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INTERGOVERNMENTAL PANEL ON climate change

WMO UNEP

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

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Swiss NGO DRR Platform
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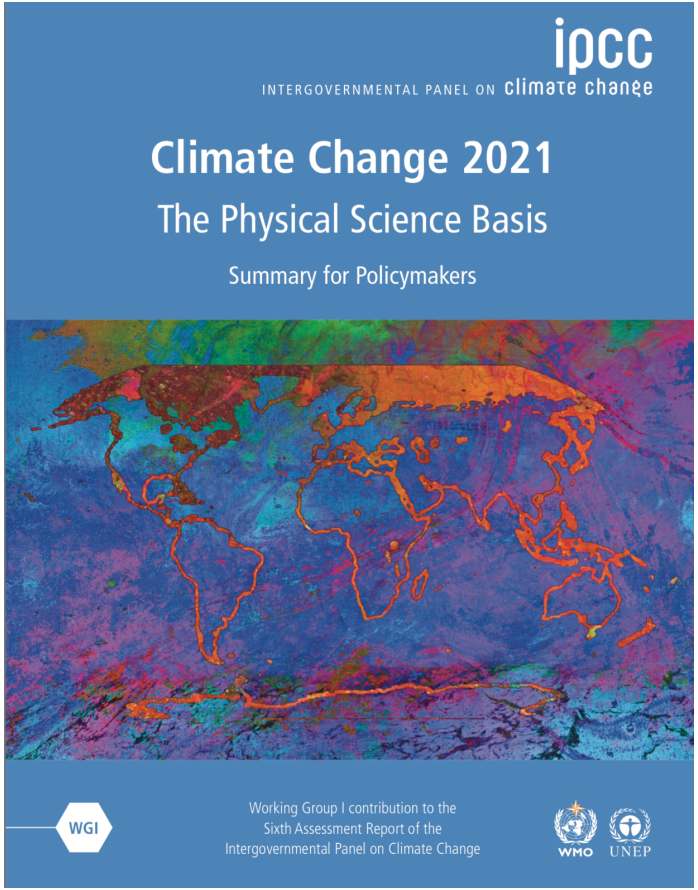
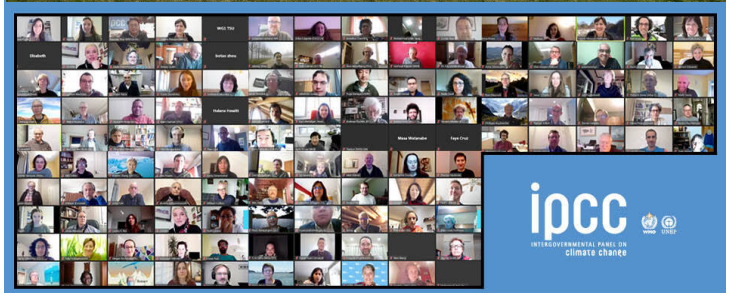
#ClimateReport #IPCC

2021 IPCC AR6 report

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

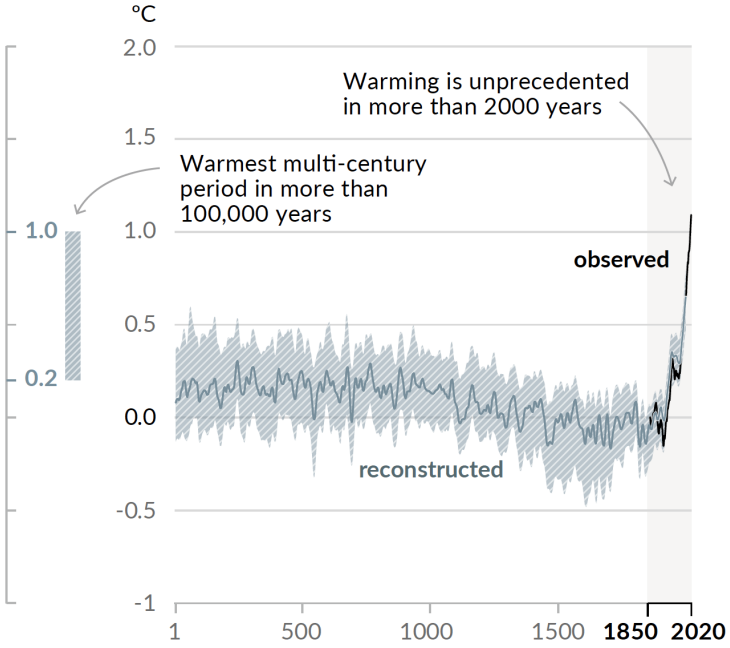




Observed global warming

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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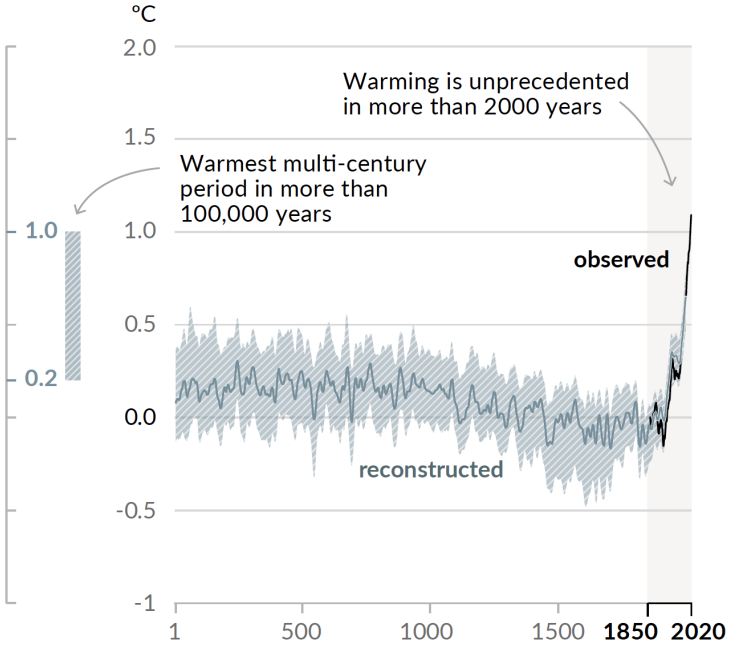

- We already had 1.1°C (1.09°C) of global warming in 2011-2020 compared to 1850-1900
- The warming rate is unprecedented in more than 2000 years, the temperature level is unprecedented in more than 100’000 years

