

Climate change; where are we?

Prof. Petteri Taalas
Secretary-General

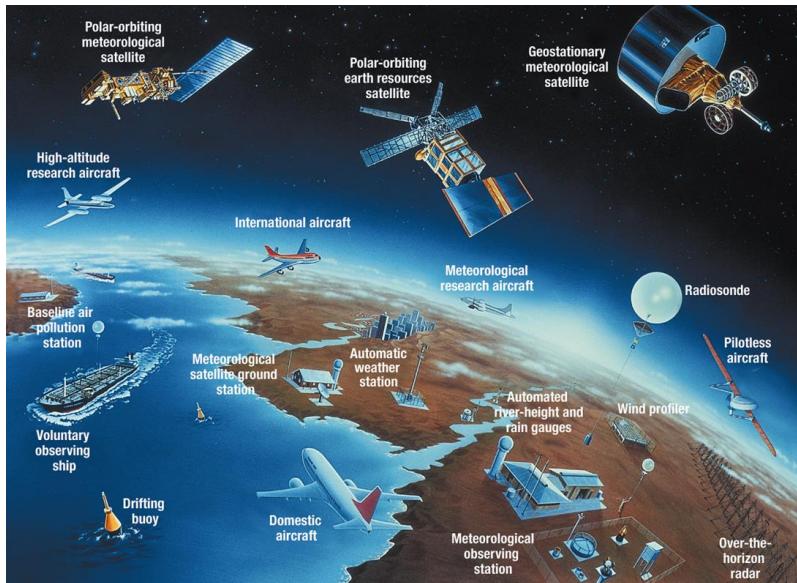
- UN/WMO perspective
- New findings
- Finland?



WMO OMM

World Meteorological Organization
Organisation météorologique mondiale

World Meteorological Organization



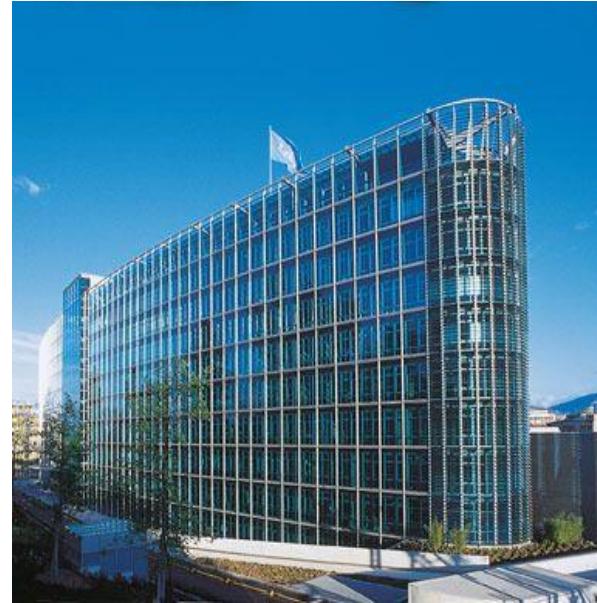
- UN Specialized Agency on weather, climate & water
- 191 Members, HQ in Geneva
- 2nd oldest UN Agency, 1873-
- Coordinates work of > 200 000 national experts from meteorological & hydrological services, academia (& private sector)
- Co-Founder and host agency of IPCC (1st World Climate Conference)
- Co-Founder of UNFCCC (2nd World Climate Conference)



WMO OMM

WMO Mission/key activities

- 1. World climate**
- 2. Weather, disasters & safety**
- 3. Water resources**
- 4. Data & technology**
- 5. Strengthening of the national service capabilities**
- 6. Earth system research**
- 7. Efficient governance**



