtually certain* that **hot extremes** have become more frequent and more intense across **most land regions**”

“There is *high confidence* that **human-induced climate change** is the **main driver** of these changes”

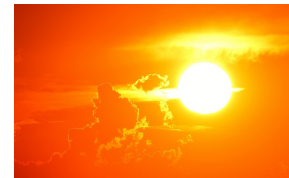
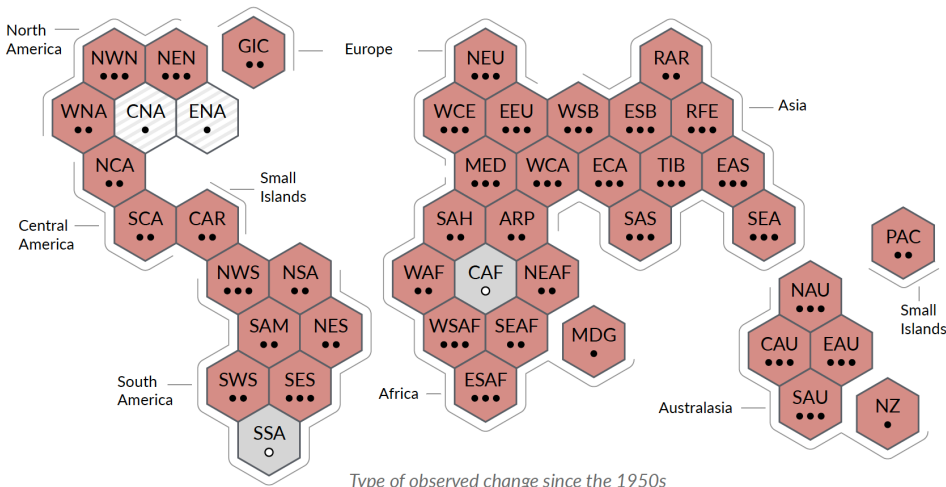
Type of observed change in hot extremes



Confidence in human contribution to the observed change



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







(IPCC AR6, Fig. SPM.3)

“The frequency and intensity of **heavy precipitation events** have increased over **most land area for which observational data are sufficient** for trend analysis (*high confidence*)”

“**Human influence**, in particular greenhouse gas emissions, is **likely the main driver** of the observed global scale intensification of heavy precipitation in land regions.”

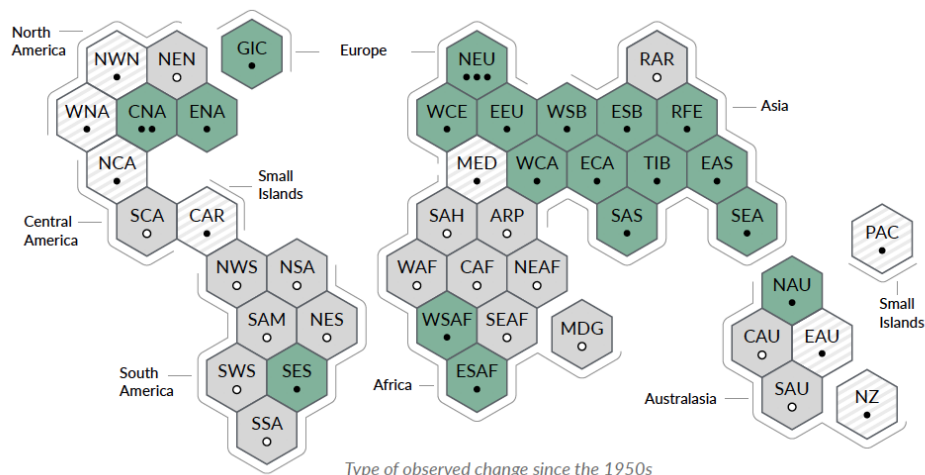
Type of observed change in heavy precipitation

-  Increase (19)
-  Decrease (0)
-  Low agreement in the type of change (8)
-  Limited data and/or literature (18)

Confidence in human contribution to the observed change

- High
- Medium
- Low due to limited agreement
- Low due to limited evidence

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 since the 1950s



(IPCC AR6, Fig. SPM.3)

“**Human-induced climate change** has contributed to increases in **agricultural and ecological droughts** in some regions **due to increased land evapotranspiration** (*medium confidence*)”

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)