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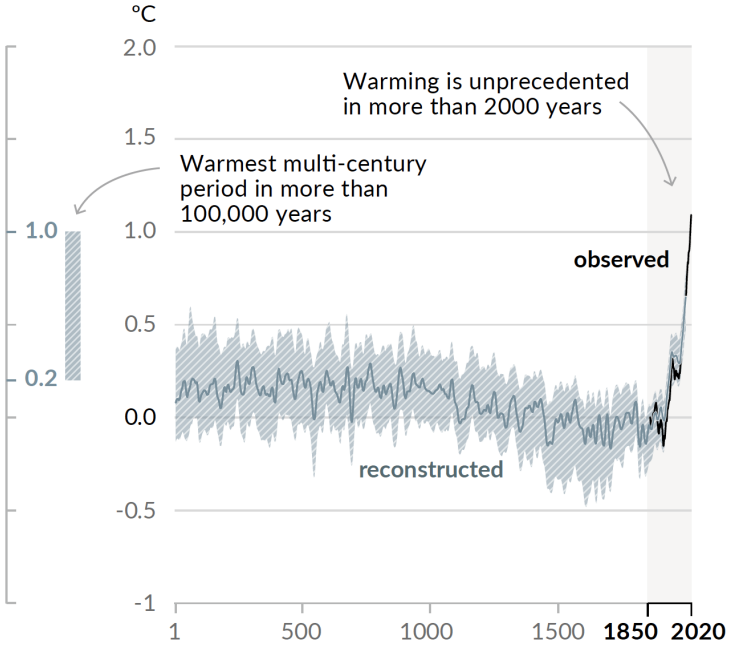


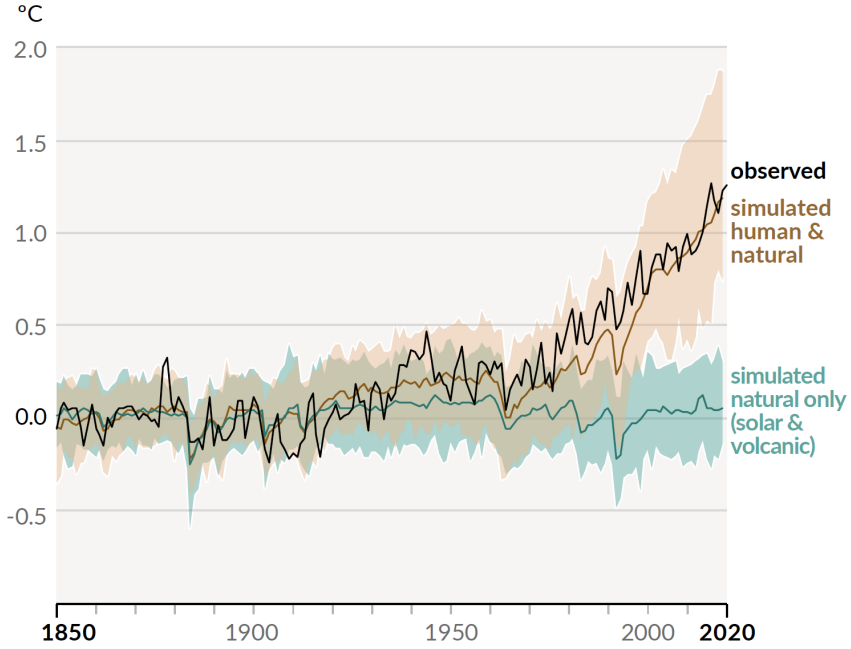
- We already had 1.1°C (1.09°C) of global warming in 2011-2020 compared to 1850-1900
- The warming rate is unprecedented in more than 2000 years, the temperature level is unprecedented in more than 100’000 years
- The largest part of this warming is irreversible for several generations

(IPCC AR6, Fig. SPM.1)

Observed global warming & attribution

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)

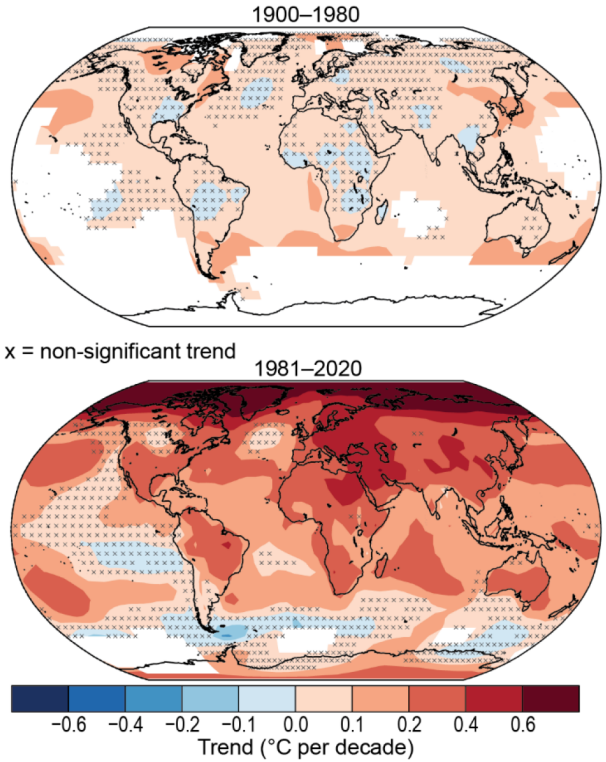


- IPCC AR6: "It is unequivocal that human influence has warmed the atmosphere, ocean and land"
- Best estimate of human-induced global warming until 2011-2020: 1.07°C, i.e. ~98% of observed global warming (1.09°C)

(IPCC AR6, Fig. SPM.1)

Warming patterns

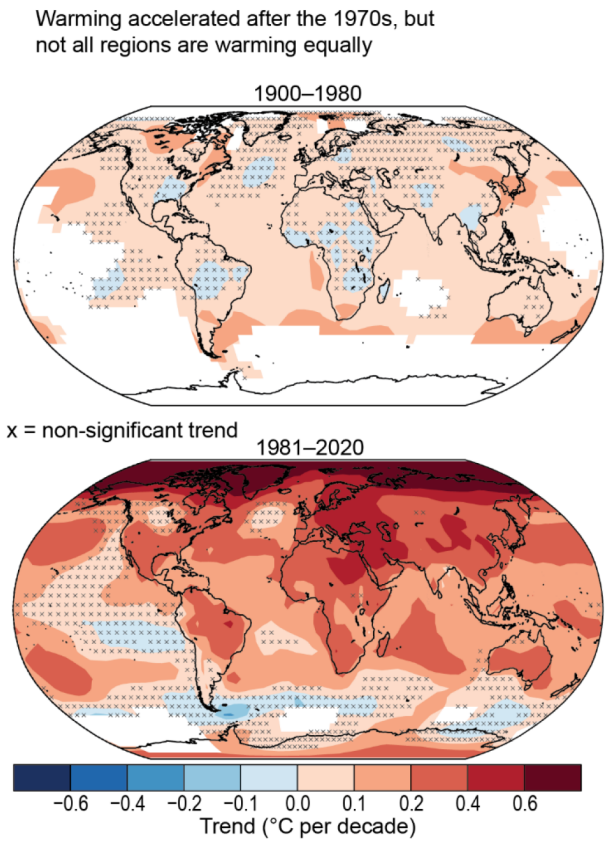
Warming accelerated after the 1970s, but not all regions are warming equally