SUSTAINABLE DEVELOPMENT GOALS/WMO



Weather resilience



Climate change & -services



Good health and well-being



Quality education



Gender equality



Water resource management



Solar, wind & hydro use



Climate resilience



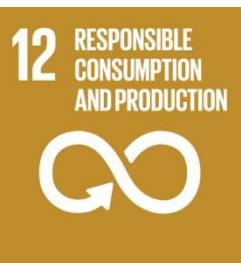
Big data, innovations



Reduced inequalities



Air quality, heat waves, flooding



Responsible consumption and production



DRR, Adaptation, carbon & climate monitoring



Sea level rise, climate<->oceans



Climate change <-> ecosystems

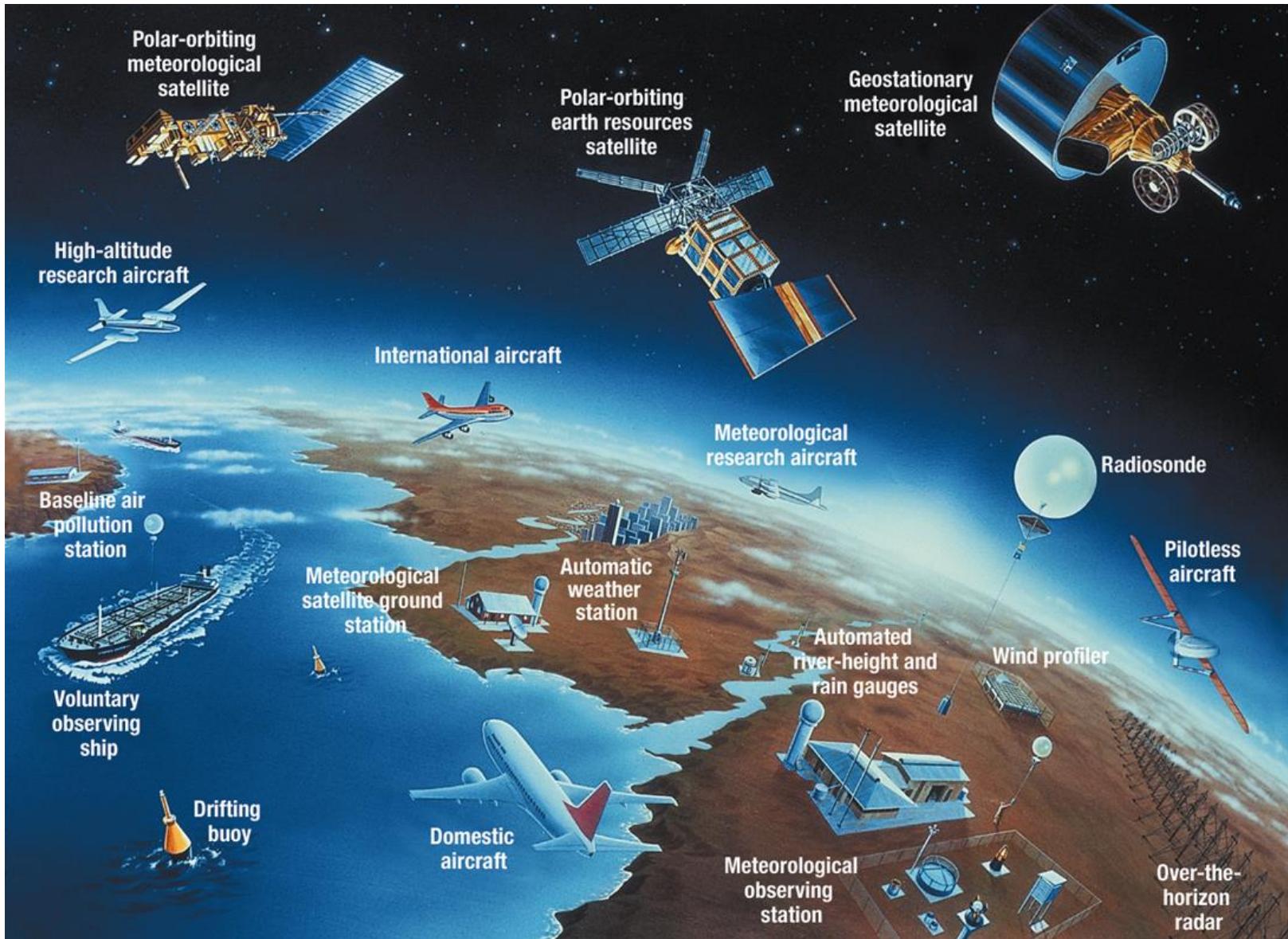


Climate driven conflicts

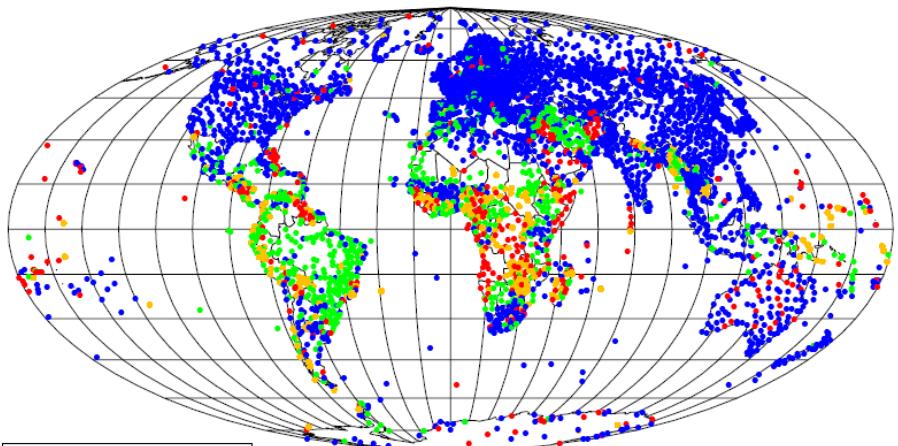


Resources for climate adaptation & DRR

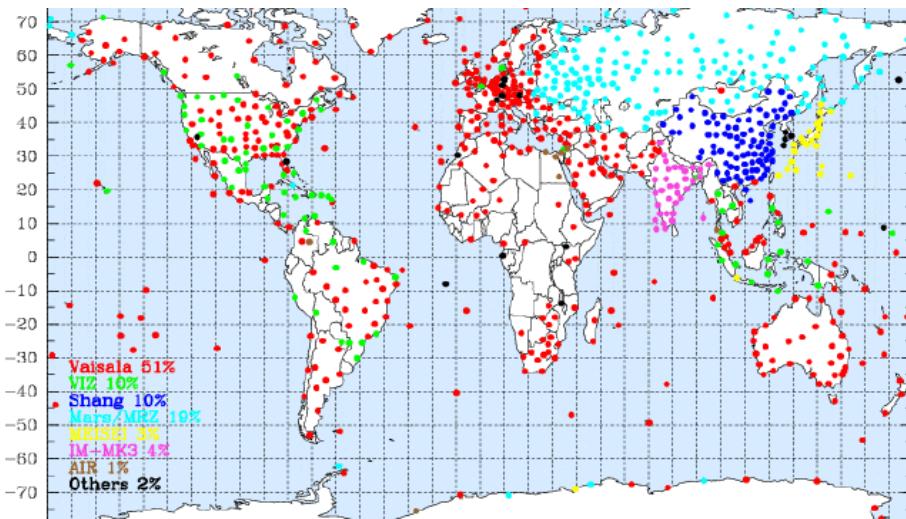
Integrated weather and climate observing system



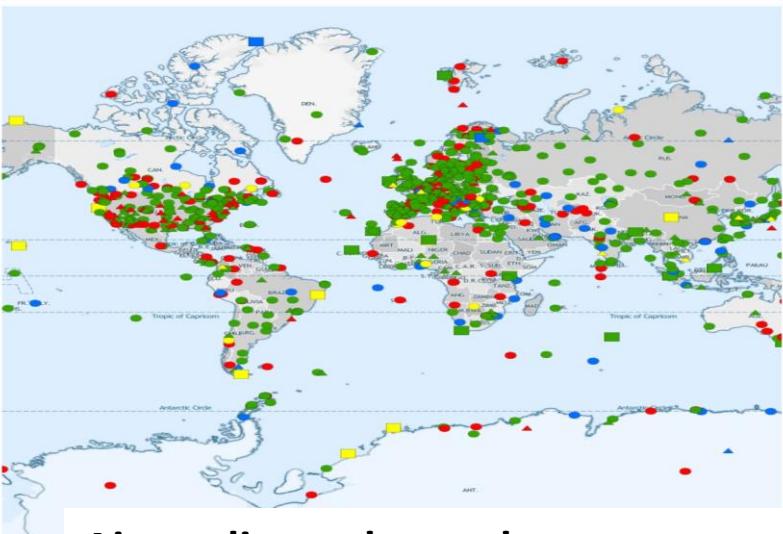
WMO Global Observing Networks >10000 stations



