

WMO, climate change & disasters

Prof. Petteri Taalas
Secretary-General



WMO OMM

World Meteorological Organization
Organisation météorologique mondiale

WEATHER CLIMATE WATER
TEMPS CLIMAT EAU

Petteri Taalas



Secretary General of the WMO 2016-19, 2020-23

- Historical reform, enhanced efficiency: Integrated Earth observations, multihazard services
- Engagement of private sector & academic sector, development & UN partnerships

Director at the WMO Development & Regional Activities 2005-7

Director General of the Finnish Meteorological Institute 2002-15, 700 staff, ~80 M€/year

- Doubling of external funding, tripling of scientific publications
- Very high customer & staff satisfaction, best public sector organization in Finland
- Modern weather, marine & climate services and atmospheric science

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

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

- Effective management of Council meetings, New polar satellite programme (~1.5 B€)

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

- Merging of two universities & a new semi-private administrative model

Fortum energy company, board member 2014-16, advisory board 2011-, 11000 staff, 6100 M€

- Emphasis on low carbon energy solutions, business in ~10 countries

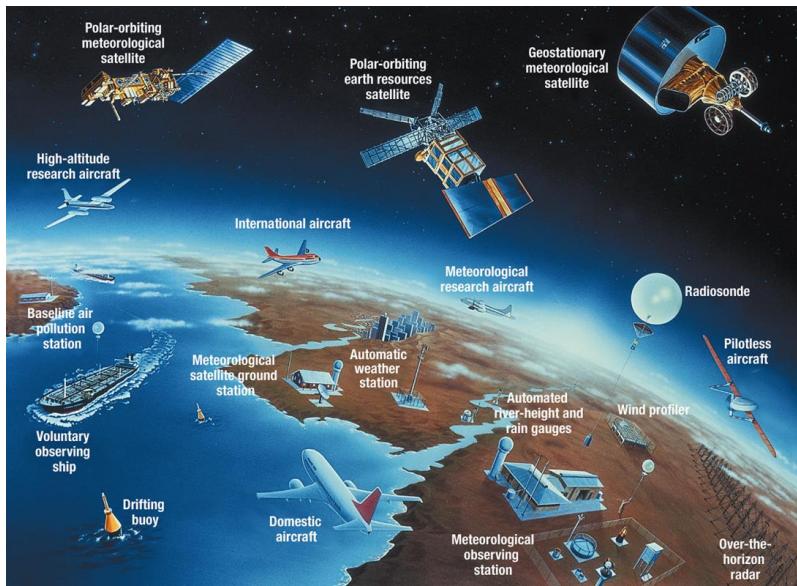
PhD & MSc Helsinki Univ/meteorology, management training Uni. Pierre & Marie Curie etc.

Military service at Naval Academy, reserve captain

English, Finnish, Swedish, German, French, Russian



World Meteorological Organization



- UN Specialized Agency on weather, climate & water
- 193 Members, HQ in Geneva
- 2nd oldest UN Agency, 1873-
- Coordinates work of > 300 000 national experts from meteorological & hydrological services, academia & private sector
- Co-Founder and host agency of IPCC (1st World Climate Conference)
- WMO SG UNSG Guterres' Climate Core Group Member (1/4)

WMO Mission/key activities

1. World climate observation & research
2. Weather, climate and hydrological services
3. Earth System observations coordination & technology standardization
4. Strengthening of the national service capabilities
5. Efficient governance



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WMO Reforms 2019-21

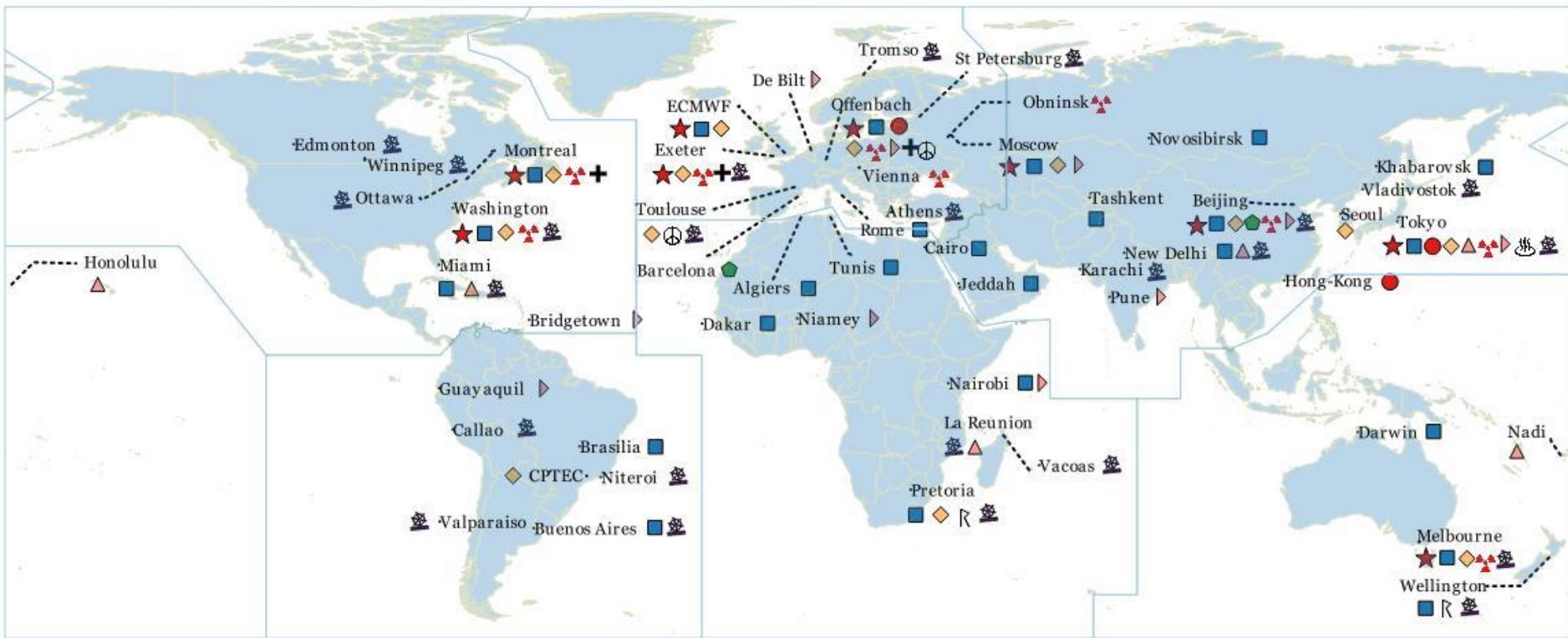
1. **Rationalization of technical commissions**, from 8 silos to 2 holistic
 - Earth System Infrastructures (weather, climate, water & oceans)
 - Services (weather, climate, hydrology, marine, transport, energy, health)
2. Wider **engagement of private & academic sector**
 - Scientific Advisory Panel & Research Board
 - Public-private engagement office
3. **Secretariat Reforms**
 - Alignment of the Secretariat structures with the new constituent bodies
 - Selection of new directors through a competitive process
 - Modernization of staff structure through early retirement, voluntary separation and competitive processes
 - Reallocation of resources to hire (young) experts to regional, technical and scientific activities
4. Communication of **climate science**: annual State of Climate & United in Science reports
5. **Less and more action oriented meetings** with shorter & more strategic documents
6. Active **partnerships**: UNSG (Climate), UNFCCC (Climate), FAO & WFP (Food security), UNESCO (Oceans, hydrology), ICAO (Aviation services), IMO (Marine Services), UNEP (Climate) & WHO (Air pollution)
7. Record amount of **external resources for capacity development**: ~130 MCHF portfolio
8. **Management training programme** 2021- to enhance the leadership skills and efficiency
9. **Regional activity reform** 2021-22 to enhance the impact of WMO activities at regional/national level



WMO Global forecasting & climate centres

WMO Designated Global Data-processing and Forecasting System Centres

Updated on 24 August 2018



Legend

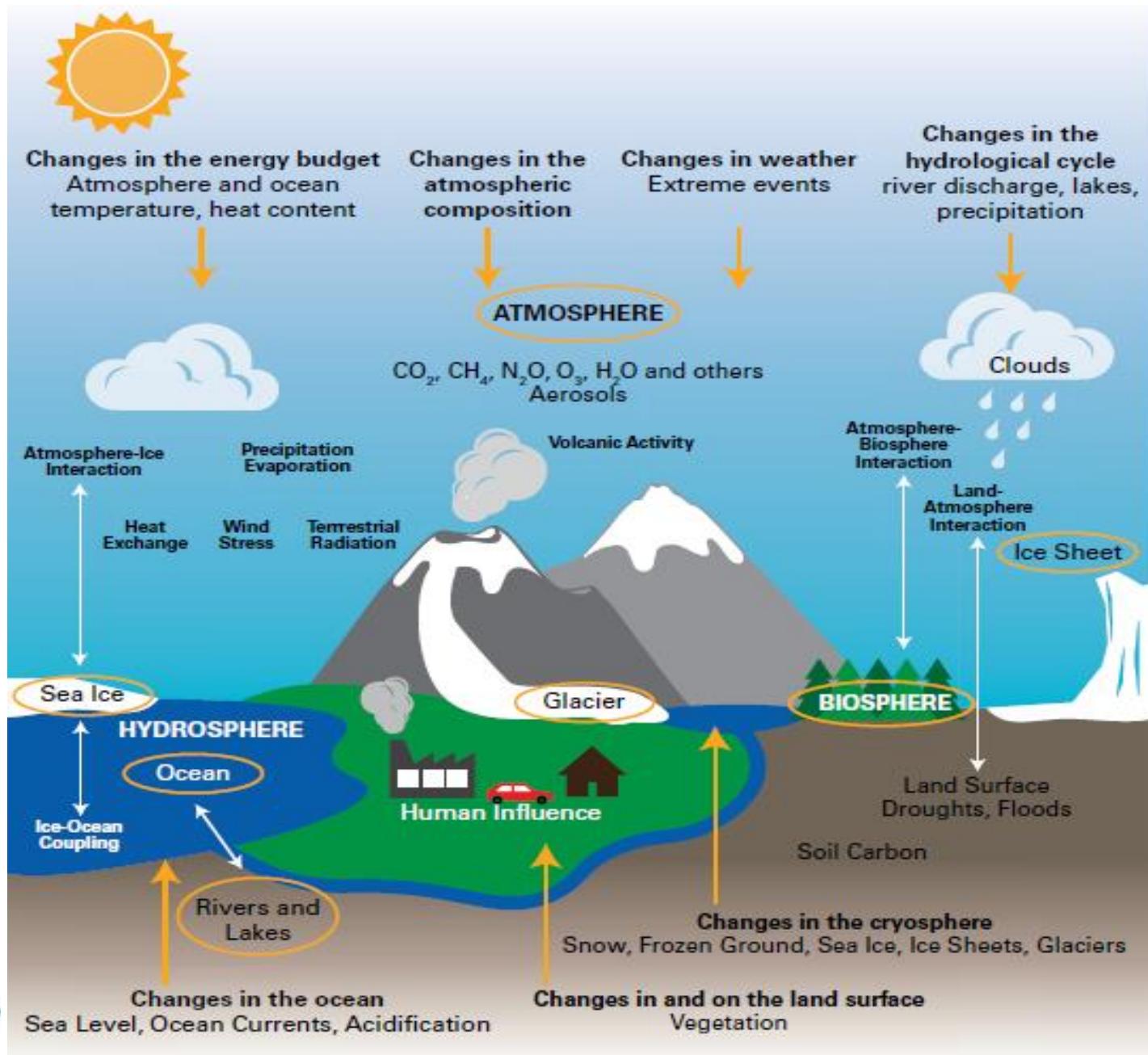
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|---|--|---|
| ★ World Meteorological Centres* (9) | ● RSMC Nowcasting (3) | ◎ RSMCs Non-Nuclear Emergency Response (2) |
| ● Atmospheric Transport Modelling (10) | ▲ RSMCs TC (6) | ● RSMCs Volcano watch services for international air navigation (1) |
| ◆ Global Producing Centres for Long-Range Forecasts (13) | ◆ RSMCs Sand/Dust (2) | ■ RSMCs Severe Weather Forecasting (2) |
| + Global Producing Centres for Annual to Decadal Climate Prediction (3) | ► Regional Climate Centres (11) | ■ RSMCs marine meteorological services (24) |
| ■ RSMCs Geographic (25) | ◆ RSMCs Nuclear Emergency Response (9) | |

* World Meteorological Centres are also Global Producing Centres for a) Deterministic Numerical Weather Prediction, b) Ensemble Numerical Weather Prediction, and c) Long-Range Forecasts.

DESIGNATIONS USED

The depiction and use of boundaries, geographic names and related data shown on maps and included in lists, tables, documents, and databases on this web site are not warranted to be error free nor do they necessarily imply official endorsement or acceptance by the WMO.