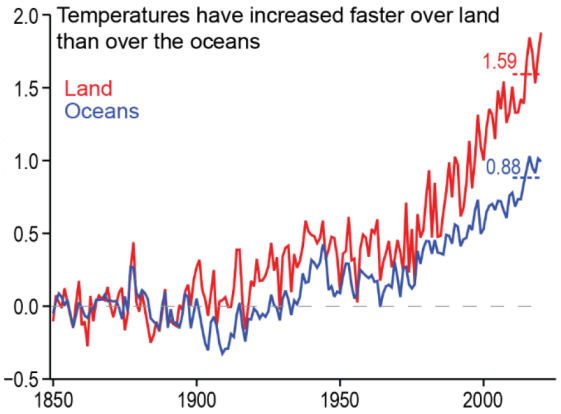


Temperature observations reveal warming acceleration after 1970s

(IPCC AR6, Chapter 2, Fig. 2.11)

Warming patterns



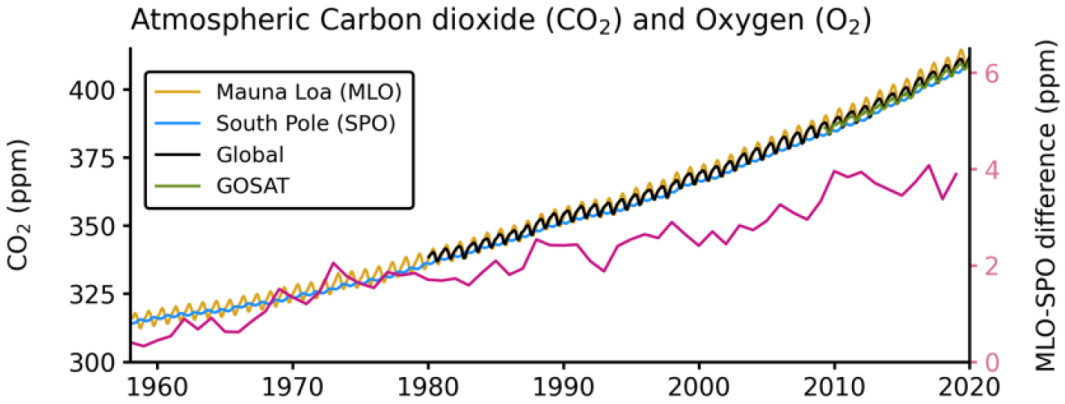


Temperature observations reveal warming acceleration after 1970s

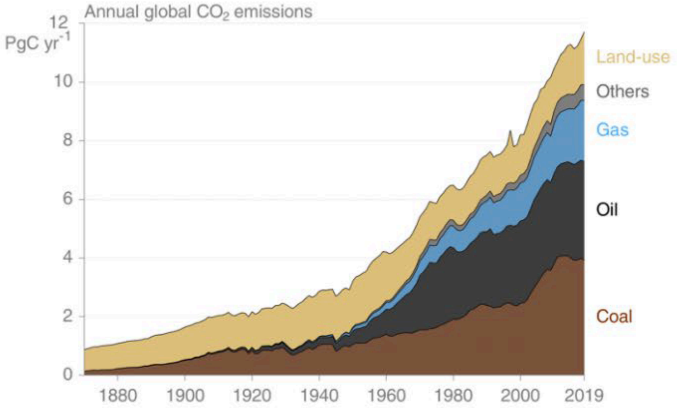
Land regions are warming substantially more than the global mean: 1.6ºC (1.59ºC)

(IPCC AR6, Chapter 2, Fig. 2.11)

Atmospheric CO_2 concentrations and CO_2 emissions



Continuous increase of CO_2 concentrations (highest measured concentration: May 2021)



The sources of CO_2 emissions are clear

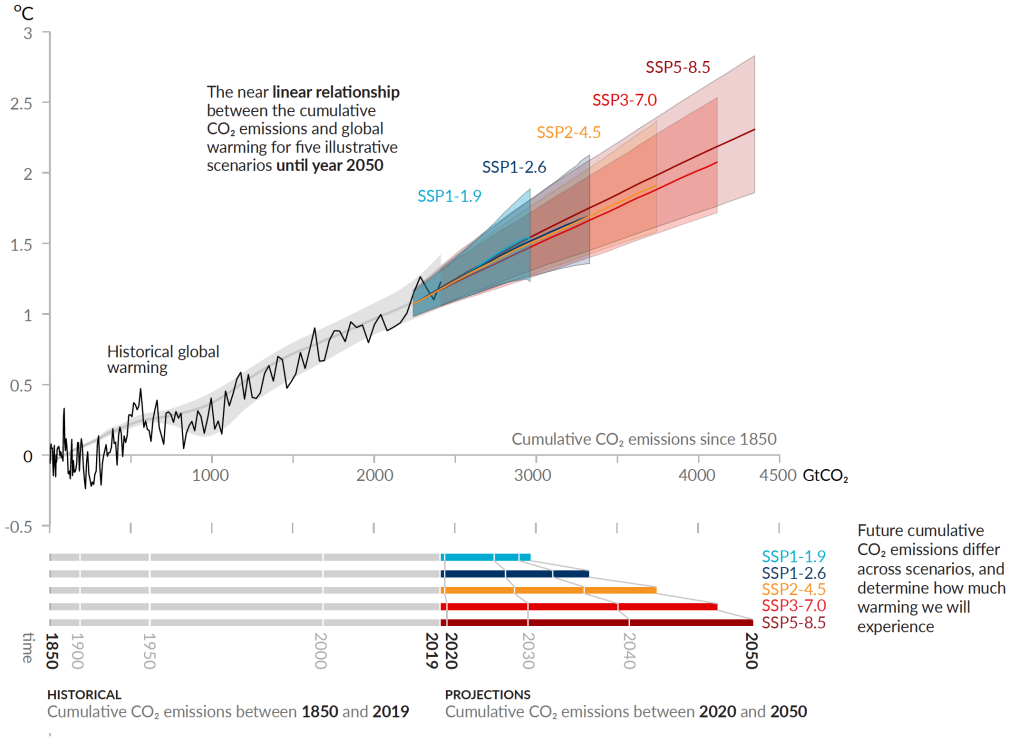
- Burning of fossil fuels
- Land use (deforestation)

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

Cumulative CO_2 emissions vs global warming

Every tonne of CO_2 emissions adds to global warming

Global surface temperature increase since 1850-1900 (°C) as a function of cumulative CO_2 emissions ($GtCO_2$)



