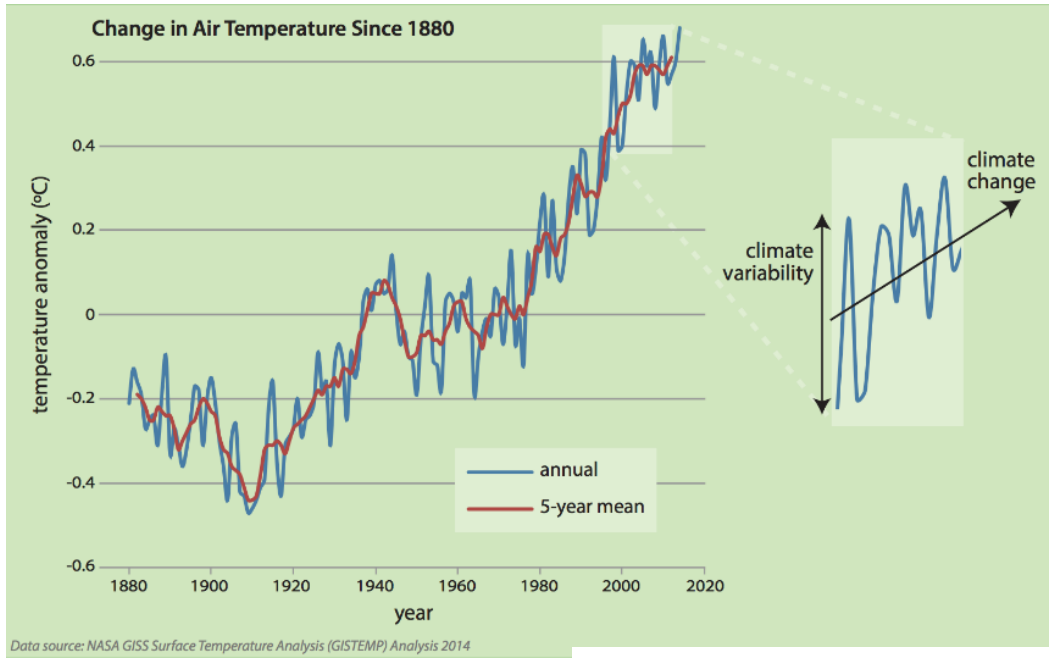
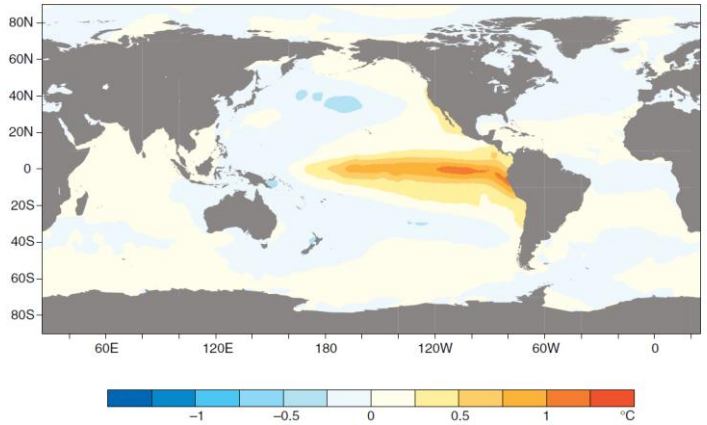
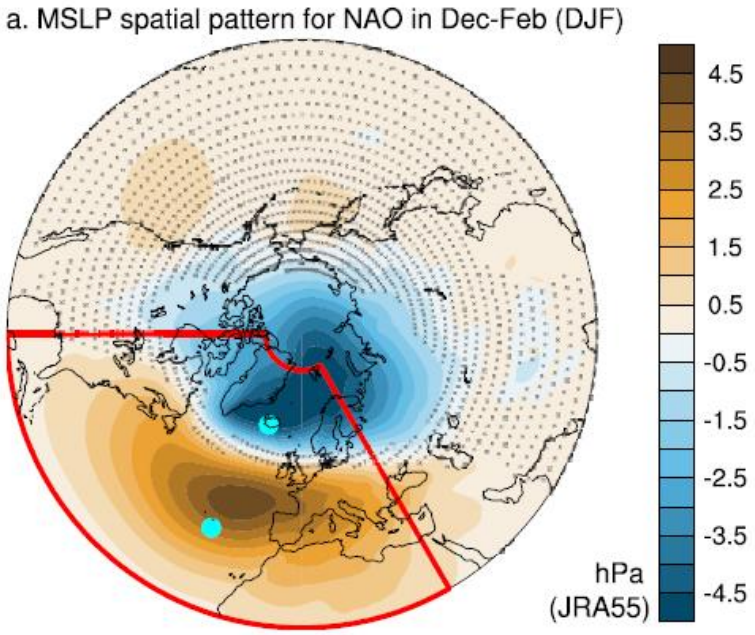
Recap from last lecture

Climate variability





Modes of climate variability



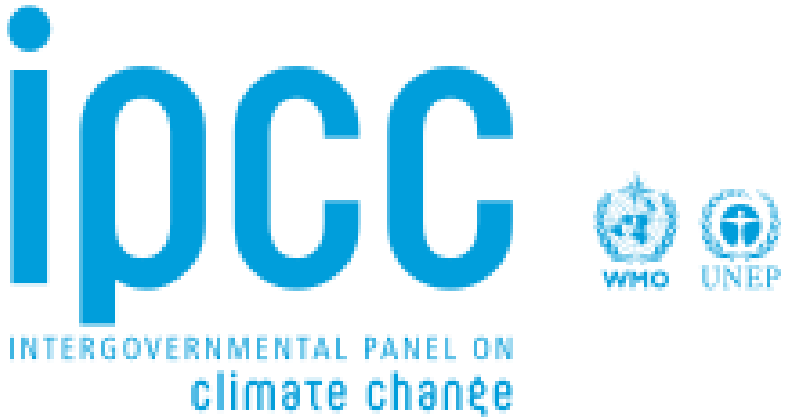
NAO has a large influence on Europe's and North America's winters

ENSO is the largest source of variabiltiy to global interannual change of surface temperature

General outline

	No.	Date	Topics	Deadlines
Basics	1.	12.09.2024	Introduction	fill in Questionnaire in exercises (not graded)
	2.	19.09.2024	Climate System, Radiation, Greenhouse effect	
	3.	26.09.2024	Earth's energy balance, Radiative transfer,	
	4.	03.10.2024	Aerosols & clouds, Radiative Forcing	Launch of poster assignment
	5.	10.10.2024	Feedback mechanisms, Climate Sensitivity	
	6.	17.10.2024	Emergent Constraints, Paleoclimate	submission of Poster proposal (01.11.2024)
Present and future Climate change	7.	31.10.2024	Climate variability	
	8.	07.11.2024	**IPCC, present day climate change, Paris Agreement, Emissions Gap, COP**	
	9.	14.11.2024	Extreme Events	
	10.	21.11.2024	Climate scenarios (RCPs, SSPs), Tipping elements, 1.5 vs 2.0°C	submission of Poster draft
	11.	28.11.2024	Carbon budget, carbon offsets, metrics	submission of assignment (graded)
Actions	12.	05.12.2024	Regional climate change	
	13.	12.12.2024	Mitigation and adaptation, Climate Engineering	**Poster Conference** (graded)
	14.	19.12.2024	Recapitulation of key points, questions and answers session	fill in Questionnaire in exercises (not graded)

IPCC Intergovernmental Panel on Climate Change



Scientific body

Objectives of the assessments:

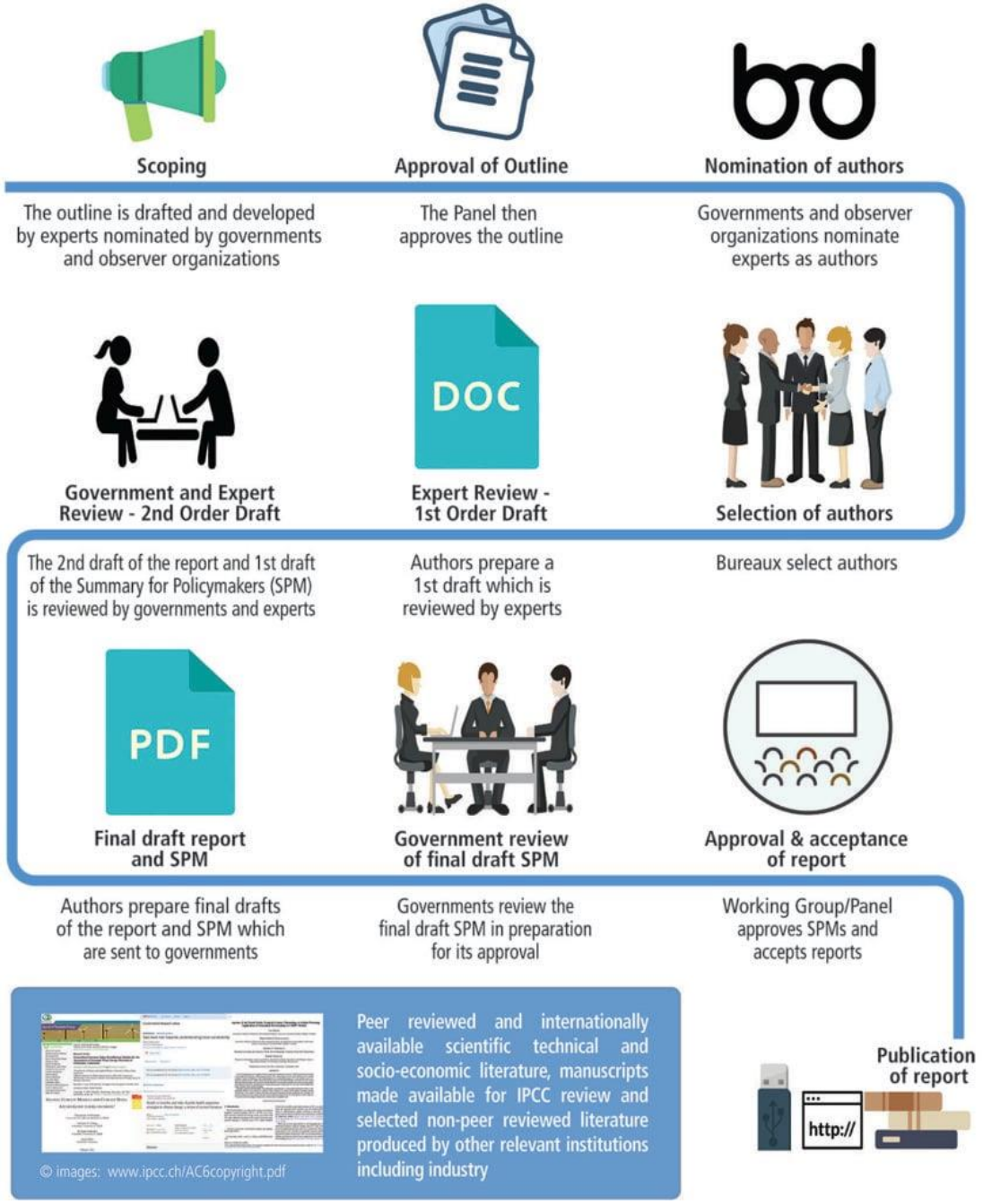
- determine the current state of climate
- estimate the environmental consequences
- estimate the socio-economic consequences

The **Intergovernmental Panel on Climate Change** (**IPCC**) was established in 1988 by the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP), and later endorsed by the United Nations General Assembly. It is based in Geneva, Switzerland, and is composed of 195 member states.

It issues scientific assessments every 5-8 years since 1990.