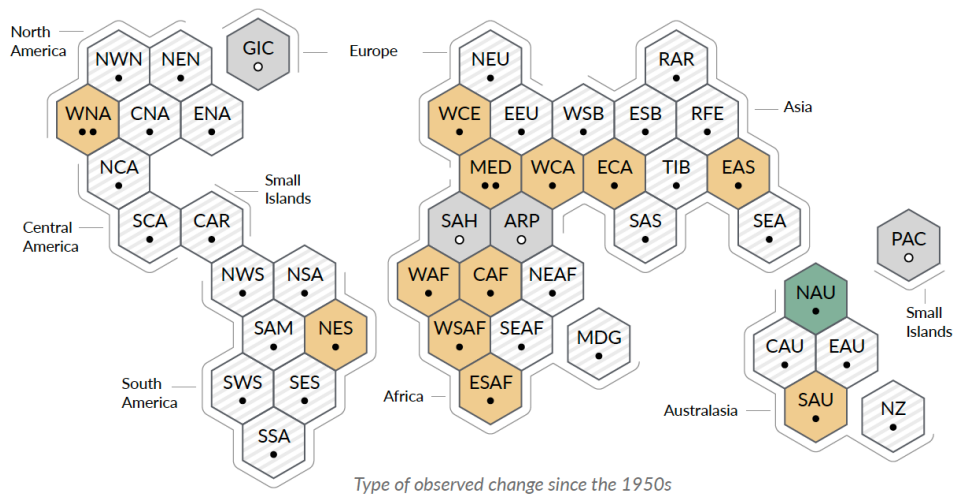
Confidence in human contribution
to the observed change

●●● High

●● Medium

● Low due to limited agreement

○ Low due to limited evidence



(IPCC AR6, Fig. SPM.3)

It is *likely* that the global proportion of **major** (Category 3–5) **tropical cyclone** occurrence has increased over the last four decades.



Human influence has *likely* increased the chance of **compound extreme events** since the 1950s:

- **concurrent heatwaves and droughts** on global scale (*high confidence*)
- **fire weather** in some regions of all inhabited continents (*medium confidence*)
- **compound flooding** in some locations (*medium confidence*)



(IPCC AR6)

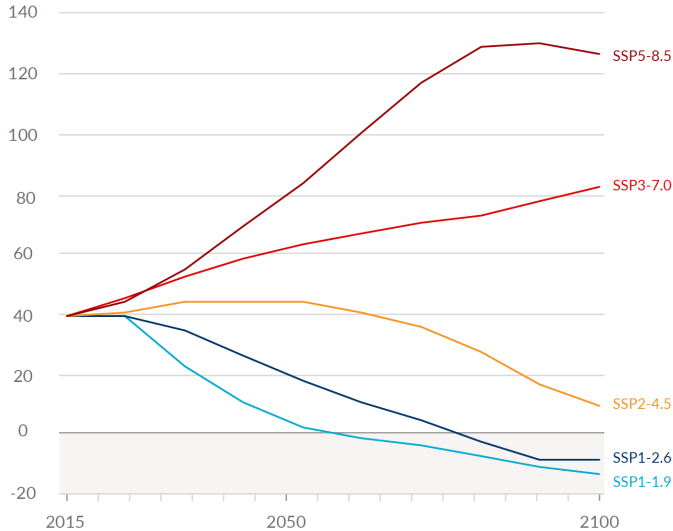
It depends on our decisions and emissions!

	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

(IPCC AR6)

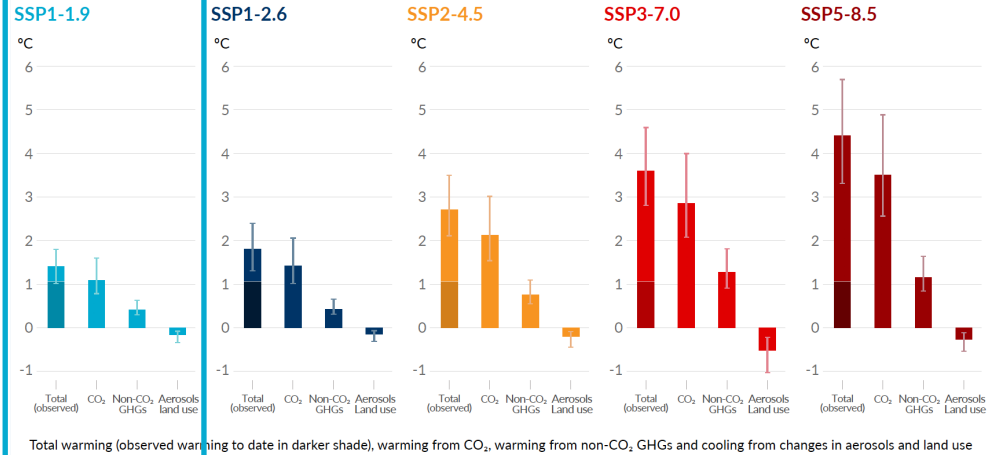
Projections

Carbon dioxide (GtCO₂/yr)