Direct relationship between cumulative CO_2 emissions and global warming

Every additional emissions of CO_2 lead to additional global warming

Very small remaining CO_2 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

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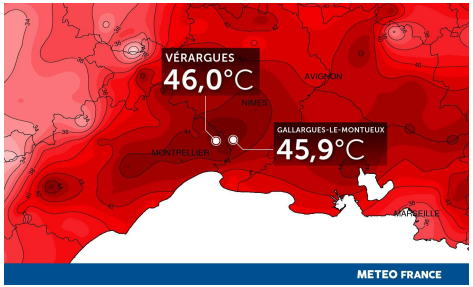
Climate at 1.1°C: Human influence on recent extreme events

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

Observed changes in extremes: Heat extremes

"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"

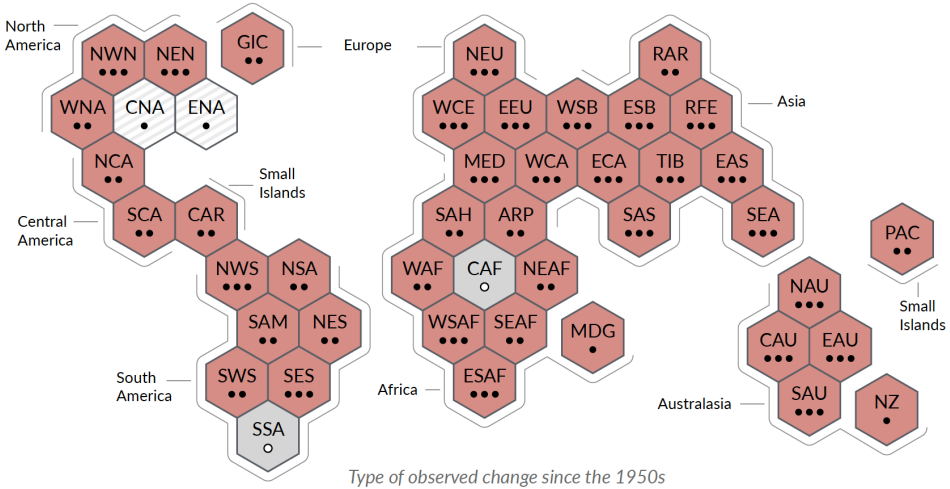
a) Synthesis of assessment of observed change in **hot extremes** and confidence in human contribution to the observed changes in the world's regions

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

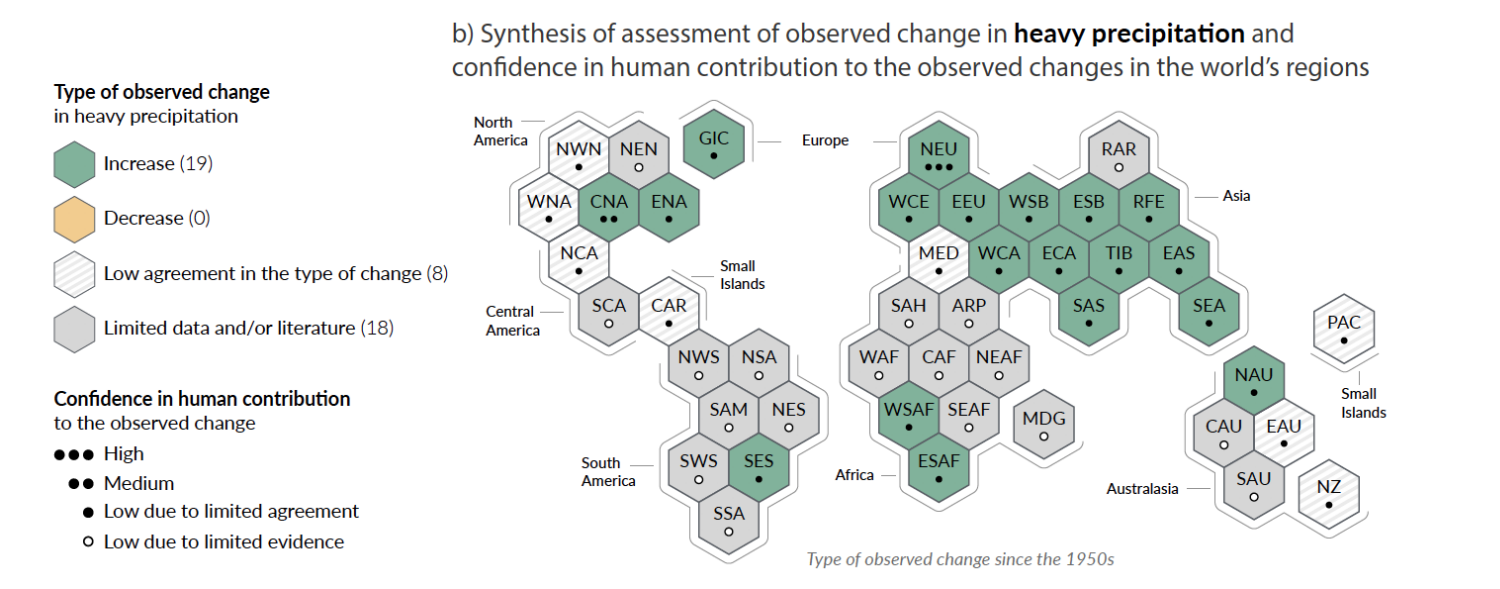


(IPCC AR6, Fig. SPM.3)

Observed changes in extremes: Heavy precipitation events

"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."

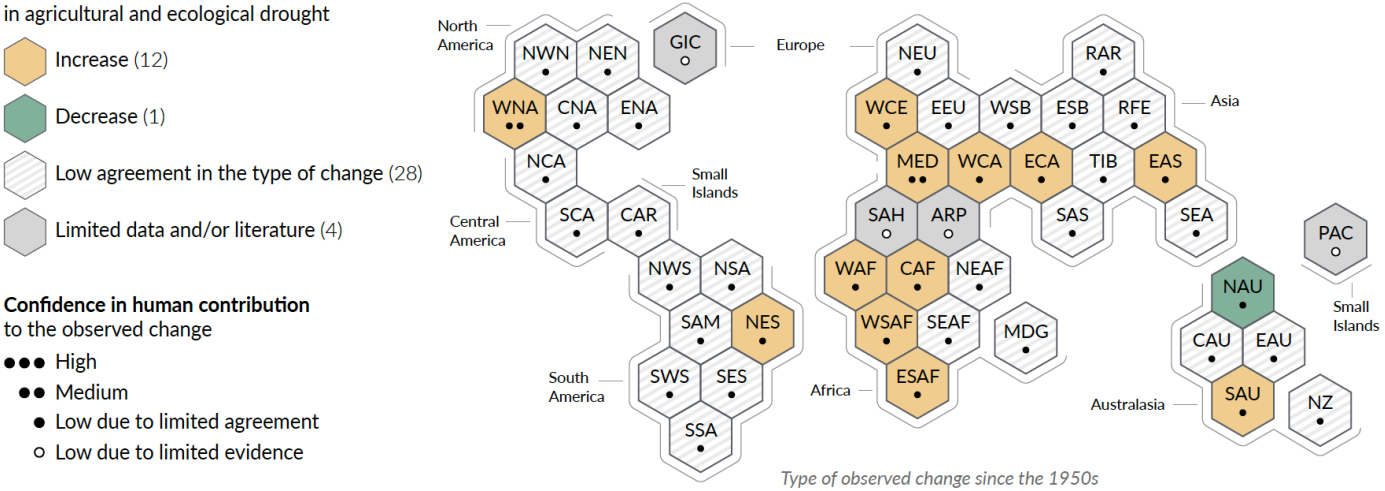


(IPCC AR6, Fig. SPM.3)

