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FINNISH METEOROLOGICAL INSTITUTE

Climate change

WEATHER – SEA – CLIMATE – SPACE

6.10.2025 **Prof Petteri Taalas, Director General**

Petteri Taalas

Secretary General of the WMO 2016-19, 2020-23, 193 Members
Director at the WMO Development & Regional Activities 2005-7

Director General of the Finnish Meteorological Institute 2002- 760 staff, ~100 M€/year

Professor & scientist 1986-2002: climate, atmospheric chemistry, satellites, Arctic/Antarctica

Climate expertise

- Leader of science programs of European Commission, NASA, EUMETSAT, Finnish Academy
- IPCC delegate of Finland, chair of IPCC group 2008-2015
- Opening speaker at COP 22-27
- European of the year 2021/Readers Digest: climate science communication

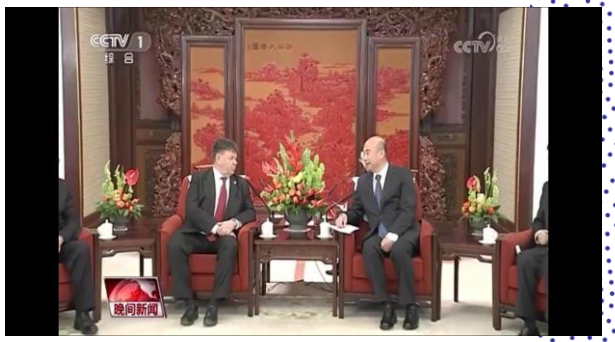
Chairman of EUMETSAT Council 2010-, 500 staff, ~400 M€/year

Univ. of Eastern Finland, Chairman of the Board 2009-15, 2800 staff, 15000 students, 260 M€

Fortum energy company, board member 2014-16, advisory board 2011

PhD & MSc Helsinki Univ., management training Uni. Pierre & Marie Curie etc.

Member of Finnish Science Academy and Academy of Technical Sciences



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WMO EUMETSAT

UNIVERSITY OF EASTERN FINLAND

Fortum

Organization & budget

DIRECTOR GENERAL'S OFFICE
PETTERI TAALAS

Communications group
Nina Kukkurainen

Research Coordination group
Jari Liski

METEOROLOGICAL AND MARINE RESEARCH PROGRAMME
SAMI NIEMELÄ

Meteorological Research
Anders Lindfors

Marine Research
Laura Tuomi

Weather and Climate Change Impact Research
Hilppa Gregow

CLIMATE RESEARCH PROGRAMME
HANNELE KORHONEN

Climate System Research
Annalea Lohila

Atmospheric Composition
Antti Hyvärinen

Atmospheric Research Centre of Eastern Finland
Sami Romakkaniemi

SPACE AND EARTH OBSERVATION CENTRE
JOUNI PULLIAINEN

Earth Observation Research
Johanna Tamminen

Space Research and Observation Technologies
Ari-Matti Harri

Arctic Space Centre
Jyri Heilimo

OBSERVING AND INFORMATION SYSTEMS CENTRE
TARJA RIIHISAARI

Observation Services
Vesa Kurki

ICT and Data Production
Matti Keränen

Service Development
Mikko Visa

WEATHER, SEA AND CLIMATE SERVICE CENTRE
JUHANA HYRKKÄNEN

Weather and Safety Centre
Anssi Vähämäki

Customer Services
Jaakko Nuottokari

Expert Services
Harri Pietarila

ADMINISTRATION
MARKO VILJANEN

Financial
Janna Karasjärvi

Personnel
Minna Laatikainen

Administrative Services
Jaana Palmunoksa

Quality Manager
Sanna Mäkinen

Risk Management Manager
Sanna Matikainen

Chief Architect
Mikko Rauhala

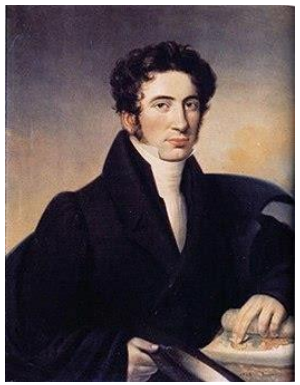
Production Manager
Anu Petäjä

Information Security Manager
Simo Poskiparta

Security Manager
Veli-Pekka Rautava

Preparedness Manager
Ari-Juhani Punkka

- FMI is a **government service and research institute** responsible for atmospheric, marine and space observations & services, modelling and research in Finland
- **Security authority**, responsible for defense sector forecasting and observing services
- **760 employees** (30% PhD's), > 350 peer-reviewed publications annually
- **Annual budget ~100 M€**, 55 M from government, 45 M services & research funds



Established in 1838 by Johan Nervander

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FMI: Wide range of 24/7 services

New service concepts by using AI/ML under development

Road, railroad and pedestrian safety

Emergency & safety authorities

Private sector: energy, agriculture, businesses

Marine safety, ice services

Civil & military aviation

Media, general public

RESULTS AND QUALITY

	RESULT 2024	TARGET 2024
Stakeholder satisfaction (scale 1–5)	4.34	4.0
Forecast accuracy (combination), %	-	-
Ranking in the accuracy of temperature forecasts compared to the Swedish and Norwegian meteorological institutes.	1	1
Accuracy of 1 day temperature forecast %	90.2	90
Wind warning accuracy (land areas) 1–2 days, %	81	80
Aerodome forecast (TAF) accuracy, %	92.3	91
Number of citations in web of science database	27,911	27,900
Peer-reviewed articles (number)	397*	370

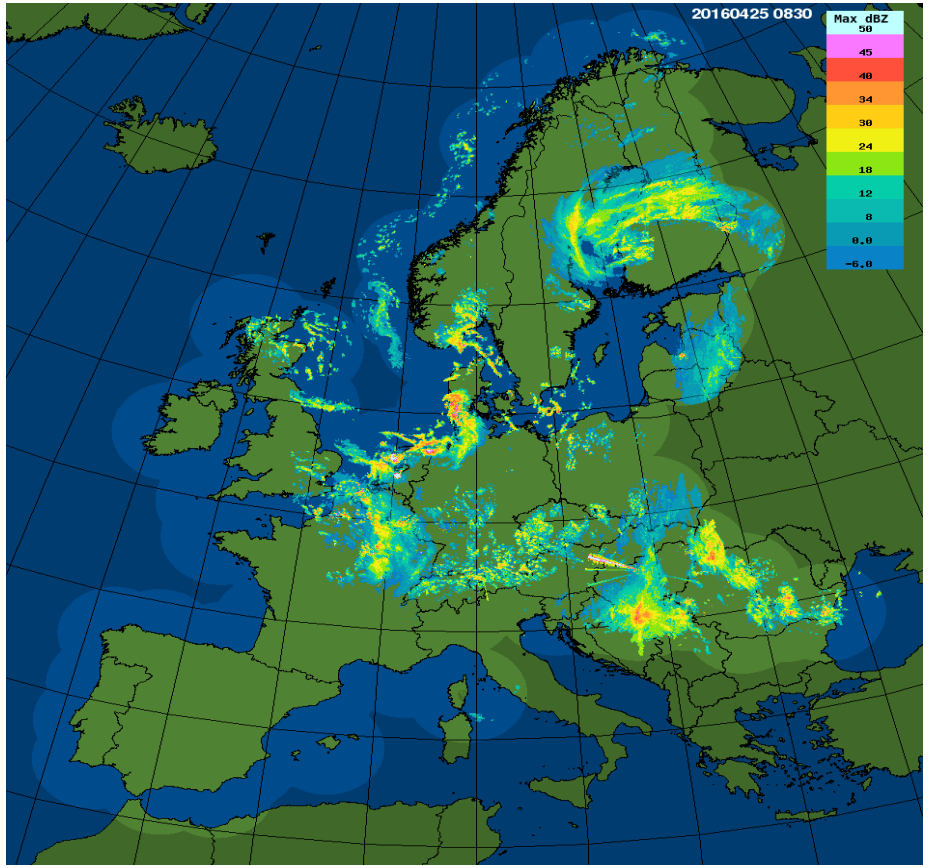
EFFICIENCY

Cost recovery of public law services, %	97	100
Cost recovery of commercial services, %	111	102
Cost recovery of co-funded projects, %	72	60
Amount of external research funding, 1,000 €	26,312	19,000
Research activity (publications/staff year)	1.28	1.35

*The number of articles is from Justus publication registry

International cooperation: ECMWF, EUMETSAT, WMO, IPCC

ipcc
INTERGOVERNMENTAL PANEL ON climate change



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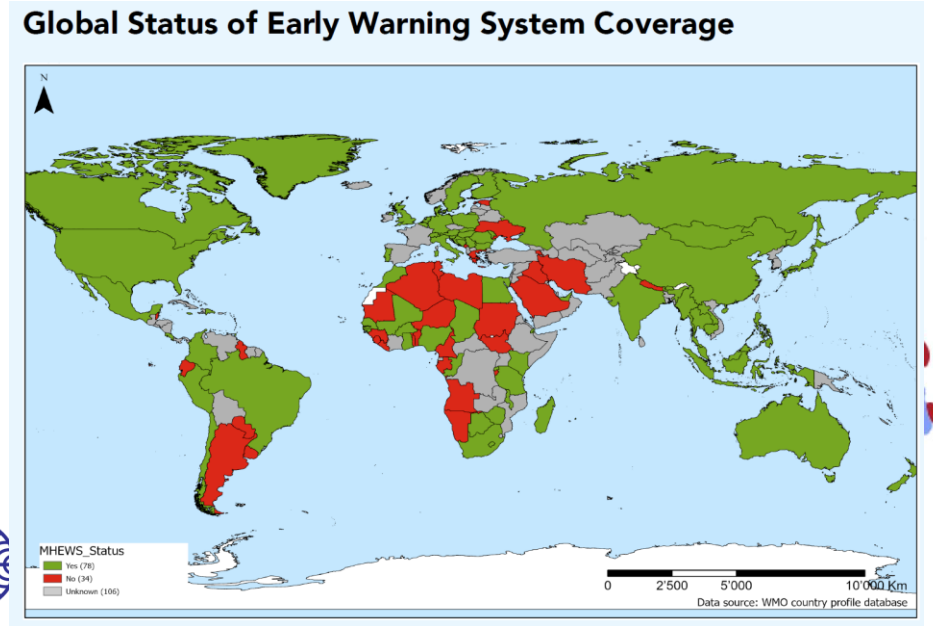
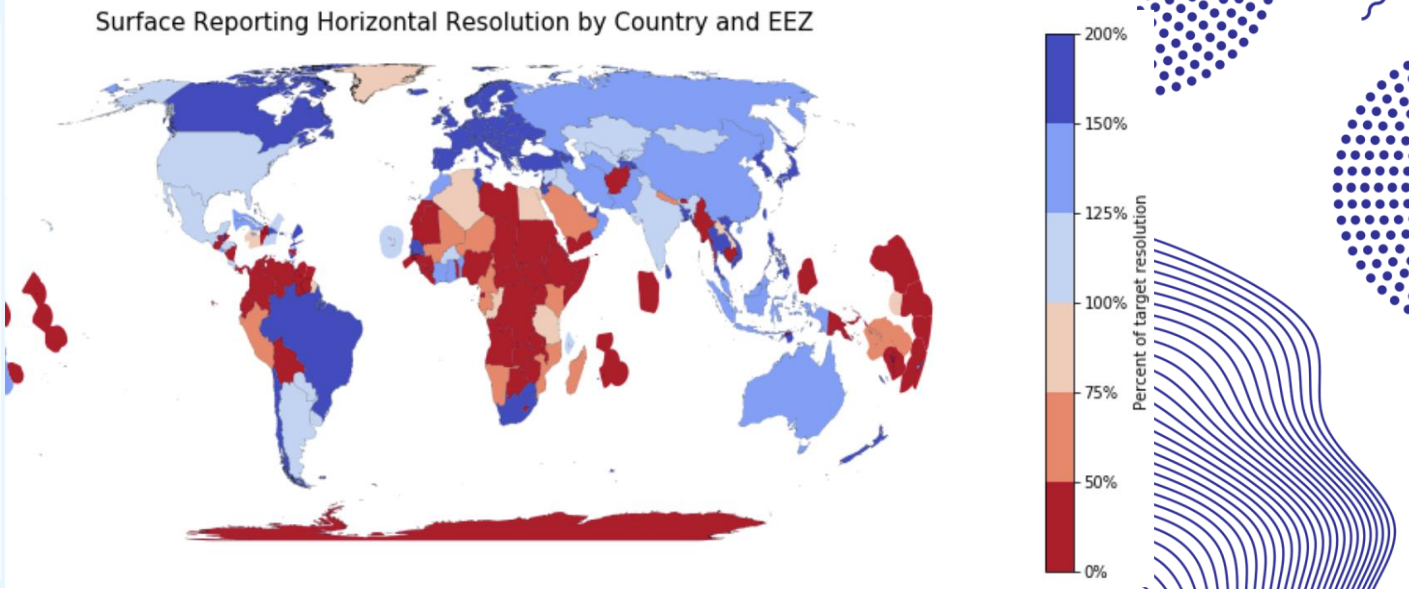
Early warnings for all initiative for COP-27