Contribution to global surface temperature increase from different emissions, with a dominant role of CO₂ emissions

Change in global surface temperature in 2081-2100 relative to 1850-1900 (°C)



Only 1 scenario compatible with aim of Paris agreement (“well below 2°C” and “pursuing efforts” to stabilize at 1.5°C)

We are at a crossroads

Projected changes in extremes as function of global warming

Many changes in the **frequency and intensity of climate extremes become larger with increasing global warming:**

- hot extremes
- marine heatwaves
- heavy precipitation
- agricultural and ecological droughts in some regions
- proportion of intense tropical cyclones

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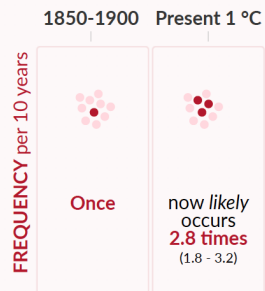
Already much higher risks at 2°C compared to 1.5°C, as well as at 1.5°C compared to now, including some irreversible impacts

Projected changes in 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



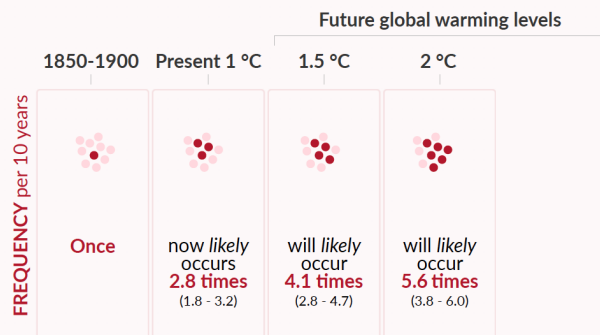
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Hot temperature extremes over land

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



Every additional 0.5°C of global warming causes clearly discernible increases in the intensity and frequency of hot extremes, including heatwaves (*very likely*)