Observed changes in extremes: Droughts

"**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



(IPCC AR6, Fig. SPM.3)

Observed changes: Tropical cyclones & compound events

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)

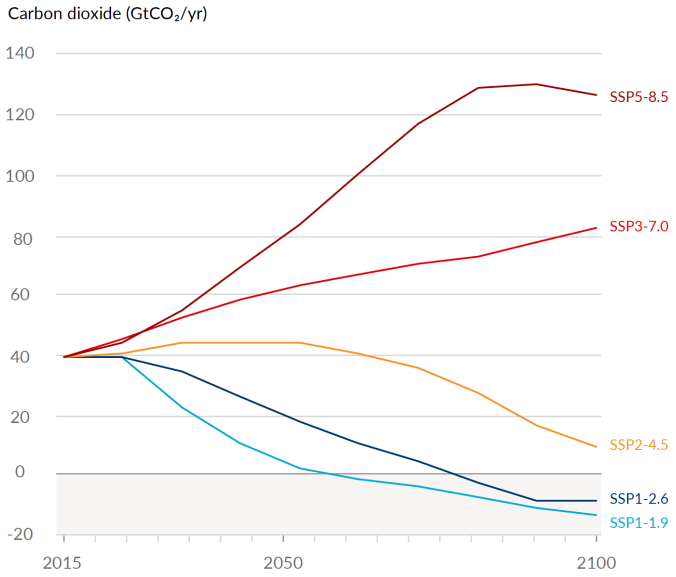
What will happen after 2030?

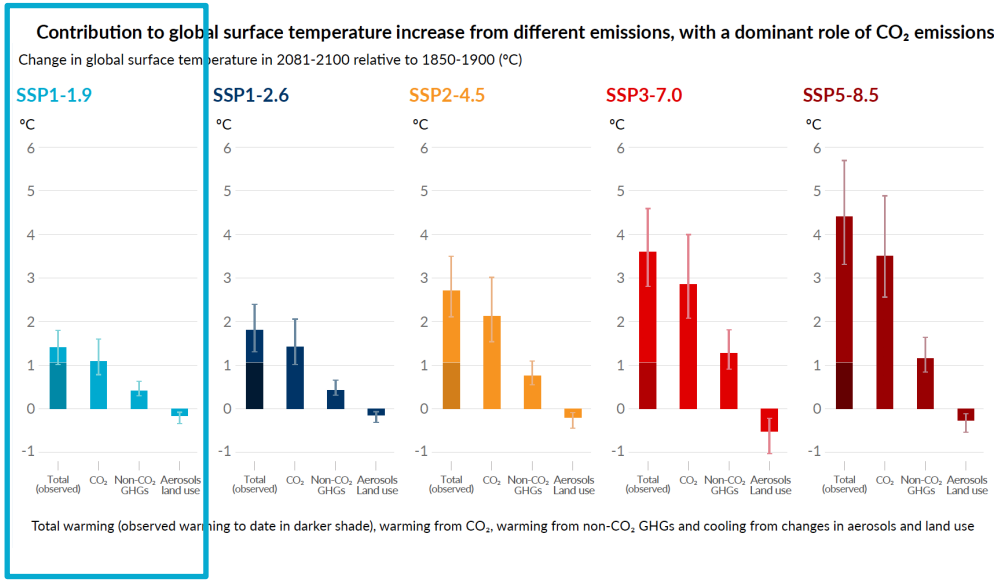
It depends on our decisions and emissions!

	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





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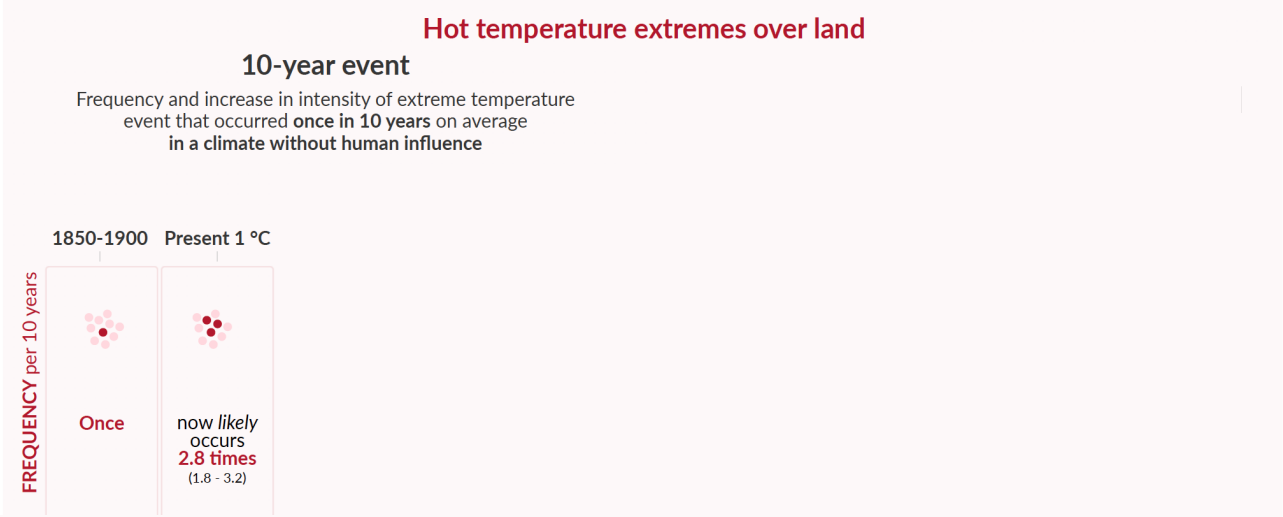
Already much higher risks at 2°C compared to 1.5°C, as well as at 1.5°C compared to now, including some irreversible impacts