"....Early warnings and action save lives. To that end, today I announce the United Nations will spearhead new action to ensure every person on Earth is protected by early warning systems within five years.
I have asked the World Meteorological Organization (WMO) to lead this effort and to present an action plan at the next United Nations climate conference, later this year in Egypt...." **UN Secretary-General Antonio Guterres 23 March 2022**

Poor early warning services



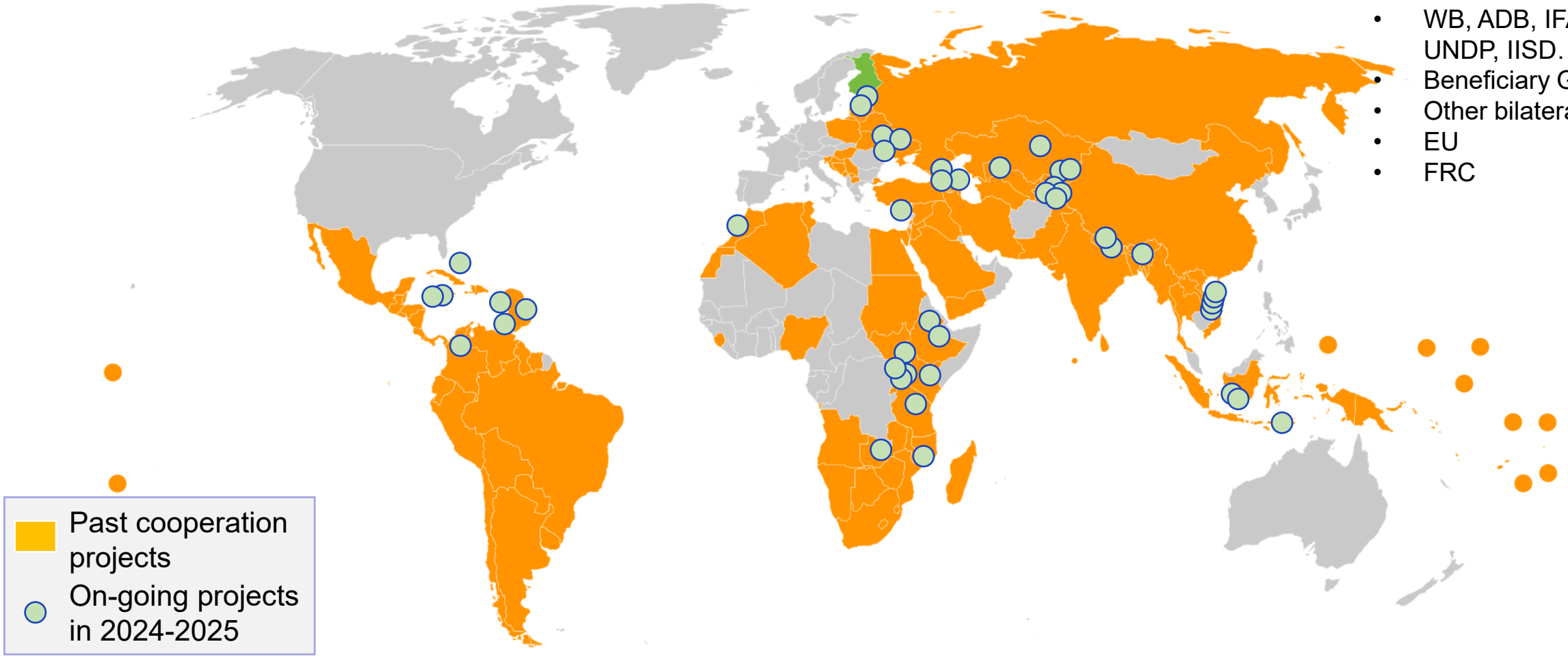
Gaps in basic observing systems



Consultancy projects of FMI in more than 100 countries

Funding sources:

- MFA - ICI and PIF
- WMO - SOFF & CREWS
- WB, ADB, IFAD, UNEP, UNDP, IISD…
- Beneficiary Governments
- Other bilateral ODA
- EU
- FRC



Past cooperation projects

On-going projects in 2024-2025

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Research infrastructures ACTRIS and ICOS

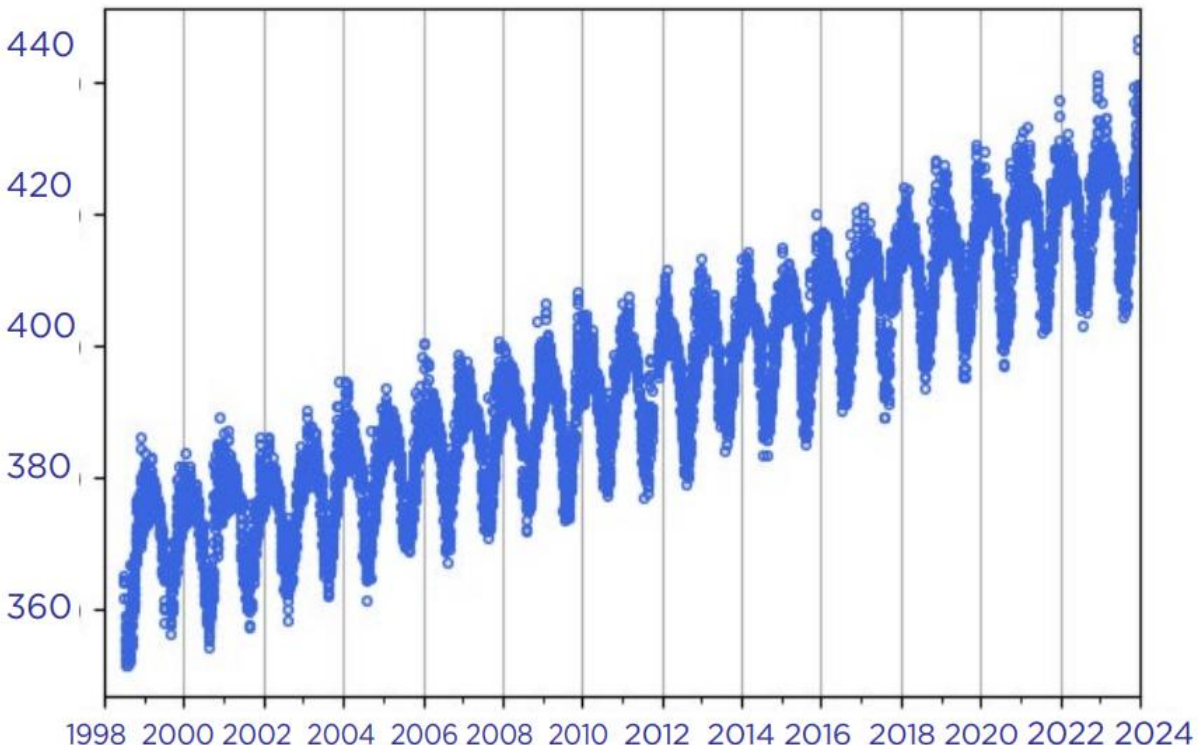
ACTRIS – Aerosol, Clouds and Trace Gases Research Infrastructure