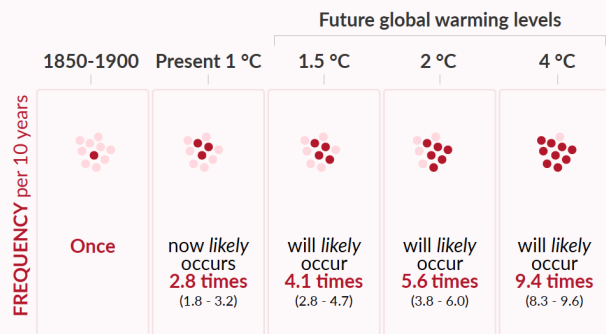
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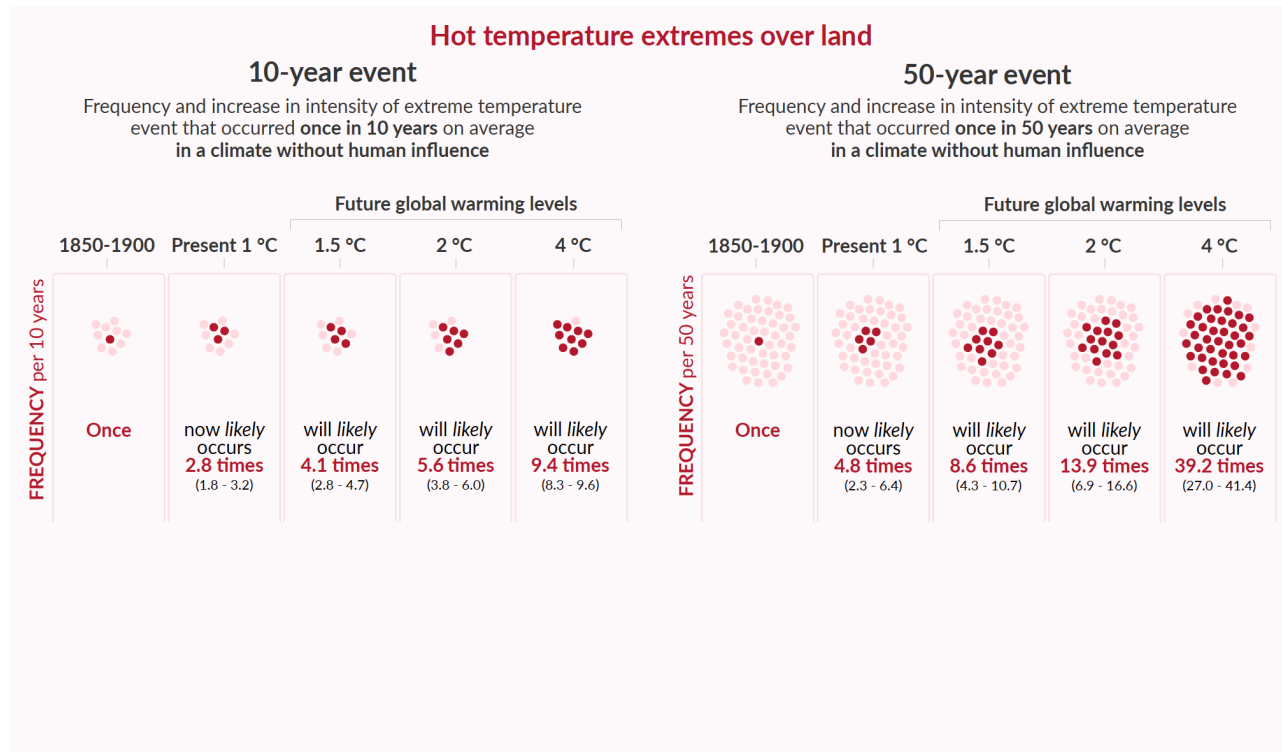
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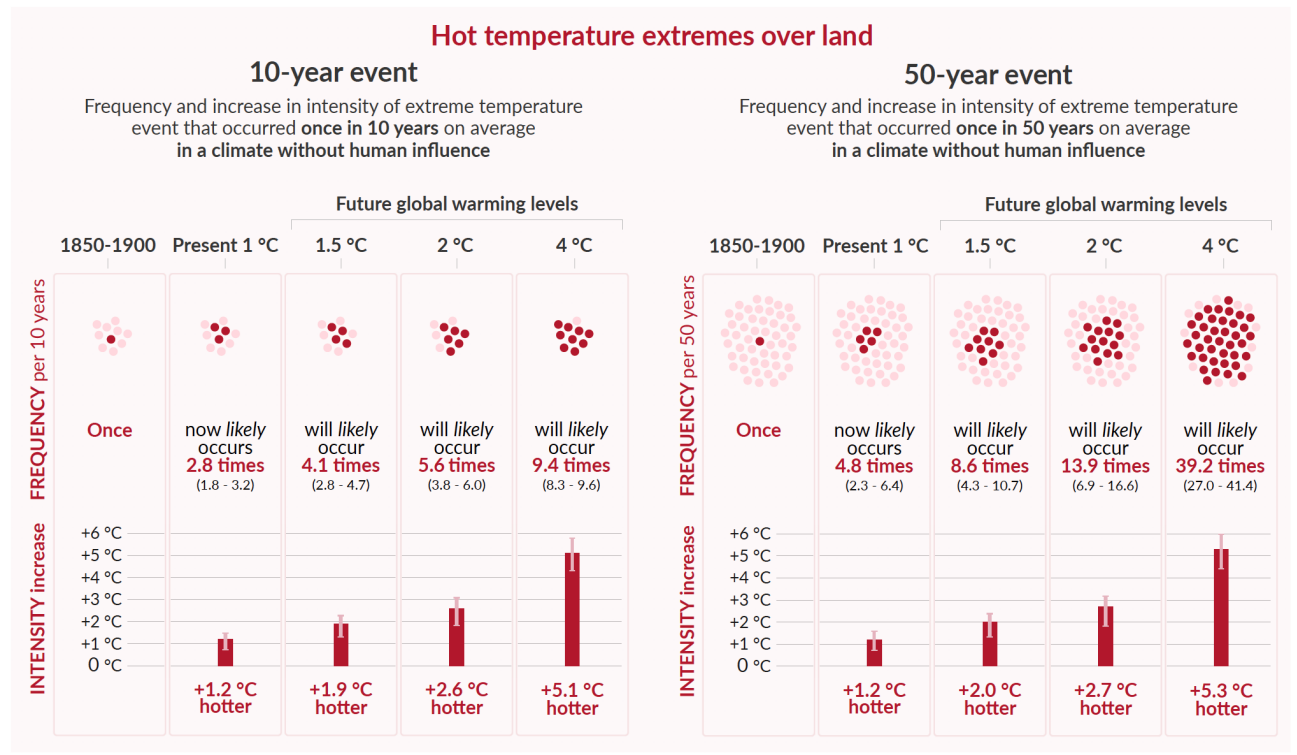
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Projected percentage changes in frequency are higher for rarer events (*high confidence*)