Changes in extremes as function of global warming

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



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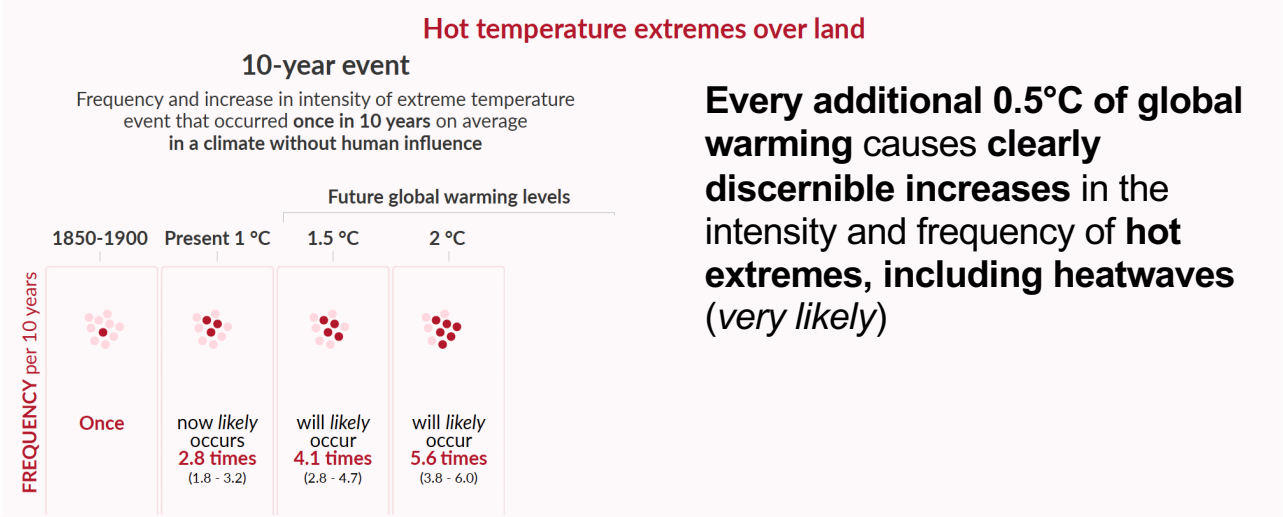

Every additional 0.5°C of global warming causes **clearly discernible increases** in the intensity and frequency of **hot extremes, including heatwaves** (*very likely*)

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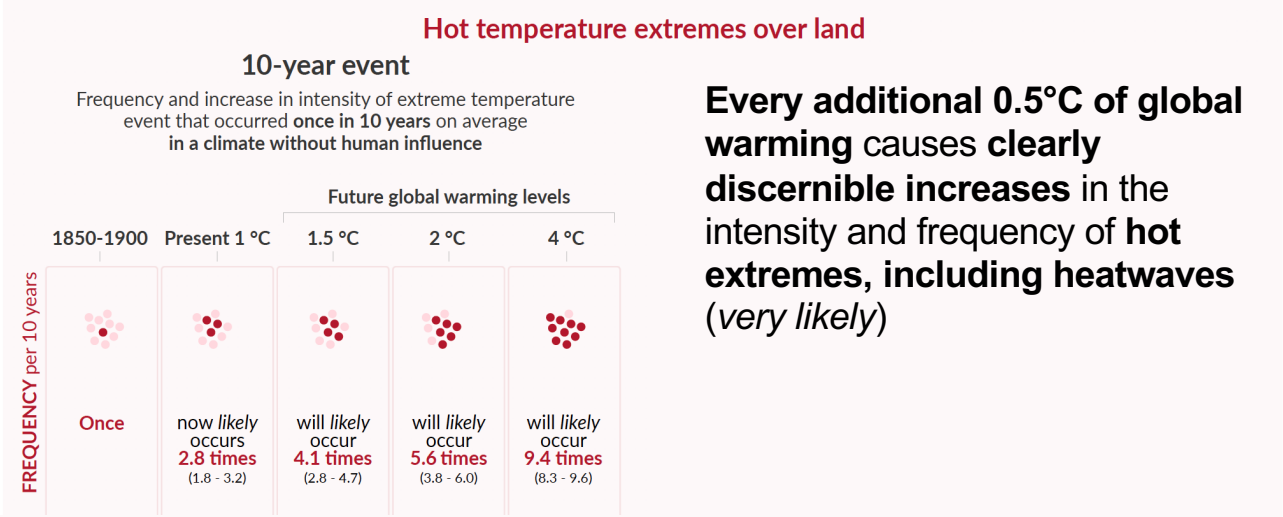

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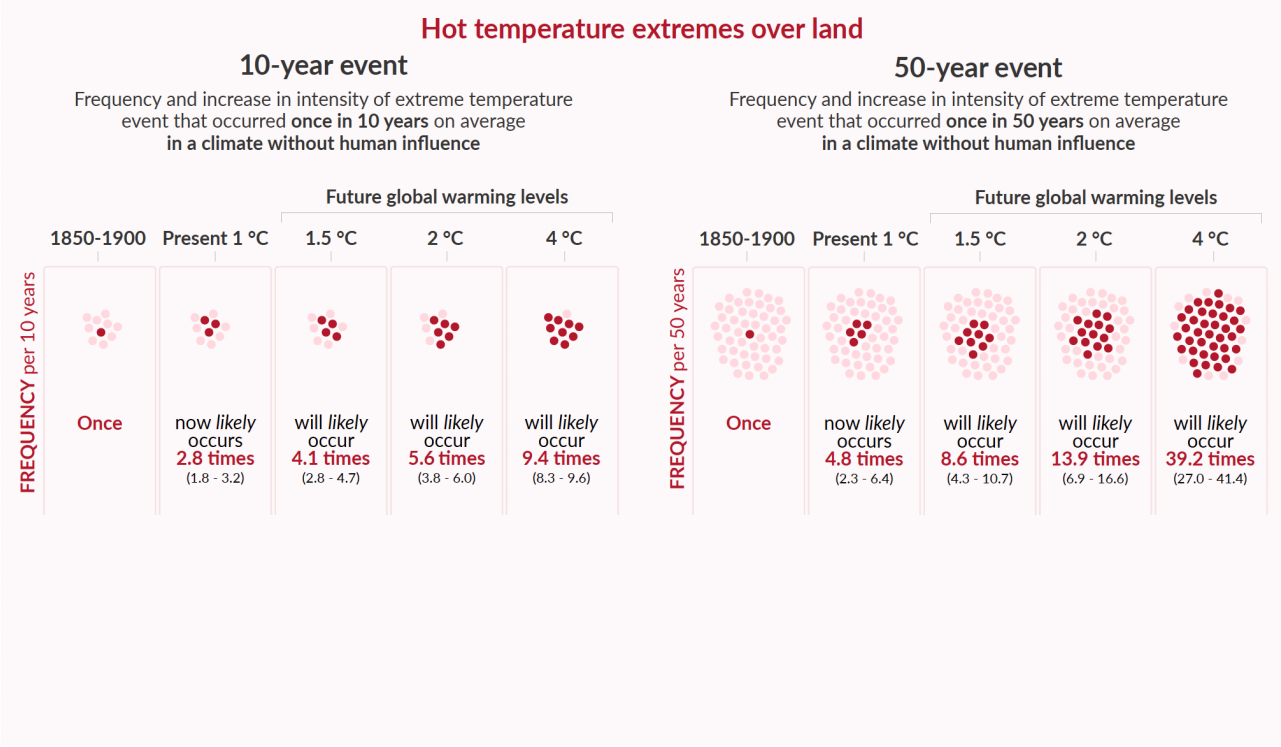