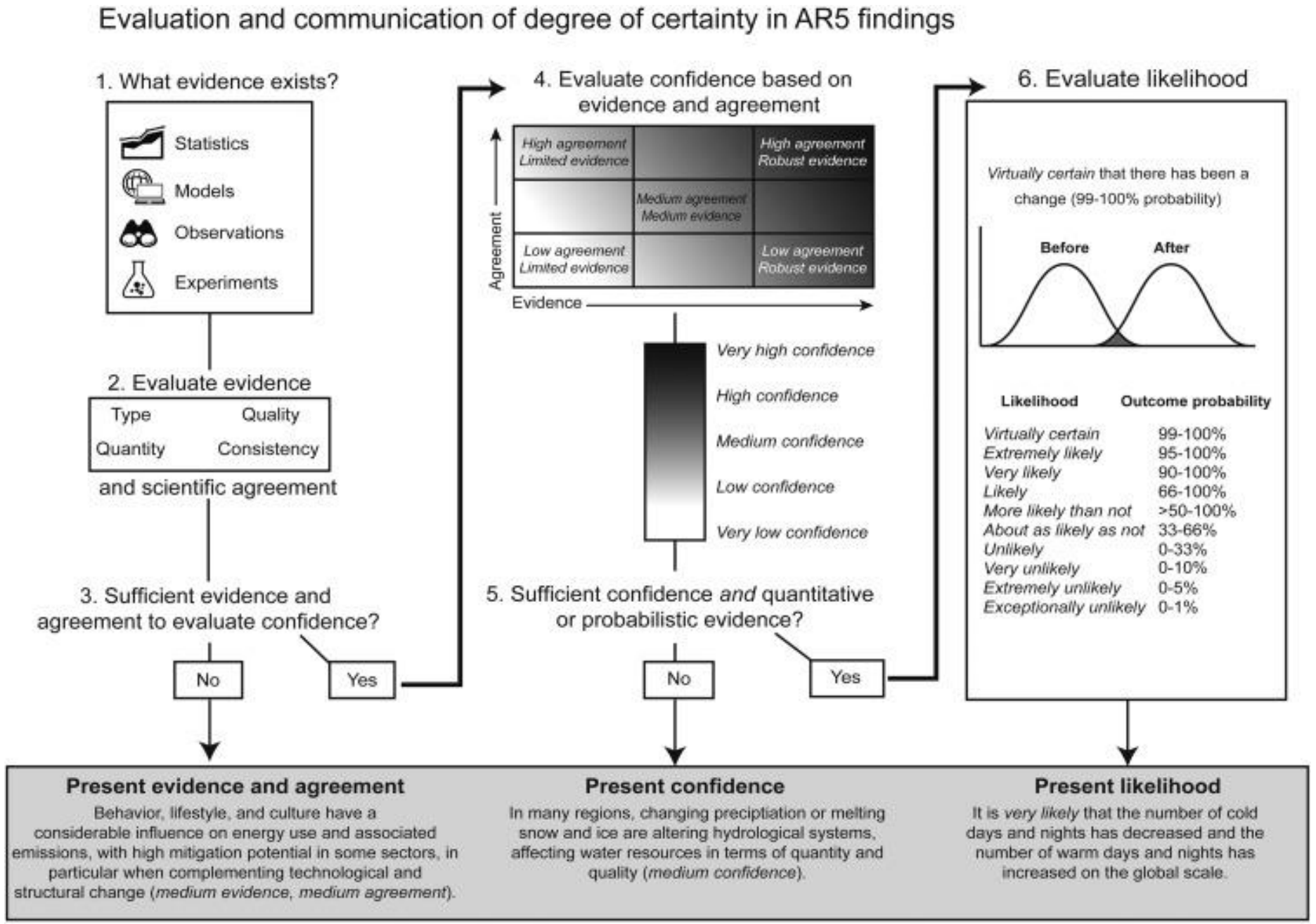
https://www.ipcc.ch/

From literature to the report



- https://www.ipcc.ch/about/preparingreports/

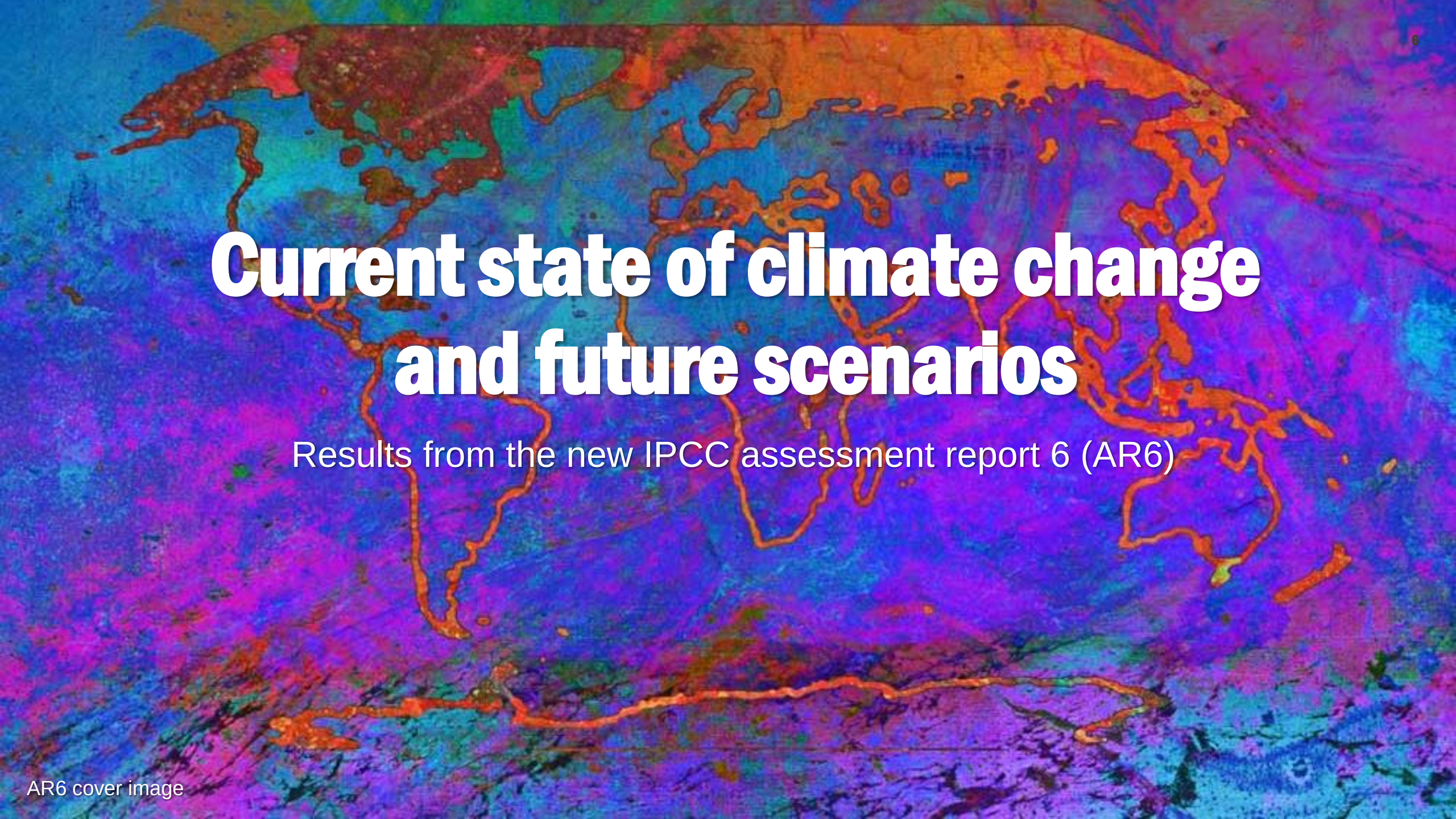
IPCC confidence and likelihood (calibrated language)



- https://www.sciencedirect.com/science/article/pii/S095937801730211X

Current state of climate change and future scenarios

Results from the new IPCC assessment report 6 (AR6)

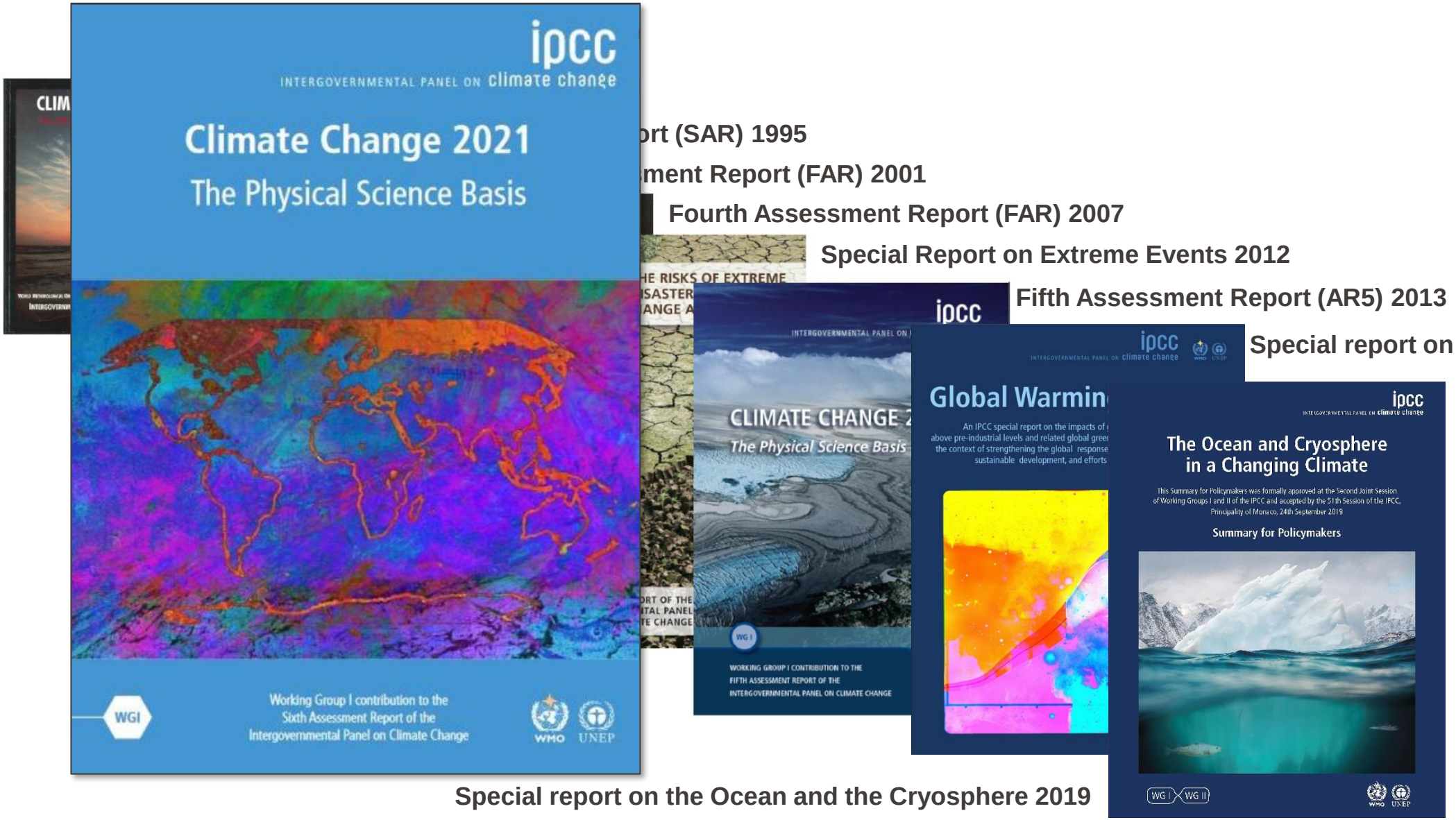


AR6 cover image

3 working groups of the IPCC

- **Working Group I The Physical Science Basis**
  - WGI aims at assessing the physical scientific basis of the climate system and climate change.
- **Working Group II Impacts, Adaptation and Vulnerability**
  - Working Group II assesses the vulnerability of socio-economic and natural systems to climate change, negative and positive consequences of climate change and options for adapting to it.
- **Working Group III Mitigation of Climate Change**
  - WG III focuses on climate change mitigation, assessing methods for reducing greenhouse gas emissions, and removing greenhouse gases from the atmosphere.

Intergovernmental Panel on Climate Change (IPCC)



ort (SAR) 1995

ment Report (FAR) 2001

Fourth Assessment Report (FAR) 2007

Special Report on Extreme Events 2012

Fifth Assessment Report (AR5) 2013

Special report on 1.5°C 2018

Special report on the Ocean and the Cryosphere 2019

IPCC AR6, 2021

Headline Statements from the Summary for Policymakers

9 August 2021 (subject to final copy-editing)

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.

Scientific consensus

Reference to paleoclimate

First time linking to extremes

ECS ~ 3°C

- https://www.ipcc.ch/report/ar6/wg1/

AR6 headline statements

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_2) 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_2 emissions, the ocean and land carbon sinks are projected to be less effective at slowing the accumulation of CO_2 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.

Currently heading for 2-3 °C, see emission scenarios

Intensification, extreme events, challenge to quantify and predict → can make impacts worse

Climate system is dynamic

Tipping points

AR6 headline statements

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.

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_2 emissions, reaching at least net zero CO_2 emissions, along with strong reductions in other greenhouse gas emissions. Strong, rapid and sustained reductions in CH_4 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*).

e.g. ENSO

Each decimal degree makes a difference.

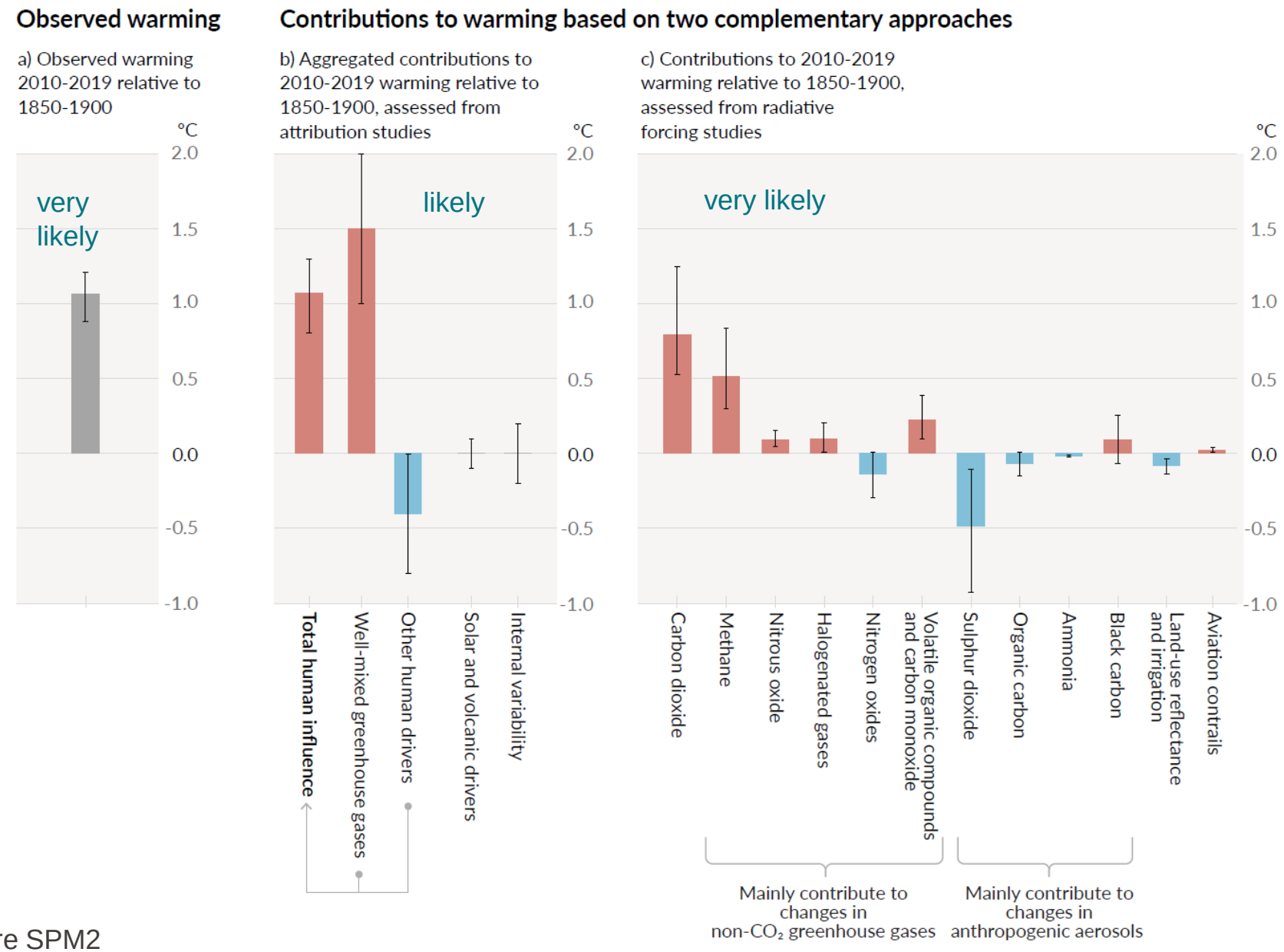
There are potential dramatic changes that cannot be ruled out.

Net-zero CO2, and reduce CH4 and air pollution

First changes visible in 2 decades if vigorous action occured now.

Attribution of today's global warming

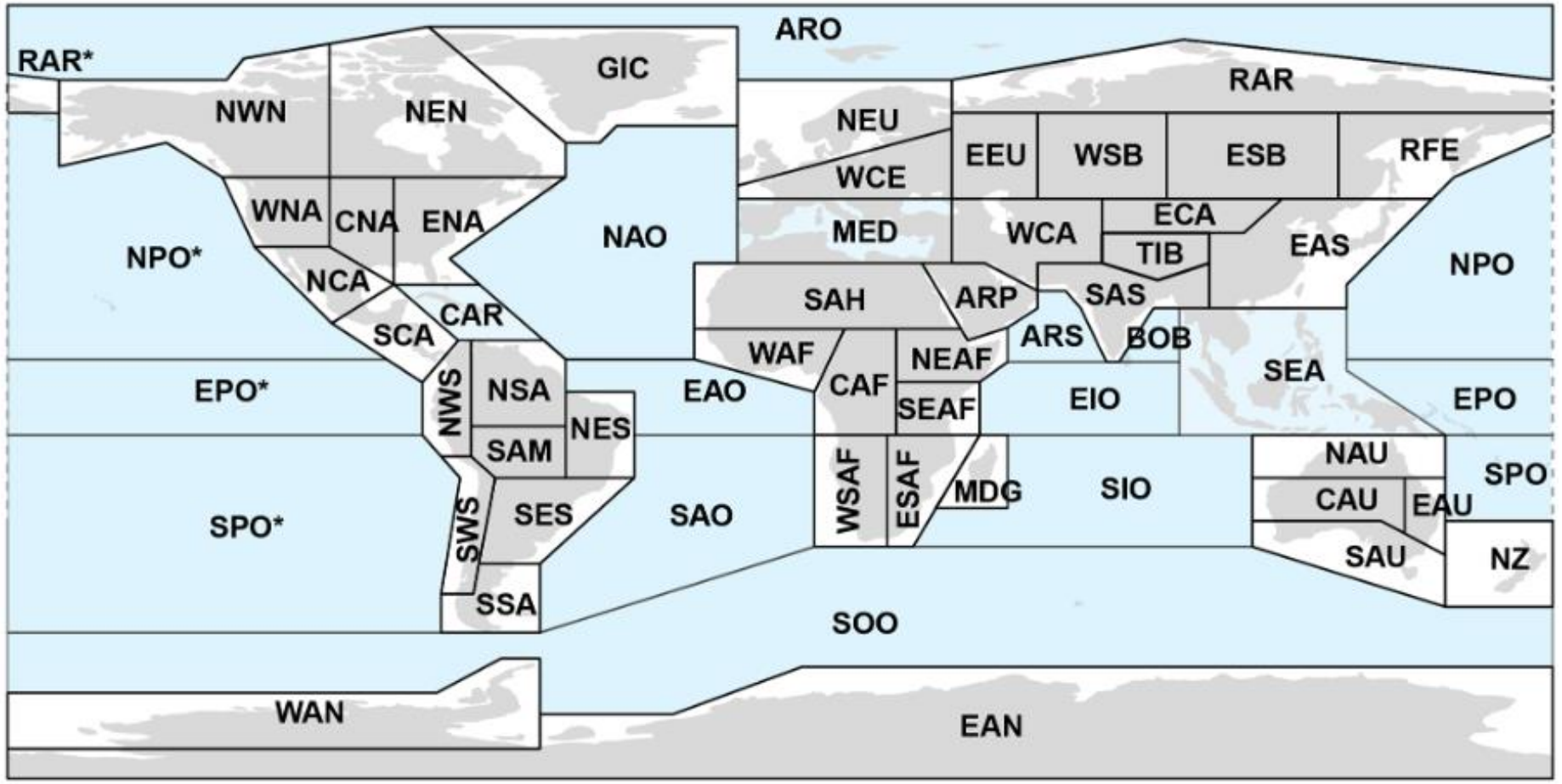
Whiskers indicate likelyhood



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

- Figure SPM2

It's not only temperature and not only global



IPCC AR6 WGI reference regions: **North America:** ***NWN*** *(North-Western North America,* ***NEN*** *(North-Eastern North America),* ***WNA*** *(Western North America),* ***CNA*** *(Central North America),* ***ENA*** *(Eastern North America),* **Central America:** ***NCA*** *(Northern Central America),* ***SCA*** *(Southern Central America),* ***CAR*** *(Caribbean),* **South America:** ***NWS*** *(North-Western South America),* ***NSA*** *(Northern South America),* ***NES*** *(North-Eastern South America),* ***SAM*** *(South American Monsoon),* ***SWS*** *(South-Western South America),* ***SES*** *(South-Eastern South America),* ***SSA*** *(Southern South America),* **Europe:** ***GIC*** *(Greenland/Iceland),* ***NEU*** *(Northern Europe),* ***WCE*** *(Western and Central Europe),* ***EEU*** *(Eastern Europe),* ***MED*** *(Mediterranean),* **Africa:** ***MED*** *(Mediterranean),* ***SAH*** *(Sahara),* ***WAF*** *(Western Africa),* ***CAF*** *(Central Africa),* ***NEAF*** *(North Eastern Africa),* ***SEAF*** *(South Eastern Africa),* ***WSAF*** *(West Southern Africa),* ***ESAF*** *(East Southern Africa),* ***MDG*** *(Madagascar),* **Asia:** ***RAR*** *(Russian Arctic),* ***WSB*** *(West Siberia),* ***ESB*** *(East Siberia),* ***RFE*** *(Russian Far East),* ***WCA*** *(West Central Asia),* ***ECA*** *(East Central Asia),* ***TIB*** *(Tibetan Plateau),* ***EAS*** *(East Asia),* ***ARP*** *(Arabian Peninsula),* ***SAS*** *(South Asia),* ***SEA*** *(South East Asia),* **Australasia:** ***NAU*** *(Northern Australia),* ***CAU*** *(Central Australia),* ***EAU*** *(Eastern Australia),* ***SAU*** *(Southern Australia),* ***NZ*** *(New Zealand),* **Small Islands:** ***CAR*** *(Caribbean),* ***PAC*** *(Pacific Small Islands)*