ICOS – Integrated Carbon Observation System infrastructure

CO_2 ja CH_4, Longest time series in the Arctic

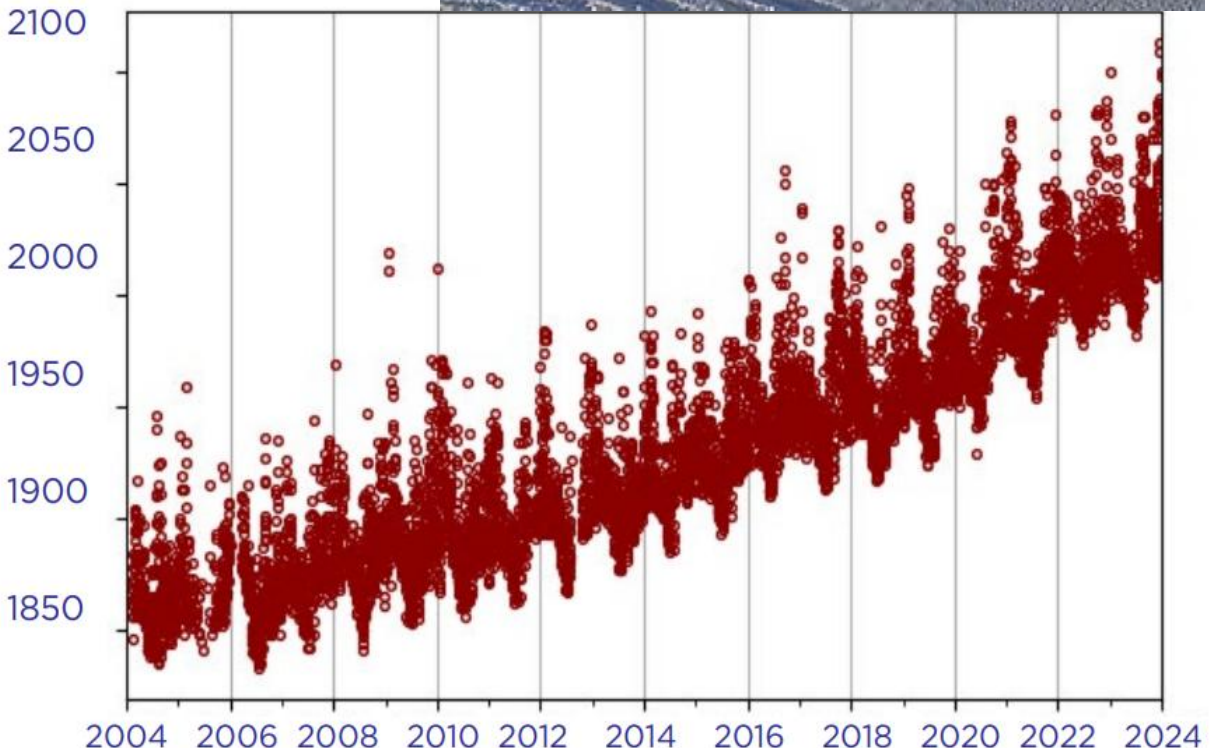
PALLAS - SAMMALTUNTURI

hiilidioksidi (CO_2), ppm

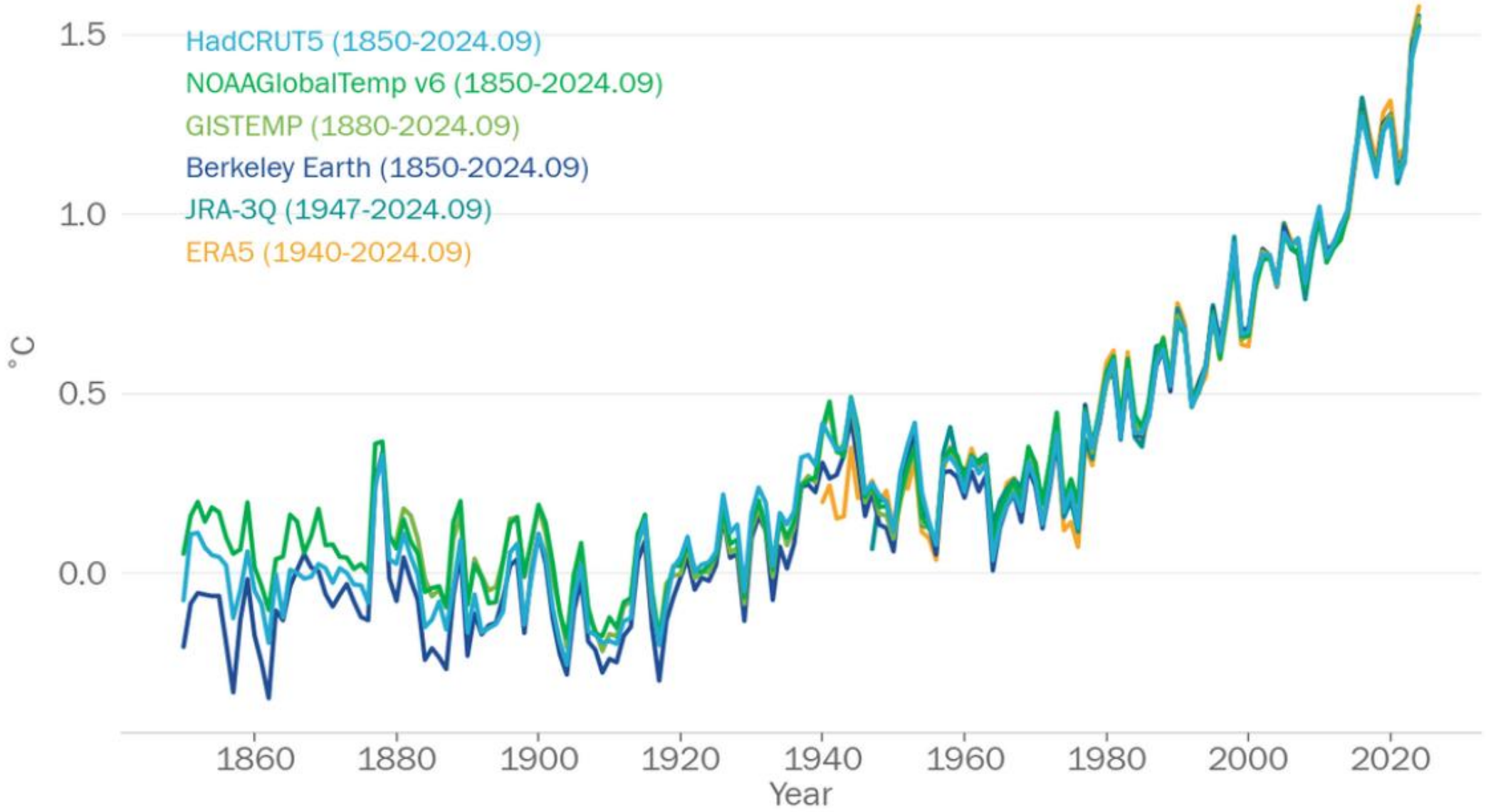


PALLAS -

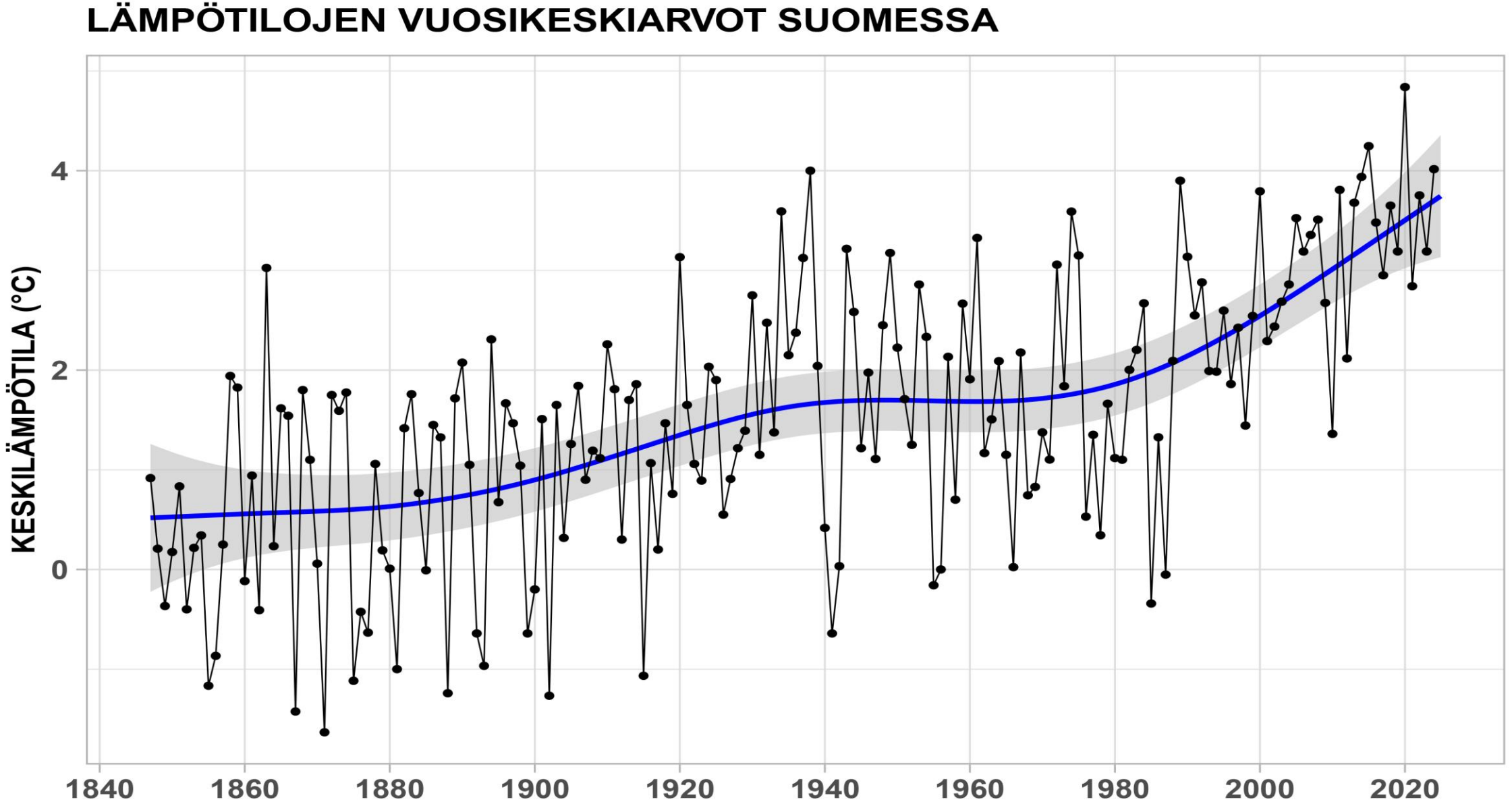
metaani (CH_4), ppb



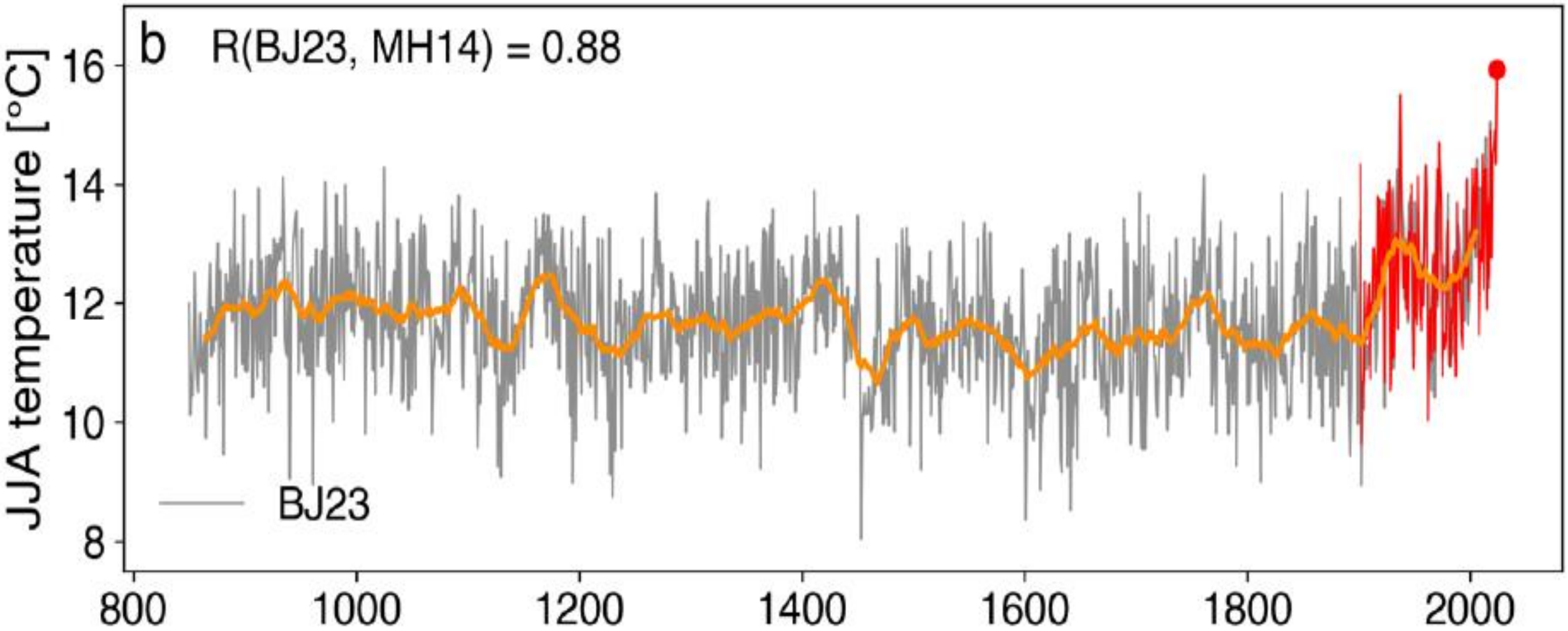
2024 record warm, 1.55 C reached



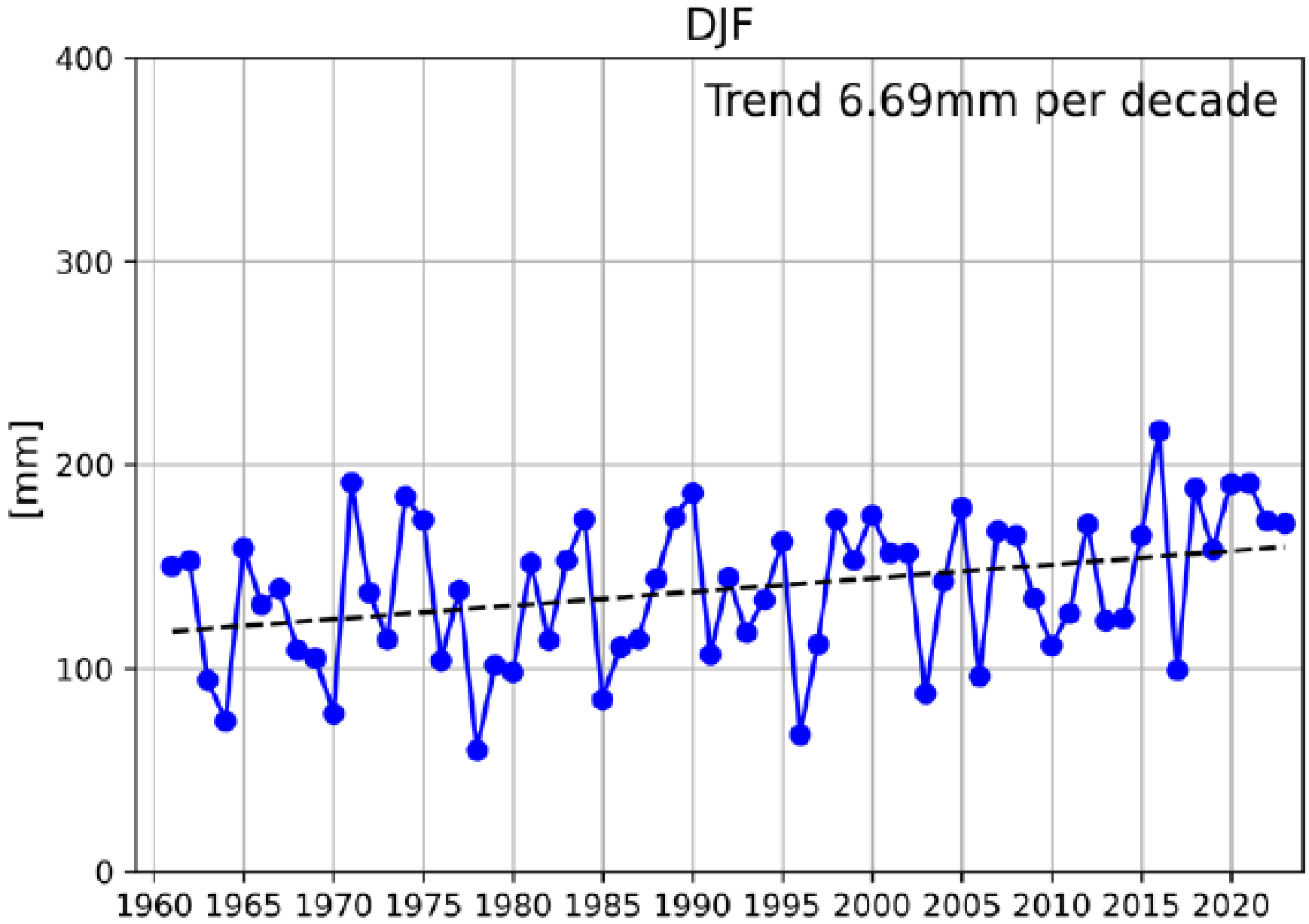
Annual temperature in Finland 0.5 => 3.7 C 1850-2024