Surface observations



Balloon soundings

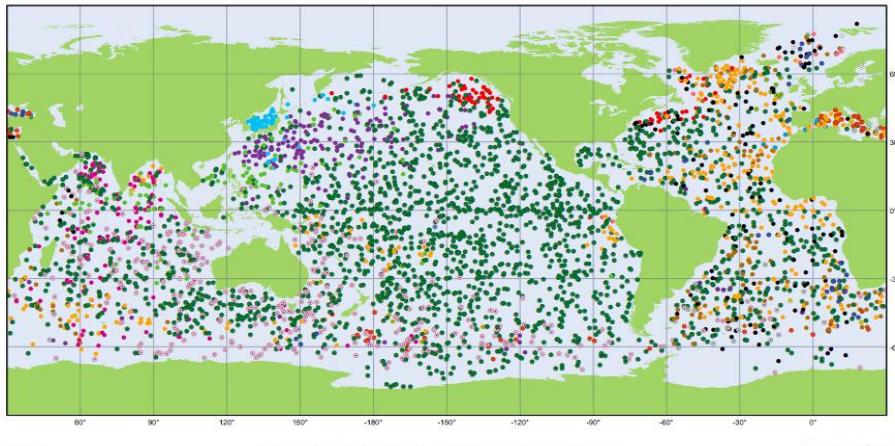


Air quality and greenhouse gases



Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun Svizra
Federal Department of Home Affairs FDHA
Federal Office of Meteorology and Climatology MeteoSwiss

Global
Regional
Contributing
Local
Partly Reporting
Non-reporting
Closed
Planned
Pre-operational



Ocean weather (with IOC UNESCO)

Figure 3.17. National contributions. Source: IOC, 2017



10/04/2017

national

WMO Satellite Observations

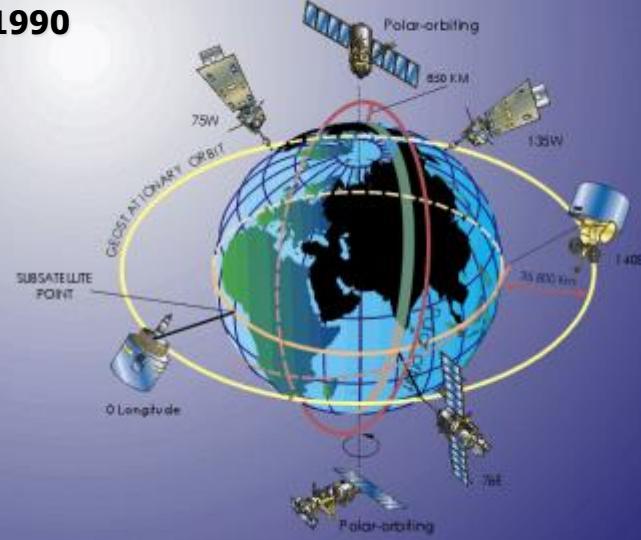
1961



1978



1990



2015



Weather and climate modelling



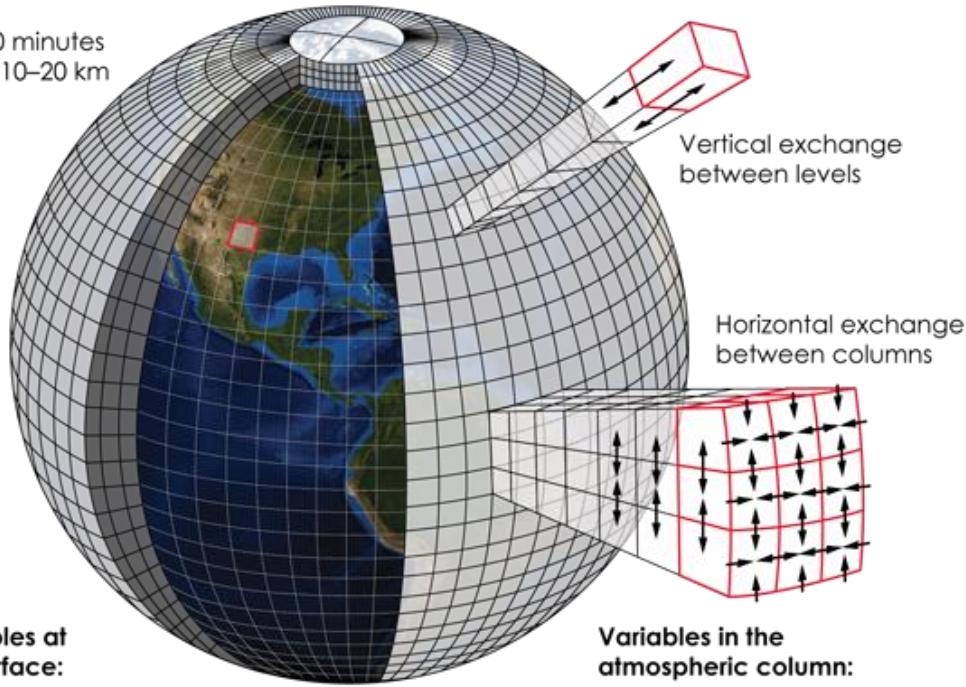
WMO Bureau visits CMC Montreal to inaugurate Cray Computer - 1984



The Cray supercomputer used for weather analysis at the ECMWF - 2016

Weather forecast modeling

Timestep 5–10 minutes
Grid spacing 10–20 km



Variables at the surface:

- Temperature
- Humidity
- Pressure
- Moisture fluxes
- Heat fluxes
- Radiation fluxes

Variables in the atmospheric column:

- Wind vectors
- Humidity
- Clouds
- Temperature
- Height
- Precipitation
- Aerosols