- https://essd.copernicus.org/articles/12/2959/2020/

Hot extremes

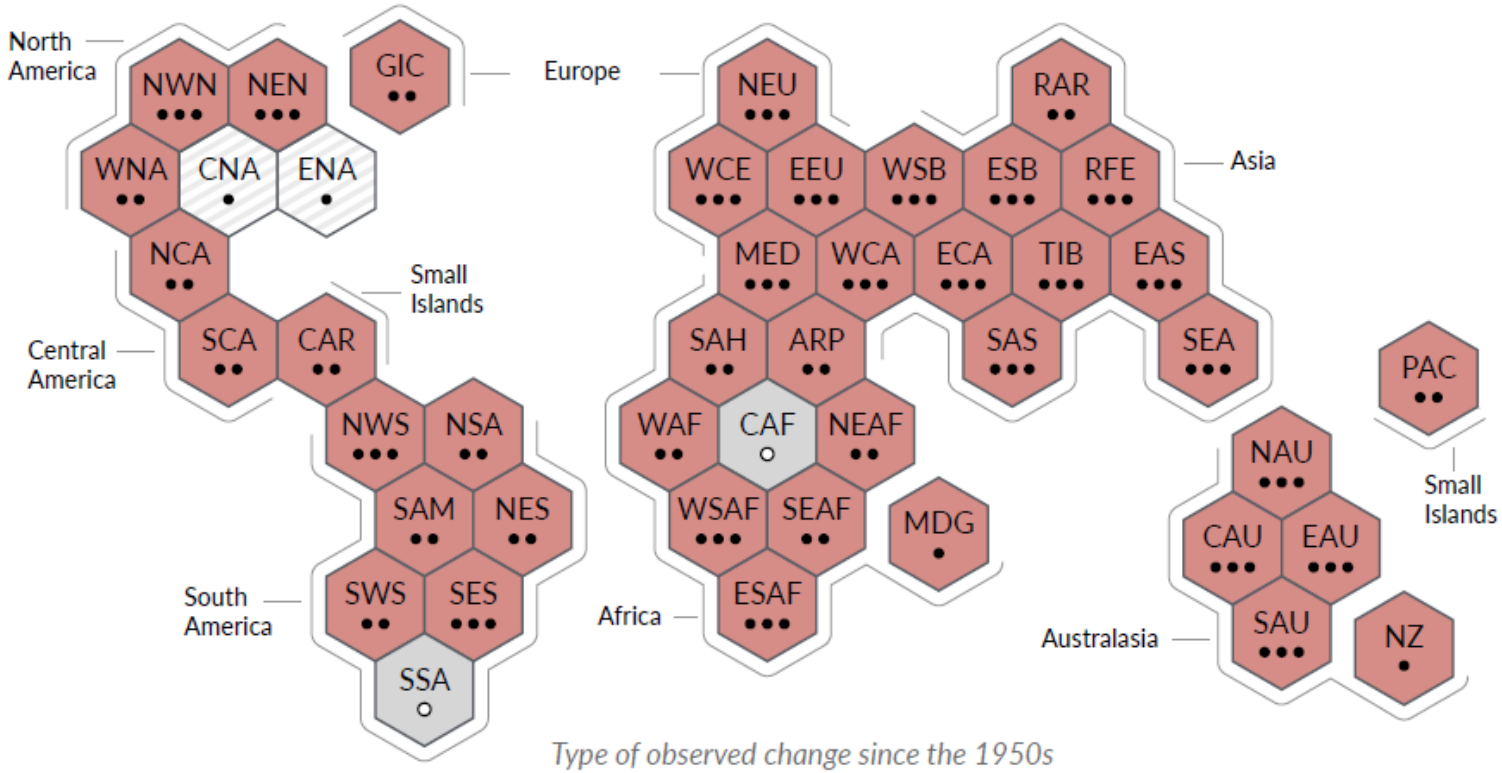
a) Synthesis of assessment of observed change in **hot extremes** and confidence in human contribution to the observed changes in the world's regions

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



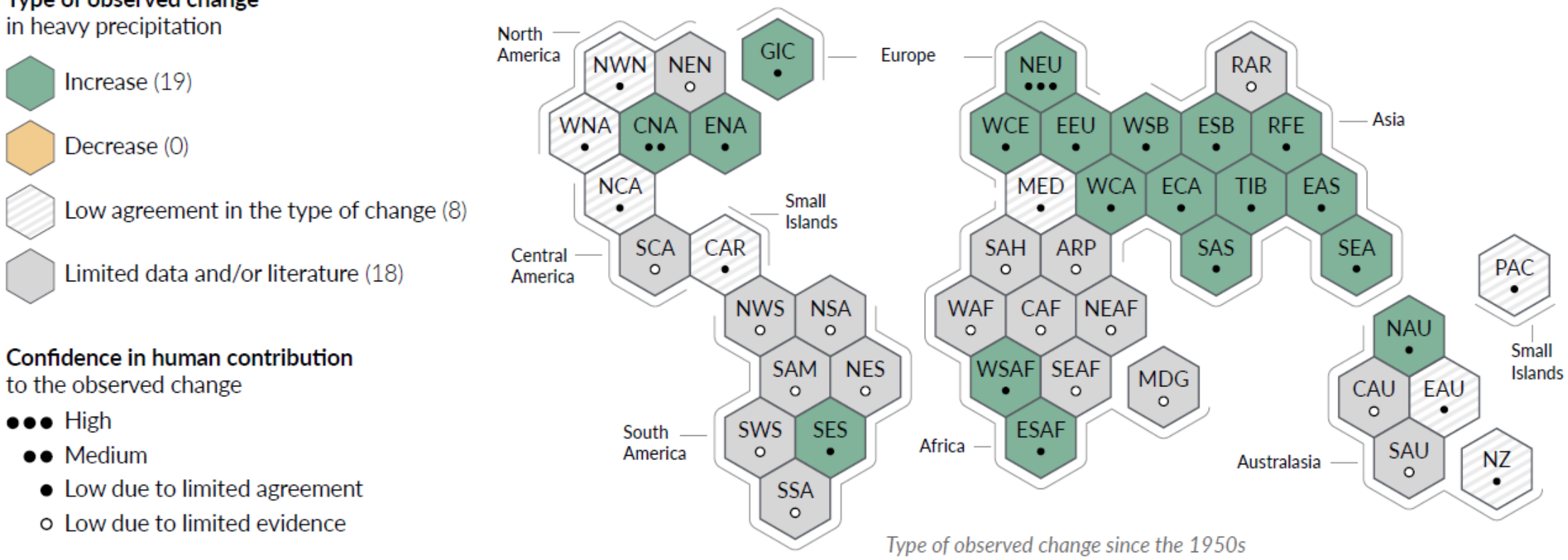
Type of observed change since the 1950s

For hot extremes, the evidence is mostly drawn from changes in metrics based on daily maximum temperatures; regional studies using other indices (heatwave duration, frequency and intensity) are used in addition. Red hexagons indicate regions where there is at least *medium confidence* in an observed increase in hot extremes.

Figure SPM.3

Heavy precipitation

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

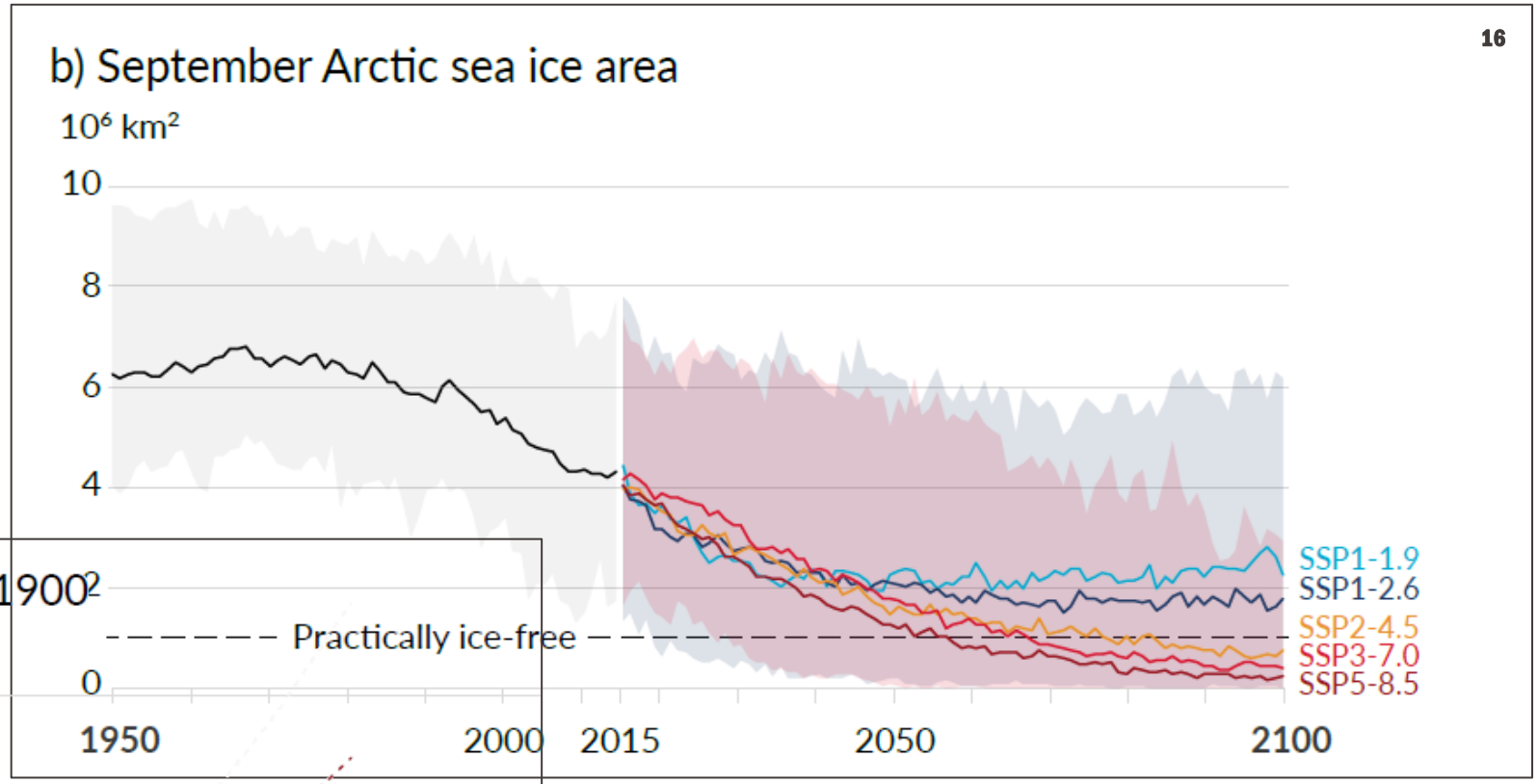


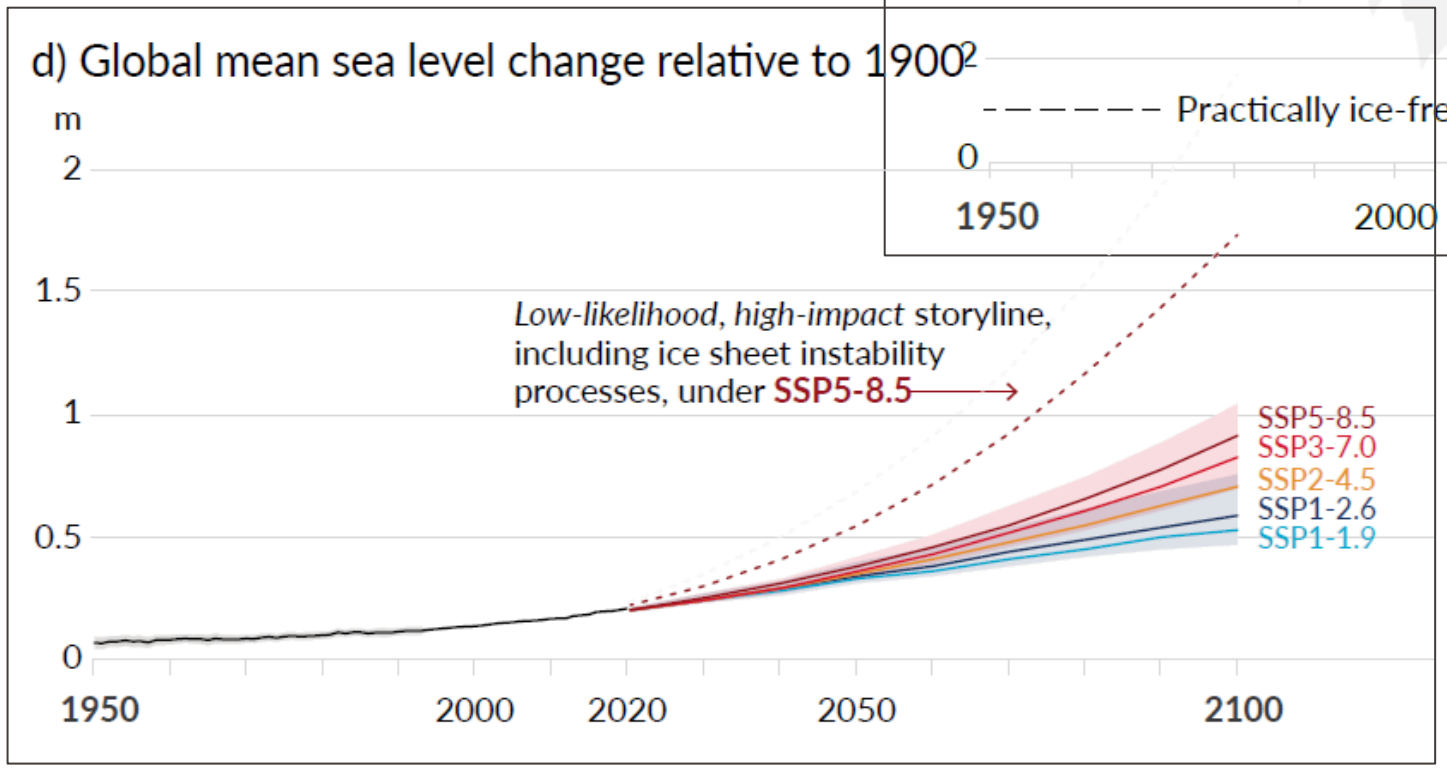
For heavy precipitation, the evidence is mostly drawn from changes in indices based on one-day or five-day precipitation amounts using global and regional studies. Green hexagons indicate regions where there is at least *medium confidence* in an observed increase in heavy precipitation.