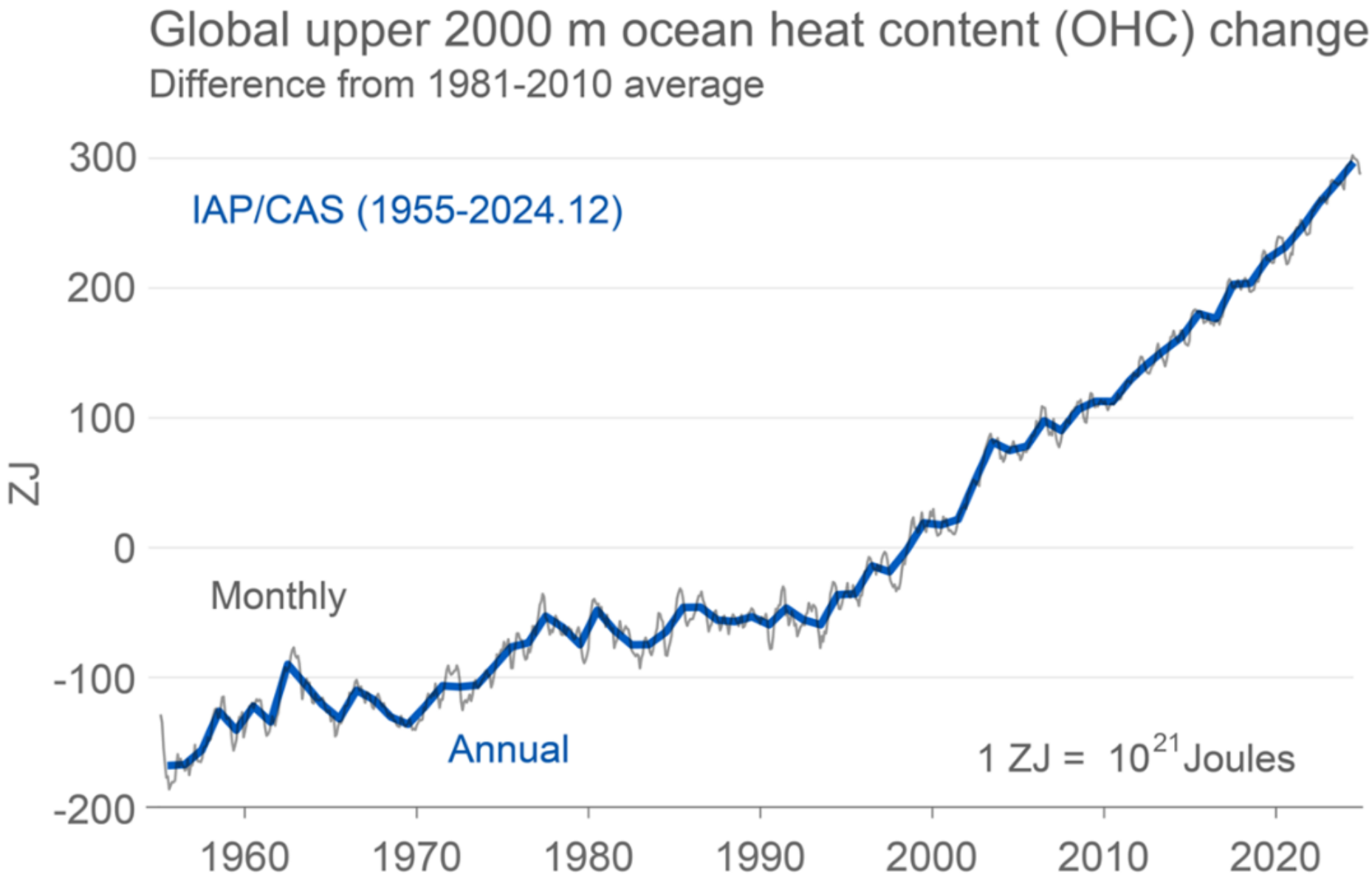
Summer temperature in Lapland 800-2024



Increase of winter rainfall by 30 % 1960-23

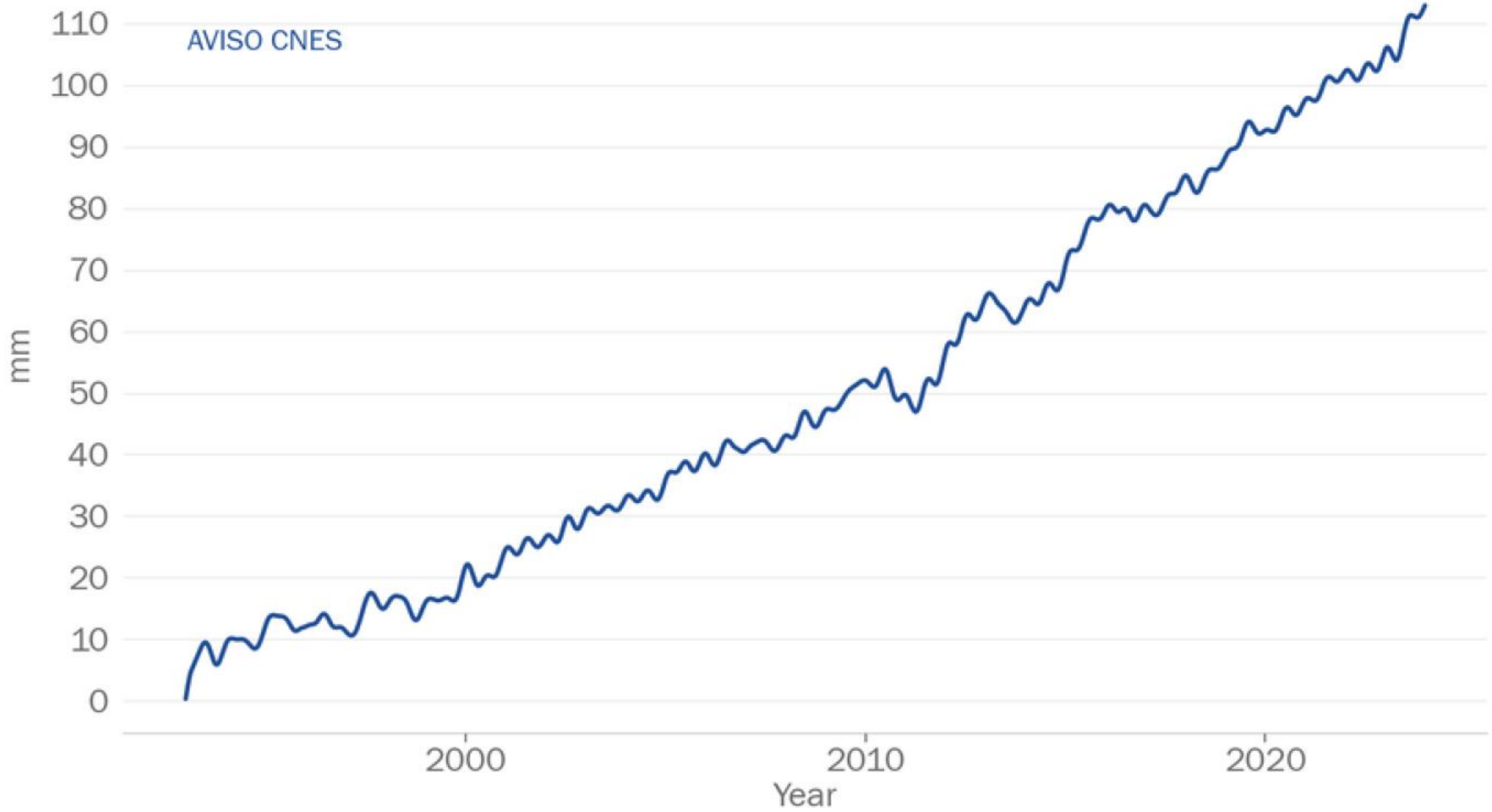


> 90 % extra heat in oceans



Sea level rise doubled 1993-2024

1993-2002 2.3mm/y, 2014-23 4.77 mm/y



Melting of glaciers 1950-2022

1970-79: -0.25 m w.e

1980-89: -0.22 m w.e.

1990-99: -0.49 m w.e.

2000-09: -0.52 m w.e.

2010-19: -0.92 m w.e.

2013-22: -0.97 m w.e.

2022 : -1.18 m w.e.

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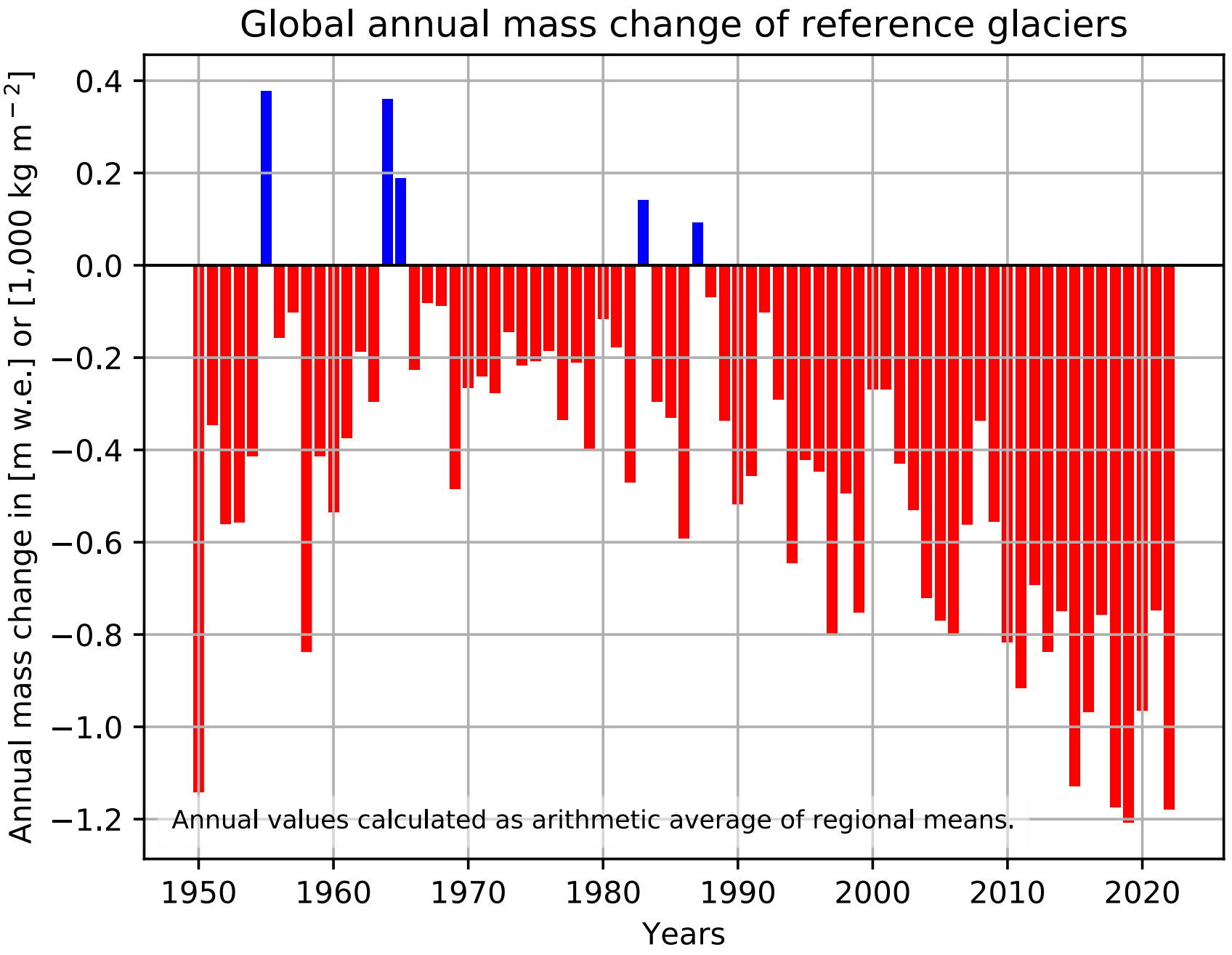
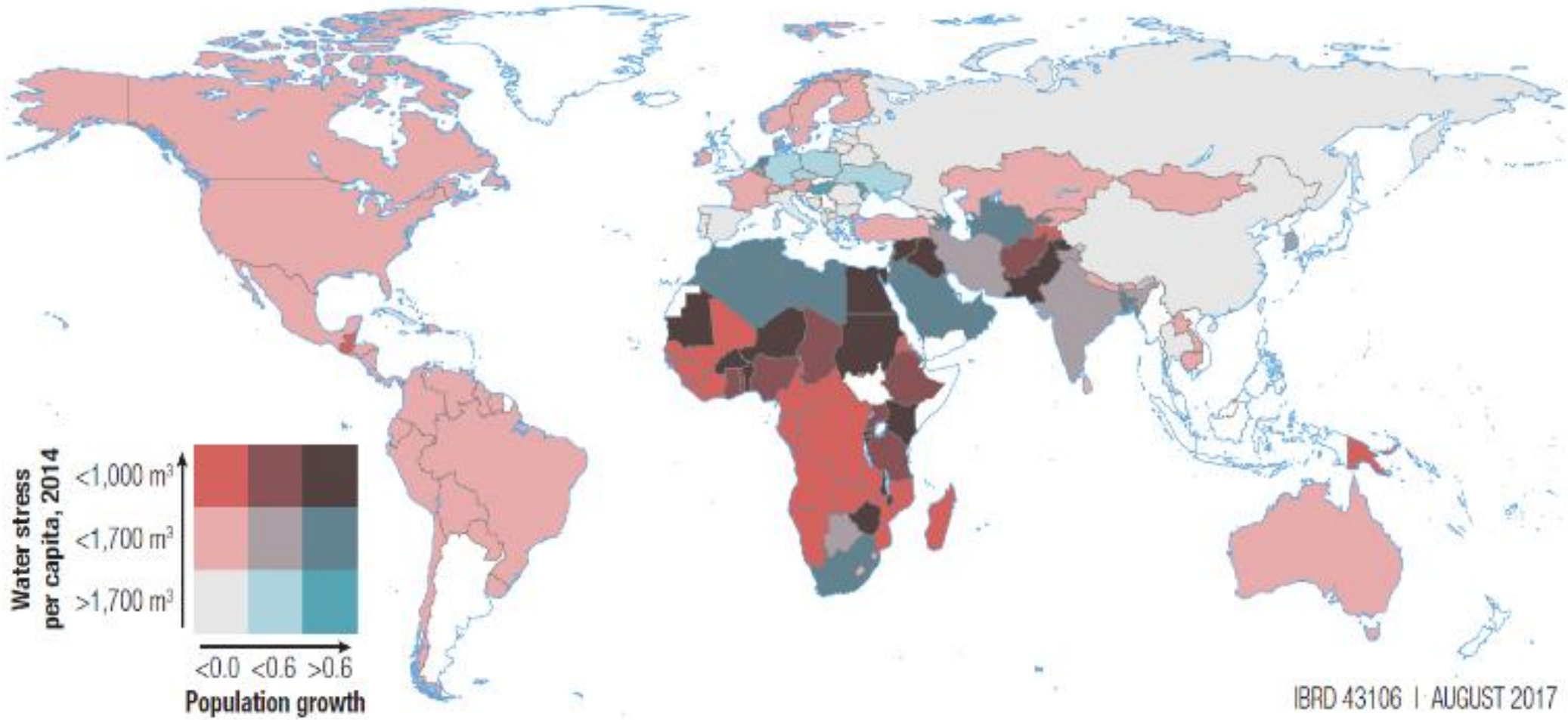