The climate system

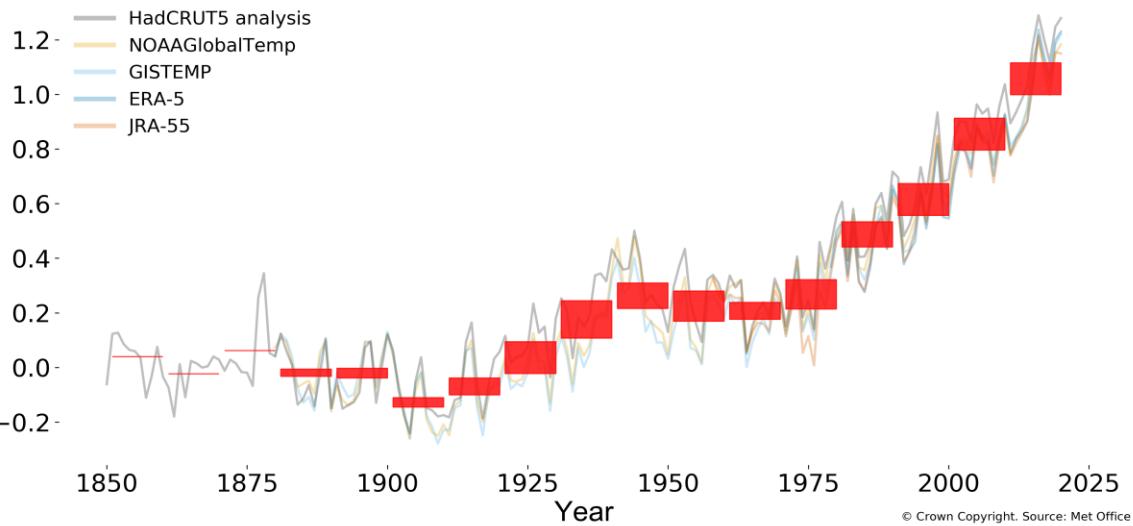


WMO

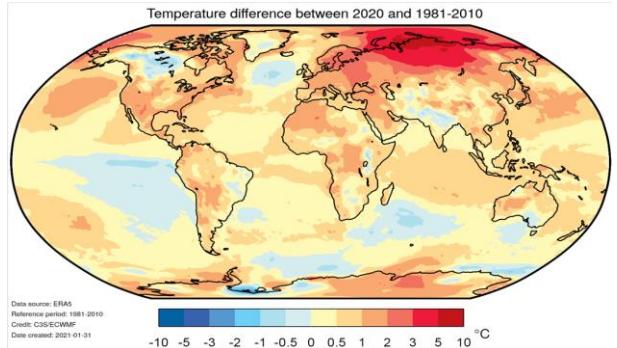
Temperature & CO₂ -> 2020



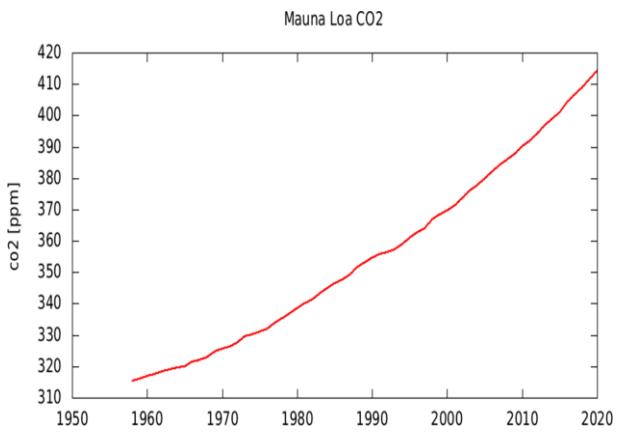
Global mean temperature difference from 1850-1900 (° C)



2011-2020 is the warmest decade on record



2020 was extremely warm over the Arctic

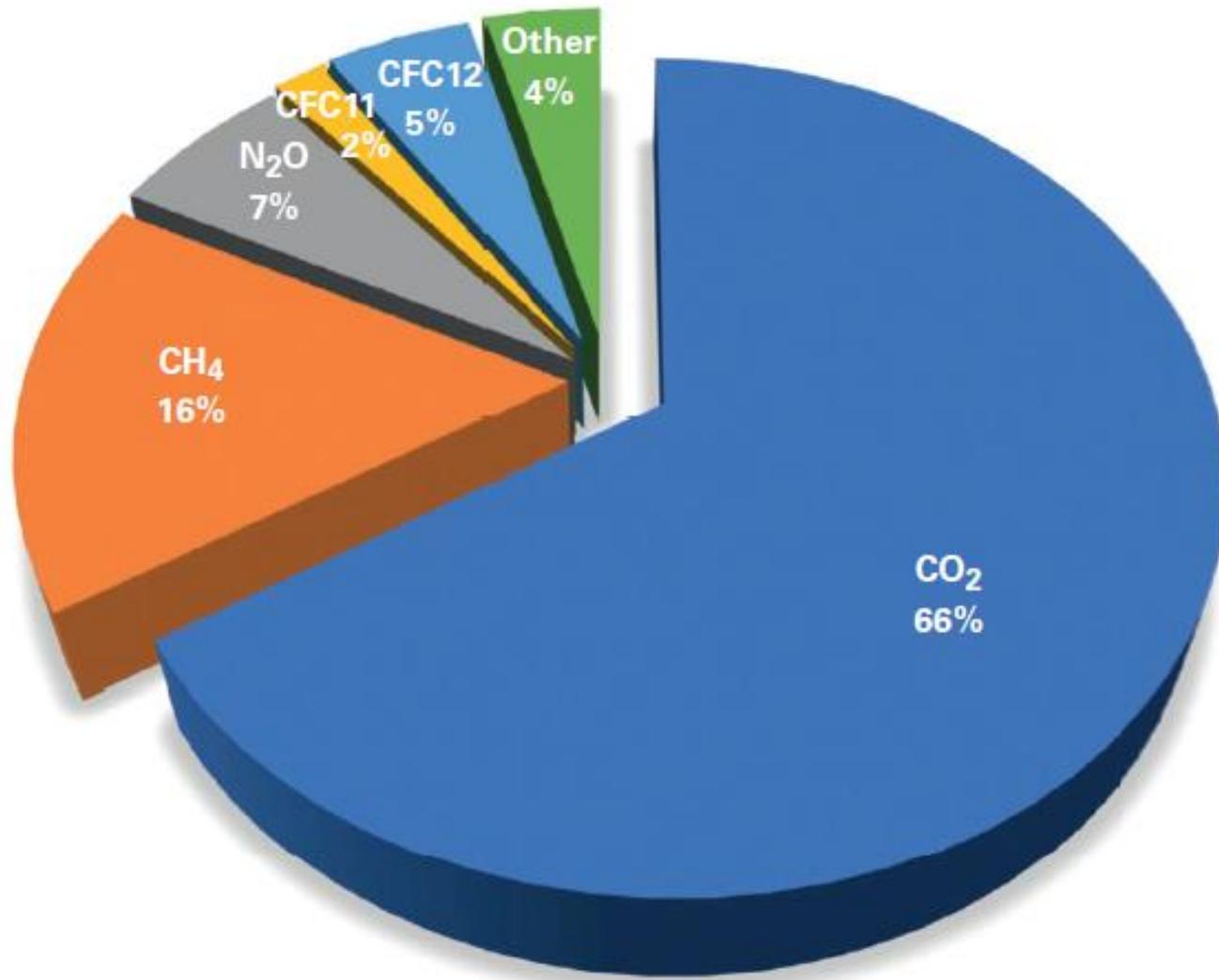


Concentrations of the major greenhouse gases increased



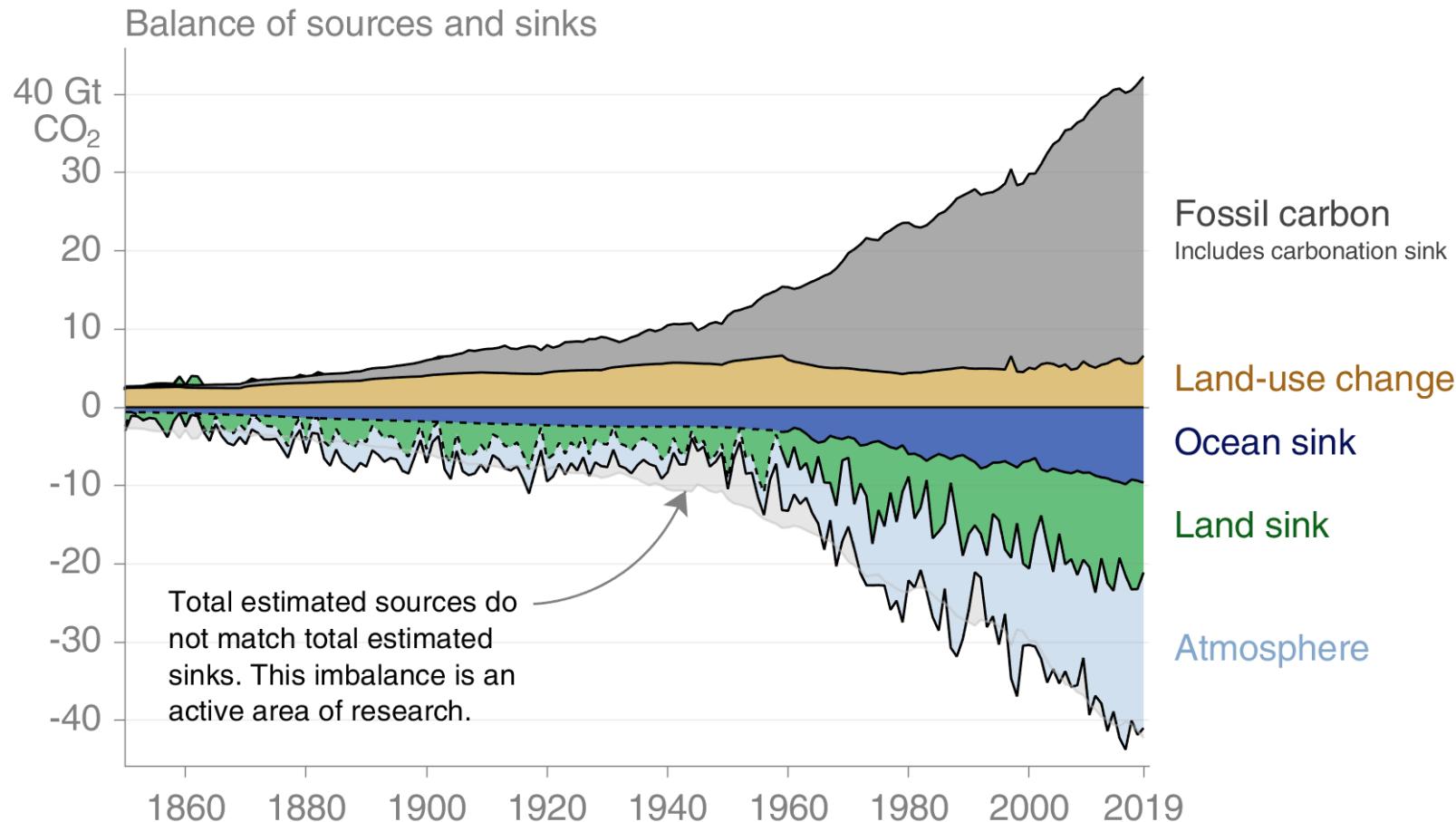
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Warming impact of greenhouse gases



Global carbon budget

Carbon emissions are partitioned among the atmosphere and carbon sinks on land and in the ocean
The “imbalance” between total emissions and total sinks is an active area of research



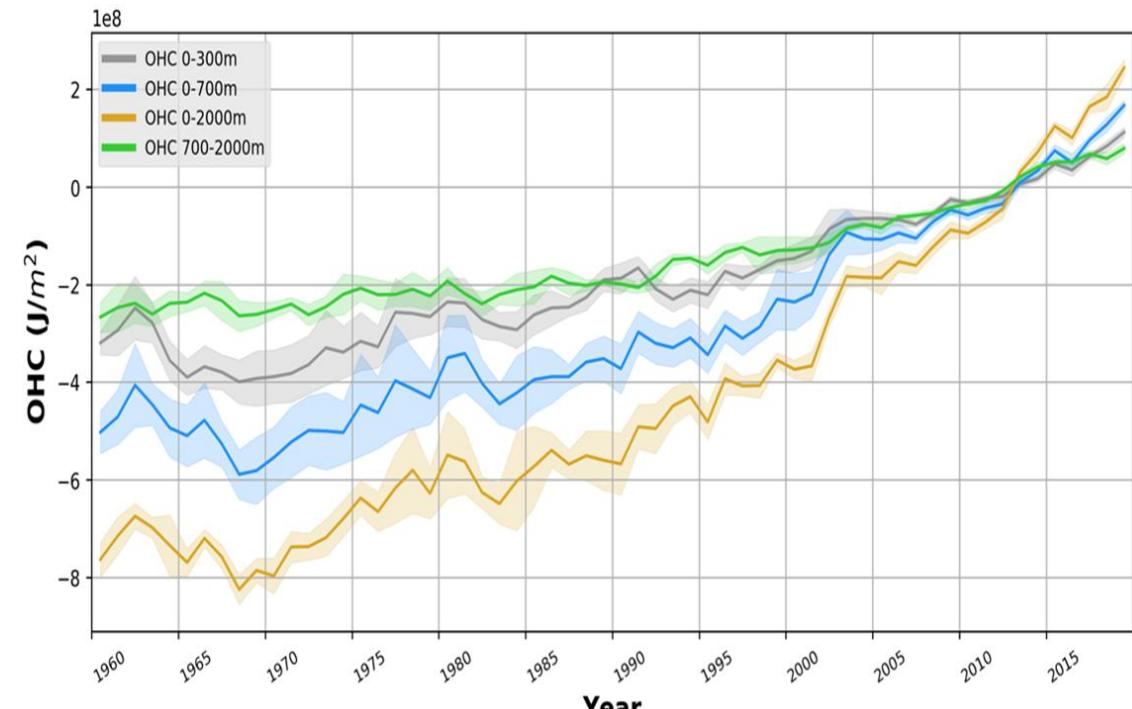
© Global Carbon Project • Data: GCP/CDIAC/NOAA-ESRL/UNFCCC



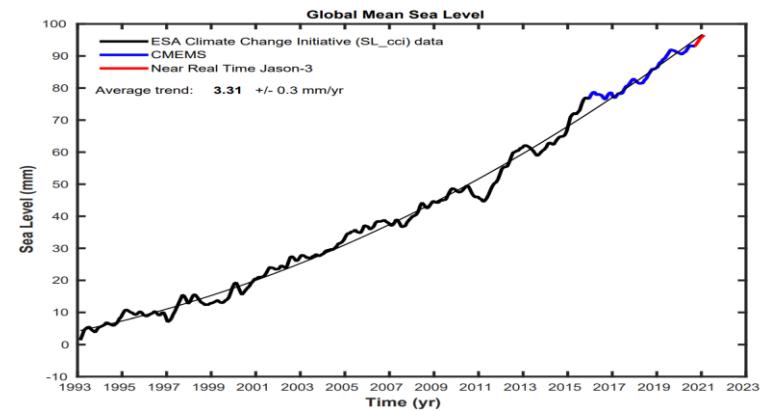
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Source: [Friedlingstein et al 2020; Global Carbon Budget 2020](#)