- Figure SPM.3

More indicators

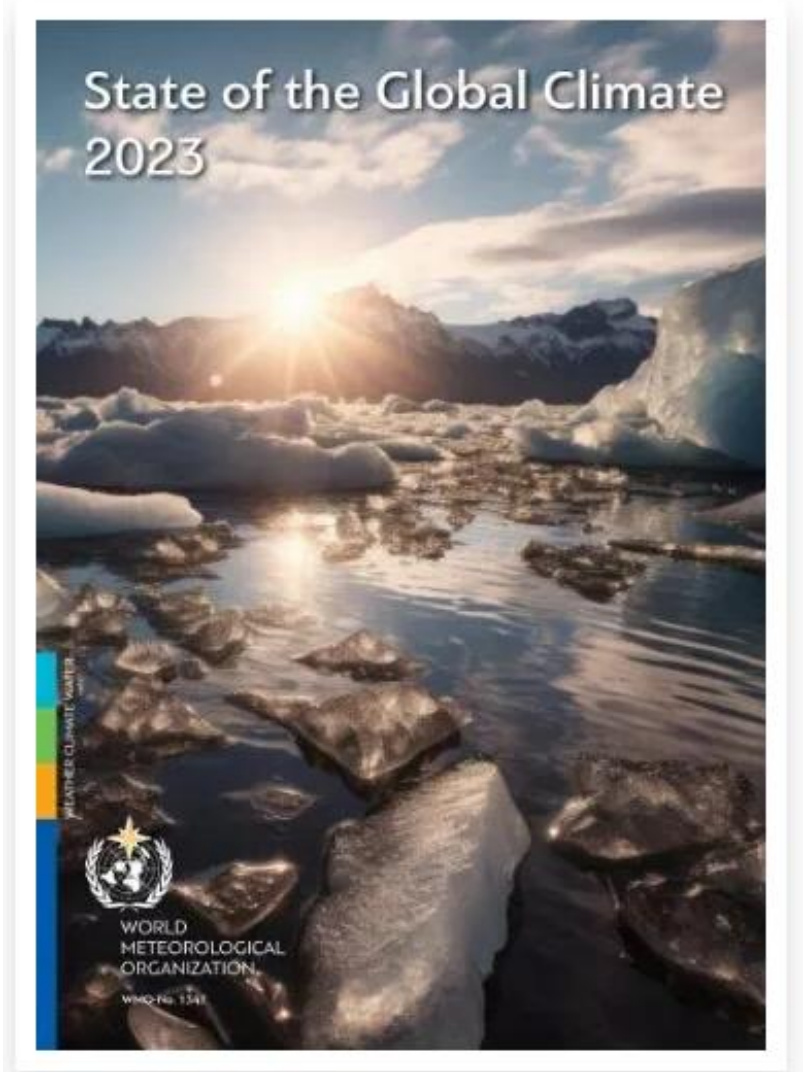
To be discussed in the exercises
(Climate Impact Drivers, CIDs)



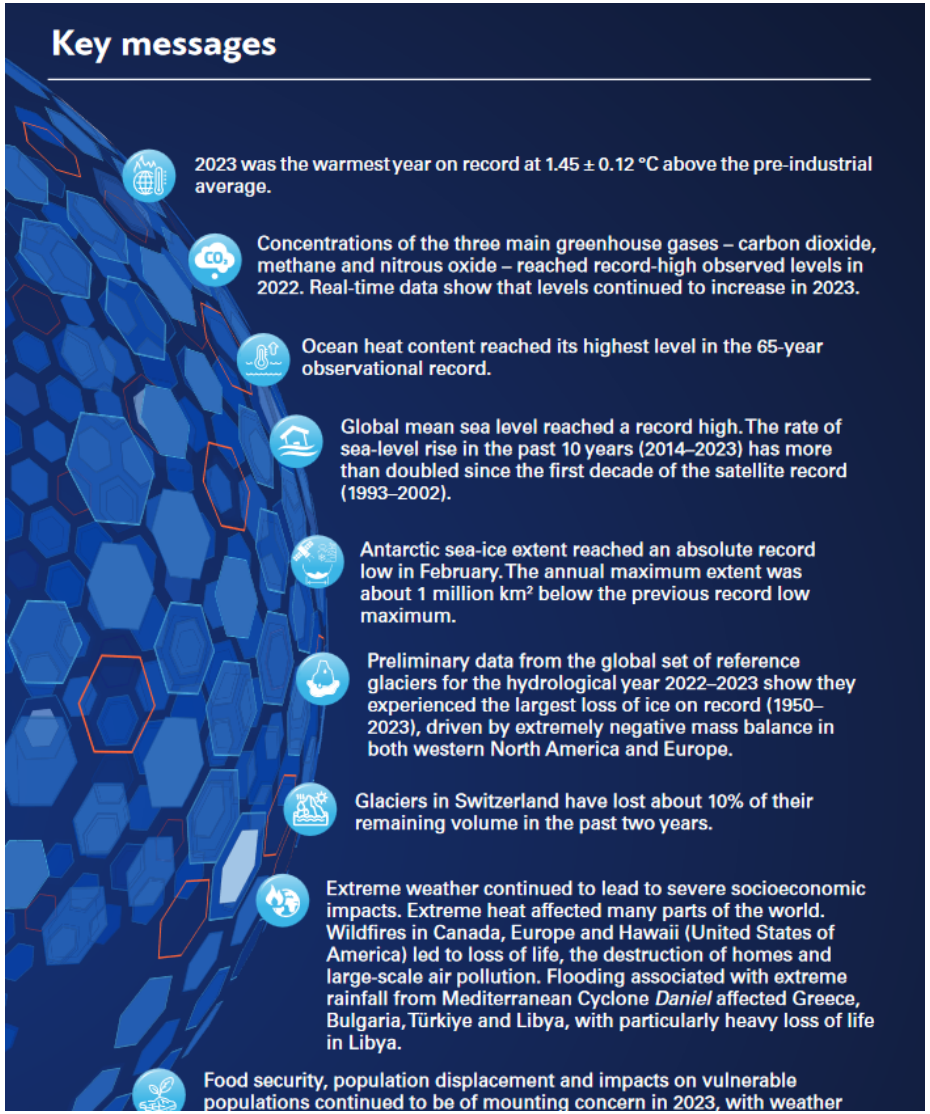


- IPCC AR6, Figure SPM.5

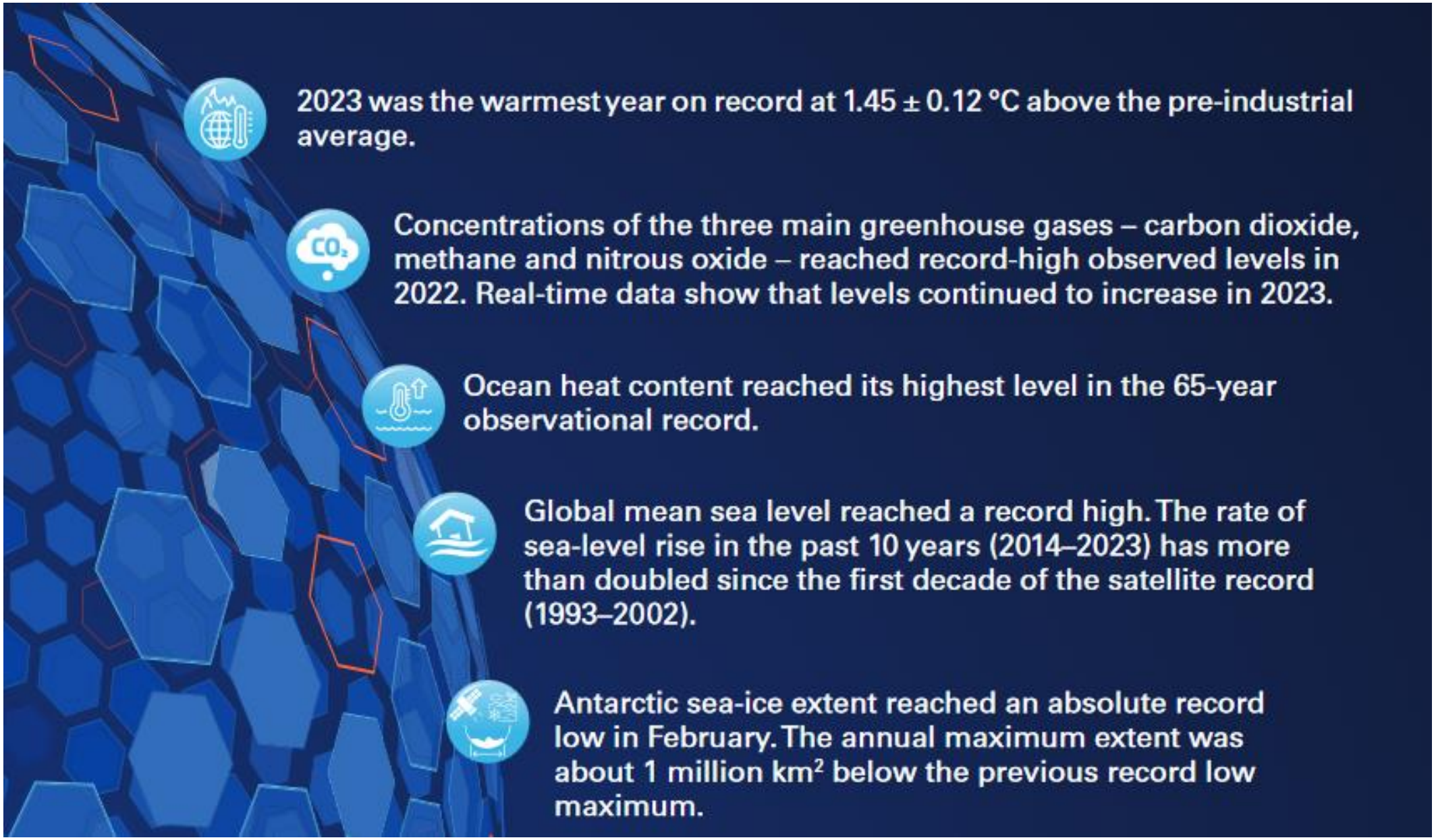
State of the Global Climate 2023

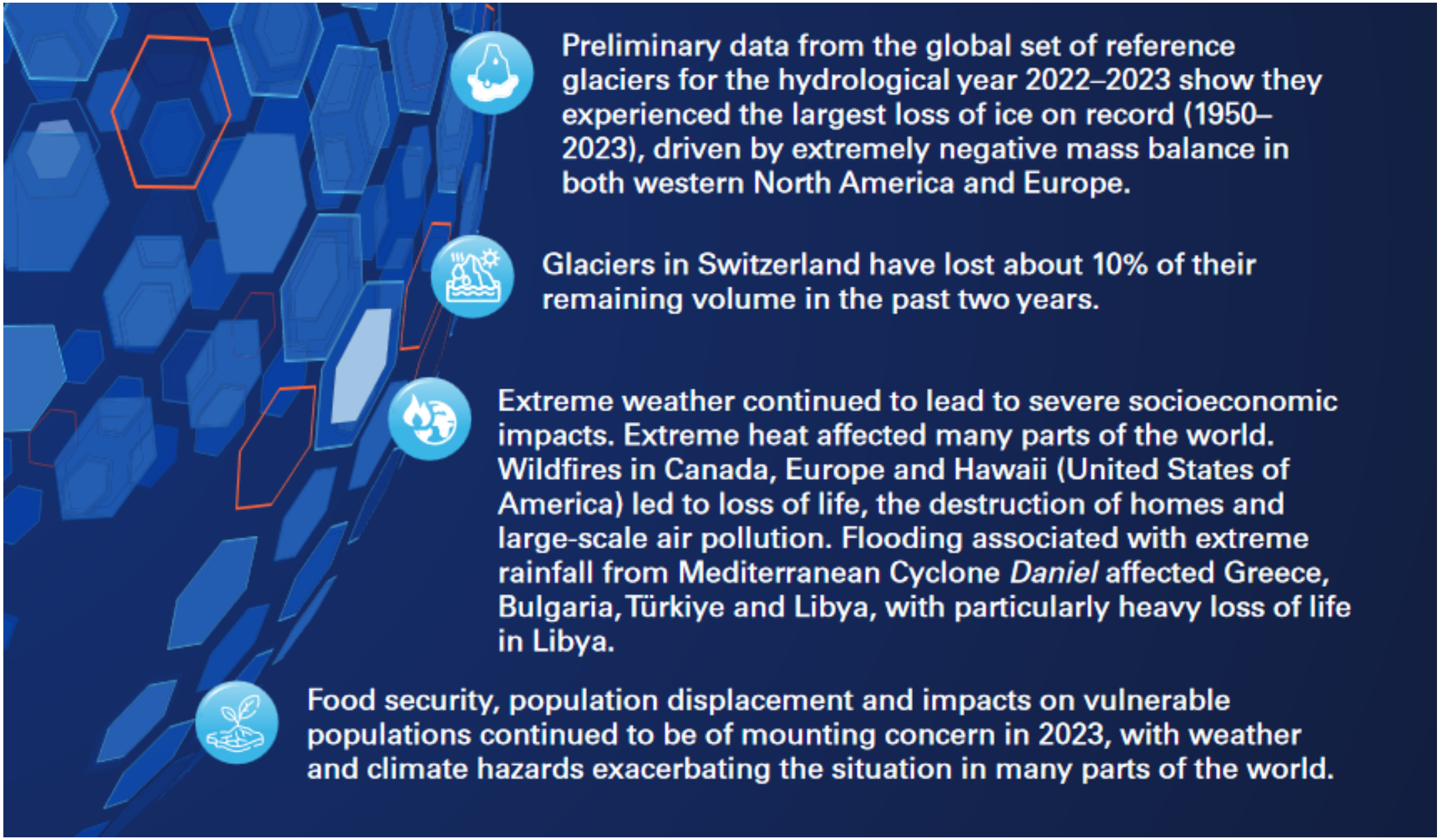


IPCC reports are issued every 5-8 years. WMO provides yearly updates.
There is less peer-reviewed literature contribution, the report is more based on monitoring activities.



https://library.wmo.int/records/item/68835-state-of-the-global-climate-2023


2023 was the warmest year on record at 1.45 ± 0.12 °C above the pre-industrial average.
Concentrations of the three main greenhouse gases – carbon dioxide, methane and nitrous oxide – reached record-high observed levels in 2022. Real-time data show that levels continued to increase in 2023.
Ocean heat content reached its highest level in the 65-year observational record.
Global mean sea level reached a record high. The rate of sea-level rise in the past 10 years (2014–2023) has more than doubled since the first decade of the satellite record (1993–2002).
Antarctic sea-ice extent reached an absolute record low in February. The annual maximum extent was about 1 million km² below the previous record low maximum.


Preliminary data from the global set of reference glaciers for the hydrological year 2022–2023 show they experienced the largest loss of ice on record (1950–2023), driven by extremely negative mass balance in both western North America and Europe.
Glaciers in Switzerland have lost about 10% of their remaining volume in the past two years.
Extreme weather continued to lead to severe socioeconomic impacts. Extreme heat affected many parts of the world. Wildfires in Canada, Europe and Hawaii (United States of America) led to loss of life, the destruction of homes and large-scale air pollution. Flooding associated with extreme rainfall from Mediterranean Cyclone *Daniel* affected Greece, Bulgaria, Türkiye and Libya, with particularly heavy loss of life in Libya.
Food security, population displacement and impacts on vulnerable populations continued to be of mounting concern in 2023, with weather and climate hazards exacerbating the situation in many parts of the world.