Water scarcity and population growth 2050



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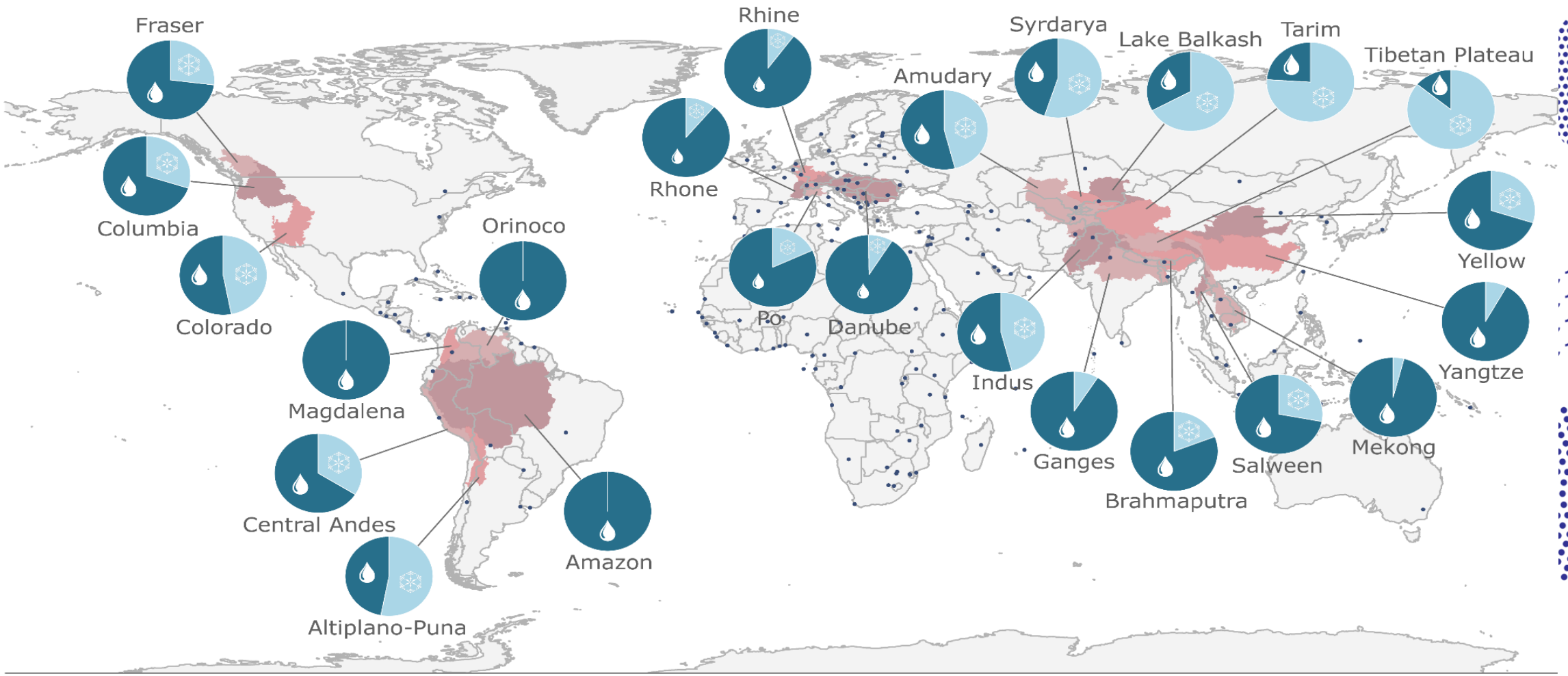
About **4 billion people**, representing nearly two-thirds of the world population, **experience severe water scarcity** during at least **one month of the year**

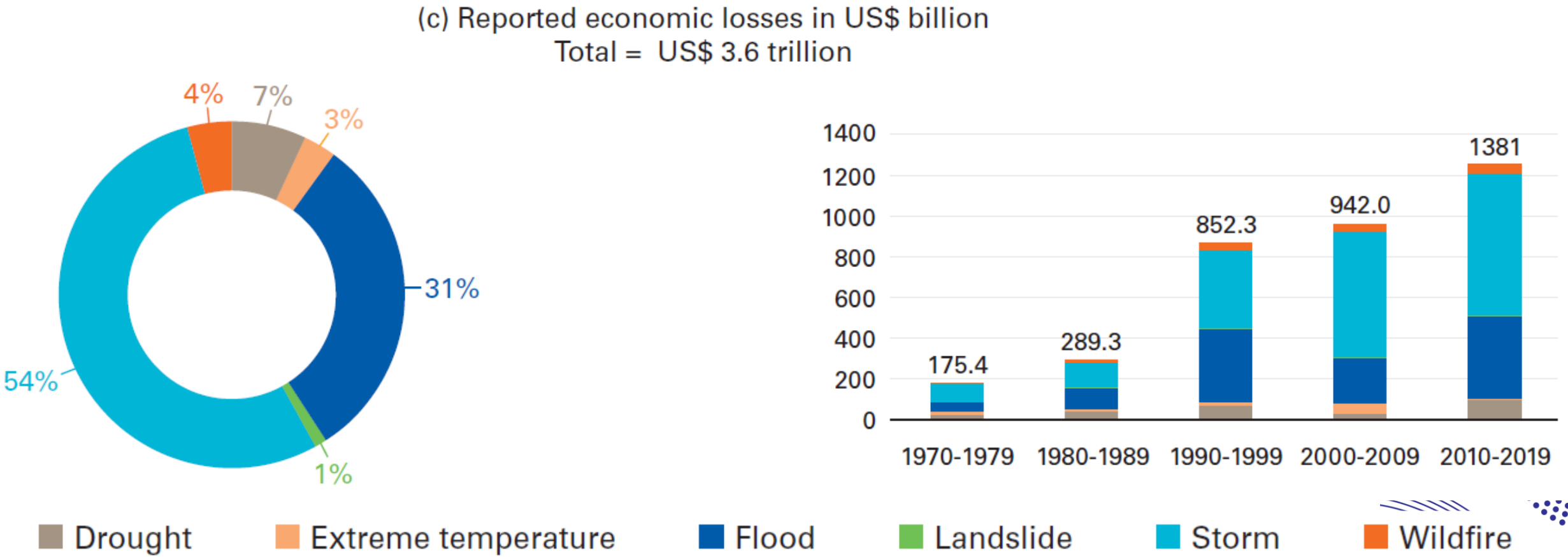
Water from glaciers and rainfall

Contribution of the cryosphere to water availability (in selected river basins of Asia, America and Europe)



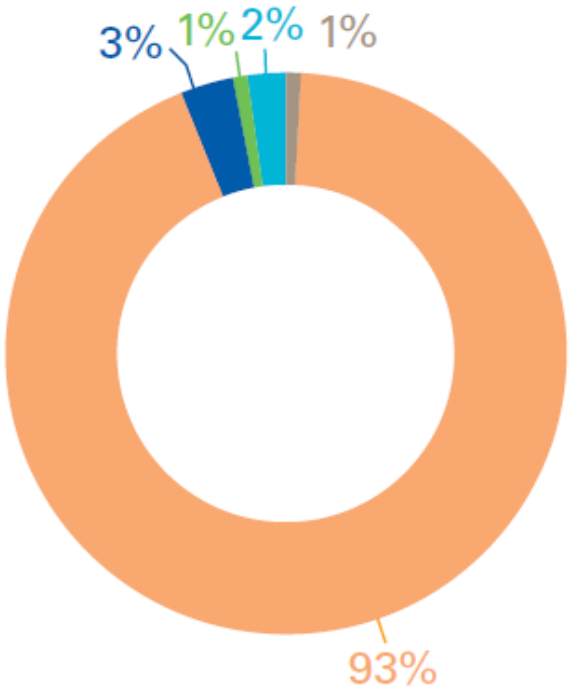
Data in "Towards mountains without permanent snow and ice" by Huss et al., 2017 (Table 2 - period: from 1998 to 2012).

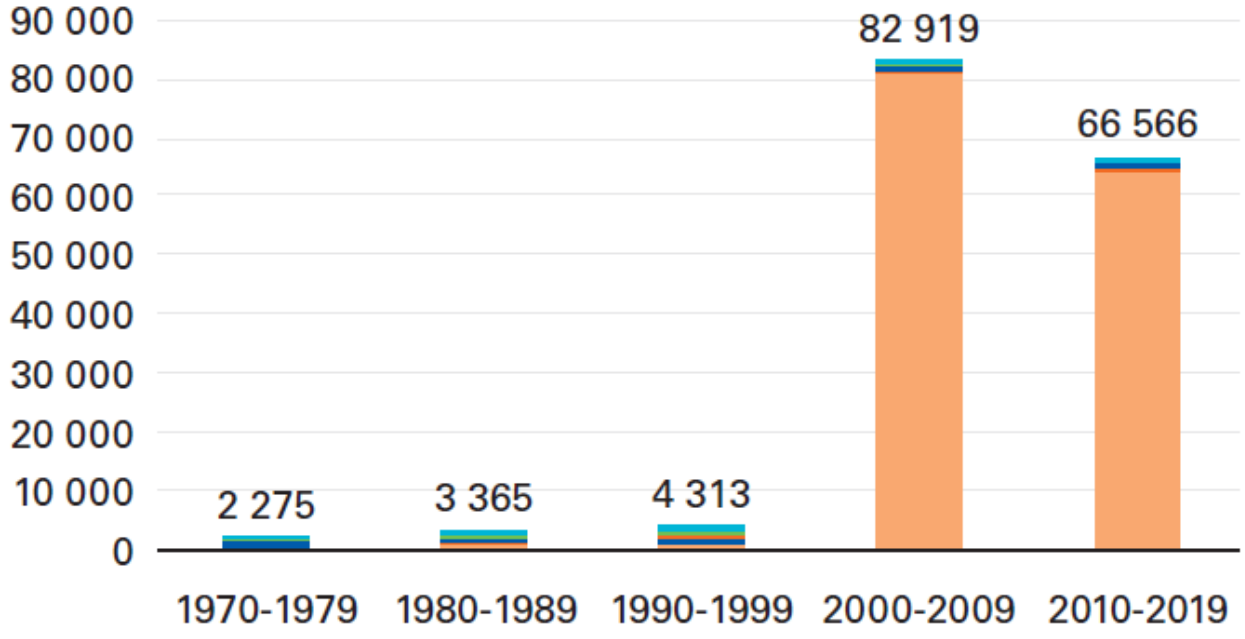
Economic losses of weather extremes 1970-2019