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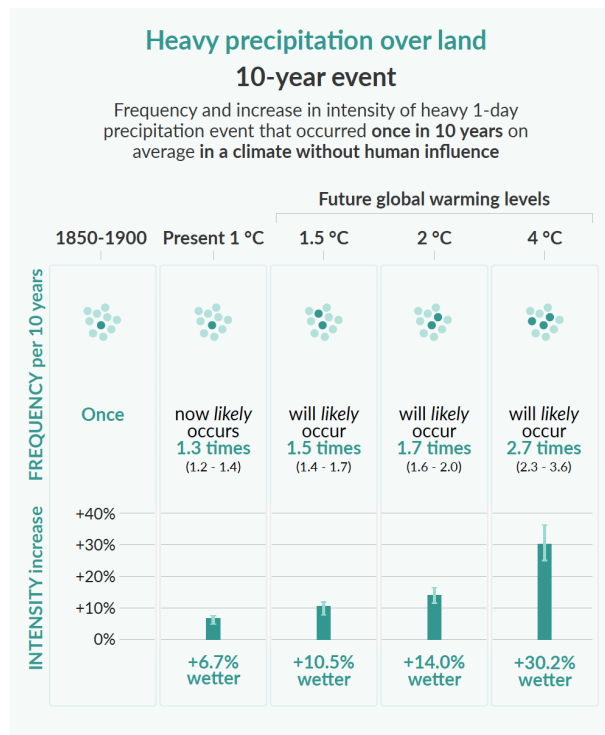


Projected percentage changes in frequency are higher for rarer events (*high confidence*)

Hot extremes on land warm more than global mean temperature

(IPCC AR6, Fig. SPM.6)

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



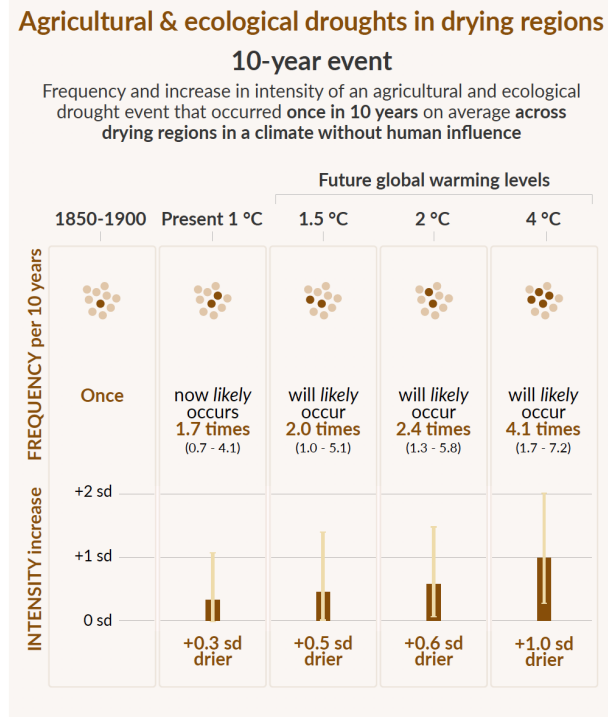
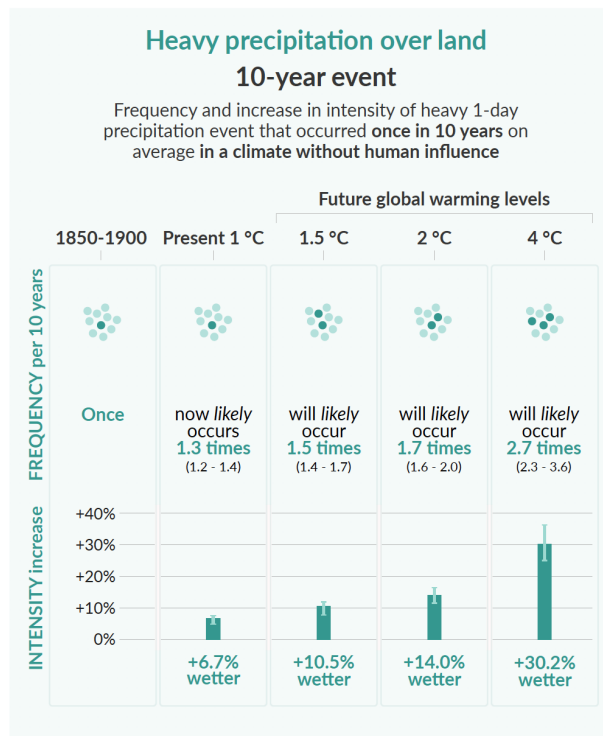
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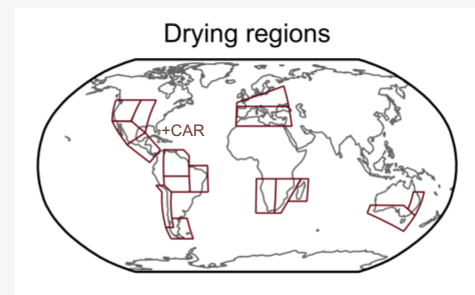
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Every additional 0.5°C of global warming causes clearly **discernible increases** in:

- **heavy precipitation** (*high confidence*)
- **agricultural and ecological droughts** in some regions (*high confidence*)

Regions with assessed drying at 2°C of global warming



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- Many regions are projected to experience an increase in the probability of **compound events** with higher global warming (*high confidence*):
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 - Further increases of **fires** and **compound flooding** (*high confidence*)



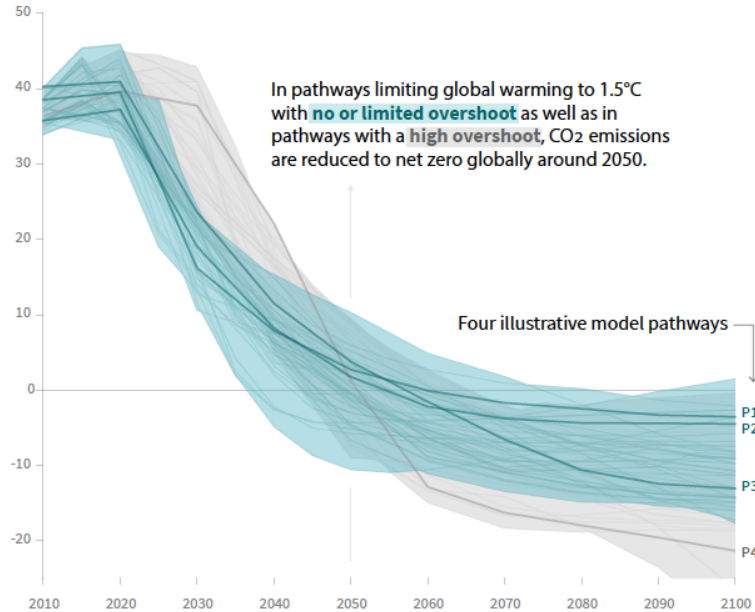
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 - Further increases of **fires** and **compound flooding** (*high confidence*)
 - **Concurrent extremes at multiple locations** become more frequent, including in **crop-producing areas**, at 2°C and above compared to 1.5°C global warming (*high confidence*)



Global total net CO₂ emissions

Billion tonnes of CO₂/yr



(IPCC SR15)

Stabilization to ~1.5°C requires changes which are unprecedented in terms of scale:

- **Immediate reduction of CO₂ emissions on global scale (until 2030: 50% of 2010)**
- **Net-zero CO₂ emissions at the latest in 2040 (66% probability) – 2050 (50% probability)**

Evidence on effects of human-induced climate change on extremes has strengthened in the past decade:

- No region is spared from changes in extremes
- Unprecedented events become more likely with increasing global warming
- Threats from extremes are multiplying with increasing global warming

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Risks we will be facing beyond 2030 depend on current decisions and actions:

- A world at $\sim 1.5^{\circ}\text{C}$ would be possible and could be nice to live in, but requires -50% CO_2 emissions in 2030 (decrease of about 5-6% per year)
- Numerous risks become much larger above 2°C (e.g. species extinctions, concurrent extremes in breadbasket regions)

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We should do all we can to limit global warming to $\sim 1.5^{\circ}\text{C}$ and avoid overshoots: Even a world at $\sim 1.5^{\circ}\text{C}$ is not safe, but it's the best option we have

Thank you!