GHG concentrations and growth rates

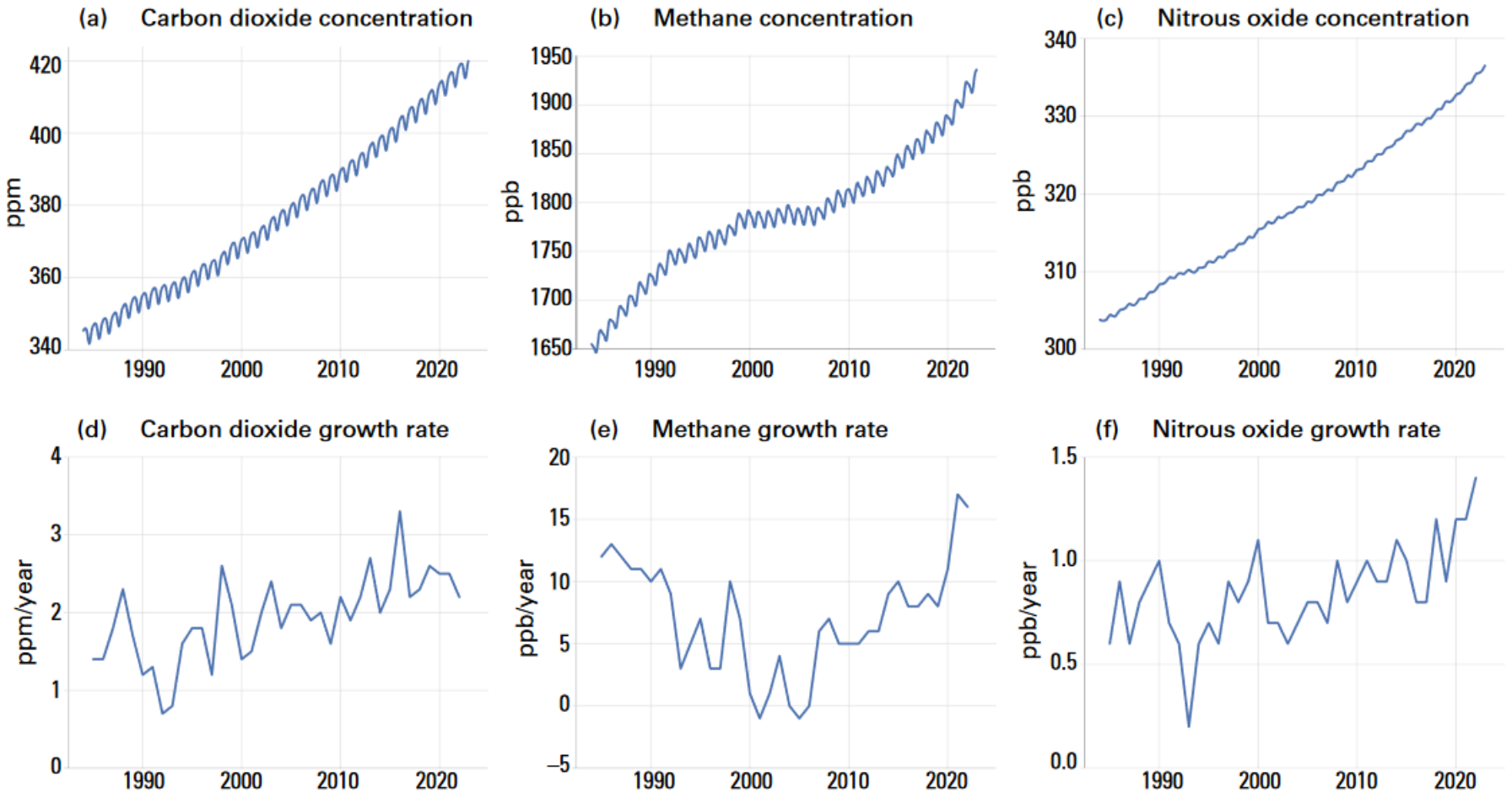


Figure 1. Top row: Monthly globally averaged mole fraction (measure of atmospheric concentration), from 1984 to 2022, of (a) CO_2 in ppm, (b) CH_4 in ppb and (c) N_2O in ppb. Bottom row: Growth rates representing increases in successive annual means of mole fractions for (d) CO_2 in ppm per year, (e) CH_4 in ppb per year and (f) N_2O in ppb per year.

Source: World Data Centre for Greenhouse Gases (WDCGG)

Surface temperature anomalies in 2023

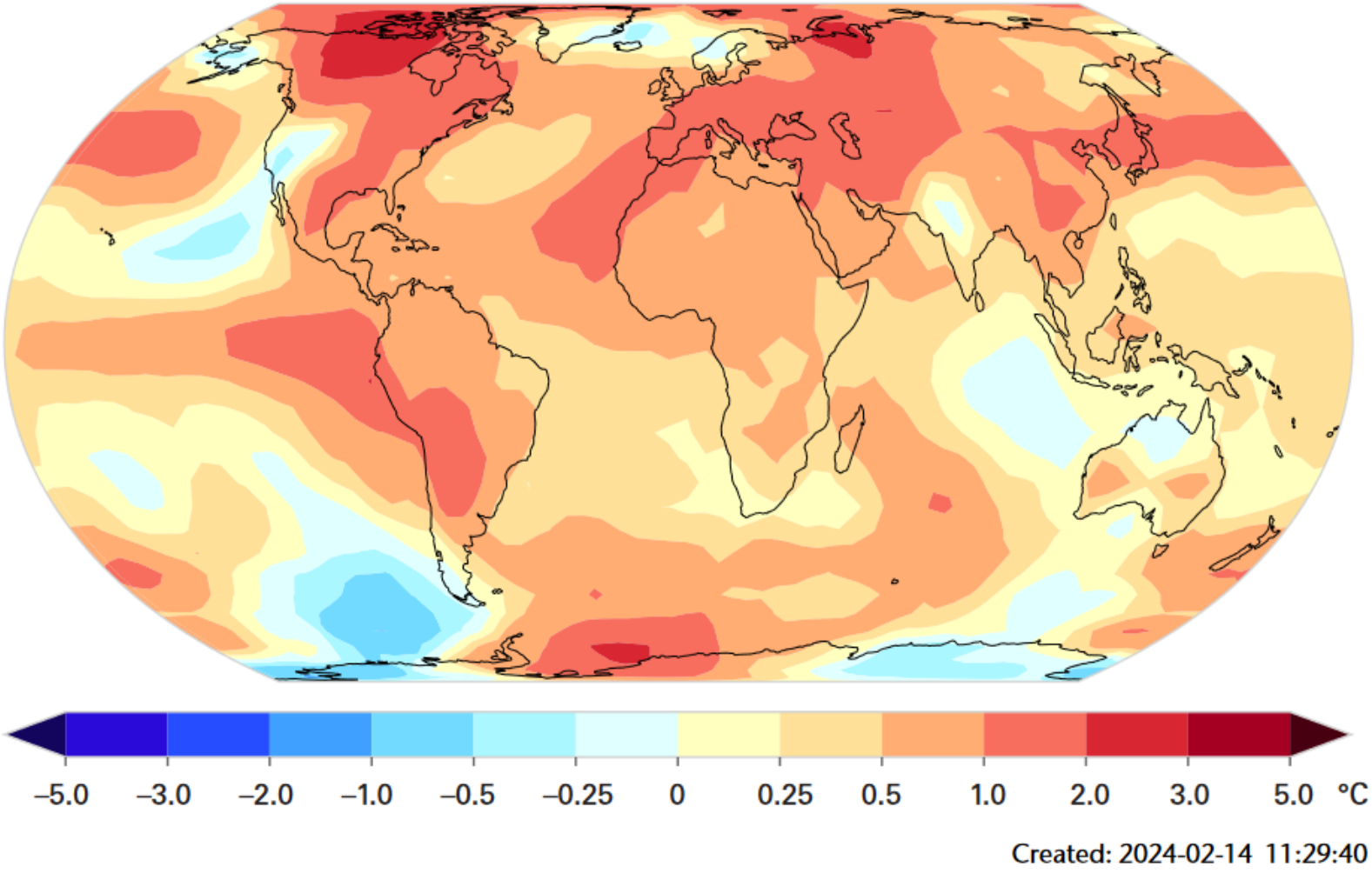


Figure 3. Mean near-surface temperature anomalies (difference from the 1991–2020 average) for 2023.

Source: Data are the median of the six datasets indicated in the legend. See Data set and methods for more details

Ocean heat content trend

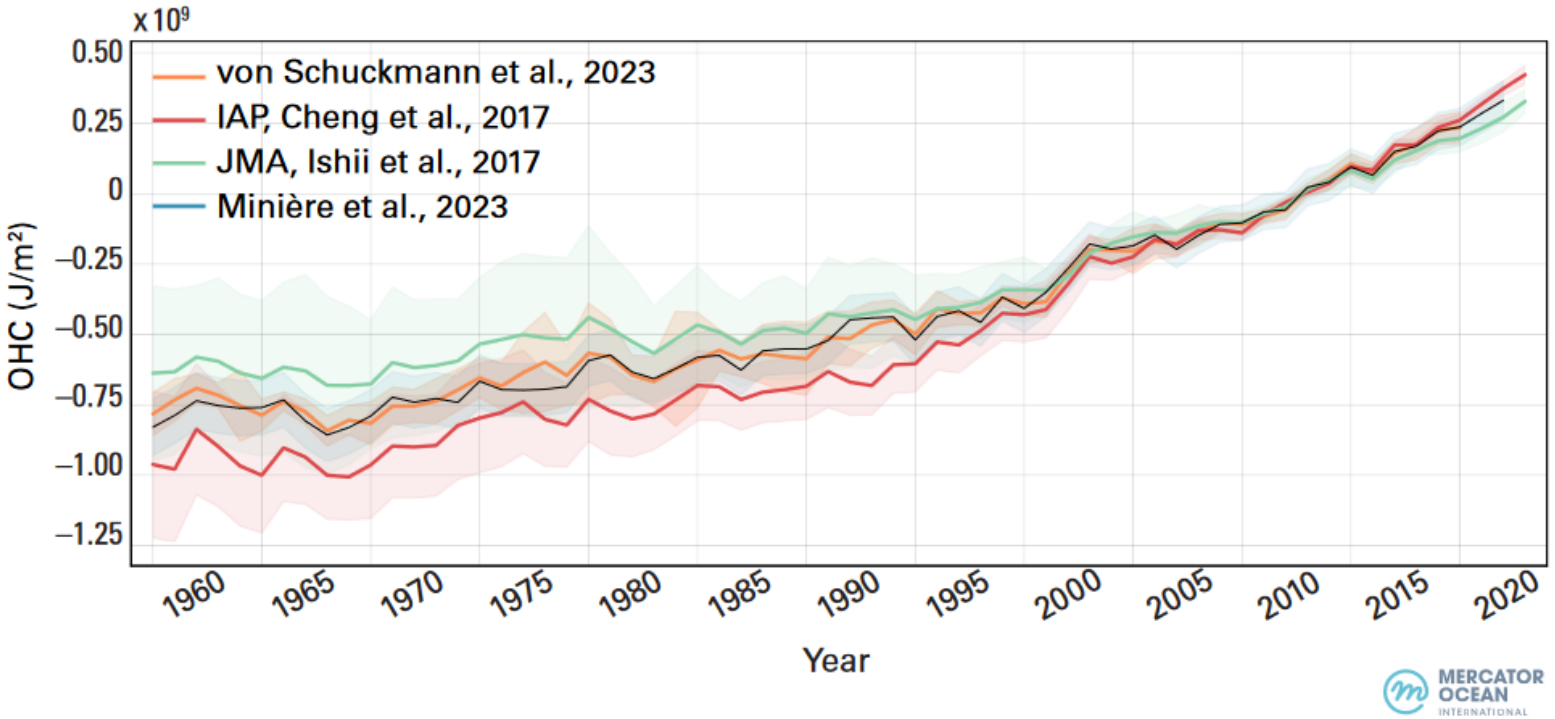


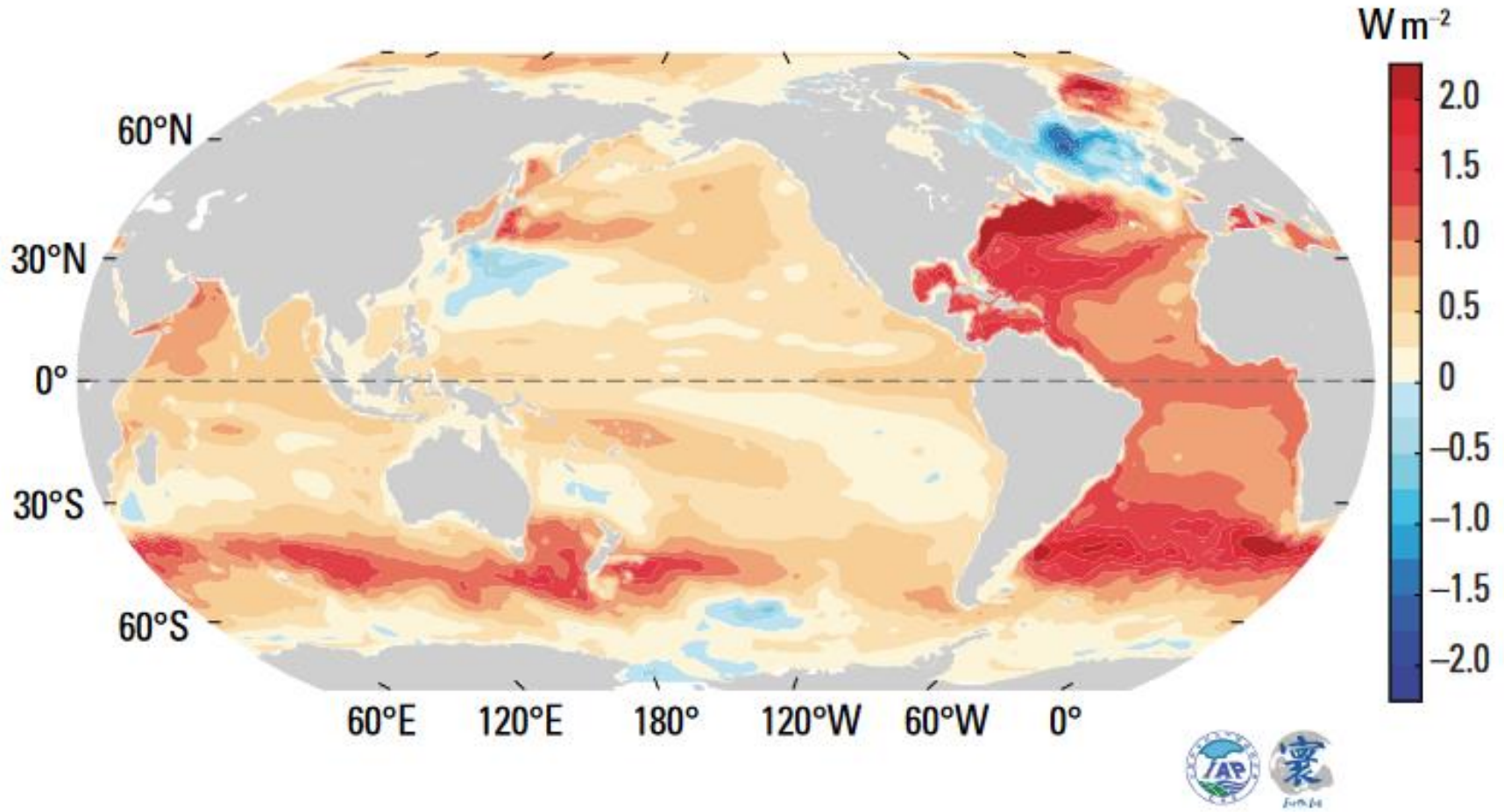
Figure 4. Global ocean heat content anomalies relative to the 2005–2021 average for the 0–2 000 m depth layer 1960–2023 (orange). Ensemble mean time series and ensemble standard deviation (2-standard deviations, shaded) updated from Schuckmann et al., 2023 (red); Cheng et al., 2017 (green); Minière et al., 2023 (light blue); and Ishii et al., 2017 (dark blue).

Source: Mercator Ocean international.

Ocean heat content trend

Figure 5. Observed upper 2000 m OHC trend from 1958 to 2023.