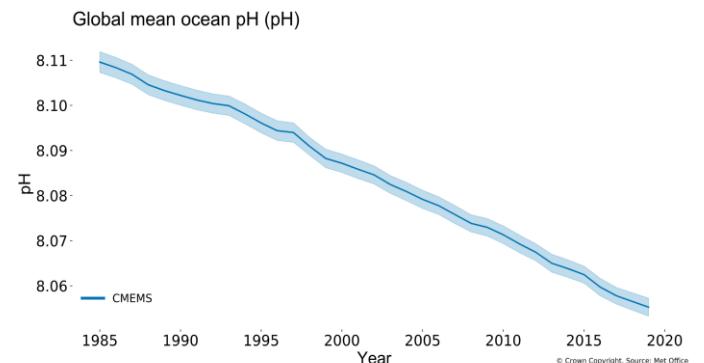
Ocean heat, sea level & pH



Record high ocean heat, at various depths



The rate of sea-level rise is increasing

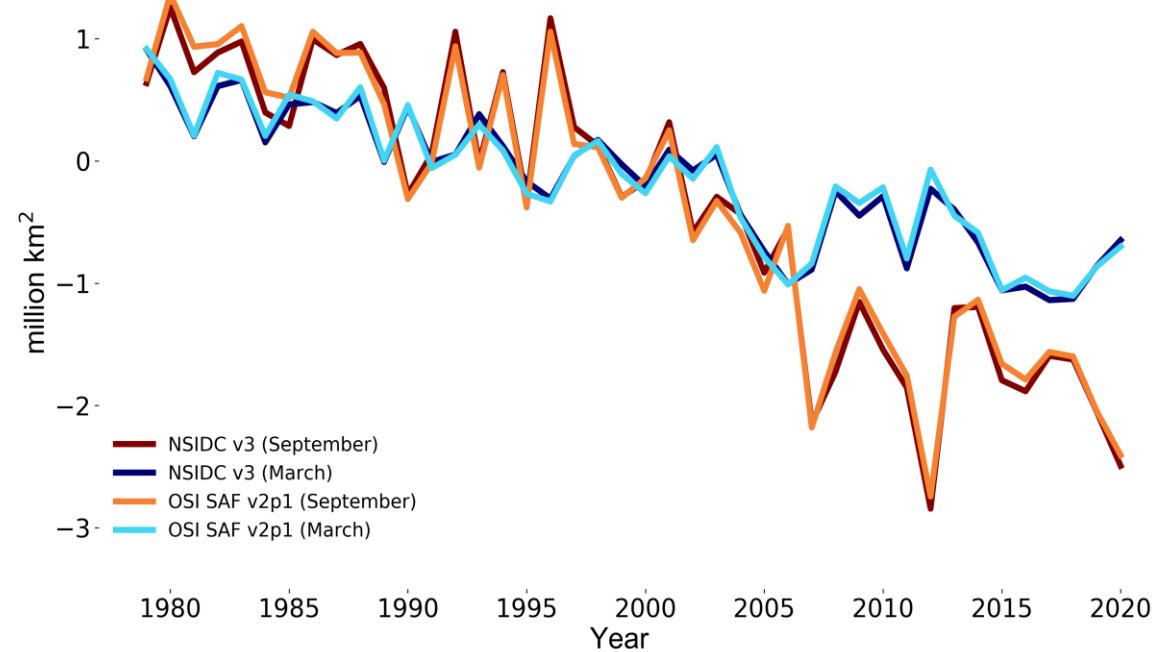


Ocean acidification is increasing

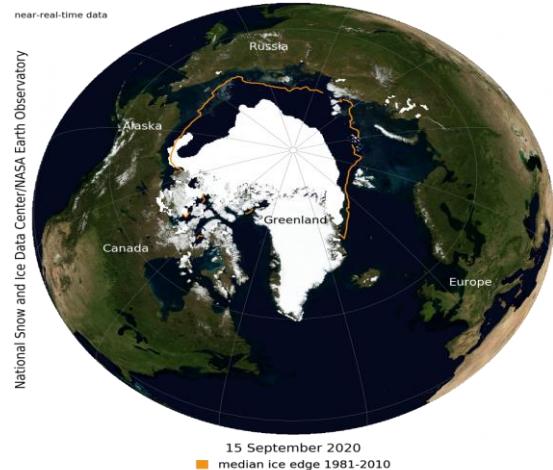


Cryosphere

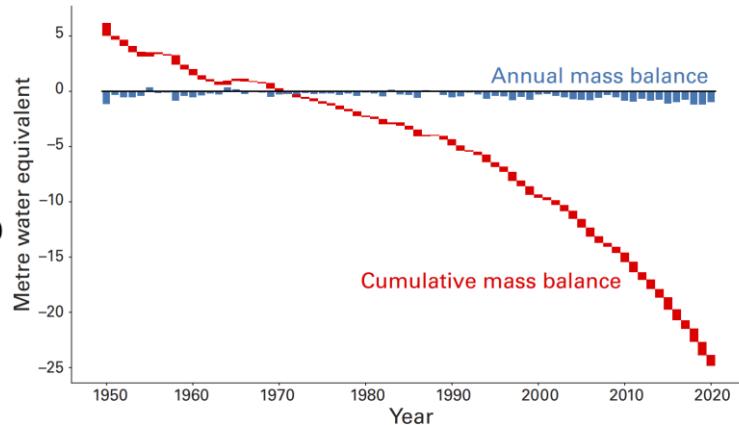
Arctic sea-ice extent difference from 1981-2010 average



Arctic sea-ice extent has declined in all months



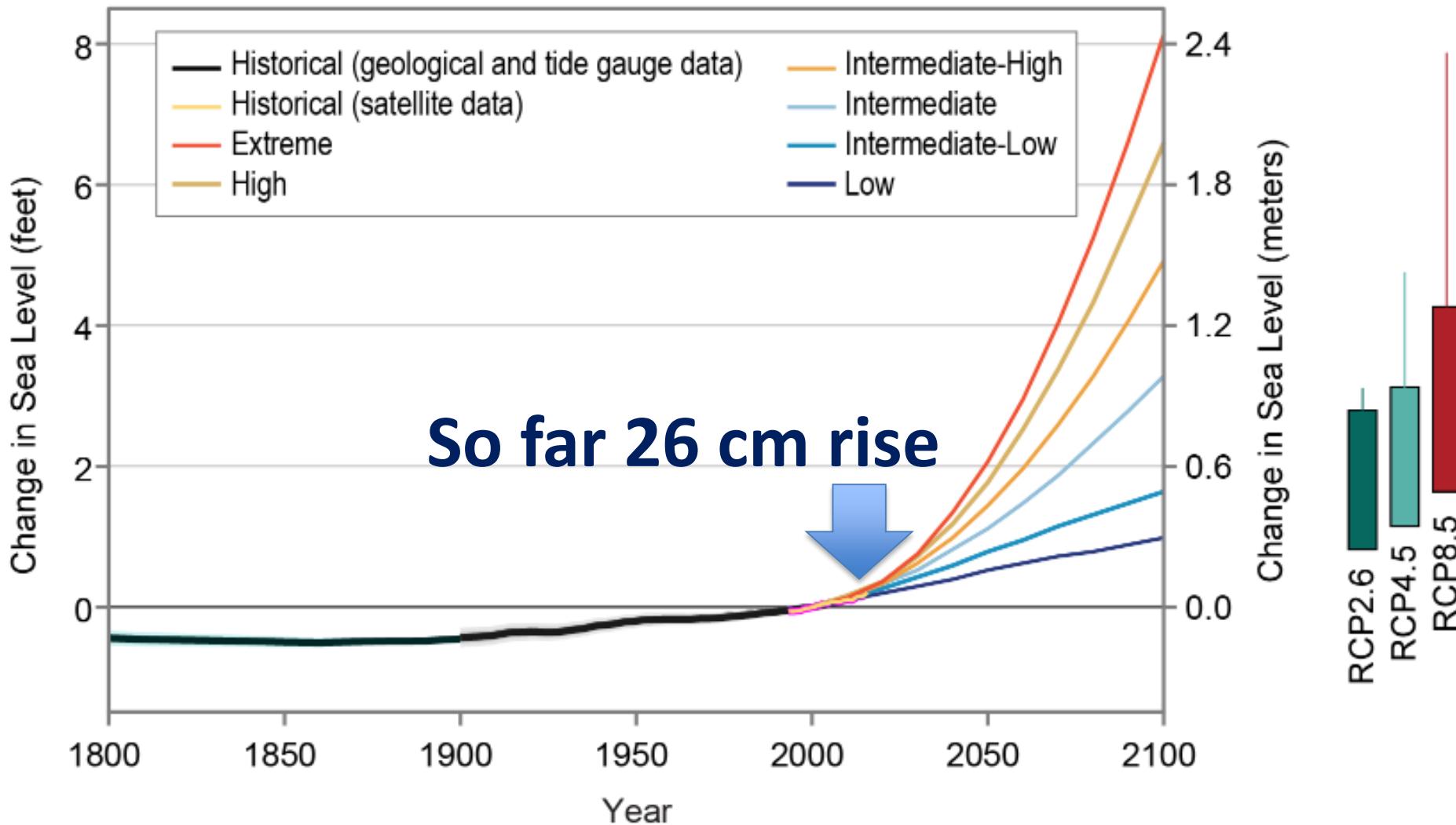
Vast areas of open ocean were observed in the Arctic