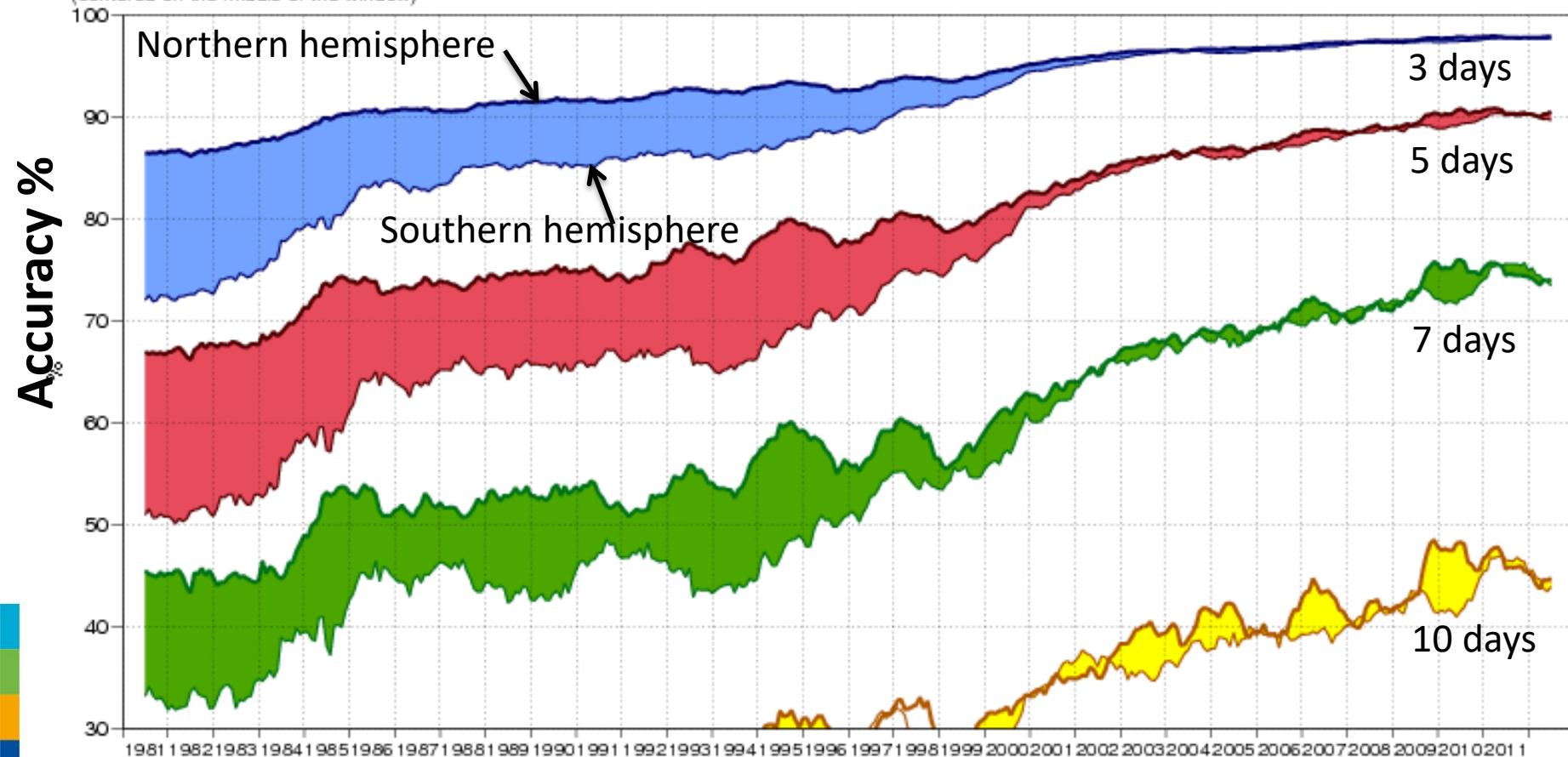


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Improved weather forecasts

500hPa geopotential height
Anomaly correlation
12-month running mean
(centered on the middle of the window)

Day 7 NHem Day 3 NHem
Day 7 SHem Day 3 SHem
Day 10 NHem Day 5 NHem
Day 10 SHem Day 5 SHem



YK-maailmanmenoa

- Isoja teemoja
 - Ilmastomuutoksen torjunta & sopeutuminen
 - Konfliktien ennaltaehkäisy
 - Digitalisaatio/cybermaailma
 - Työn luonteen muutos/katoaminen
- Guterresin intressina YKn uudistaminen, "Lahopuu pois", kehitystoiminnat, lisää naisia
- YK hampaaton esim. islamilaisen maailman kriiseissä, osapuolina Saudi-Arabia, Iran, Turkki, Venäjä & USA
- USA saatu mukaan YK:n uudistamishankkeeseen, leikkaukset pelättyä pienempiä
- Oma kokemus: Päälekkäisyksiä, paljon puhetta ja paperia. Toimita jäsenmaissa keskiöön! Potentiaali sisäisen yhteistyön lisäämiselle suuri. WMO, WB, UNDP, FAO & WHO toimii.