Source: Data updated from Cheng et al.[25]



Sea level rise

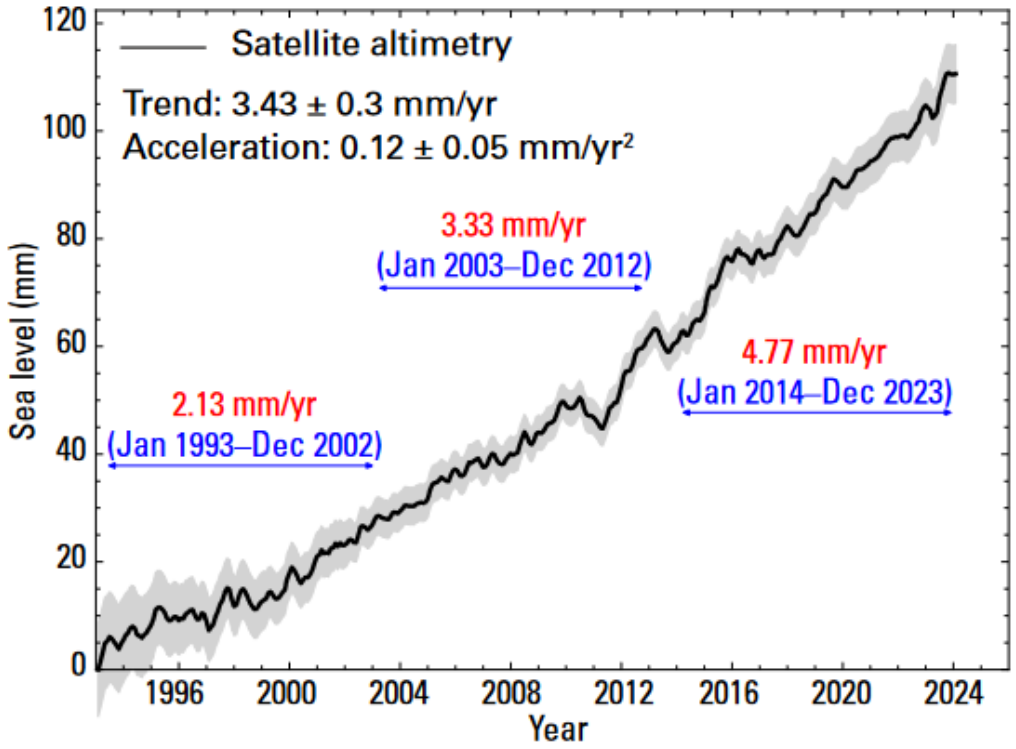


Figure 6. GMSL evolution between January 1993 and December 2023 based on satellite altimetry. The black line is the best estimate, and the grey shaded area indicates uncertainty. Red and blue annotations indicate the average rate of sea-level rise during three decades of the record as indicated.

Source: AVISO altimetry

Sea level anomalies

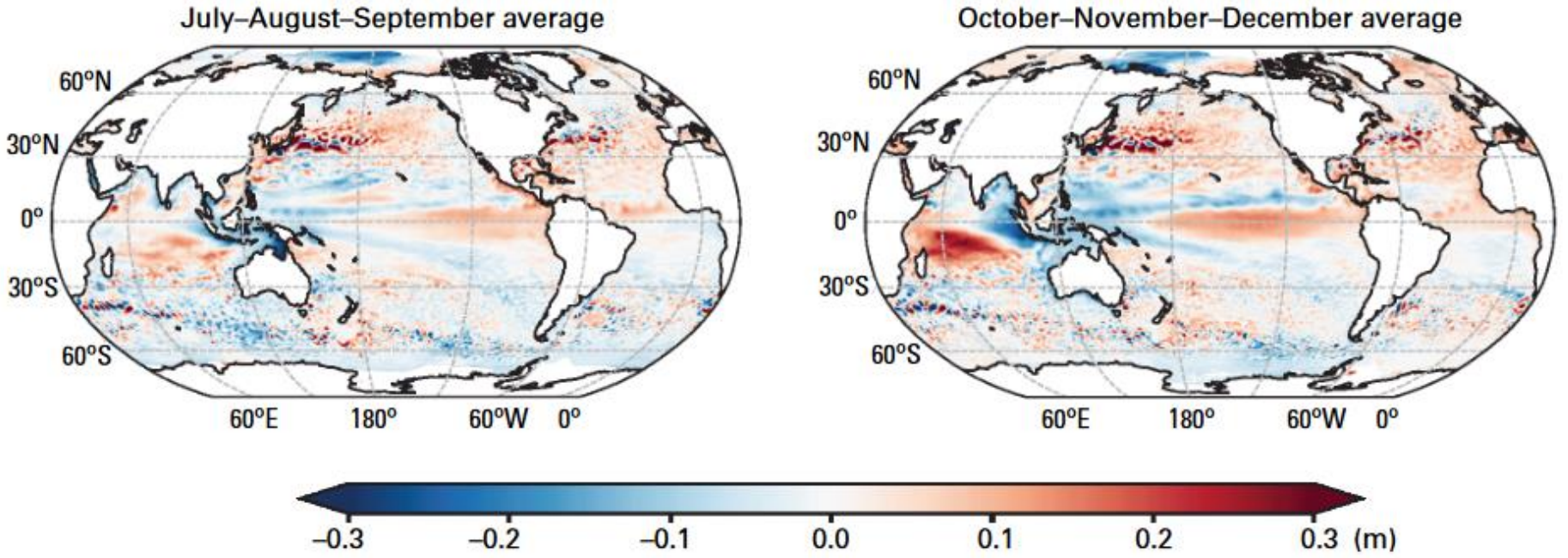


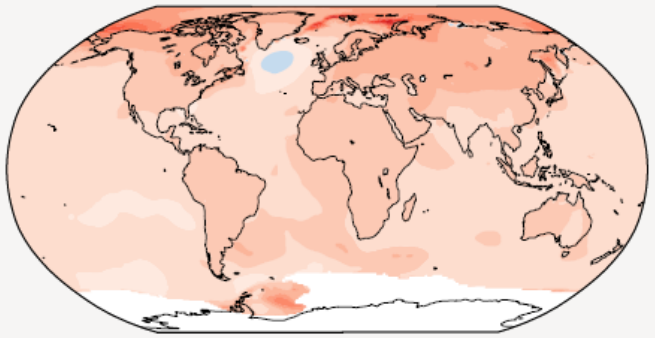
Figure 7. Three-month averages of altimetry-based sea-level anomalies (relative to the 1993–2012 average, which is the product climatology) for (top left) January–March 2023, (top right) April–June 2023, (bottom left) July–September 2023 and (bottom right) October–December 2023

Source: Data downloaded from the Copernicus Marine Service

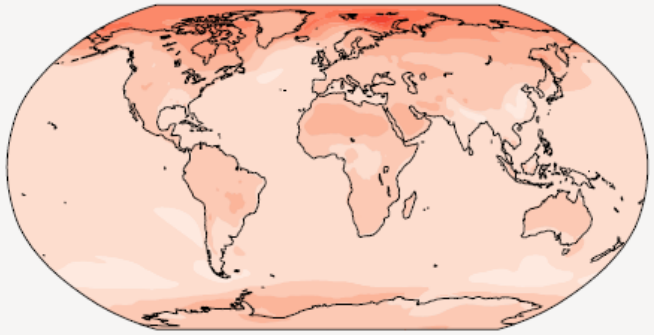
a) Annual mean temperature change (°C) at 1 °C global warming

Warming at 1 °C affects all continents and is generally larger over land than over the oceans in both observations and models. Across most regions, observed and simulated patterns are consistent.

Observed change per **1 °C** global warming



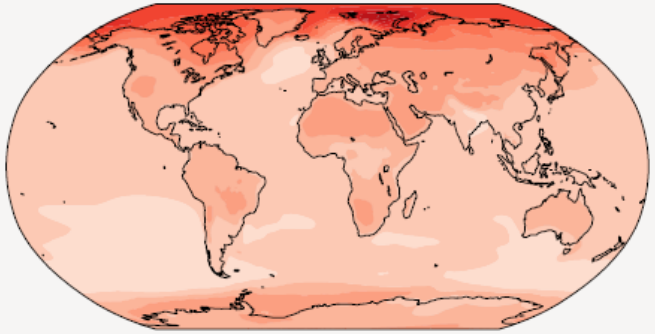
Simulated change at **1 °C** global warming



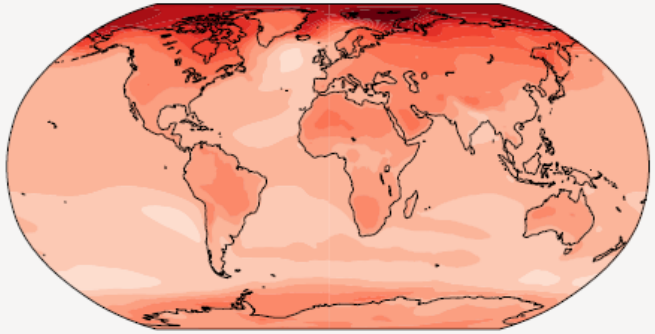
b) Annual mean temperature change (°C) relative to 1850-1900

Across warming levels, land areas warm more than oceans, and the Arctic and Antarctica warm more than the tropics.

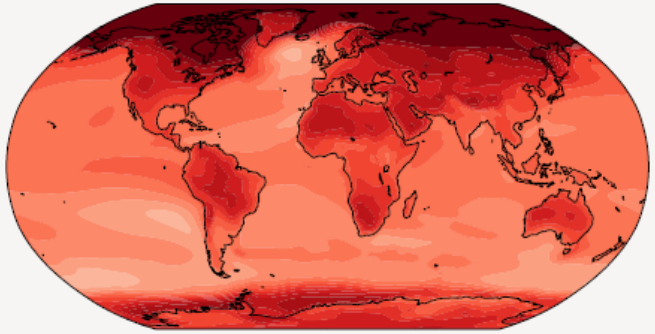
Simulated change at **1.5 °C** global warming

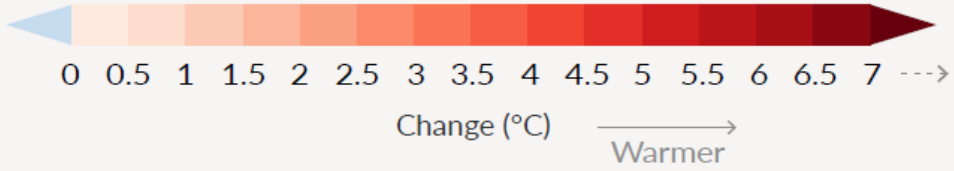


Simulated change at **2 °C** global warming



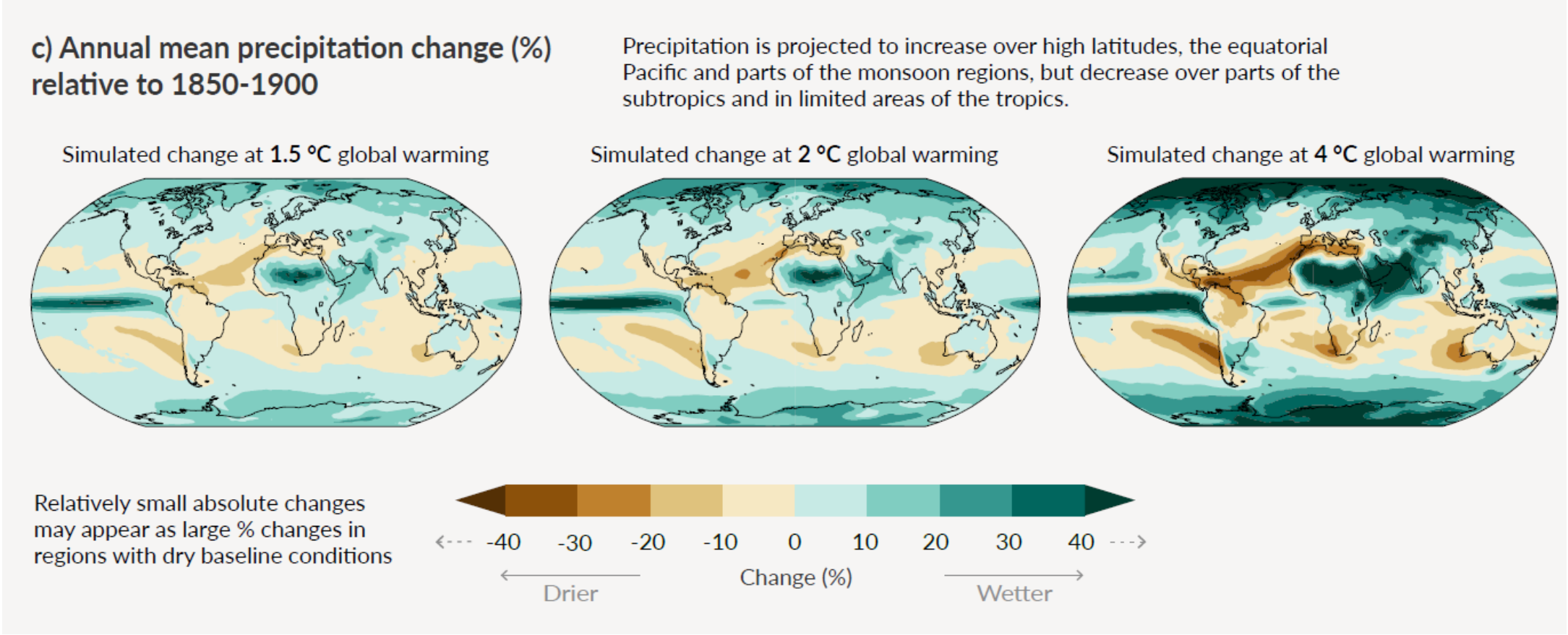
Simulated change at **4 °C** global warming





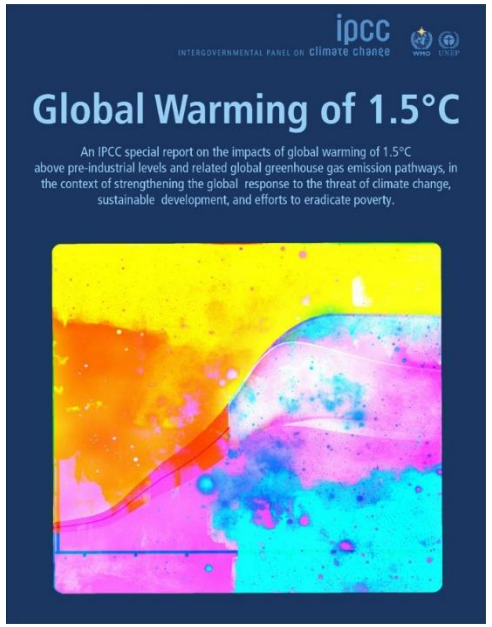
- IPCC AR6, Figure SPM.5

Precipitation change



- IPCC AR6, Figure SPM.5

IPCC special report on 1.5° versus ≥ 2.0°C



A. Understanding Global Warming of 1.5°C[4]

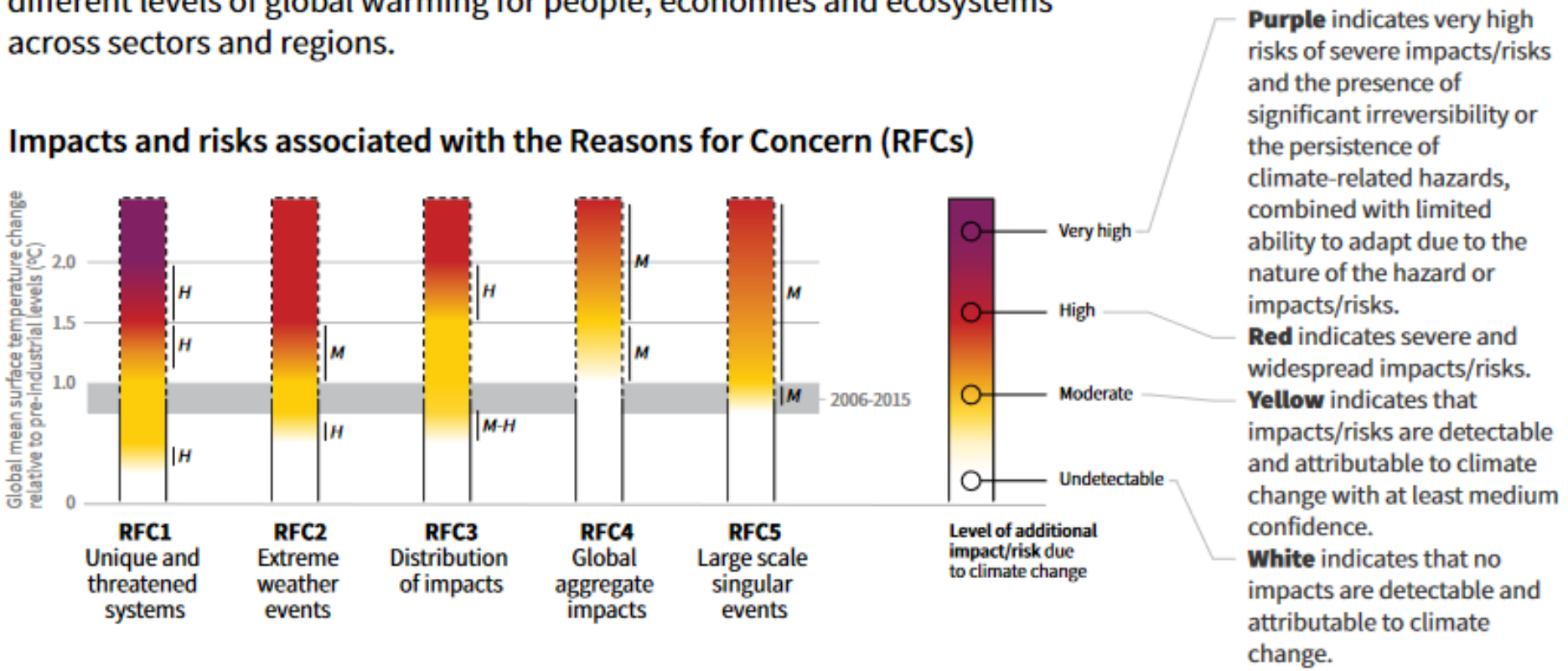
A.1 Human activities are estimated to have caused approximately 1.0°C of global warming[5] above pre-industrial levels, with a *likely* range of 0.8°C to 1.2°C. Global warming is *likely* to reach 1.5°C between 2030 and 2052 if it continues to increase at the current rate. (*high confidence*) (Figure SPM.1) {1.2}

A.2 Warming from anthropogenic emissions from the pre-industrial period to the present will persist for centuries to millennia and will continue to cause further long-term changes in the climate system, such as sea level rise, with associated impacts (*high confidence*), but these emissions alone are *unlikely* to cause global warming of 1.5°C (*medium confidence*). (Figure SPM.1) {1.2, 3.3, Figure 1.5}

A.3 Climate-related risks for natural and human systems are higher for global warming of 1.5°C than at present, but lower than at 2°C (*high confidence*). These risks depend on the magnitude and rate of warming, geographic location, levels of development and vulnerability, and on the choices and implementation of adaptation and mitigation options (*high confidence*). (Figure SPM.2) {1.3, 3.3, 3.4, 5.6}

Five Reasons For Concern (RFCs)

Five Reasons For Concern (RFCs) illustrate the impacts and risks of different levels of global warming for people, economies and ecosystems across sectors and regions.