Glaciers, Greenland and Antarctica are losing ice

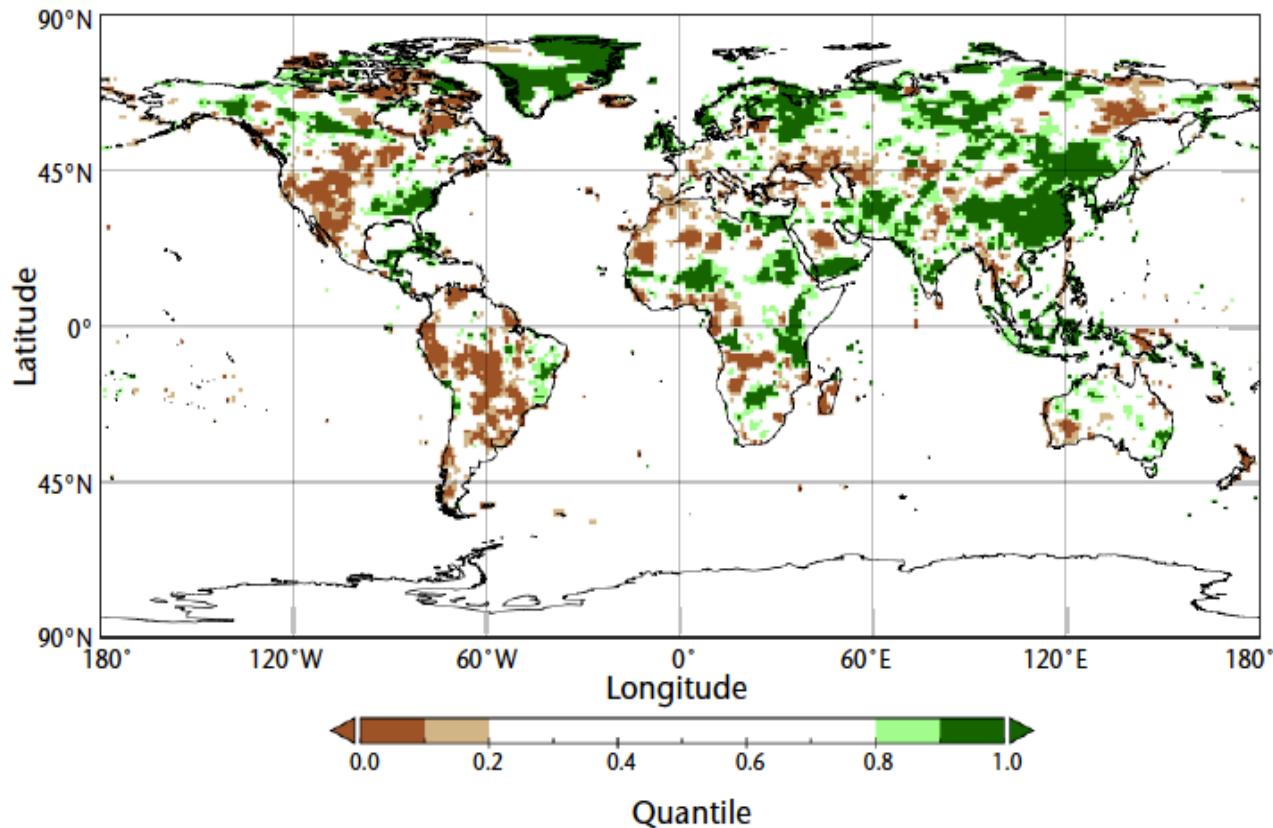


Emissions-sea level rise 1800-2100

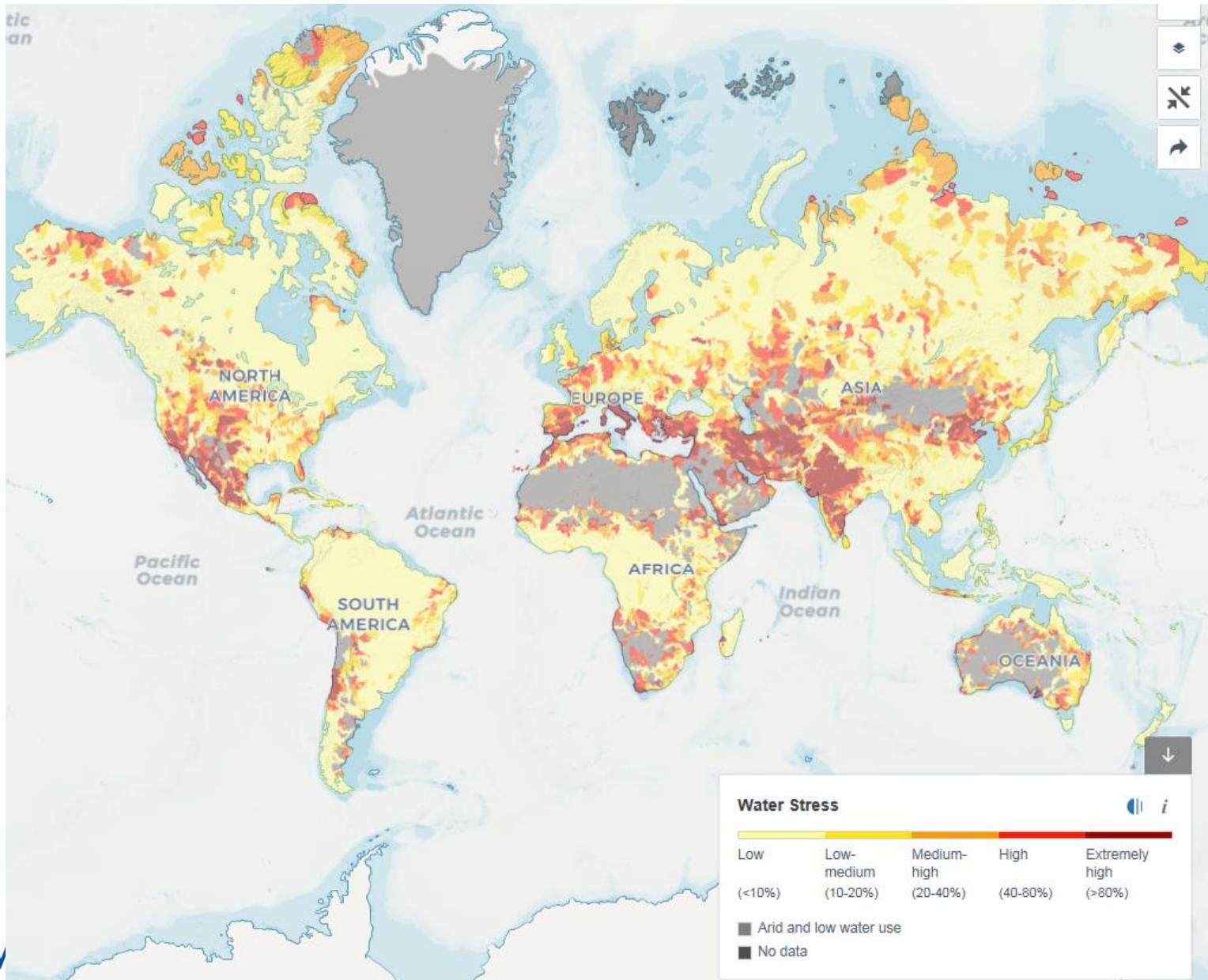


Drought, heat, floods, cyclones and wildfires impacted countries around the globe 2020

- Drought affected USA, Argentina, Paraguay, and parts of Brazil
- Extreme heat: 38.0 °C Arctic circle, 54.4 °C Death Valley, 48.9 °C Sydney, and 51.8 °C in Baghdad
- Extreme flooding in China and East Africa, and record active Atlantic Hurricane Season
- Largest fires on record for California and Colorado. Many fires in Pantanal wetlands of Brazil

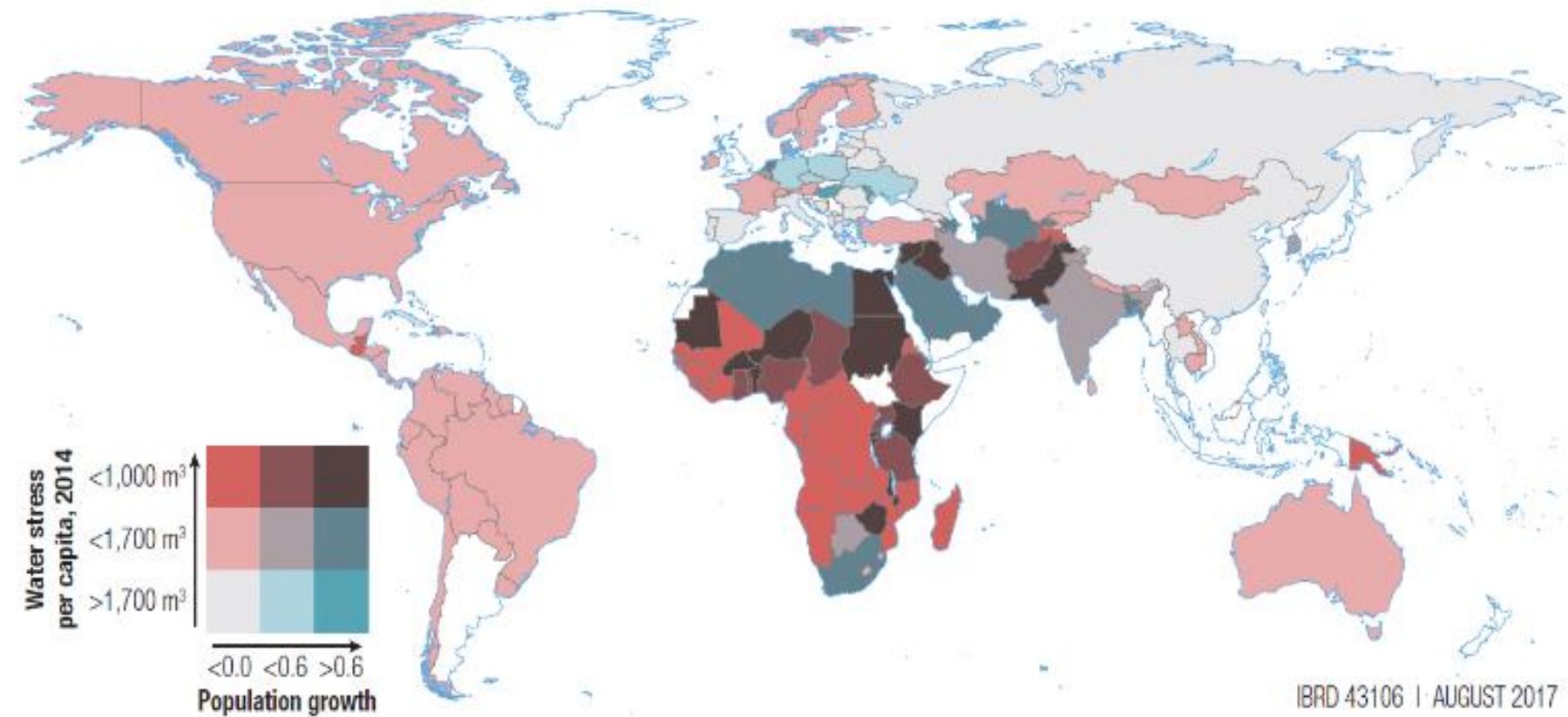


Water stress is a global challenge



Source WRI

Water availability & population growth 2050



IBRD 43106 | AUGUST 2017

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

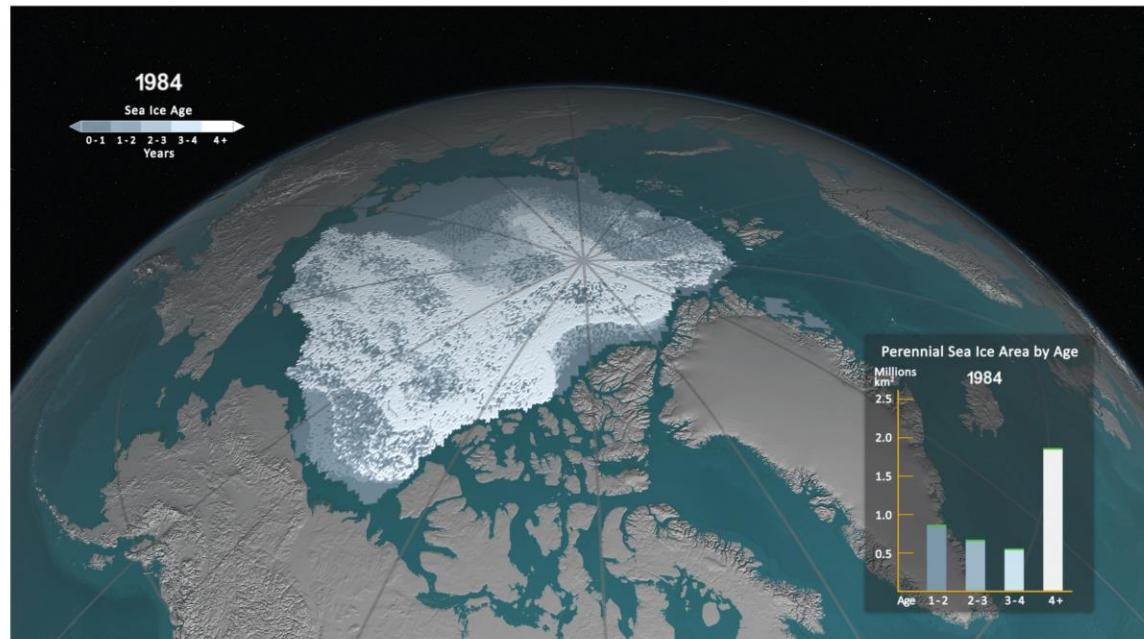


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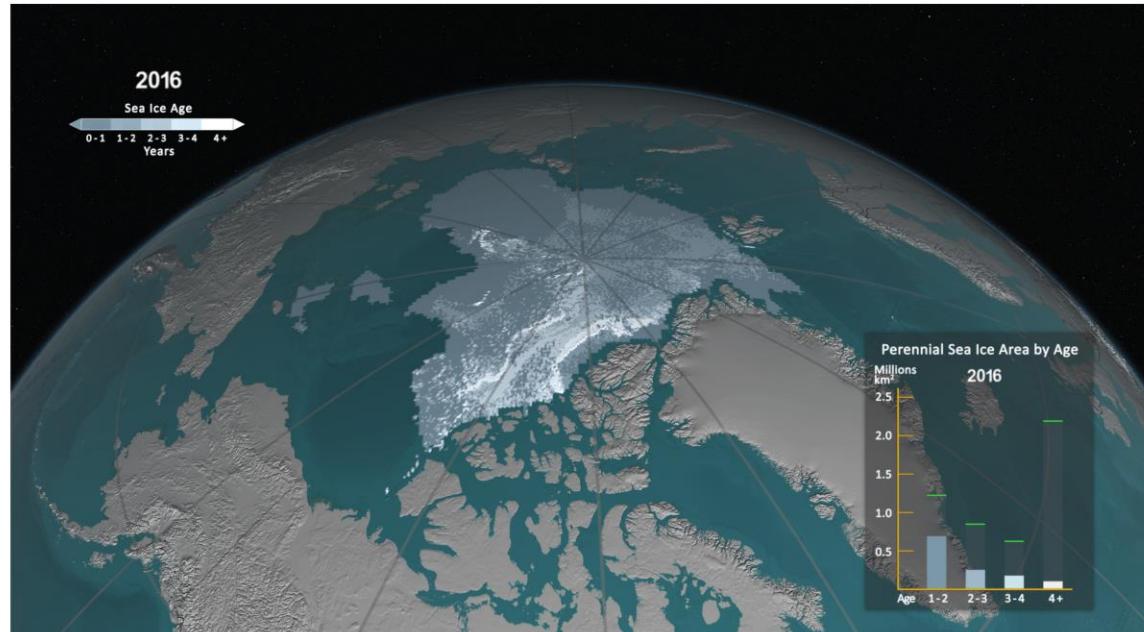
Largest changes in the Arctic

Multi-year ice

1984

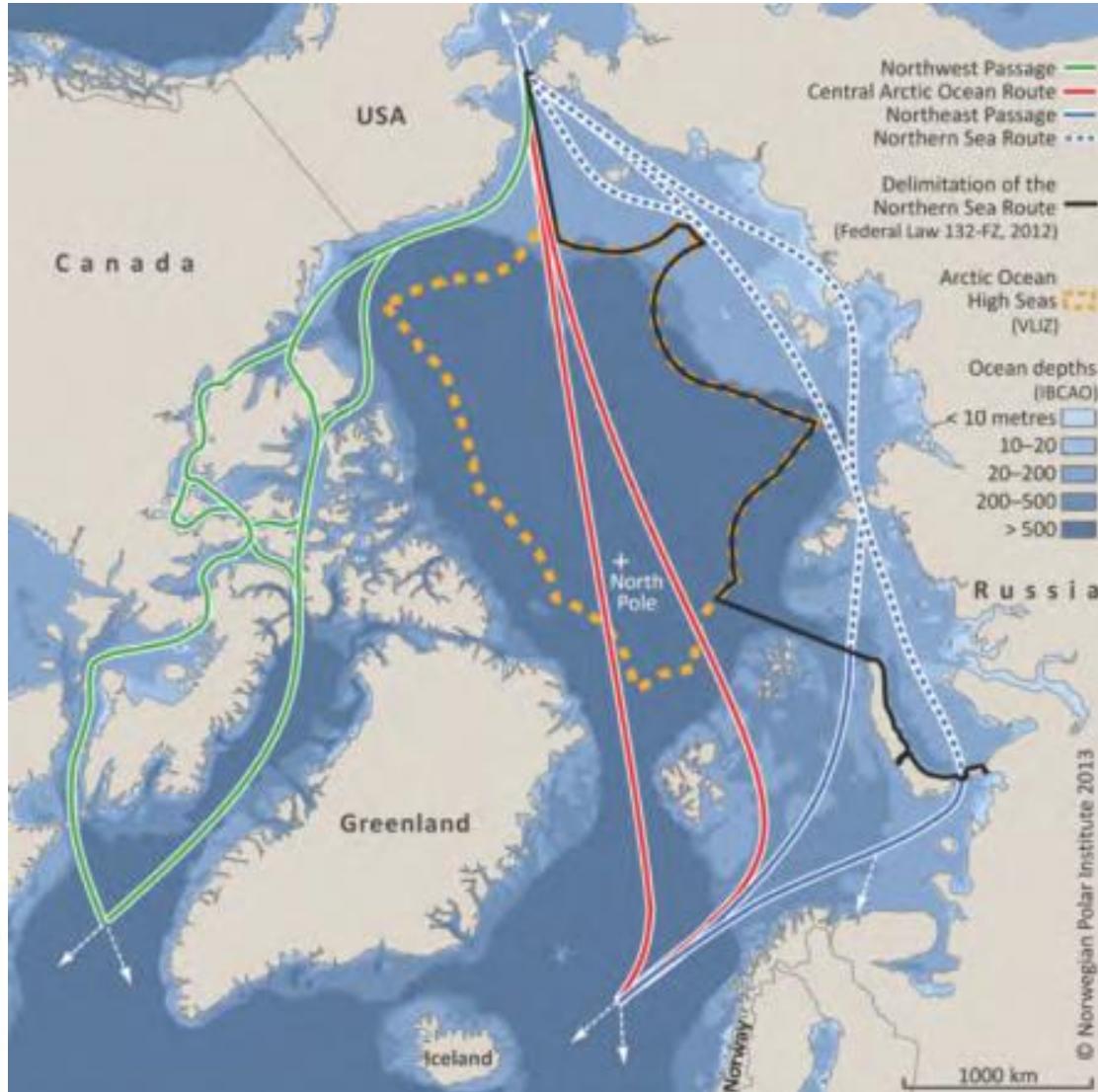


2016



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The Northern sea routes



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Biggest risks for World's economy 2021 by WEF