Human losses in Europe 1970-2019

(b) Number of reported deaths
Total = 159 438 deaths





Drought Extreme temperature Flood Landslide Storm Wildfire

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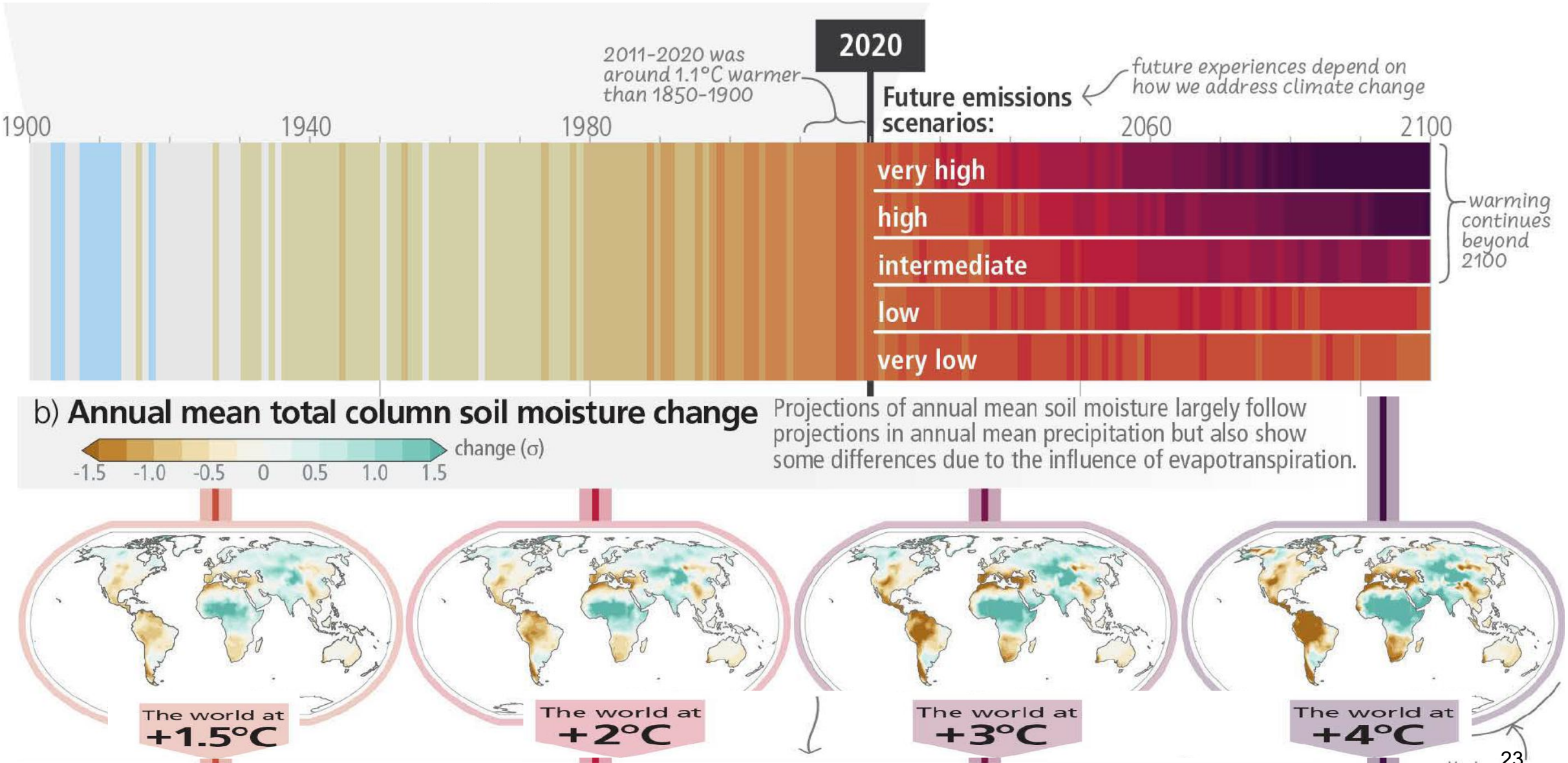
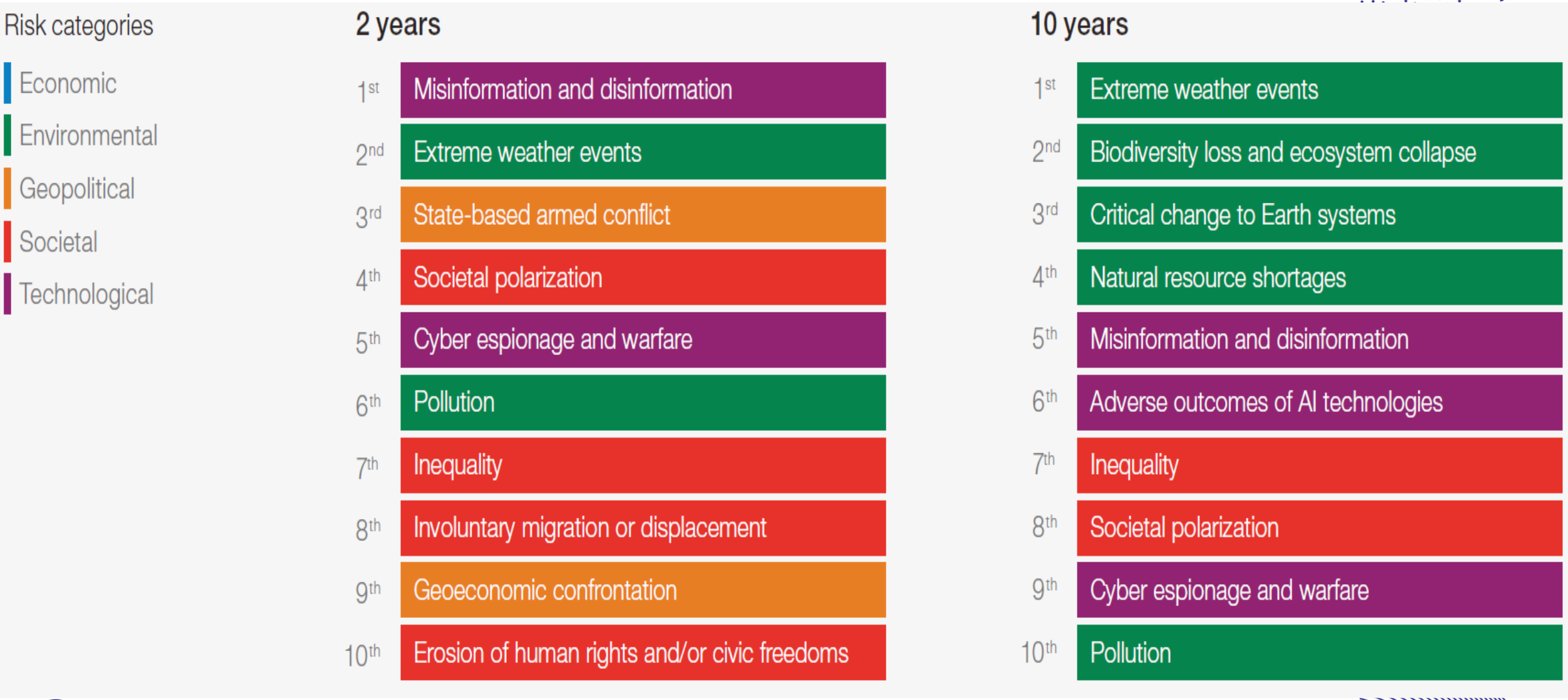
Human casualties in Europe 1970-2019

(a)	Disaster type	Year	Country	Deaths
1	Extreme temperature	2010	Russian Federation	55 736
2	Extreme temperature	2003	Italy	20 089
3	Extreme temperature	2003	France	19 490
4	Extreme temperature	2003	Spain	15 090
5	Extreme temperature	2003	Germany	9 355
6	Extreme temperature	2015	France	3 275
7	Extreme temperature	2003	Portugal	2 696
8	Extreme temperature	2006	France	1 388
9	Extreme temperature	2003	Belgium	1 175
10	Extreme temperature	2003	Switzerland	1 039

Future temperature and soil moisture



Biggest risks for the World economy, WEF 2025



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Impact of climate change on agriculture

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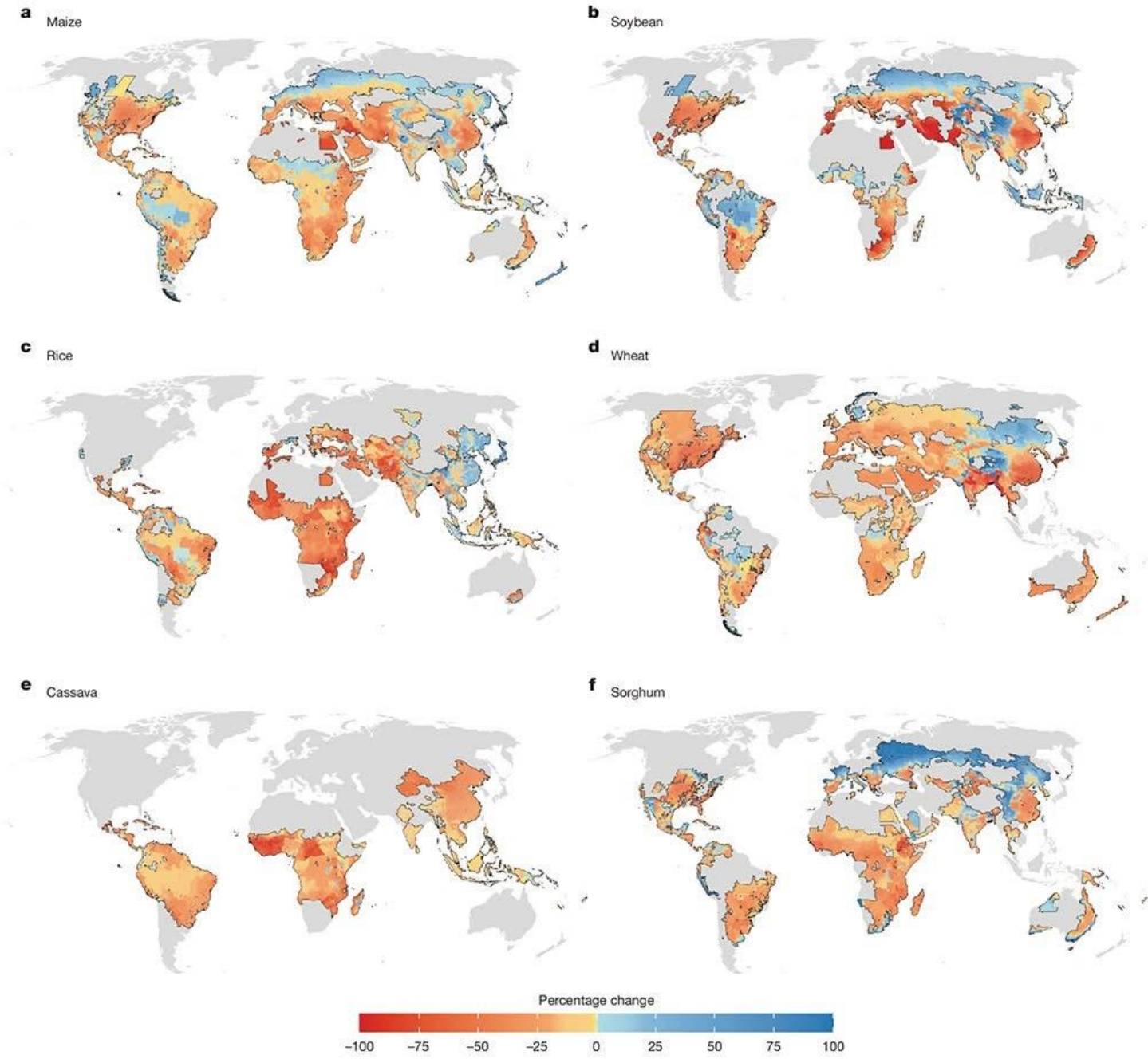
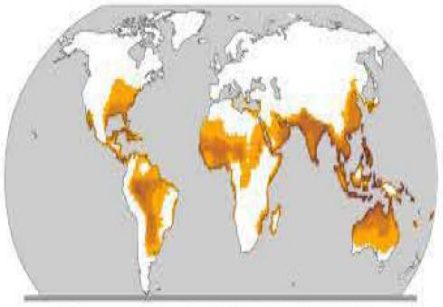
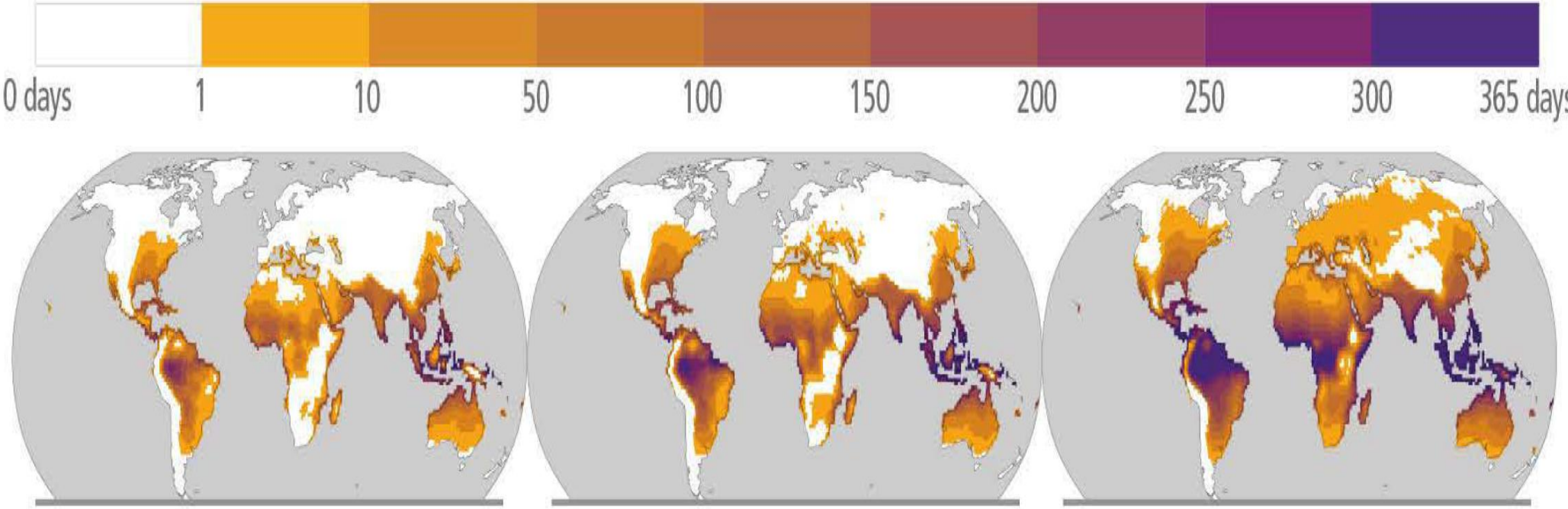