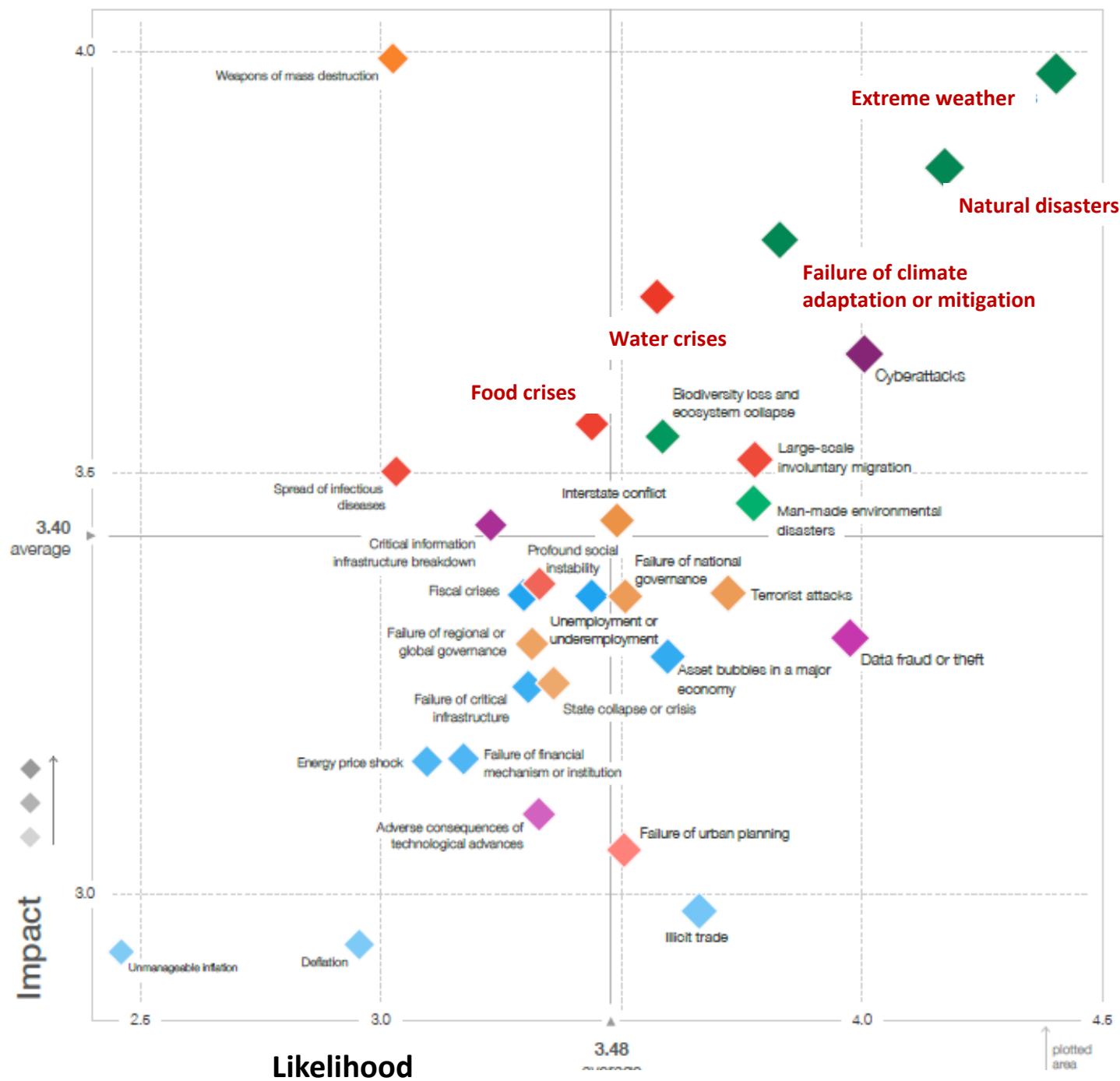


UN Chief Executive Board 4/2017



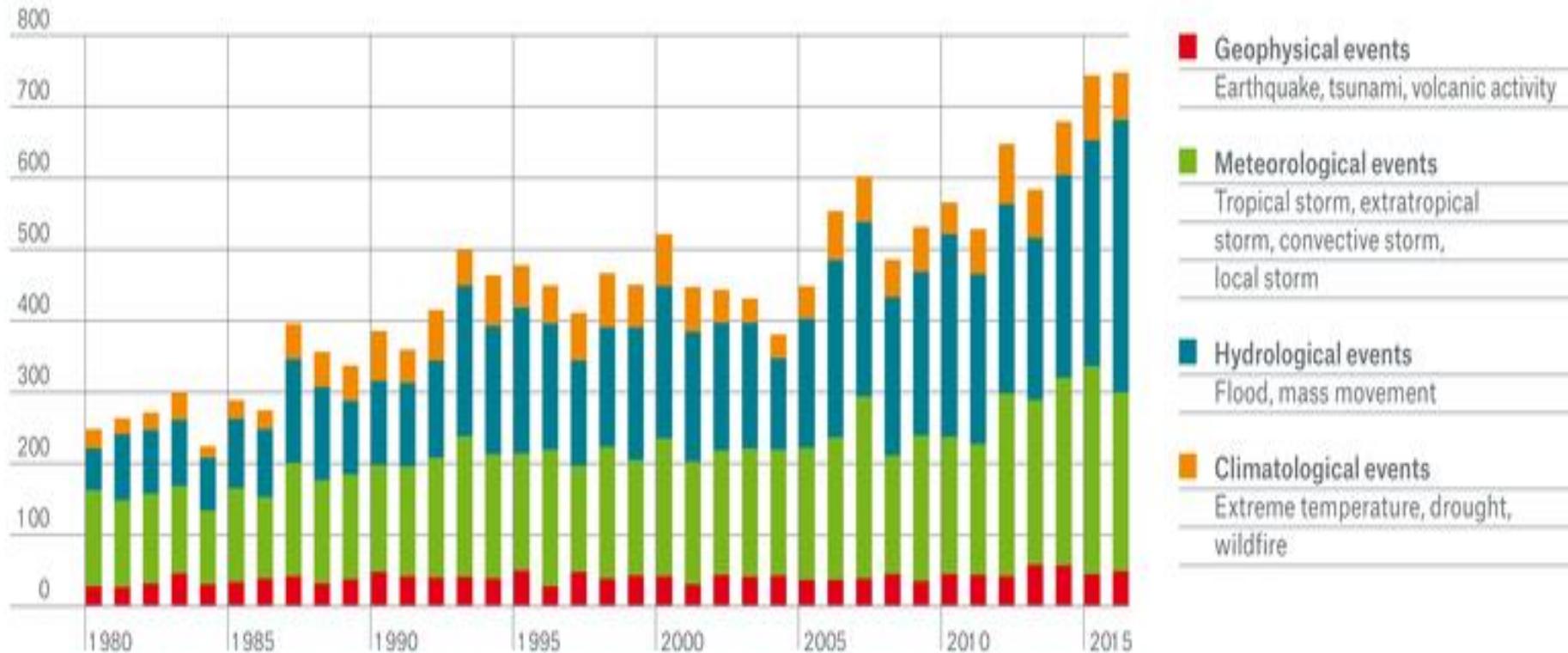
Global risks landscape 2018

World Economic Forum



WMO OMM

Growing number of weather related disasters 1980-2016



2017 Record breaking economic losses

Losses from natural catastrophes
2017

US\$ 330bn



Less than half of the losses insured

US\$ 135bn (41%)