Top Risks

by likelihood

- 1 Extreme weather
- 2 Climate action failure
- 3 Human environmental damage
- 4 Infectious diseases
- 5 Biodiversity loss
- 6 Digital power concentration
- 7 Digital inequality
- 8 Interstate relations fracture
- 9 Cybersecurity failure
- 10 Livelihood crises

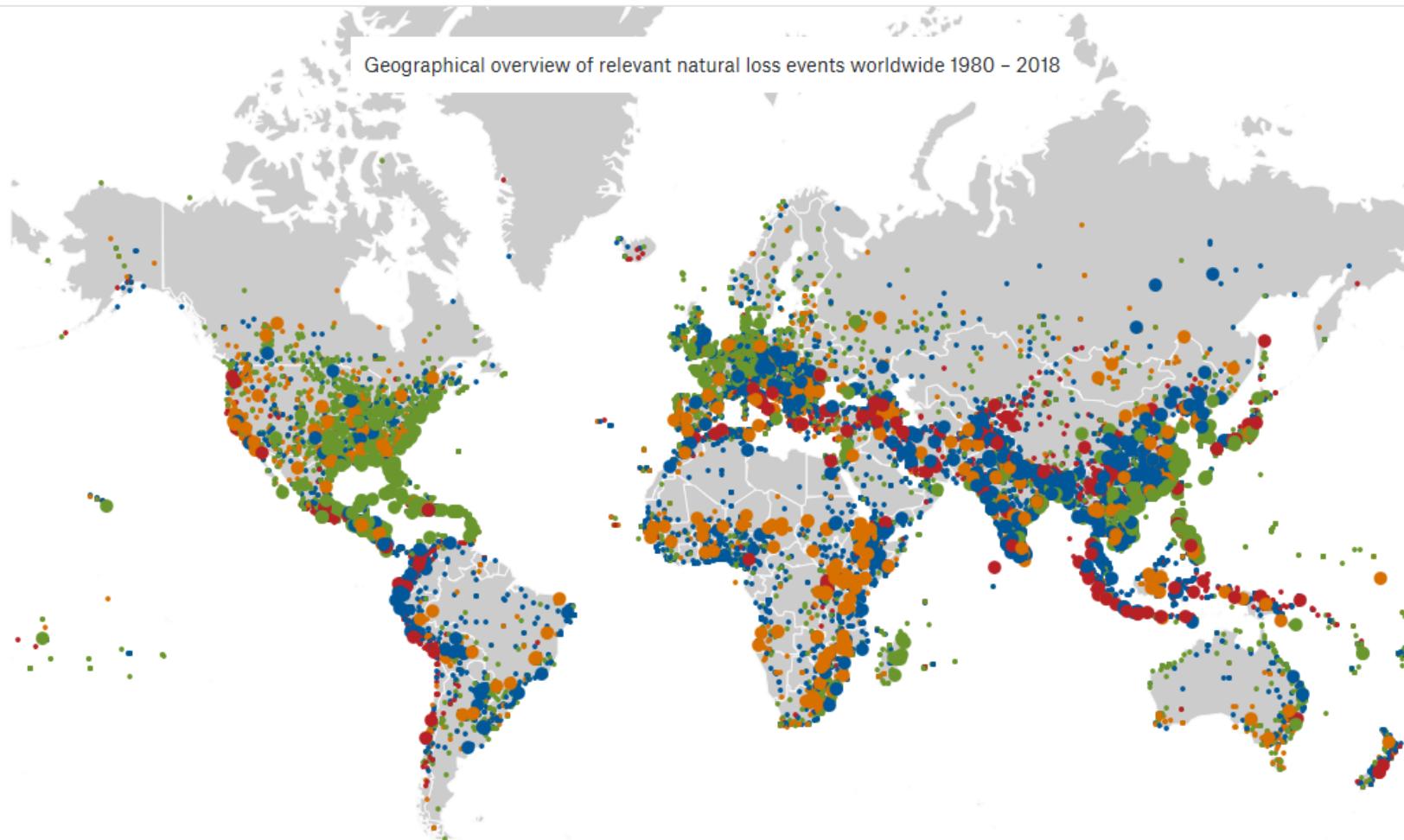
Top Risks

by impact

- 1 Infectious diseases
- 2 Climate action failure
- 3 Weapons of mass destruction
- 4 Biodiversity loss
- 5 Natural resource crises
- 6 Human environmental damage
- 7 Livelihood crises
- 8 Extreme weather
- 9 Debt crises
- 10 IT infrastructure breakdown



Major natural disasters 1980 - 2018



● Earth quakes/
tsunamis

● Storm events

● Flooding events

● Heat wave/drought

Source MunichRE

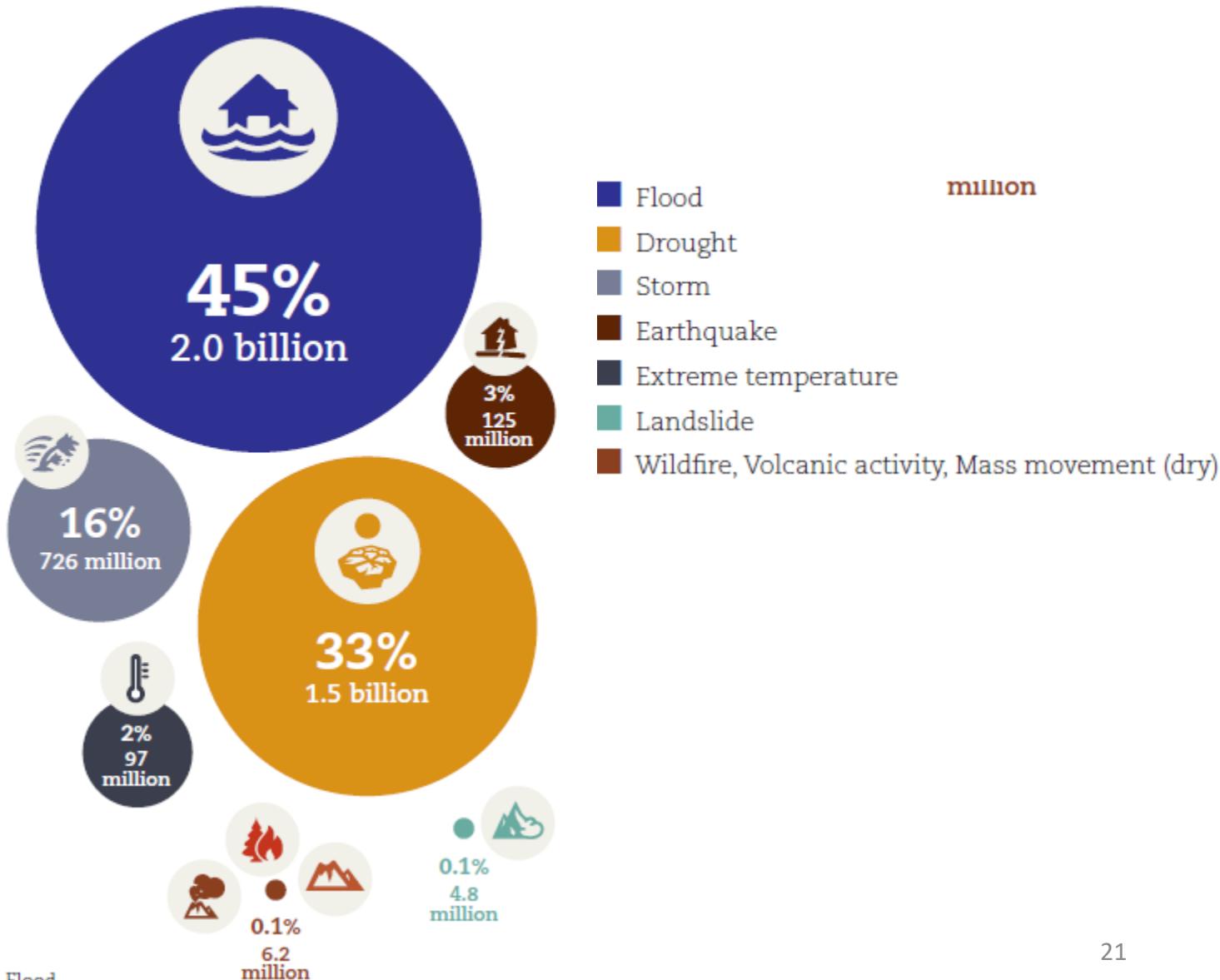
Period Year



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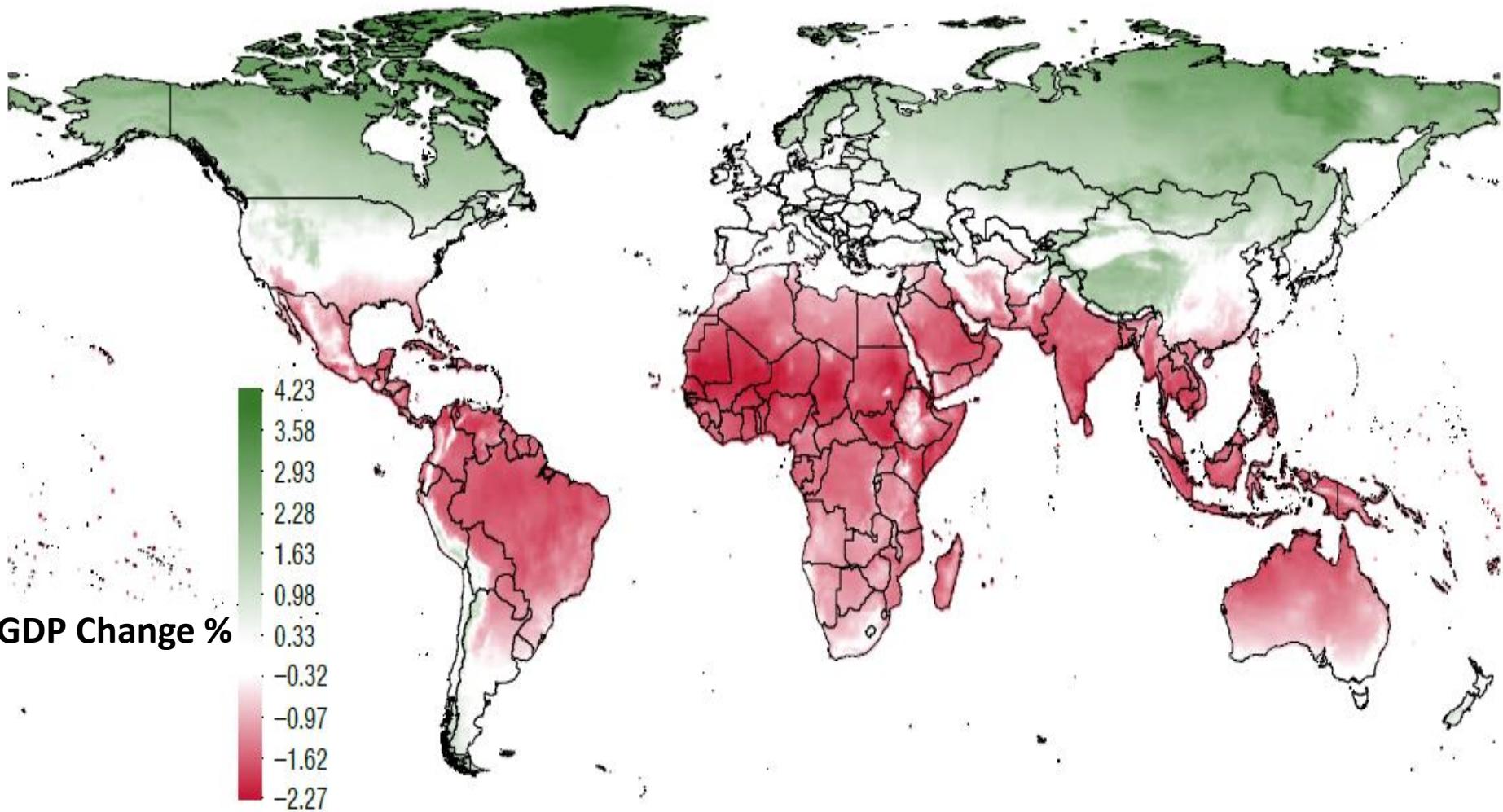
~4.5 billion people affected 1998-2017