RFC4 Global aggregate impacts: global monetary damage, global-scale degradation and loss of ecosystems and biodiversity.

RFC5 relatively large, abrupt and sometimes irreversible changes in systems that are caused by global warming. Examples include disintegration of the Greenland and Antarctic ice sheets.

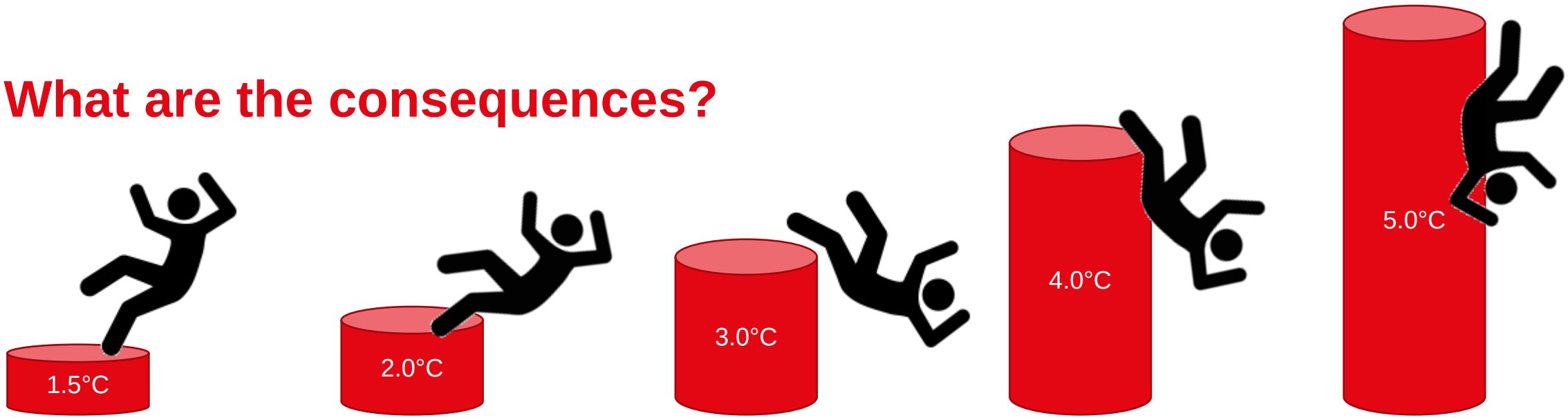
RFC1 ecological and human systems that have restricted geographic ranges constrained by climate-related conditions and have high endemism or other distinctive properties. Examples include coral reefs, the Arctic and its indigenous people, mountain glaciers and biodiversity hotspots.
RFC2 risks/impacts to human health, livelihoods, assets and ecosystems from extreme weather events such as heat waves, heavy rain, drought and associated wildfires, and coastal flooding.
RFC3 risks/impacts that disproportionately affect particular groups due to uneven distribution of physical climate change hazards, exposure or vulnerability.

1.5°C versus warmer

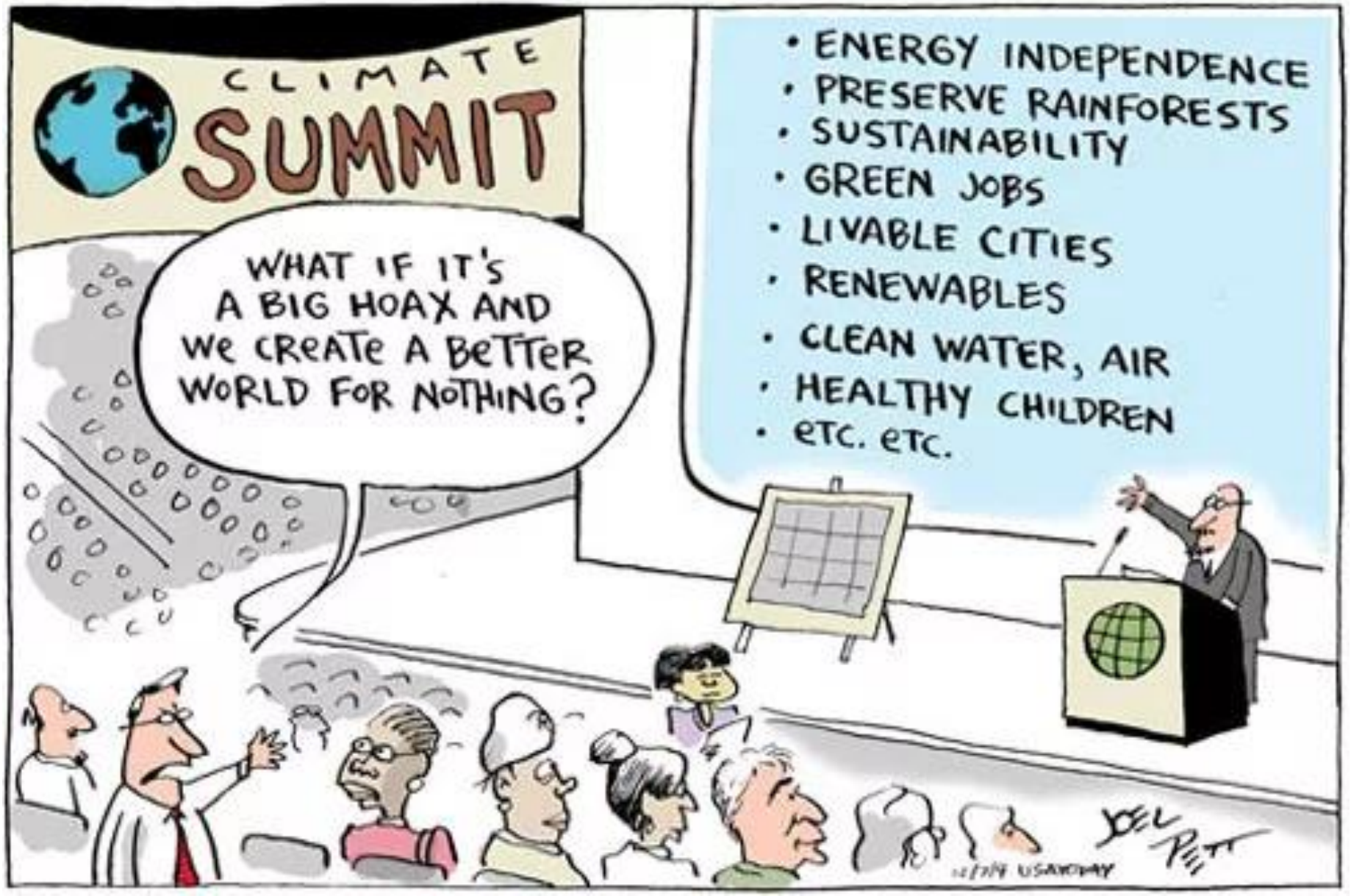
- Limitation of global warming to 1.5°C compared to more than 2°C allows to avoid substantial additional changes in living conditions, in extremes and (irreversible) impacts.
- Living conditions
  - Sea level rise requires evacuation of neighborhoods / entire islands
  - Crops might not grow anymore where they used to, or new crops can be planted
  - Some regions will get too hot to live
  - …
- Extremes
  - Increase in hot extremes in most inhabited regions of the world
  - Heavier precipitation accompanied by cyclones in several regions
  - Increased droughts in some regions
  - …
- Irreversible impacts
  - Sea level rise,
  - Loss of glaciers and sea ice
  - Biodiversity loss: e.g., extinction of animals, plants, corals
  - …

1.5°C versus warmer

What are the consequences?



Implications of 1.5°C, 2 °C or warmer by 2100



https://www.liveabout.com/global-warming-cartoons-4122873

UNFCCC United Nations Framework Convention on Climate Change

The UNFCCC is a political body. It entered into force on 21 March 1994. Today, it has near-universal membership. The 198 countries that have ratified the Convention are called Parties to the Convention. **Preventing "dangerous" human interference with the climate system is the ultimate aim of the UNFCCC.**

Conference of the Parties (COP)

The COP is the supreme decision-making body of the Convention. All States that are Parties to the Convention are represented at the COP, at which they review the implementation of the Convention and any other legal instruments that the COP adopts and take decisions necessary to promote the effective implementation of the Convention, including institutional and administrative arrangements. **The COP meets annually.**

- https://unfccc.int/

Climate Agreements

The **Kyoto Protocol**, which was signed in 1997 and ran from 2005 to 2020, was the first implementation of measures under the UNFCCC.

The Kyoto Protocol was superseded by the **Paris Agreement**, which entered into force in 2016

- https://unfccc.int/

Paris Agreement 2015

*"The **Paris Agreement** central aim is to […] keep global temperature rise […] well below 2°C above pre-industrial levels and to pursue efforts to limit the […] increase […] to 1.5 °C."*

https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement

In 2021, at the Conference of the Parties (COP) in Glasgow, the international community agreed to strive for a maximum warming of 1.5 °C.

https://unfccc.int/process-and-meetings/the-paris-agreement/the-glasgow-climate-pact-key-outcomes-from-cop26

Paris Agreement

- The Paris Agreement is a **legally binding international treaty on climate change**. It was adopted by 196 Parties at COP 21 in Paris, on 12 December 2015 and entered into force on 4 November 2016.
- The Paris agreement:
  - Has 16 introductory paragraphs and 29 articles
  - contains procedural articles (e.g., the criteria for its entry into force) and operational articles (covering, for example, mitigation, adaptation and finance).
  - is a binding agreement, but many of its articles do not imply obligations.
  - facilitates international collaboration.
  - covers most greenhouse gas emissions, but does not apply to international aviation and shipping, which fall under the responsibility of the International Civil Aviation Organization and the International Maritime Organization.

- https://unfccc.int/sites/default/files/english_paris_agreement.pdf

Paris Agreement

- Its goal is to **limit global warming** to well below 2, **preferably to 1.5 degrees Celsius**, compared to pre-industrial levels (**Article 2**).
- To achieve this long-term temperature goal, countries aim to **reach global peaking of greenhouse gas emissions as soon as possible** to achieve a climate neutral world by mid-century (**Article 4**).
- Implementation of the Paris Agreement requires **economic and social transformation**, based on the best available science. The Paris Agreement works on a **5- year cycle** of increasingly ambitious climate action carried out by countries. By 2020, countries submit their plans for climate action known as **nationally determined contributions (NDCs, Article 3)**.
- In 2023 the first **global stock take** has taken place.

- https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement

Nationally determined contributions

Reductions of emissions to reach Paris Agreement goals.

The Paris Agreement and NDCs

- Nationally determined contributions (NDCs) are at the heart of the Paris Agreement and the achievement of these long-term goals. NDCs embody efforts by each country to reduce national emissions and adapt to the impacts of climate change. The Paris Agreement (Article 4, paragraph 2) requires each Party to prepare, communicate and maintain successive nationally determined contributions (NDCs) that it intends to achieve. Parties shall pursue domestic mitigation measures, with the aim of achieving the objectives of such contributions.

What does this mean?

- The Paris Agreement requests each country to outline and communicate their post-2020 climate actions, known as their NDCs.
- **Together, these climate actions determine whether the world achieves the long-term goals of the Paris Agreement and to reach global peaking of greenhouse gas (GHG) emissions as soon as possible** and to undertake rapid reductions thereafter in accordance with best available science, so as to achieve a balance between anthropogenic emissions by sources and removals by sinks of GHGs in the second half of this century. It is understood that the peaking of emissions will take longer for developing country Parties, and that emission reductions are undertaken on the basis of equity, and in the context of sustainable development and efforts to eradicate poverty, which are critical development priorities for many developing countries.

Submissions of NDCs

- The Paris Agreement recognizes that the long-term goals specified in its Articles 2 and 4.1 will be achieved through time and, therefore, builds on a ratcheting up of aggregate and individual ambition over time.

- NDCs are submitted every five years to the UNFCCC secretariat. In order to enhance the ambition over time the Paris Agreement provide that successive NDCs will represent a progression compared to the previous NDC and reflect its highest possible ambition.

- Parties are requested to submit the next round of NDCs (new NDCs or updated NDCs) by 2020 and every five years thereafter (e.g. by 2020, 2025, 2030), regardless of their respective implementation time frames.
- Conditional NDCs (as opposed to unconditional): Some countries attached conditions to the implementation of some measures. In total, about 78% of the NDCs in the first round in 2015 included conditional contributions. In addition to conditions relating to collective ambition or the framework of the PA, over 80 %of the NDC are attached to international financial and technical support.

Swiss Nationally Determined Contribution

Update from December 2020

Switzerland's NDC

Switzerland is committed to follow recommendations of science in order to limit warming to 1.5 degrees Celsius. In view of its climate neutrality target by 2050, Switzerland's NDC is to reduce its greenhouse gas emissions by at least 50 percent by 2030 compared with 1990 levels, corresponding to an average reduction of greenhouse gas emissions by at least 35 percent over the period 2021–2030. By 2025, a reduction of greenhouse gases by at least 35 percent compared with 1990 levels is anticipated. Internationally transferred mitigation outcomes (ITMOs) from cooperation under Article 6 of the Paris Agreement will partly be used. The methodological approaches underlying the Swiss NDC are included in this communication.

Long-term: Switzerland aims to reduce its greenhouse gas emissions to net zero by 2050. This target lays the foundations for Switzerland's 2050 climate strategy, which is to be transmitted to the UNFCCC Secretariat within a few weeks of this submission.

https://genevasolutions.news/climate/switzerland-s-updated-paris-climate-plan-lacks-sufficient-ambition

- https://www.bafu.admin.ch/bafu/en/home/topics/climate/publications-studies/publications/klimapolitik-der-schweiz.html

Swiss Nationally Determined Contribution

- In its updated NDC, Switzerland aimed to increase the **domestic emissions reduction component of its 2030 target to 75%, an increase of 15 percentage points from its previous 60% share**, with the remaining emissions reductions under its overall 50% target to come from abroad, based on bilateral agreements. This increase in its domestic emissions reduction was part of the proposed amended **CO_2 Act, which was rejected in a referendum in June 2021**.
- A proposed revision to the CO_2 Act, released in December 2021, targets **a 33% reduction in domestic emissions**, which constitutes two thirds of the overall emissions reduction in its 50% target. A further update to its NDC was made which removed reference to the increased domestic emissions reduction that was included in its 2020 submission. This amended NDC was submitted to the UNFCCC on 17 December 2021.