Costliest hurricane season on record

US\$ 215bn



Floods in South Asia:
a humanitarian disaster

2,700 people killed



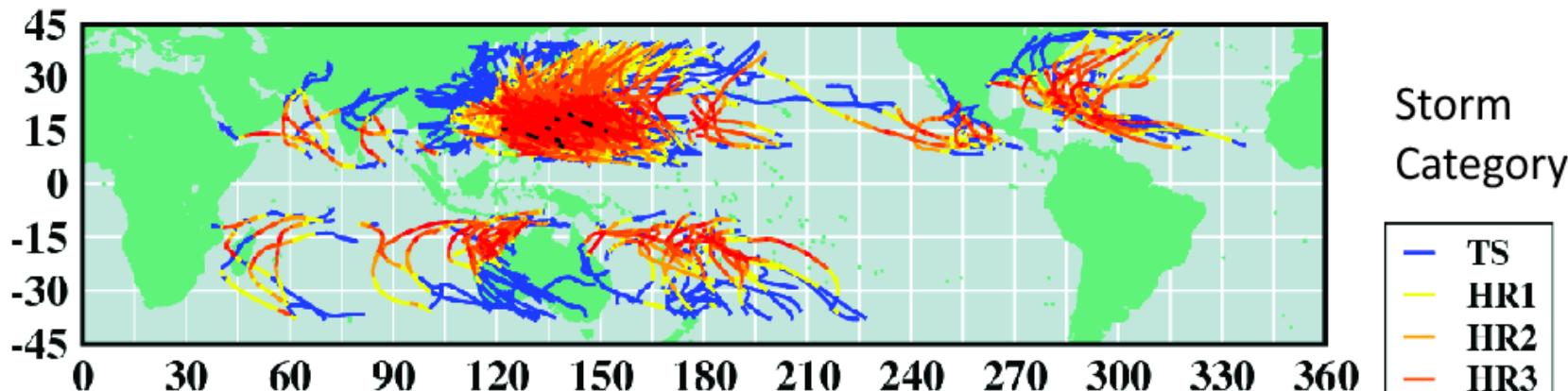
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© Munich Re NatCatSERVICE

Tropical storms today and in 2 C warmed climate

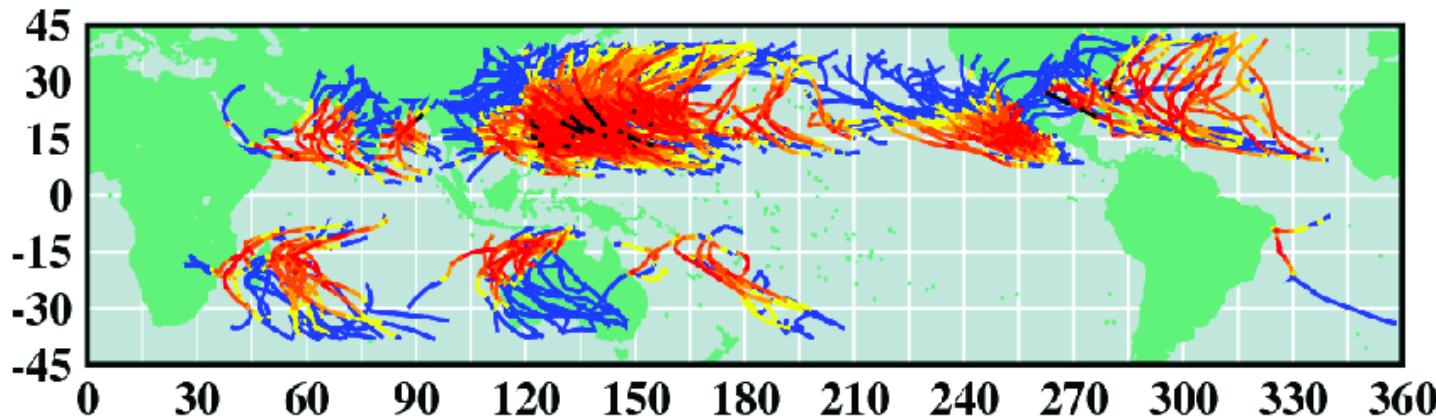
a)

Present Day Simulation: 244 Cat 4-5 storms



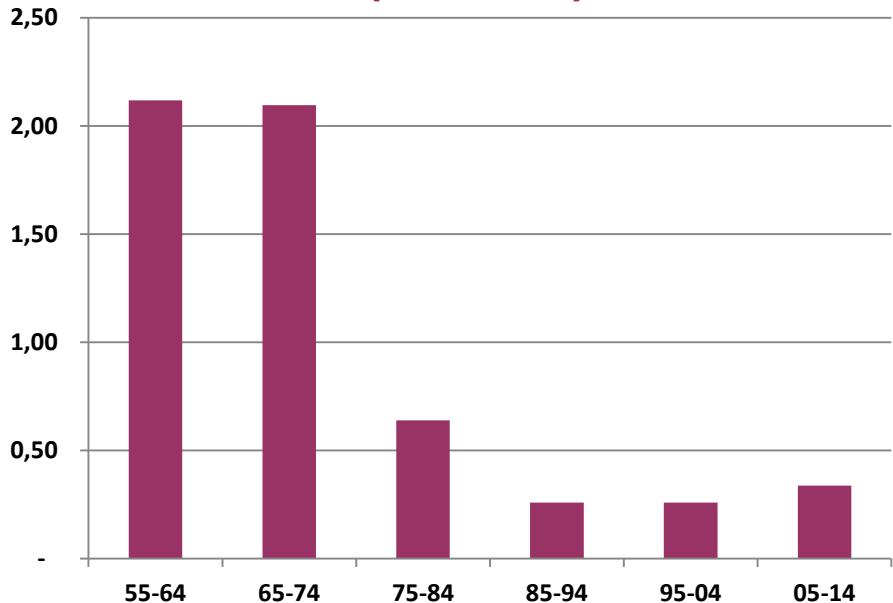
b)

RCP4.5 Late 21st Century: 313 Cat 4-5 storms

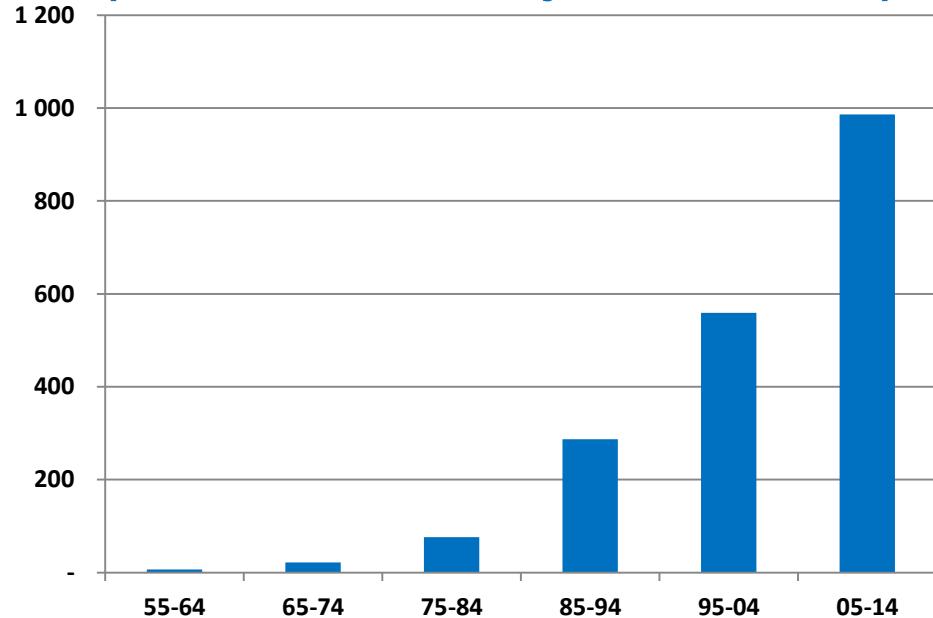


Impacts of hydrometeorological and climatological hazards (1955–2014)