96% of disasters weather related



Uneven economic impact of current warming

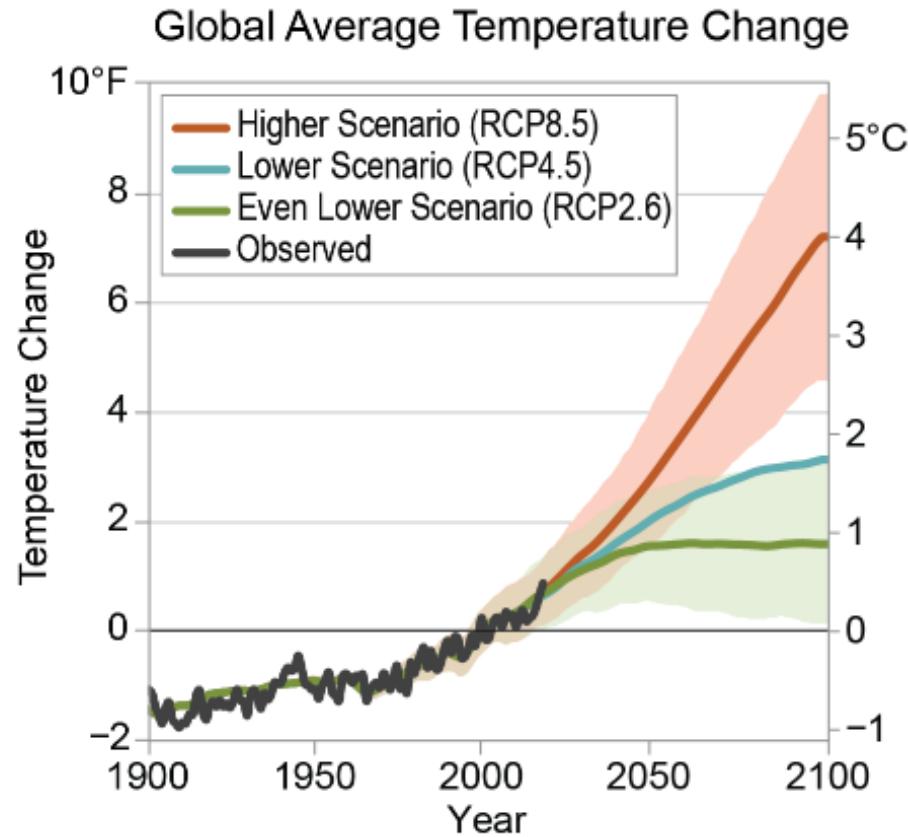
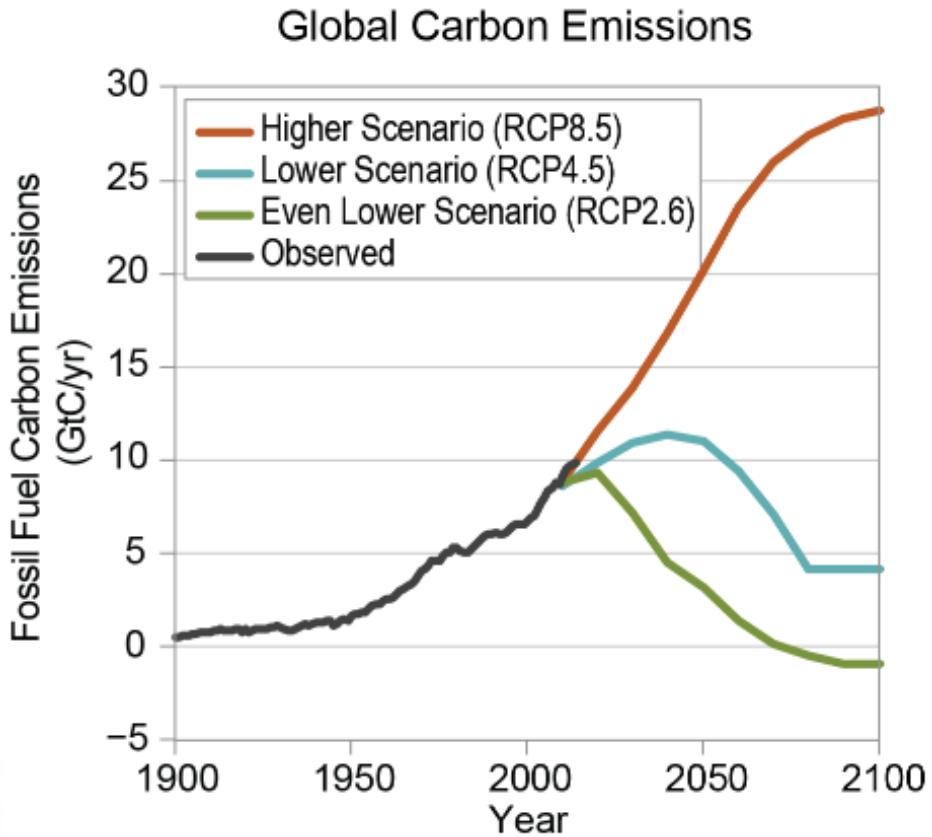
Impact of 1°C temperature increase on per capita output



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Source: International Monetary Fund (IMF) World Economic Outlook

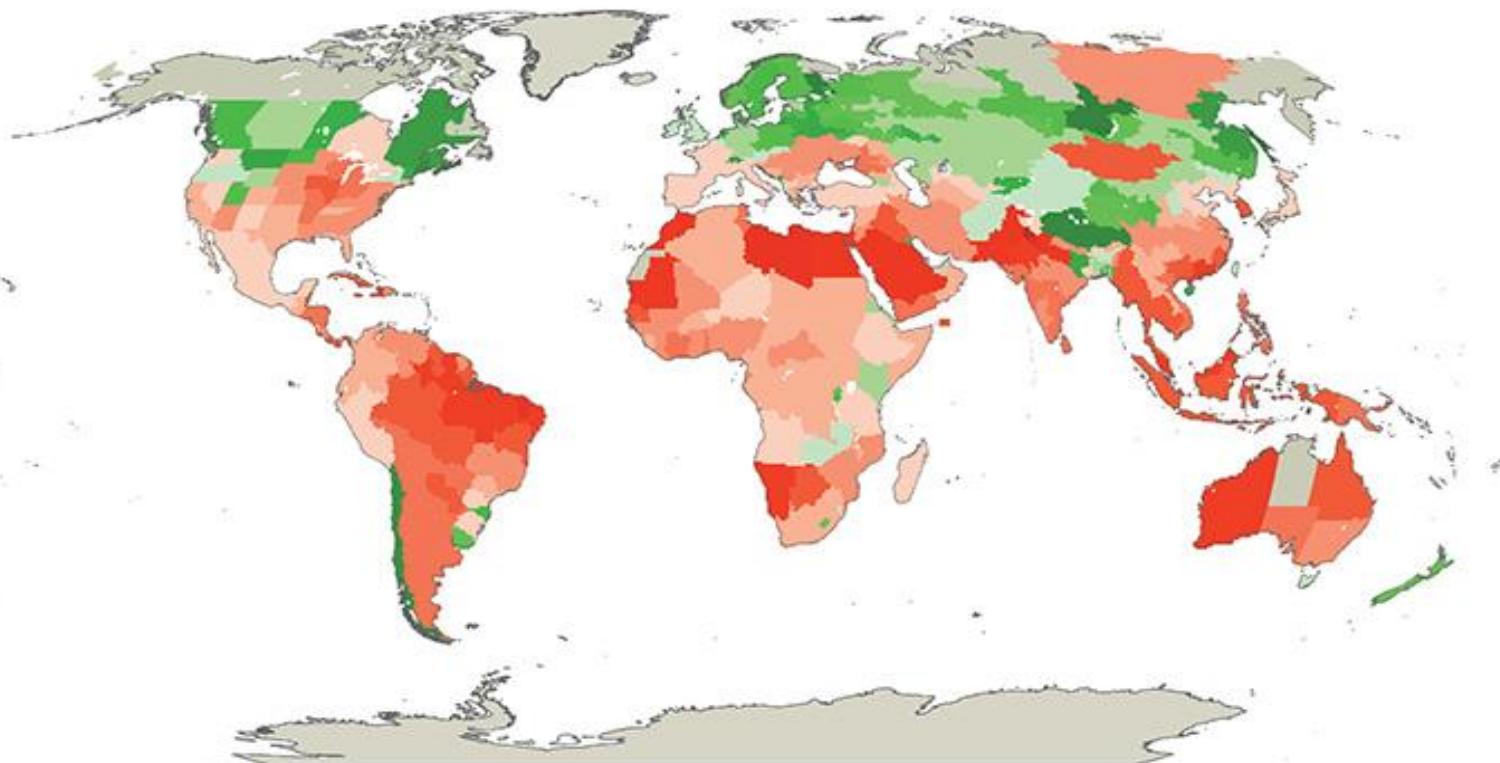
Carbon emissions-temperature



3 C warming is a major risk for food security

Loss of crop yield in most parts of the world

Most studies now project adverse impacts on crop yields due to climate change (3°C warmer world)



Percentage change in yields between present and 2050

-50% Change

+100% Change

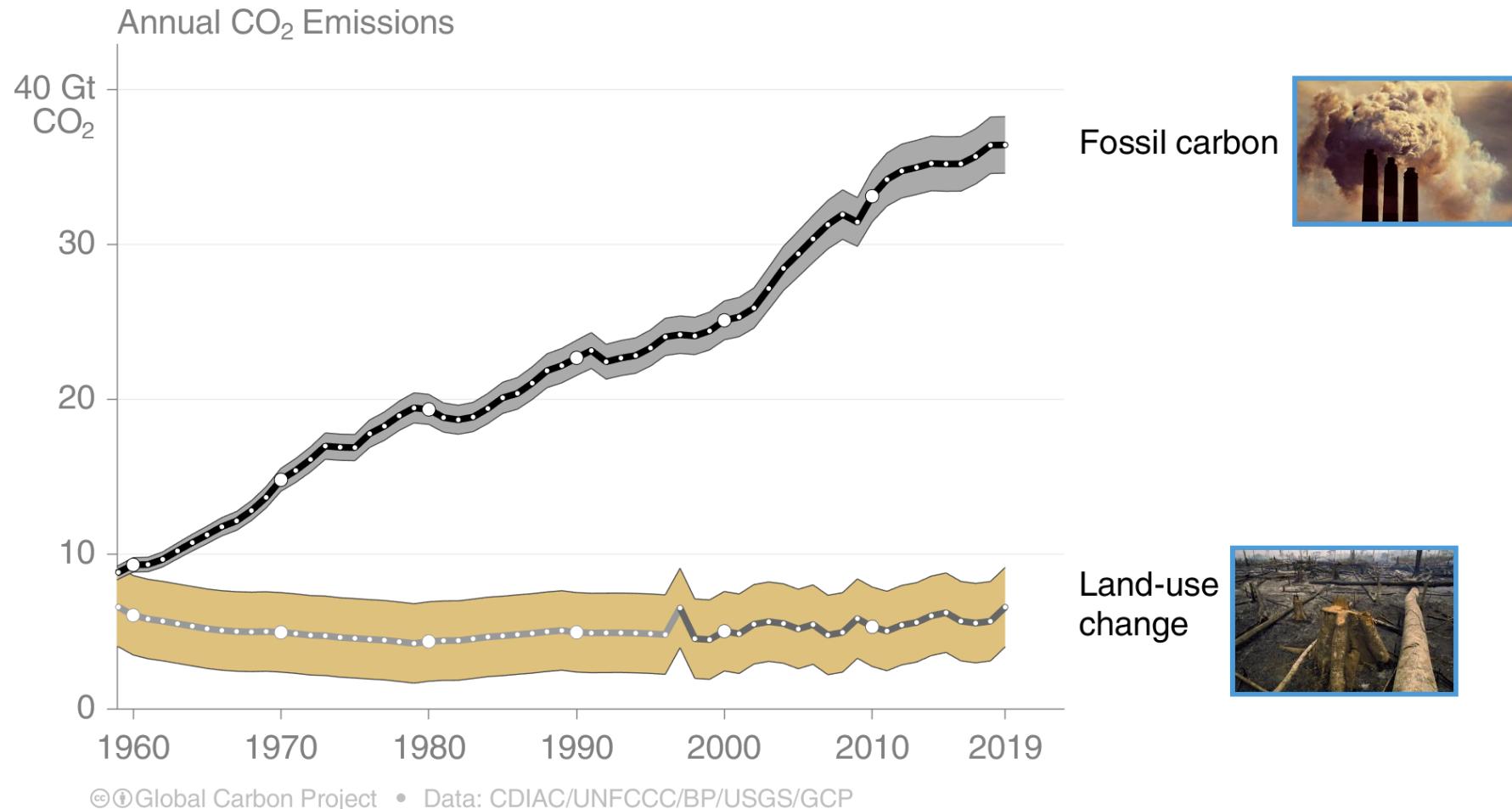


WORLD RESOURCES INSTITUTE

Sources: <http://ow.ly/rpfMN>

Total global emissions

Total global emissions: $43.0 \pm 3.3 \text{ GtCO}_2$ in 2019, 56% over 1990
 Percentage land-use change: 39% in 1960, 14% averaged 2010–2019