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Projected percentage changes in frequency are higher for rarer events (*high confidence*)

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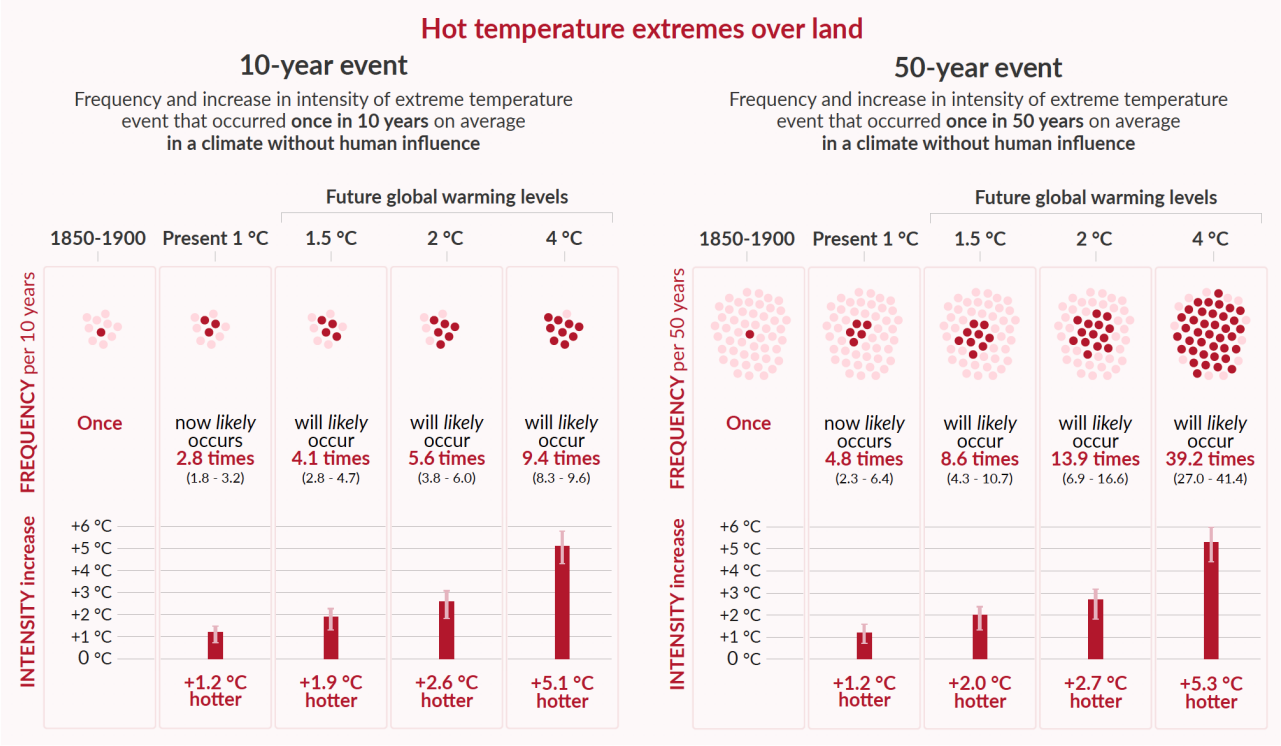

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Hot extremes on land warm more than global mean temperature

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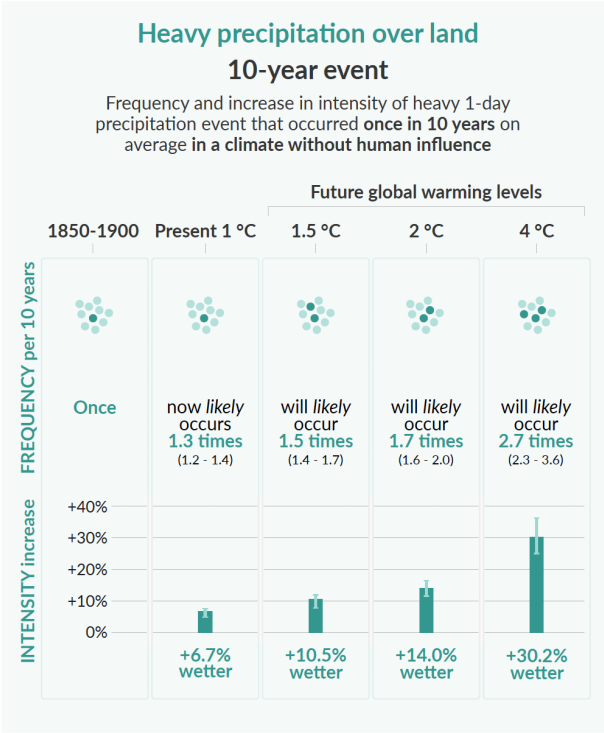

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Every additional 0.5°C of global warming causes clearly **discernible increases** in:

- **heavy precipitation** (*high confidence)*

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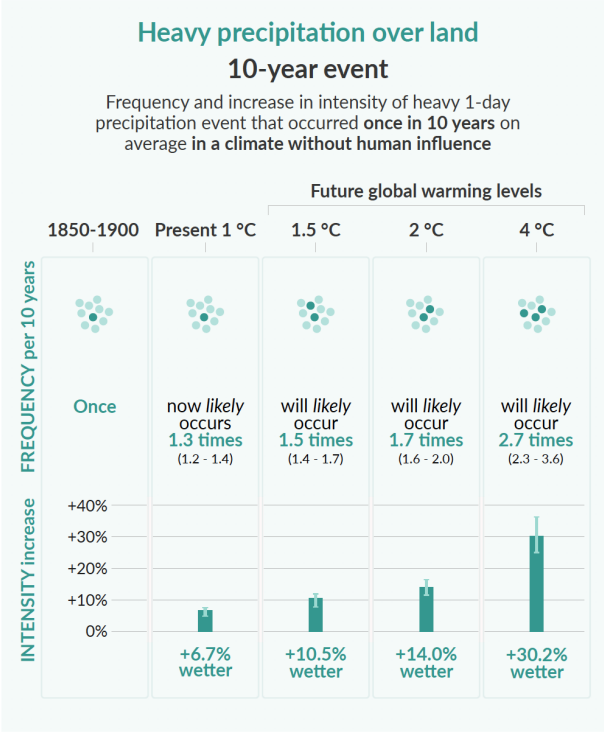