- https://climateactiontracker.org/countries/switzerland/

Outcome of Global Stocktake (GST23)

- **Mitigation and response measures:**
  - window to raise ambition and implement existing commitments to limit warming to 1.5°C above pre-industrial levels is narrowing rapidly.
  - to reduce global GHG emissions by 43% by 2030 and by 60% by 2035, compared to 2019 levels, to reach net zero CO2 emissions by 2050, “much more ambition in action and support is needed,” including more ambitious targets in countries’ nationally determined contributions (NDCs) and systems transformations across all sectors and contexts.
- **Adaptation and loss and damage:**
  - increased adaptation action and efforts to avert, minimize, and address loss and damage are urgently needed, particularly for those who are least prepared and least able to recover from disasters.
  - warning, “most observed adaptation efforts are fragmented, incremental, sector-specific and unequally distributed across regions.”
  - transformative adaptation needs to be informed by local contexts, populations, and priorities, to improve its adequacy and effectiveness.

https://sdg.iisd.org/news/unfccc-report-identifies-areas-for-further-action-to-meet-paris-agreement/

Outcome of global stock take (GST23)

- **Means of implementation and finance:**
  - “scaled-up mobilization of support for climate action in developing countries entails strategically deploying international public finance, which remains a prime enabler for action.”
  - calls for “creating opportunities to unlock trillions of dollars [from international and domestic, public and private sources] and shift investments to climate action across scales.”
  - calls for “effective country-led and needs-based cooperation,” to ensure capacities are built, enhanced, and retained.

What happens each year...

- The COP meets annually.
- Before each COP several annual updates are provided.

Emissions Gap Report

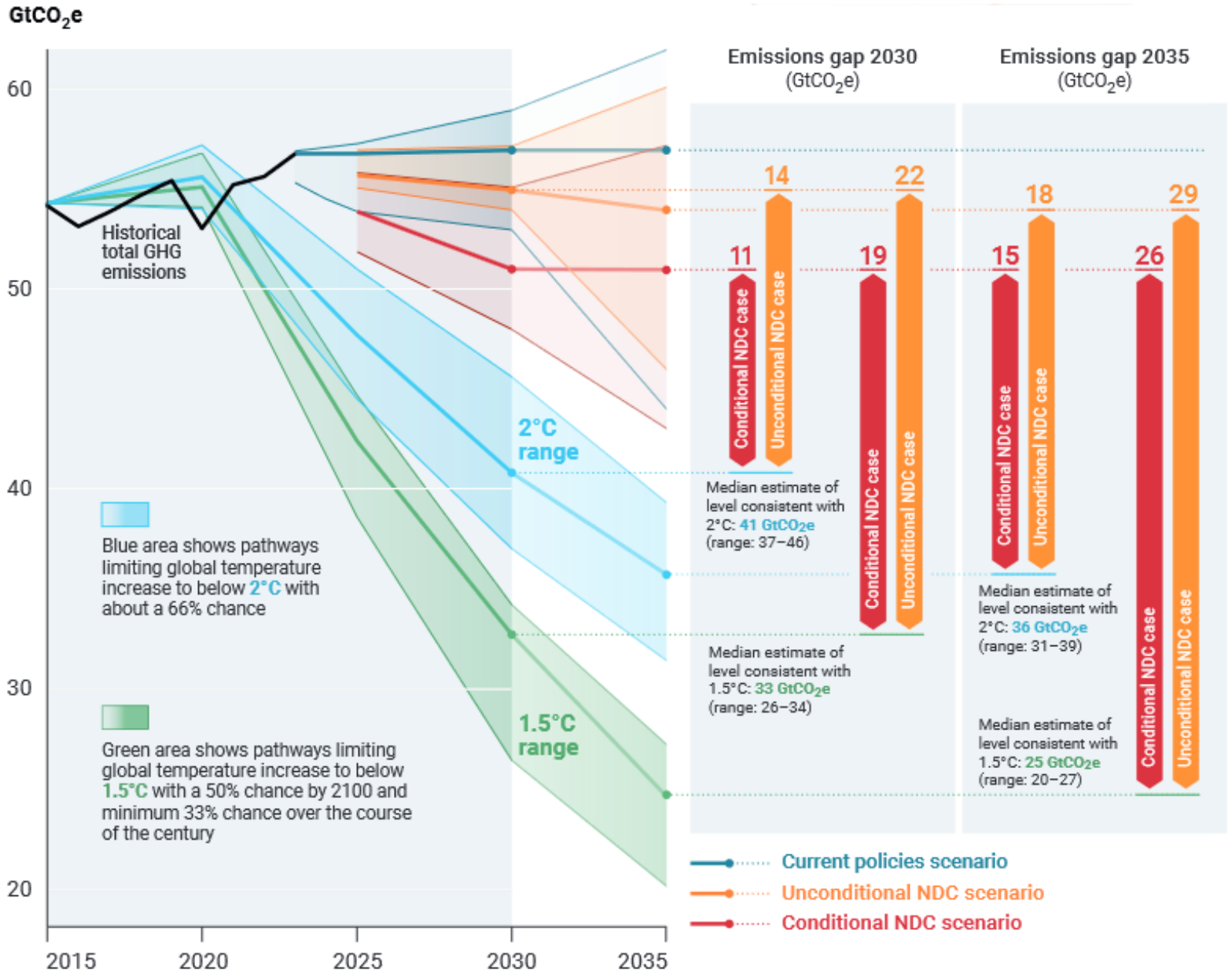
No more hot air ... please!

With a massive gap between rhetoric and reality, countries draft new climate commitments

- https://www.unep.org/resources/emissions-gap-report-2024

Emissions Gap Report 2024

Figure ES.3 Global GHG emissions under different scenarios and the emissions gap in 2030 and 2035



https://www.unep.org/resources/emissions-gap-report-2024

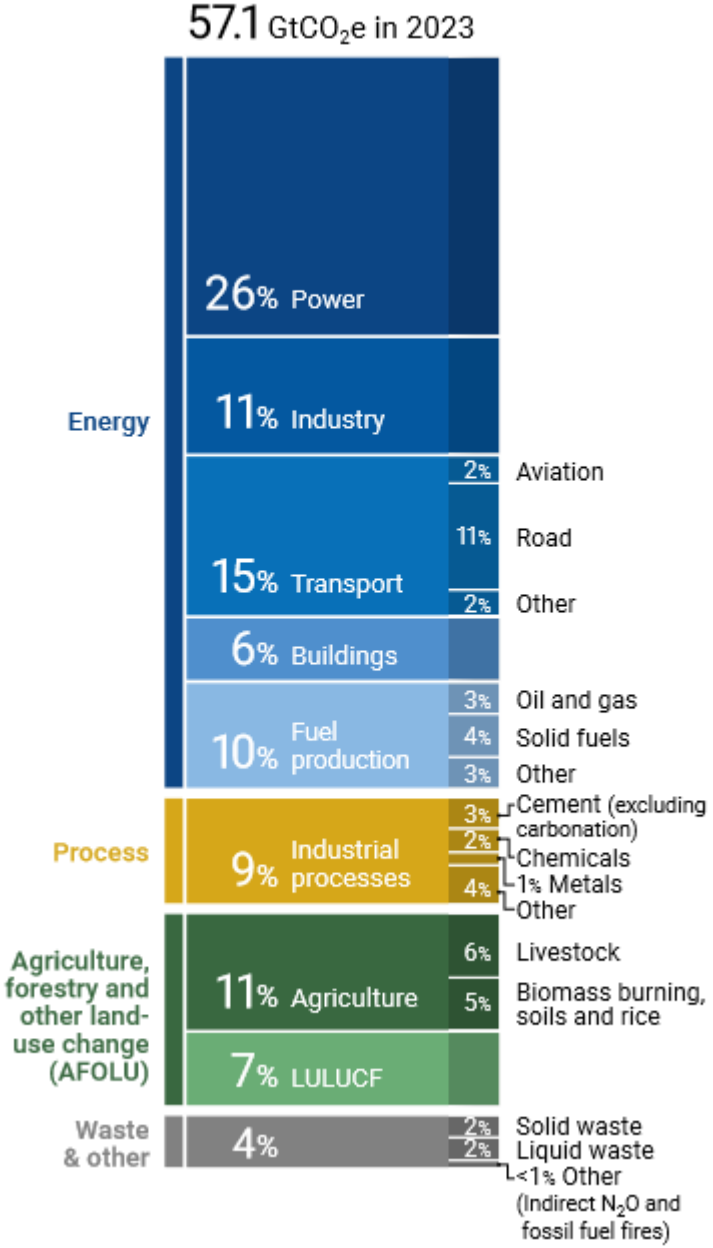
Core messages

- The core message is that **ambition means nothing without action** – unless global emissions in 2030 are brought below the levels implied by existing policies and current NDCs, it will become impossible to reach a pathway that would limit global warming to 1.5°C with no or limited overshoot (>50 per cent chance), and strongly increase the challenge of limiting warming to 2°C (>66 per cent chance). The next NDCs must deliver a quantum leap in ambition in tandem with accelerated mitigation action in this decade.
- The updated assessment of sectoral emission reduction potentials included in this year's report shows that the **techno-economic emission reduction potential based on existing technologies and at costs below US$200 per ton of carbon dioxide equivalent (tCO2e) remains sufficient** to bridge the emissions gap in 2030 and 2035. But this will require overcoming formidable policy, governance, institutional and technical barriers as well as an unprecedented increase in the support provided to developing countries along with a redesigning of the international financial architecture.

Key findings

- The increase in total greenhouse gas (GHG) emissions of 1.3 per cent from 2022 levels is above the average rate in the decade preceding the COVID-19 pandemic (2010–2019), when GHG emissions growth averaged 0.8 per cent per year.

Figure ES.1 Total GHG emissions in 2023



land use, land-use change and forestry (LULUCF)

Evolution of country and per capita emissions

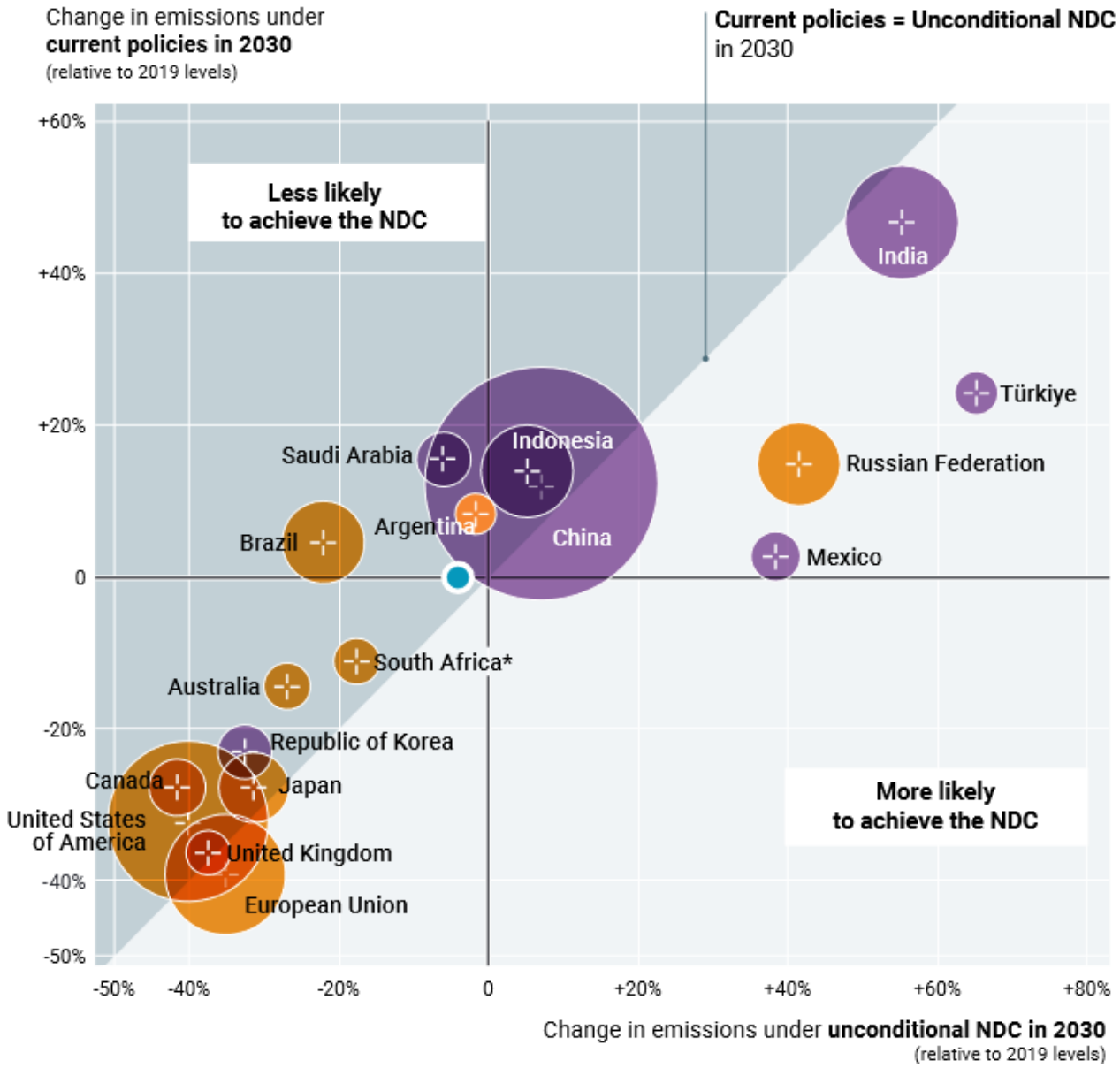
Table ES.1 Total, per capita and historical emissions of selected countries and regions

	Total GHG emissions in 2023	Change in total GHG emissions, 2022–2023	Per capita GHG emissions in 2023	Historical CO_2 emissions, 1850–2022
	$MtCO_2e$ (% of total)	%	tCO_2e/capita	$GtCO_2$ (% of total)
China	16,000 (30)	+5.2	11	300 (12)
United States of America	5,970 (11)	-1.4	18	527 (20)
India	4,140 (8)	+6.1	2.9	83 (3)
European Union (27 countries)	3,230 (6)	-7.5	7.3	301 (12)
Russian Federation	2,660 (5)	+2	19	180 (7)
Brazil	1,300 (2)	+0.1	6.0	119 (5)
African Union (55 countries)	3,190 (6)	+0.7	2.2	174 (7)
Least developed countries (47 countries)	1,730 (3)	+1.2	1.5	115 (4)
G20 (excl. African Union)	40,900 (77)	+1.8	8.3	1,990 (77)

Note: Emissions are calculated on a territorial basis. LULUCF CO_2 emissions are excluded from current and per capita GHG emissions but are included in historical CO_2 emissions based on the bookkeeping approach. Some countries in the African Union are also least developed countries.

NDC targets and implementation gap

Figure ES.2 The landscape of current NDC targets and implementation gaps for the G20 members collectively and individually by 2030, relative to 2019 emissions



Post-peak countries

Pre-peak countries

G20 average

GHG emissions in 2019:

500 $MtCO_2e$ 2,000 $MtCO_2e$ 5,000 $MtCO_2e$

Supplement

Likelihood of warming exceeding a specific temperature limit (%)

Scenarios	1.5°C	2°C	3°C
Current policies continuing	100% (85–100%)	97% (28–100%)	37% (1–80%)
Unconditional NDCs continuing	100% (86–100%)	94% (28–100%)	22% (1–75%)
Conditional NDCs continuing	100% (77–100%)	79% (19–100%)	10% (0–69%)
Conditional NDCs + all net-zero pledges	77% (64–97%)	20% (64–97%)	0% (0–6%)

A continuation of the mitigation effort implied by current policies is estimated to limit global warming to a maximum of 3.1°C (range: 1.9–3.8) over the course of the century.

Discussion: Nature – carbon sinks – climate change

- What is the main topic that both articles discuss?
- What has been observed in 2023 that is of major concern?
- How could this observation be taken into account at the upcoming COP29?

- What was COP16 in Cali about?
- How many different COPs are there?

https://www.theguardian.com/environment/2024/oct/14/nature-carbon-sink-collapse-global-heating-models-emissions-targets-evidence-aoe?CMP=Share_AndroidApp_Other

https://www.theguardian.com/environment/2024/nov/04/two-sides-of-the-same-coin-governments-stress-links-between-climate-and-nature-collapse?CMP=Share_AndroidApp_Other