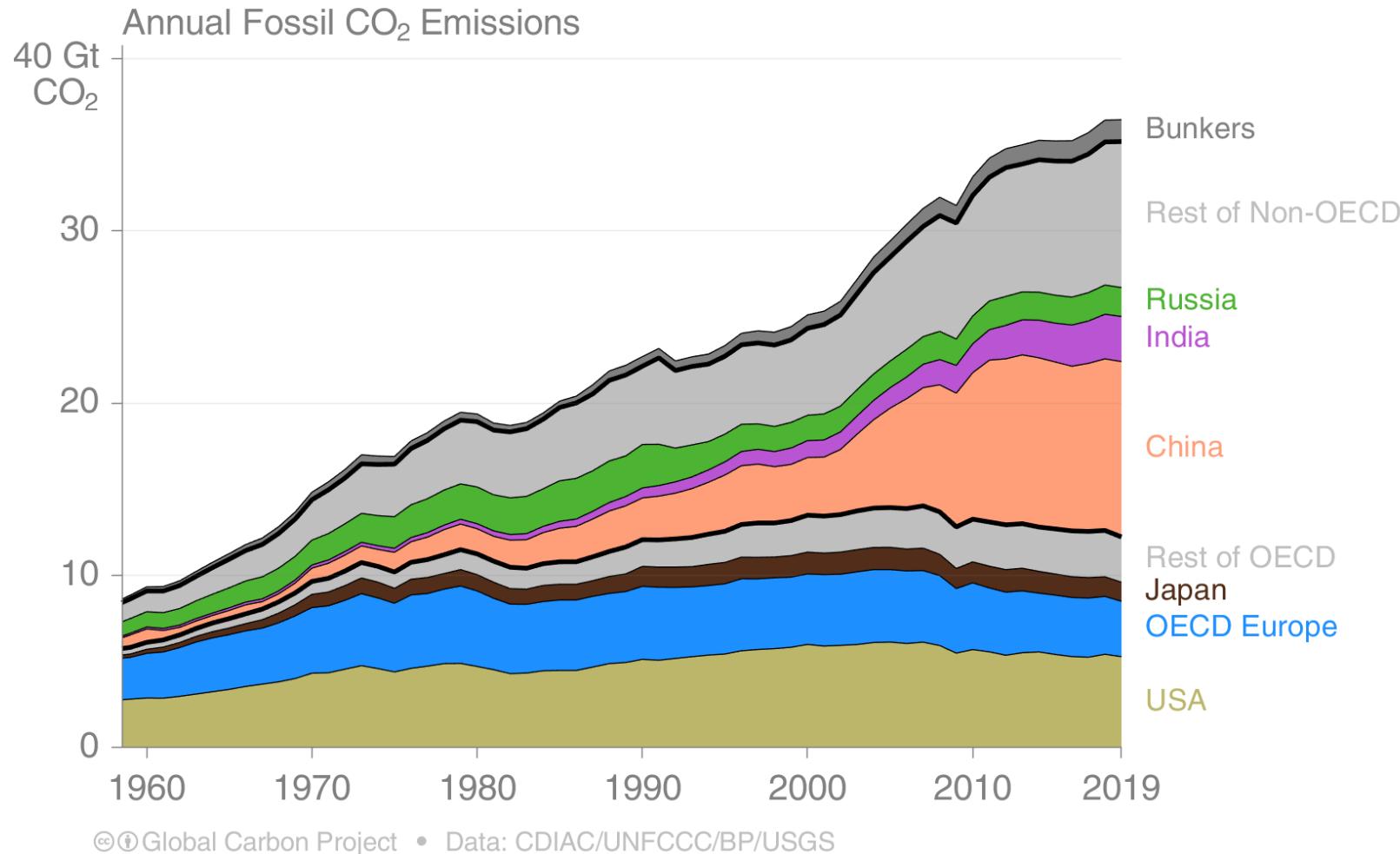
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Land-use change estimates from three bookkeeping models, using fire-based variability from 1997
 Source: CDIAC; Houghton and Nassikas 2017; Hansis et al 2015; Gasser et al 2020; van der Werf et al. 2017;
 Friedlingstein et al 2020; Global Carbon Budget 2020

Global fossil CO₂ emissions by country

Emissions in OECD countries have increased by 1% since 1990, despite declining 13% from their maximum in 2007

Emissions in non-OECD countries have more than doubled since 1990



© Global Carbon Project • Data: CDIAC/UNFCCC/BP/USGS

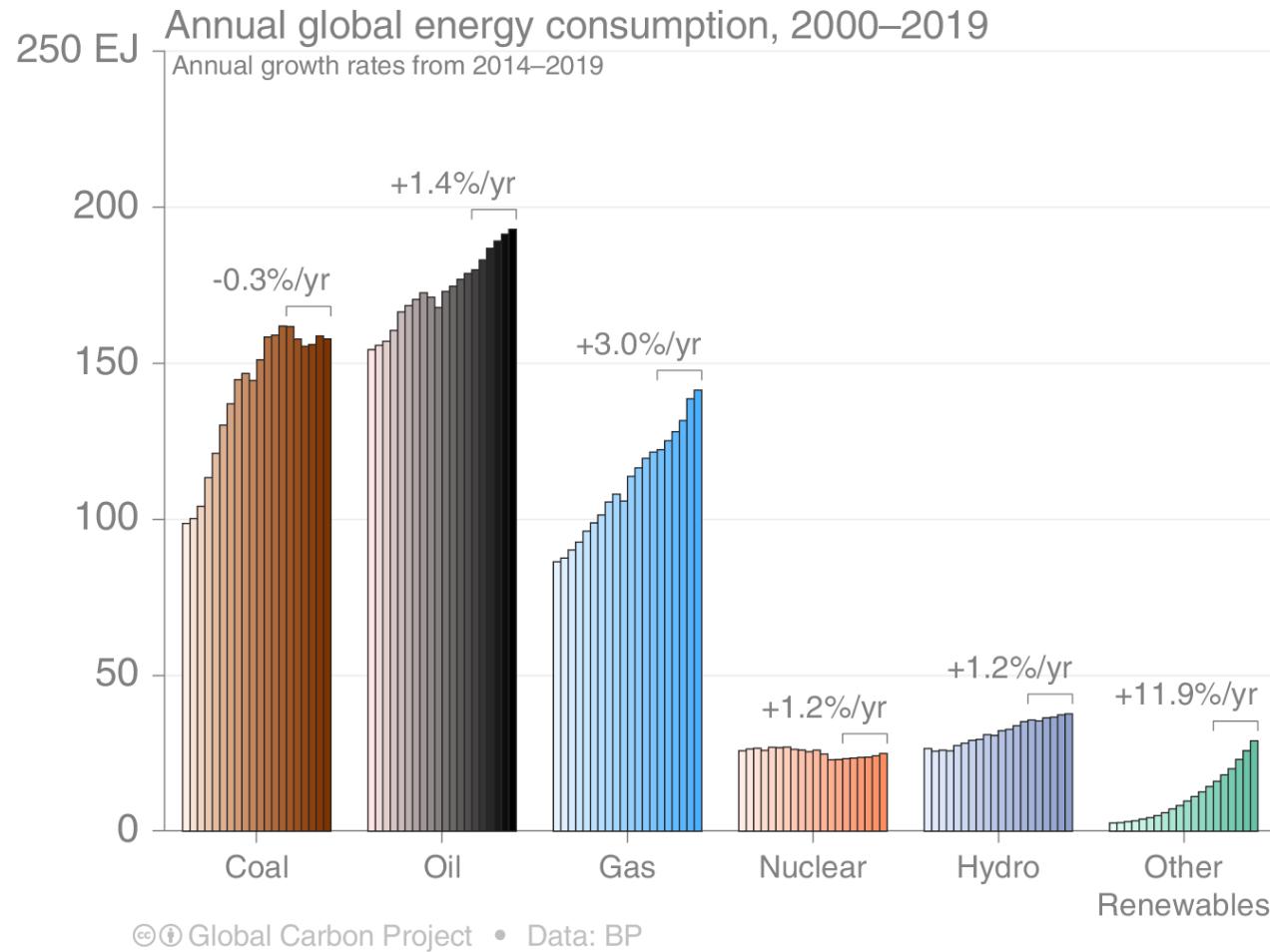


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Source: [CDIAC](#); [Friedlingstein et al 2020](#); [Global Carbon Budget 2020](#)

Fossil/other energy use by source

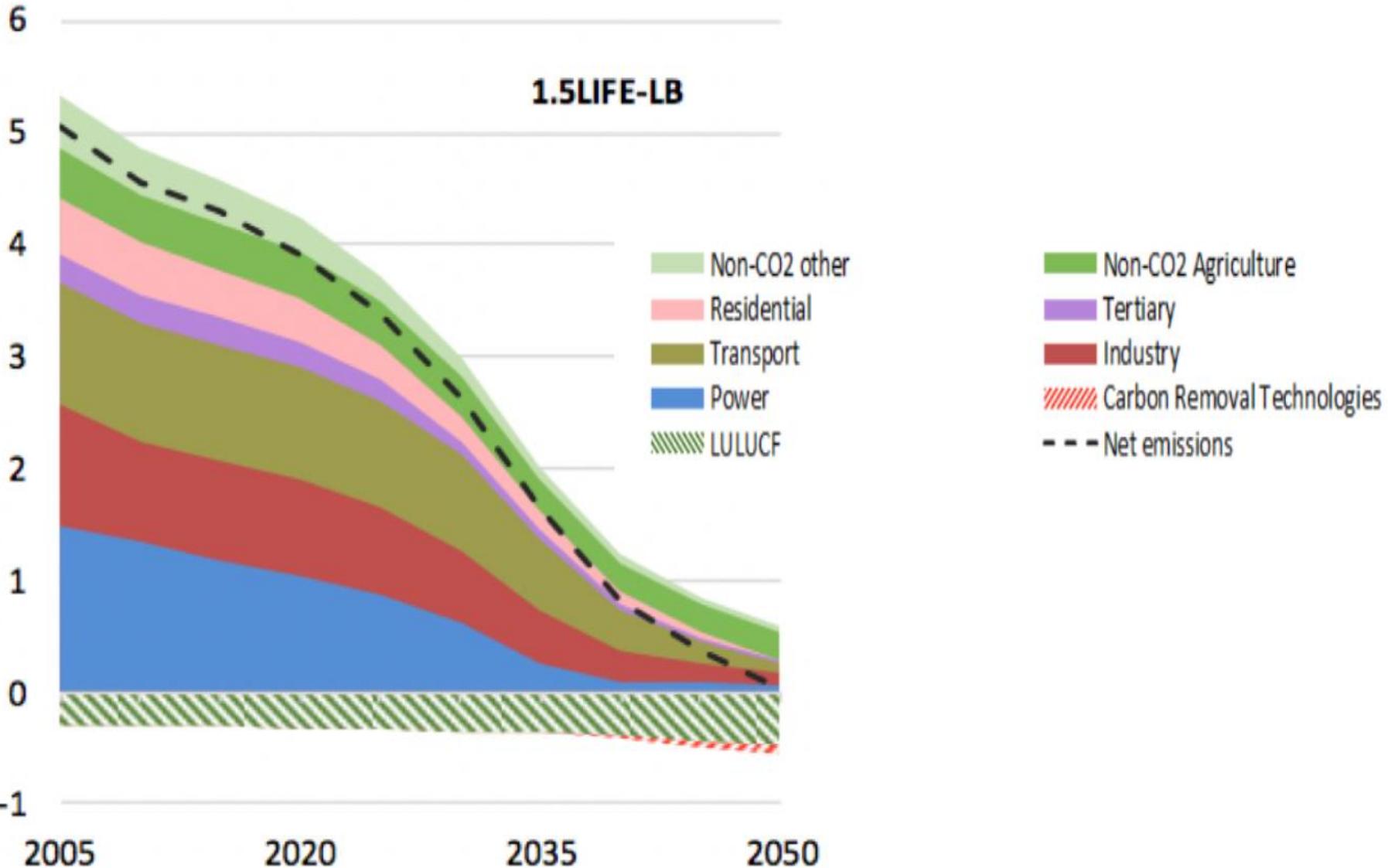
Energy consumption by fuel source from 2000 to 2019, with growth rates indicated for the more recent period of 2014 to 2019



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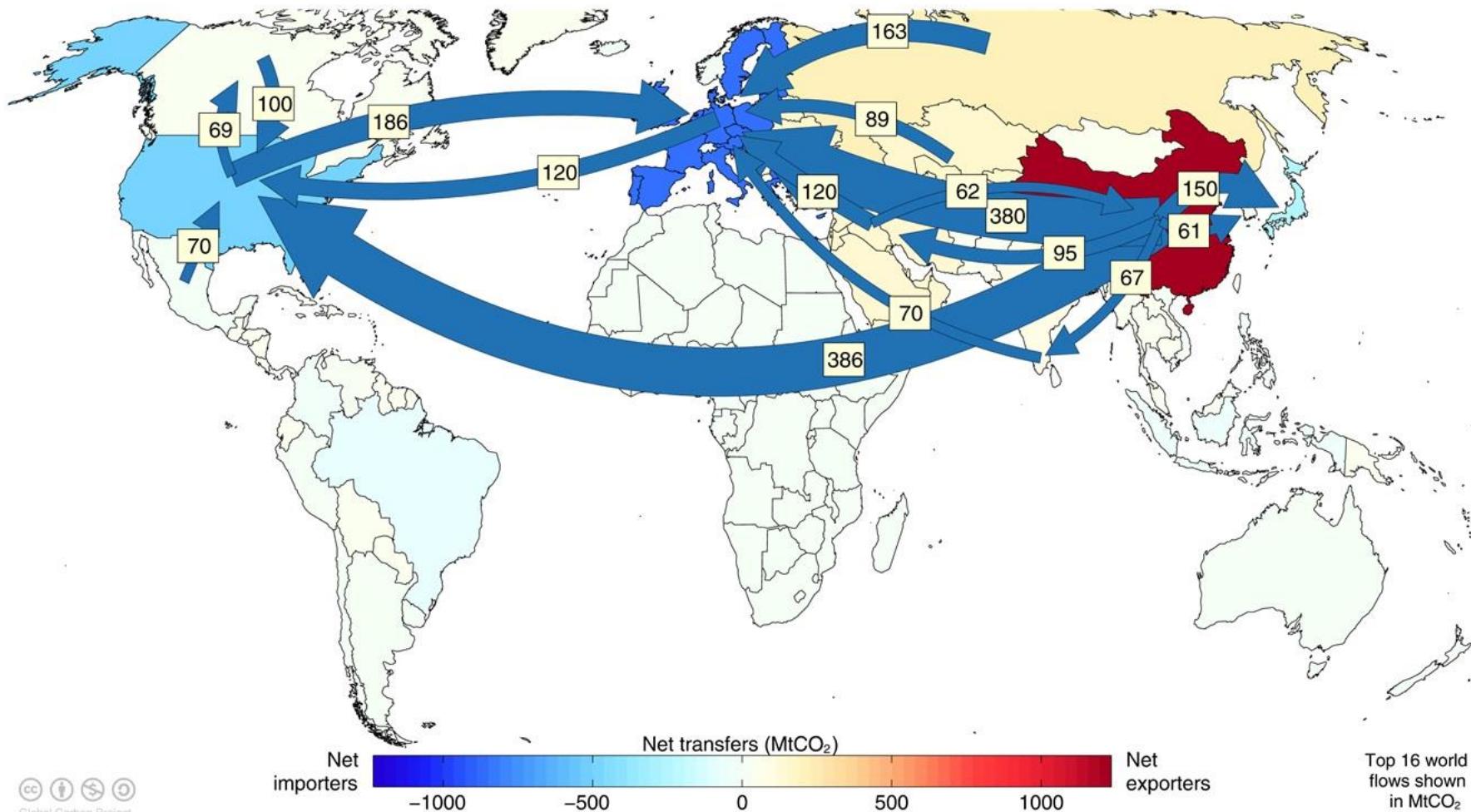
This figure shows “primary energy” using the BP substitution method
 (non-fossil sources are scaled up by an assumed fossil efficiency of approximately 0.38)
 Source: [BP 2020](#); [Jackson et al 2019](#); [Global Carbon Budget 2020](#)

How to become carbon neutral by 2050?