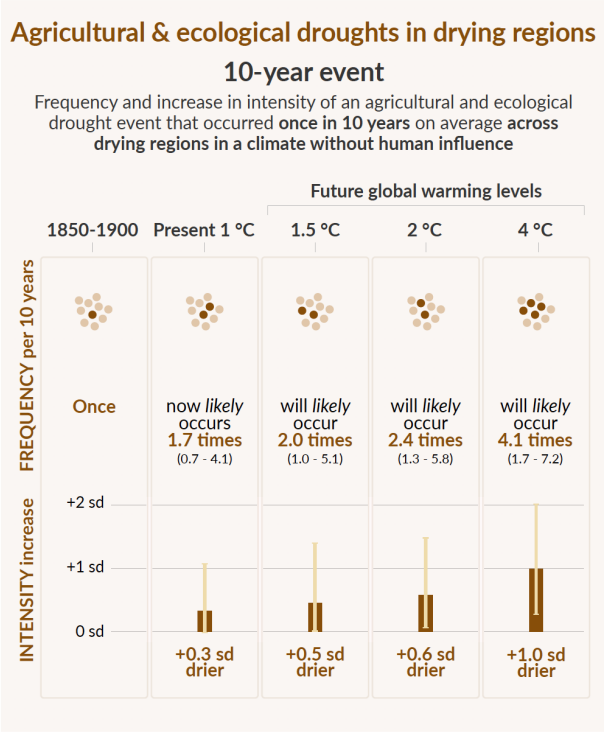

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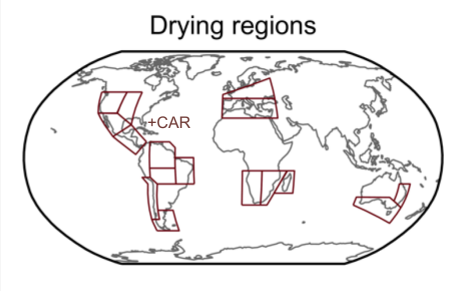
- **agricultural and ecological droughts** in some regions (*high confidence*)

Regions with assessed drying at 2°C of global warming



Changes in extremes as function of global warming

Compound events:

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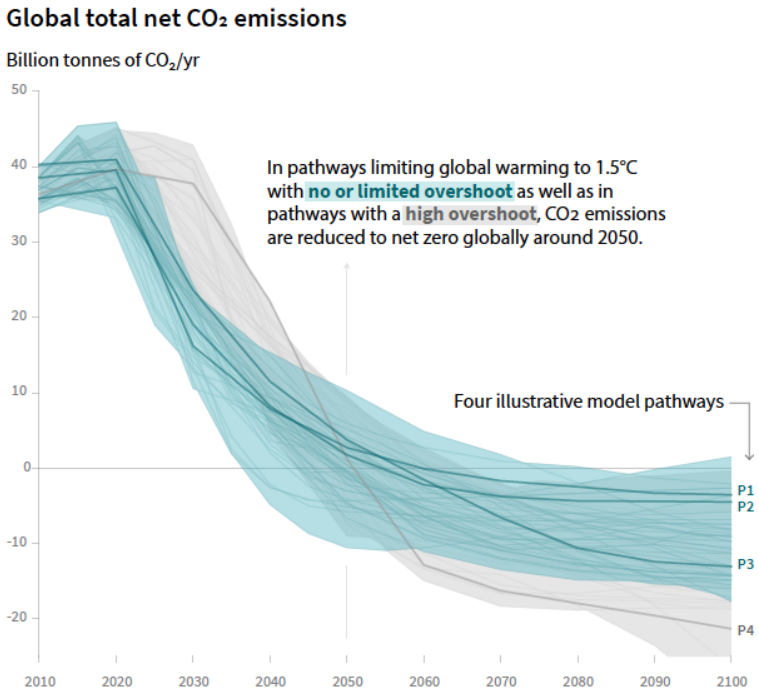
  - Further increases of **fires** and **compound flooding** (*high confidence*)
  - **Concurrent extremes at multiple locations** become more frequent, including in **crop-producing areas**, at 2°C and above compared to 1.5°C global warming (*high confidence*)

Scenarios for stabilization at ~1.5°C



(IPCC SR15)

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

- **Immediate reduction of CO_2 emissions on global scale** (until 2030: 50% of 2010)
- **Net-zero CO_2 emissions at the latest in 2040** (66% probability) **– 2050** (50% probability)

Conclusions

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

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- A world at ~1.5°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 ~1.5°C and avoid overshoots: Even a world at ~1.5°C is not safe, but it's the best option we have

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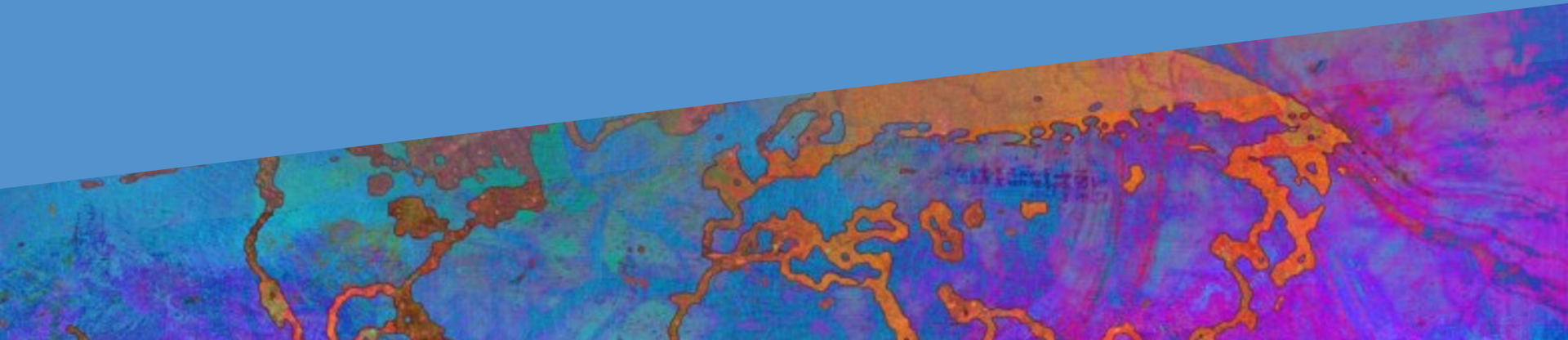
Thank you!