Heat-humidity impacts on health

Heat-humidity risks to human health



Historical 1991–2005



1.7 – 2.3°C

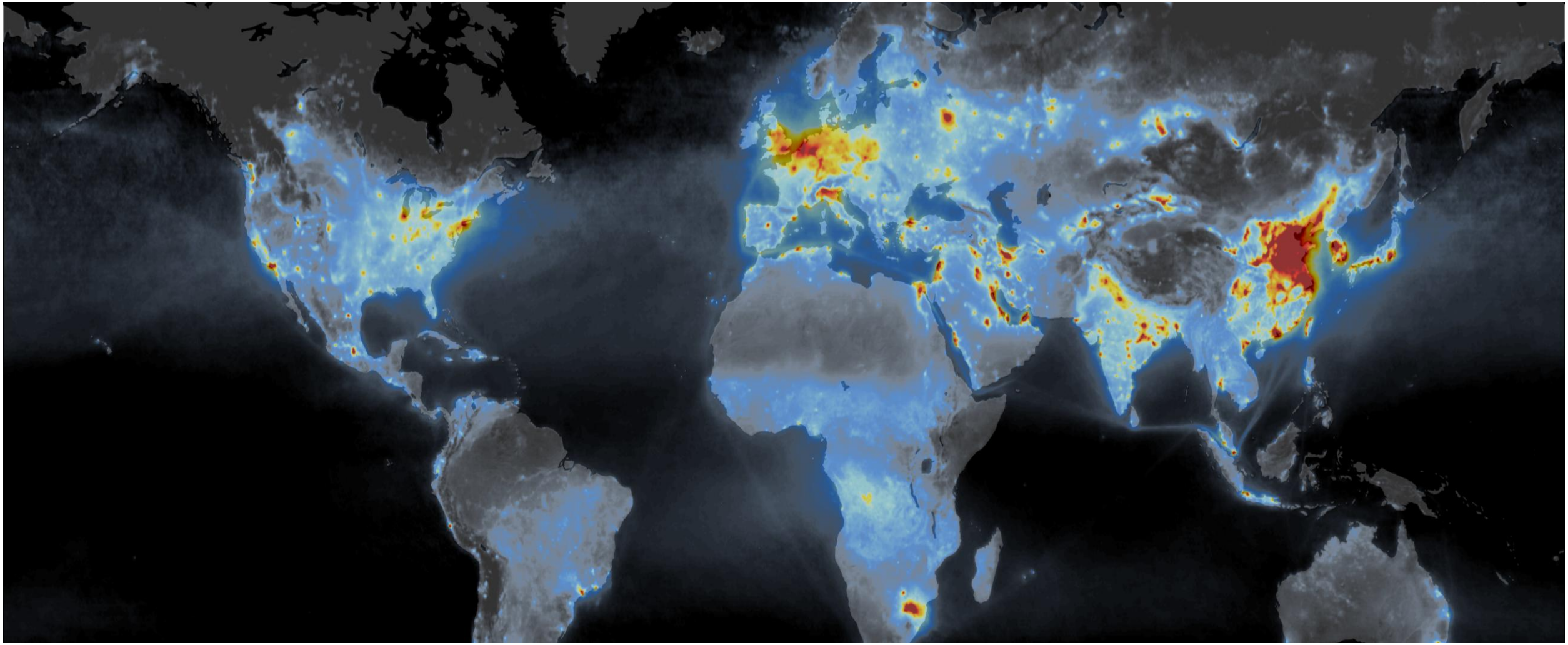
2.4 – 3.1°C

4.2 – 5.4°C

Days per year where combined temperature and humidity conditions pose a risk of mortality to individuals[3]

[3]Projected regional impacts utilize a global threshold beyond which daily mean surface air temperature and relative humidity may induce hyperthermia that poses a risk of mortality. The duration and intensity of heatwaves are not presented here. Heat-related health outcomes vary by location and are highly moderated by socio-economic, occupational and other non-climatic determinants of individual health and socio-economic vulnerability. The threshold used in these maps is based on a single study that synthesized data from 783 cases to determine the relationship between heat-humidity conditions and mortality drawn largely from observations in temperate climates.

Air quality (NO_2) monitored by the NASA OMI



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CO_2 emissions

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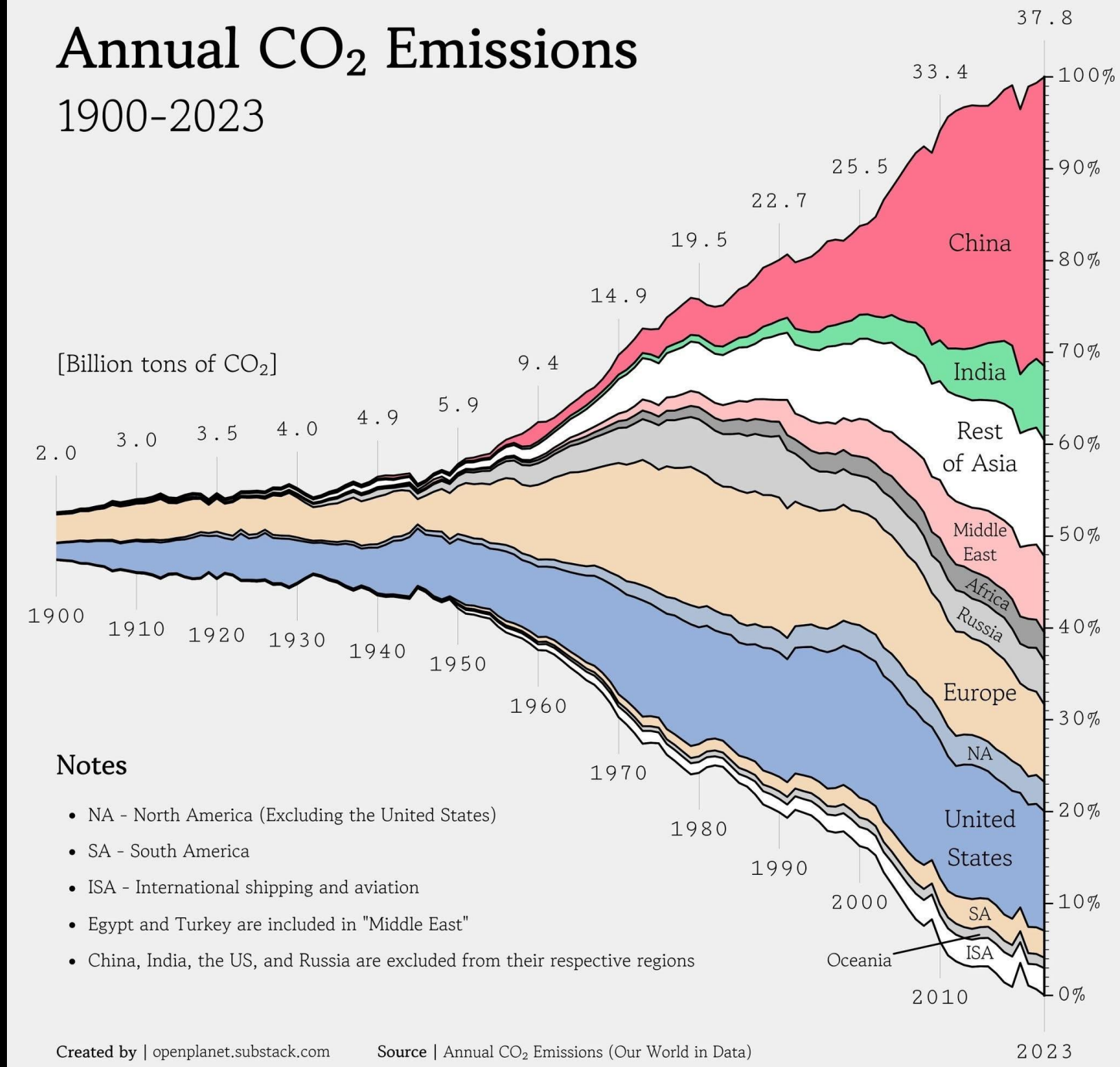
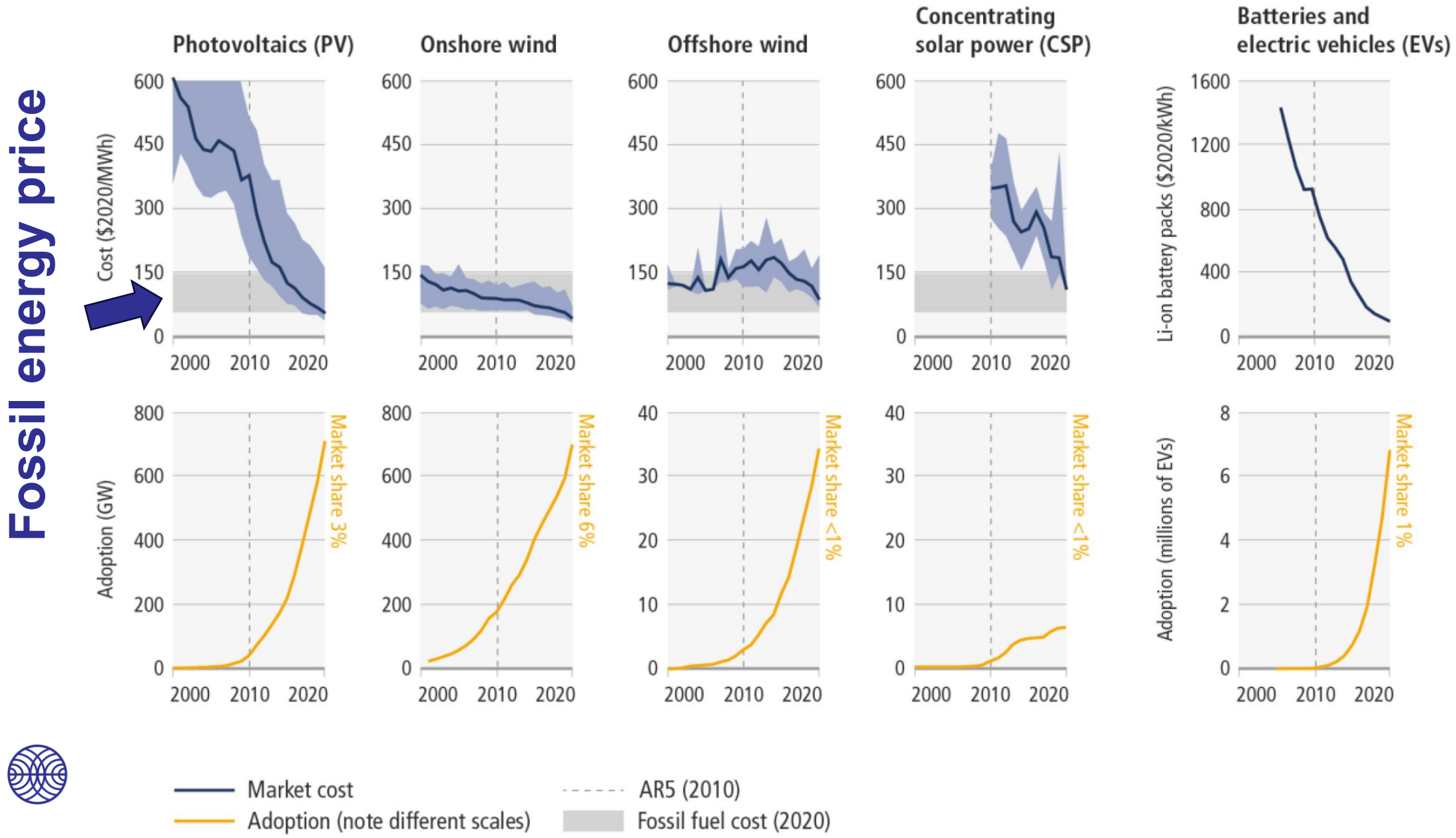