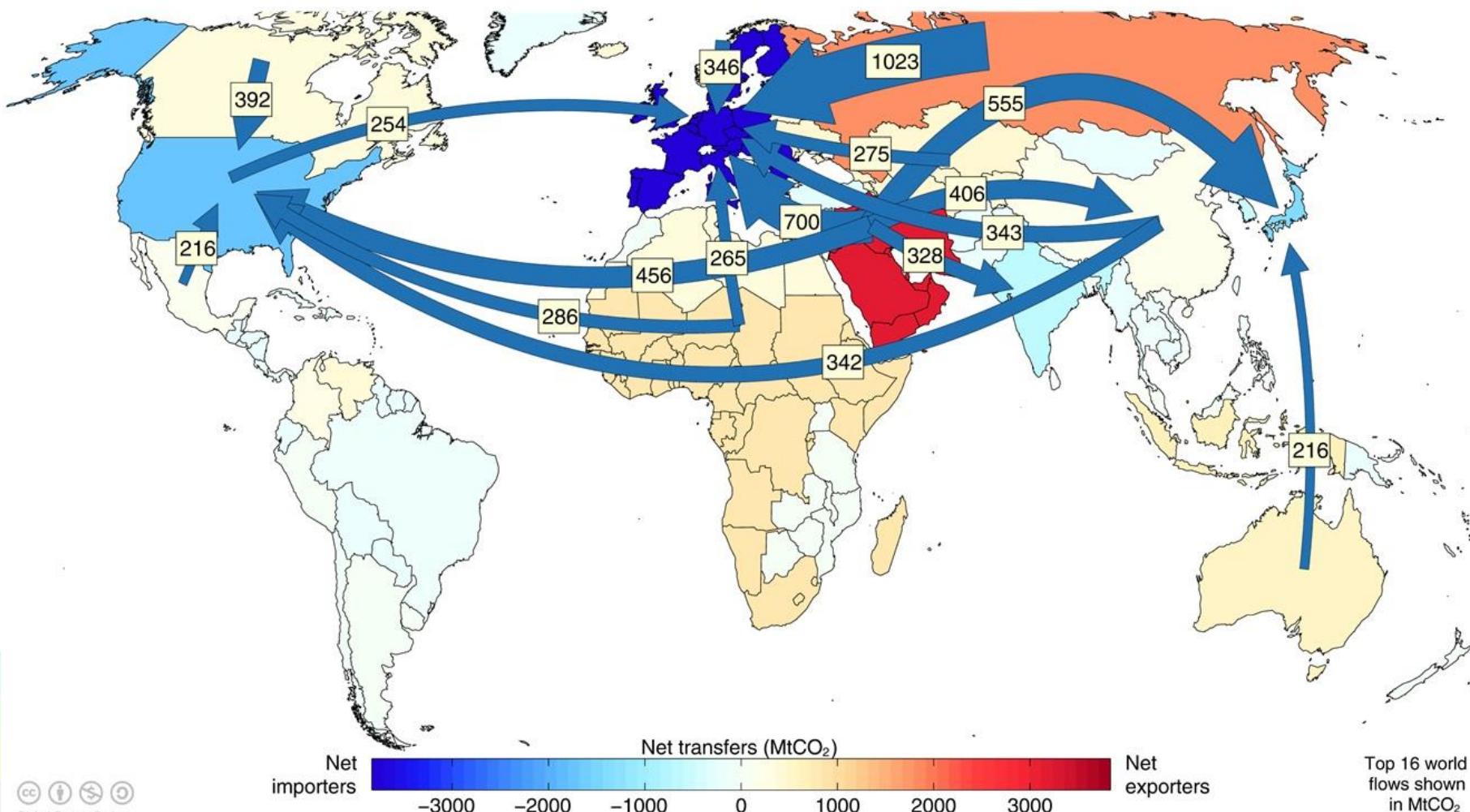
Major flows production -> consumption

Flows from location of generation of emissions to location of consumption of goods and services

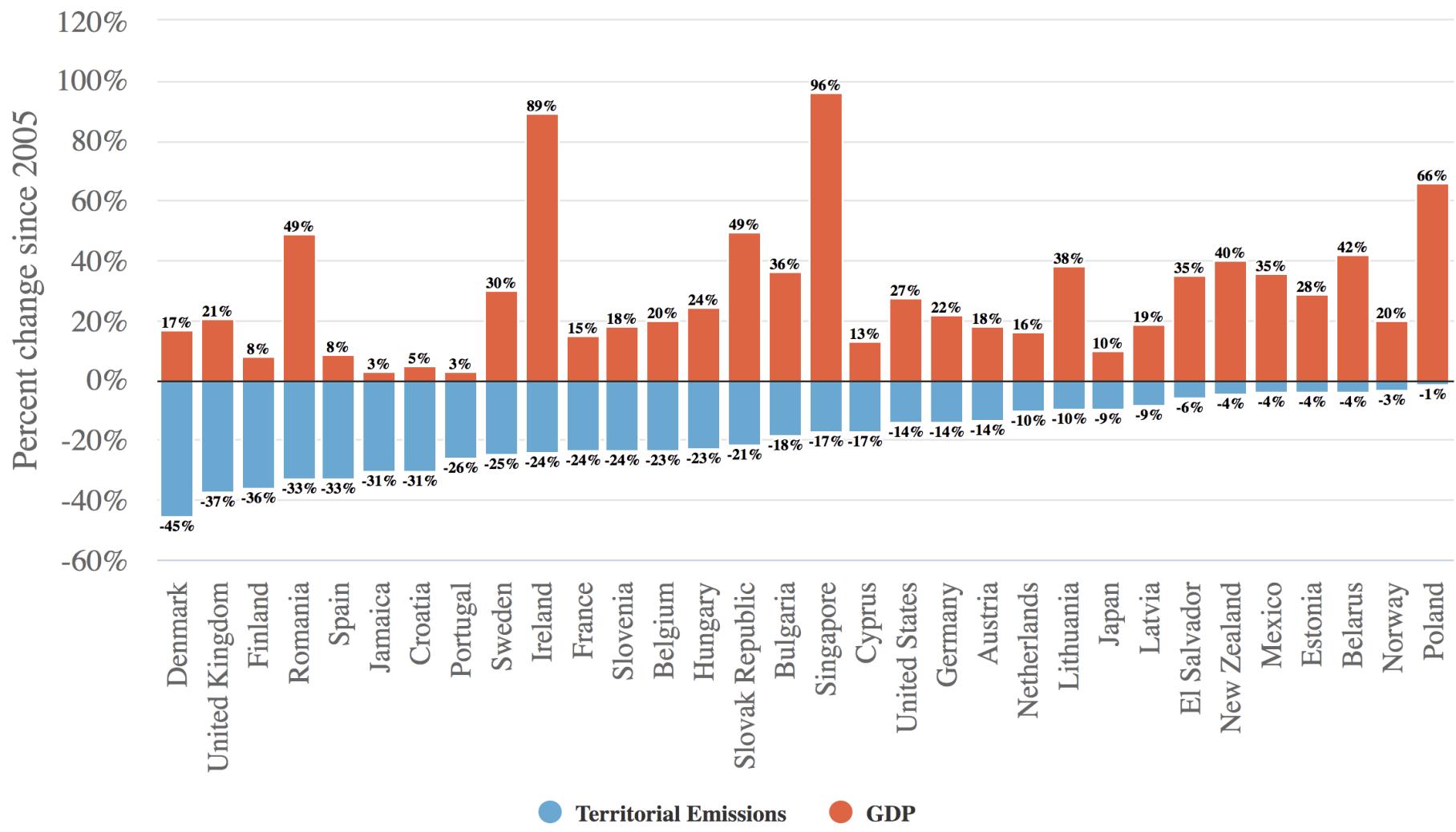


Major flows extraction -> consumption

Flows from location of fossil fuel extraction to location of consumption of goods and services



Decoupling of territorial emissions and GDP: 2005-2019

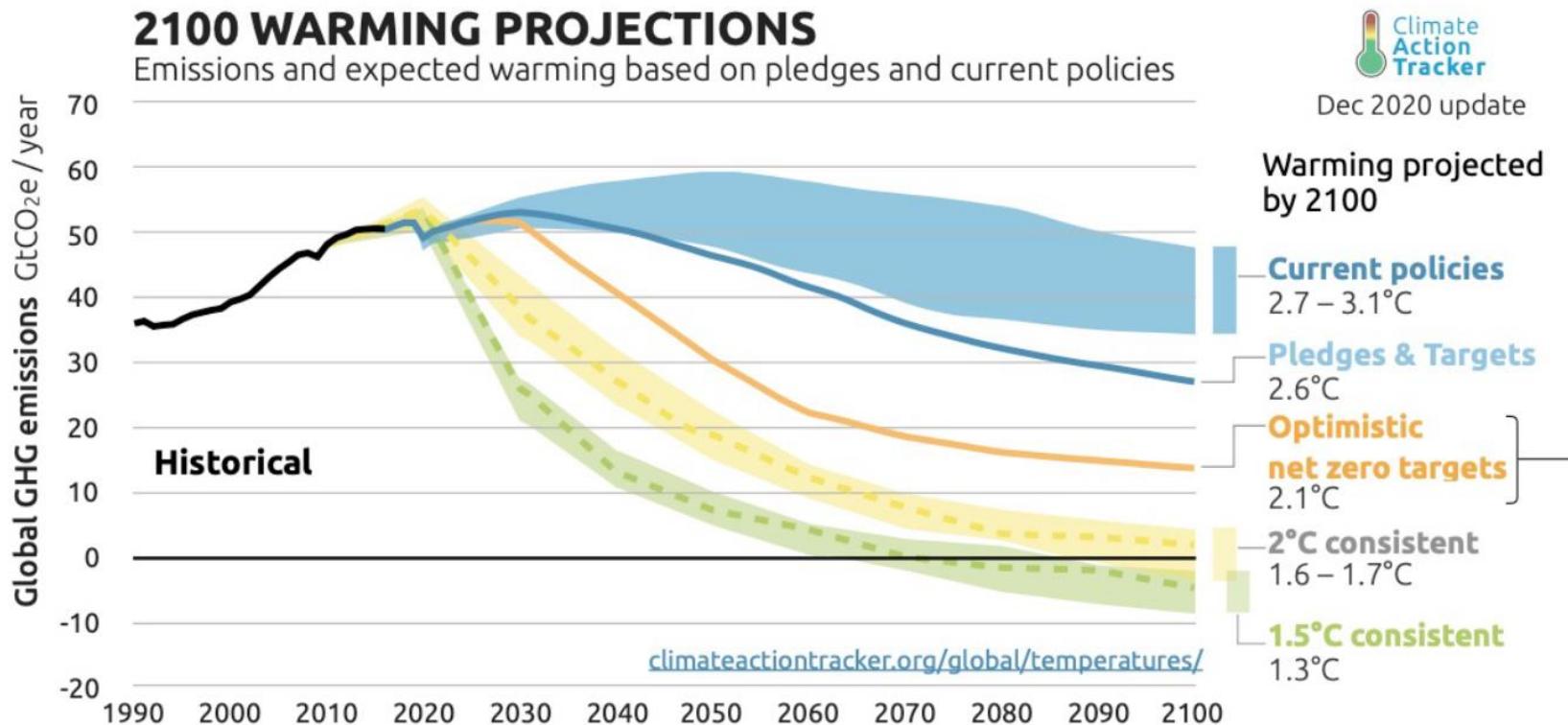


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BREAKTHROUGH
INSTITUTE

Emissions vs. warming

Optimistic net zero targets scenario projects that warming will be limited to 2.1°C by 2100
and is based on the successful achievement of all announced net zero targets



Source: Climate Action Tracker 2020 Global Update



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Climate change/security policy

1. **Agriculture:** great difficulties in Africa, Mediterranean region, Americas, India, China. High northern latitudes are gaining, but can not compensate losses in more fertile areas.
2. **World economy.** Climate mitigation to reach 1.5-2.0 C ~twenty fold cheaper than inaction. Economic losses rapidly growing, island and African economies hit hardest. Absolute losses greatest in USA & Eastern Asia.
3. **Oil & gas dependent economies.** E.g. Russia, Arabic countries etc. highly dependent on fossil energy income. Risk for destabilization related to climate mitigation and/or cessation of oil/gas resources.
4. **Africa.** Economies, employment and food security highly dependent on rain-fed agriculture. Population growth 1 => 4 billion by 2100 expected: source of crisis, refugees and death of hunger.
5. **Europe.** Mediterranean countries will suffer. Potential for immigration great, political impacts already visible; threat for European Union.

Ulkosuomalaisen havaintoja



- 1. Suomessa on huippulaatuinen julkinen sektori:** työmoraali, luottamus, yhteistyökyky ja toimintojen aktiivinen uudistaminen. Joskus poliitikkojen uudistusinto on mennyt järkevyyden edelle.
- 2. Suomen vahvuus on kyky yhteistöhön poikki yhteiskunnan:** Julkinen-yksityinen-poliittinen sektori. Tämän keinotekoinen rajoittaminen USA:n tai Ruotsin esimerkin mukaan on Suomelle vahingollista; illallisten, kulttuuri-, urheilu- ja metsästystapahtumien kielot. Näissä luodaan Suomelle tärkeitä yhteistyösuheteita.
- 3. Vaatimattomuus ei kaunista, vaan on tyhmää.** Suomen kv. asema on Skandinavian maita selvästi heikompi. Tarvitaan rohkeutta, tervettä itsetuntoa ja osaamisen markkinointia. Suomi ja suomalainen korkeatasoinen tekemisen tapa ansaatisivat paremman aseman. Myös kielitaitoon on panostettava.
- 4. “Ulkomaalaiset” ovat samoja ihmisiä.** Tarvitsemme selektiivistä maahanmuuttoa; vähintään suomalaisissa oppilaitoksissa tutkinnon suorittaneille kansalaisuus. Suomessa on osin historiallisista syistä, osin pakolaispolitiikasta johtuvia ennakkoluuloja.



WMO-Forerunner in the UN



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