Prices of renewable energy, batteries & cars dropping



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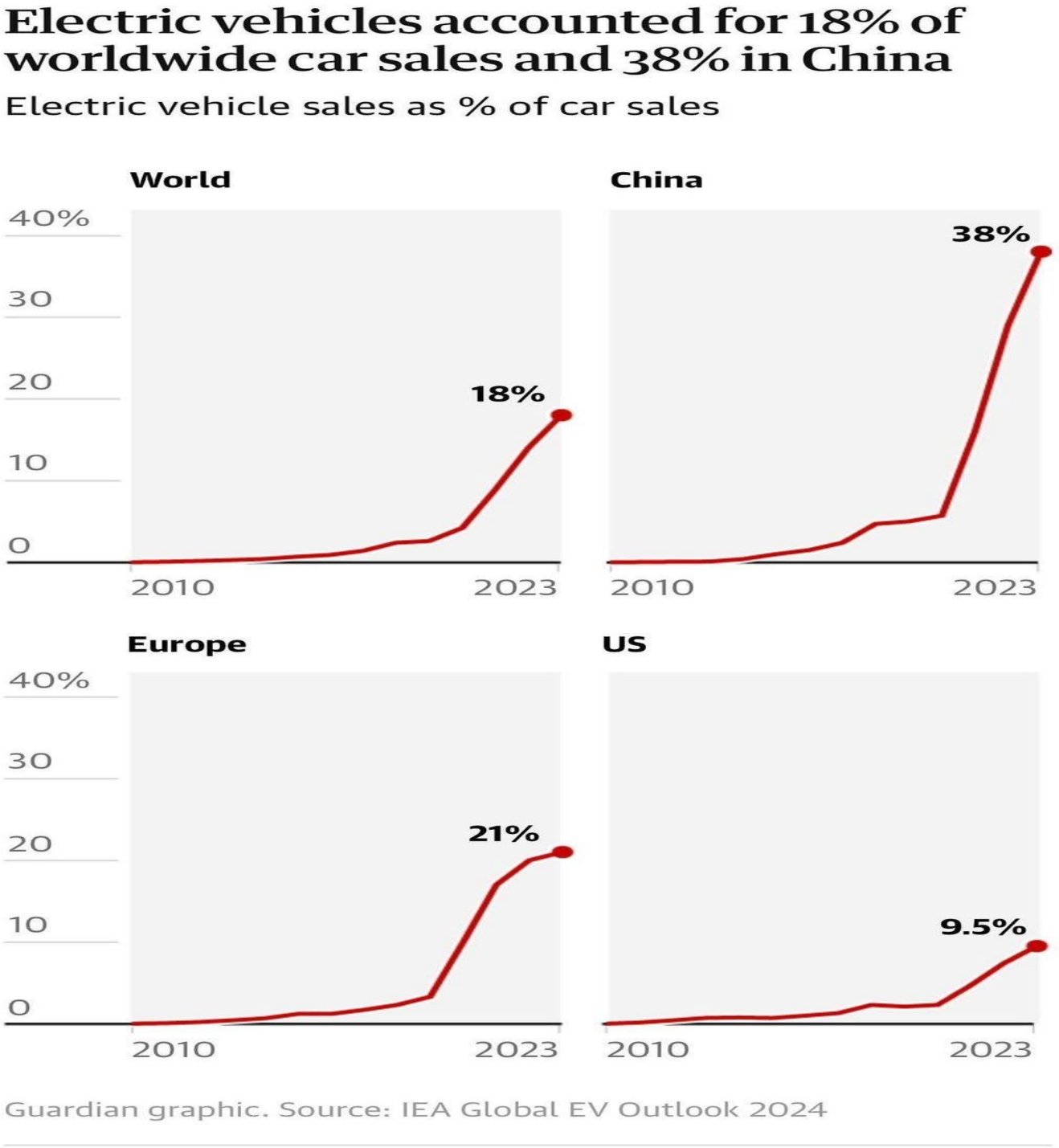
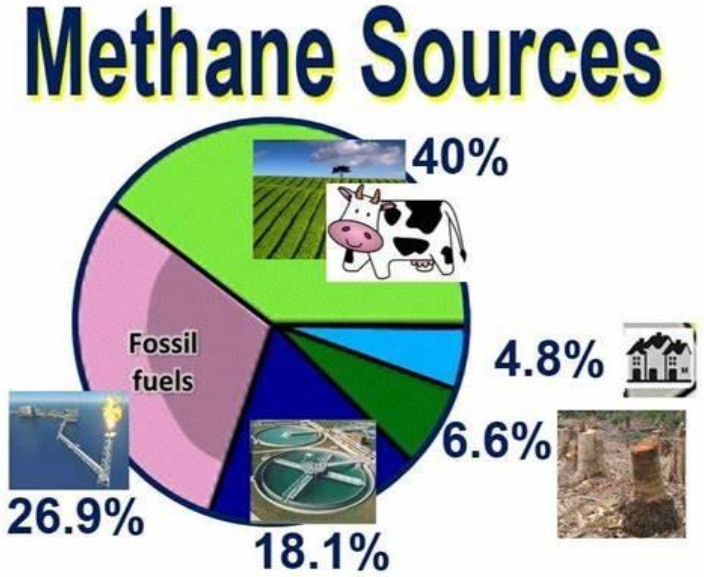
Sales of electric cars

6.10.2025 **Nimi**



How to solve the climate problem?

- **Stop use of fossil fuels** (1. Coal, 2. Oil ja 3. Natural gas) = 2/3 of the problem
- Second biggest challenge is **methane from tropical soils, cattle, rise paddies & oil/gas production**. The lifetime of CH4 is 11 y, CO2 thousansds of years.
- Thirdly we should **stop deforestation on non-renevable tropical rain forests** (Amazon, Central Africa and Southeastern Asia)

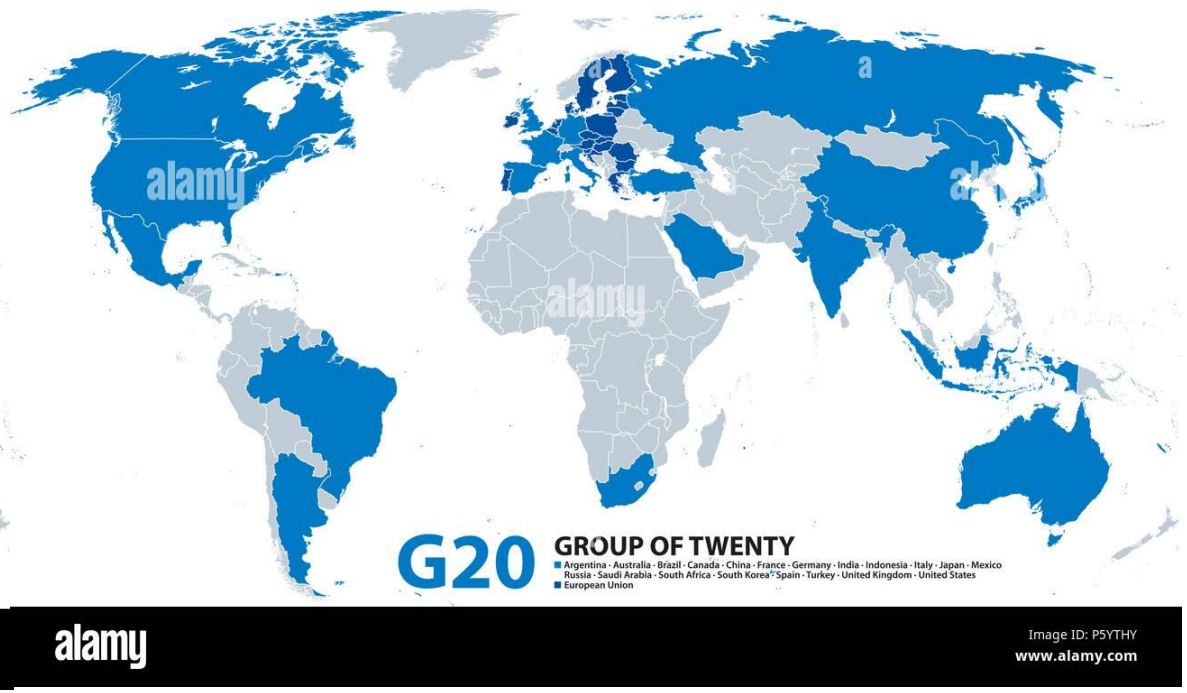


Emissions from G7+EU and G20

- **G20-countries produce 80 % of the global emissions**. Out of those the G7 and EU are responsible for 30 % of the global emissions, and have made commitments for 1.5 C target
- **The rest of the G20, which are responsible for 50 % of global emissions have not made similar commitments.** (E.g. China, Brazil, Argentina, India, Russia, Saudi-Arabia, South-Africa and Indonesia). Without rise of the ambition level in those countries the 2050/1.5 C will not be reached.

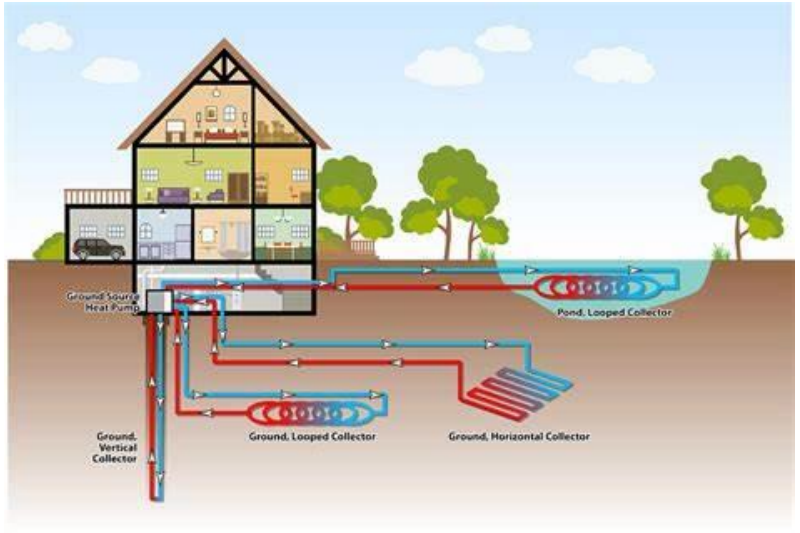
~30 % of global emissions

~80 % of global emissions



Potential of consumers?

- Also **consumers** may contribute through **transport means, diets, heating/cooling of premises** and through **avoiding buying goods produced by fossil energy**



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Wide security implications of climate change

1. **Lower soil moisture, change of precipitation patterns, lack of fertilizers & disappearance of most mountain glaciers**
   - Threat for global food security
   - Massive refugee potential from Africa
2. **Climate mitigation**
   - If successful, major impacts on Russian, Middle East etc. economies => instability consequences
3. **Melting of Arctic sea ice**
   - Growth of military and transport interests, new players like China, India, Japan onboard
4. **World economy/regional economy**
   - WEF: Weather extremes biggest risk for world economy from 2030's onwards
   - Regional losses, like Mediterranean countries may lose agricultural capacity and tourism

Health dimensions of climate change

1. **More weather extremes:** heat waves, humidity, drought, heavy rain & tropical storms

2. **Water availability a special challenge**: change of rain patterns, more evaporation & melting of glaciers => impact on **global nutrition**, combined with population growth

3. **Vector-borne diseases**, like malaria, dengue fever, cholera or Lyme disease are weather dependent. **Tick and mosquito** prevalence &related disease risks are expected to change.

4. Often **combined impact of high temperatures & poor air quality leads to death (ozone, particles)**

5. Besides weather extreme mortality sometimes the **aftermath has led to higher mortality rates** due to **destruction of the healthcare infrastructure** (e.g. Puerto Rico)

6. Risk of climate change is also a **mental challenge among especially young people**

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integrated carbon observation system

ACTRiS

Thank you!
Kiitos!
Tack!