Human losses by decade
(millions)



Economic losses by decade
(billions of US\$ adjusted to 2013)



Reduction of the number of victims thanks to greater effectiveness of early warning systems and prevention measures



Global adaptation index



2014 Annual Scores for 157 Countries

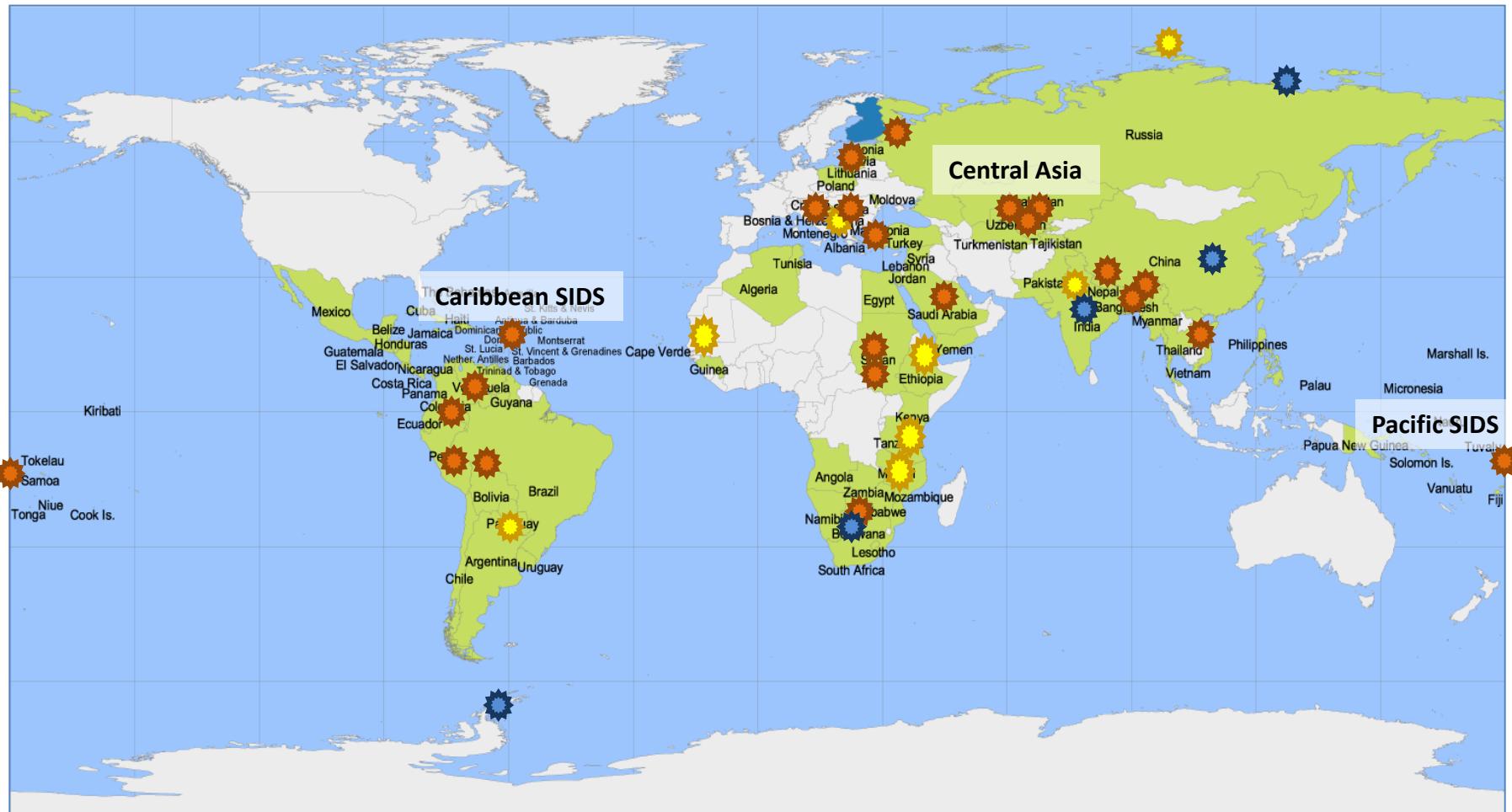
Univ. Notre Dame



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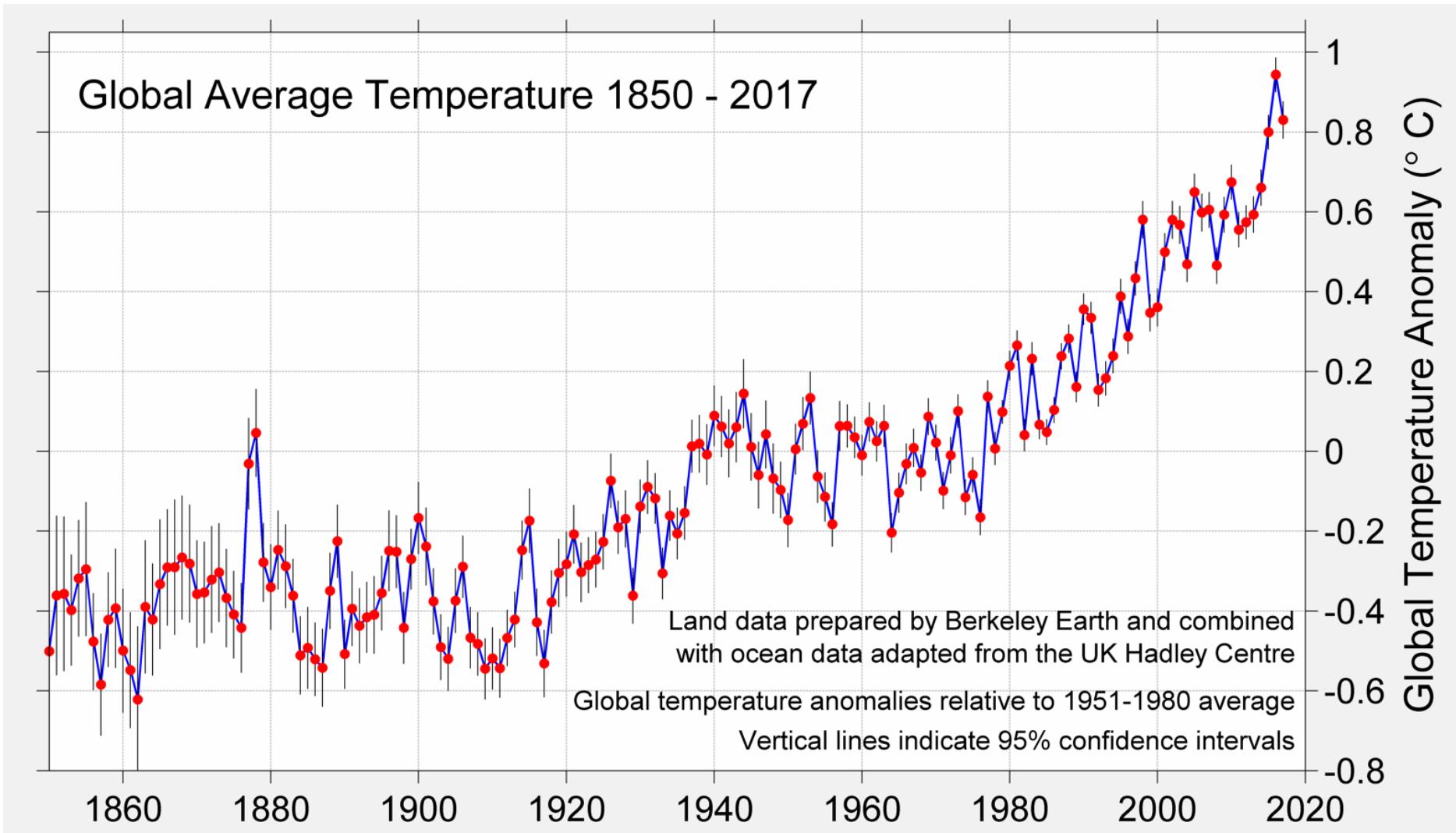


Co-operation projects of FMI, > 100 M€

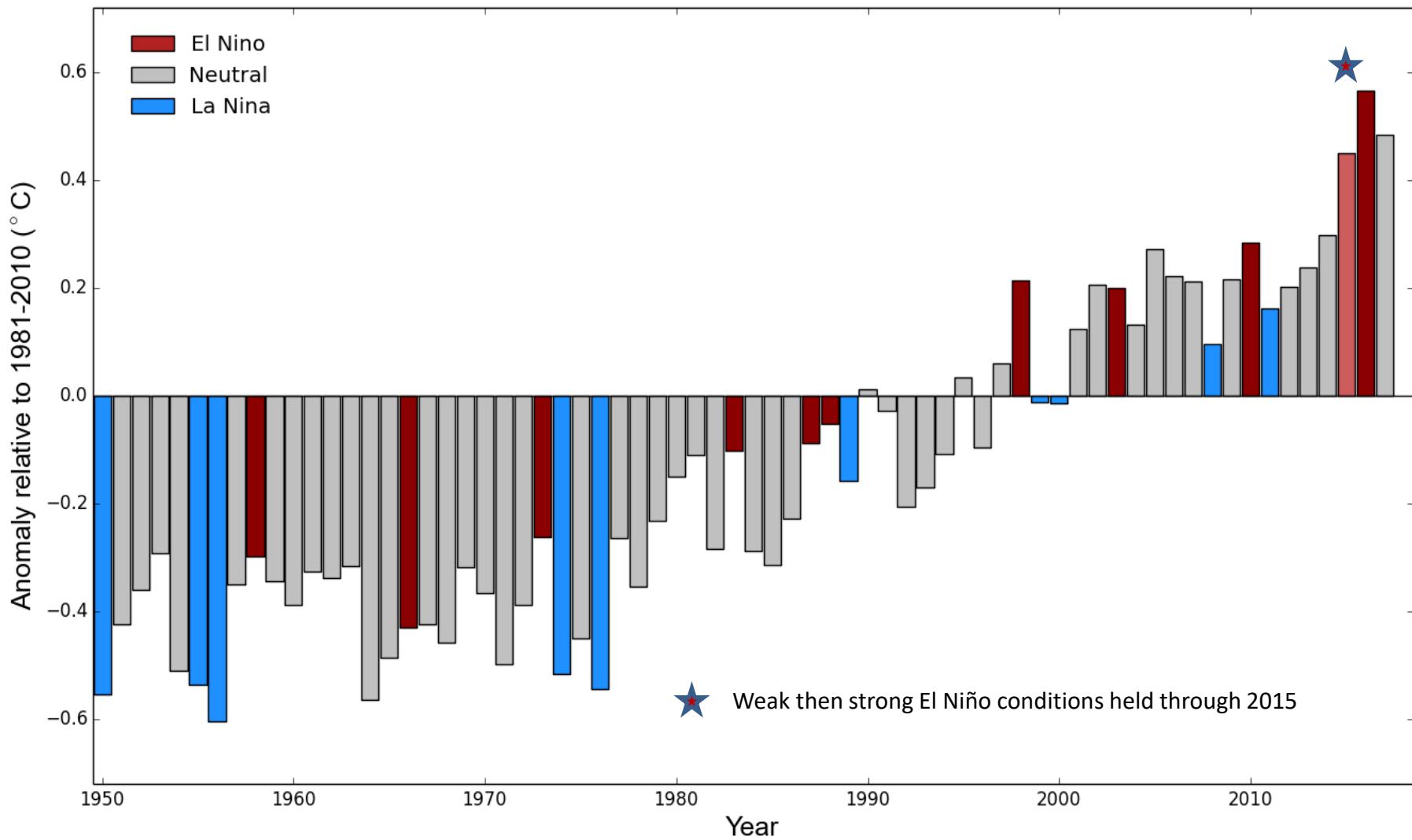


Project Ongoing Project in Preparation Scientific Collaboration

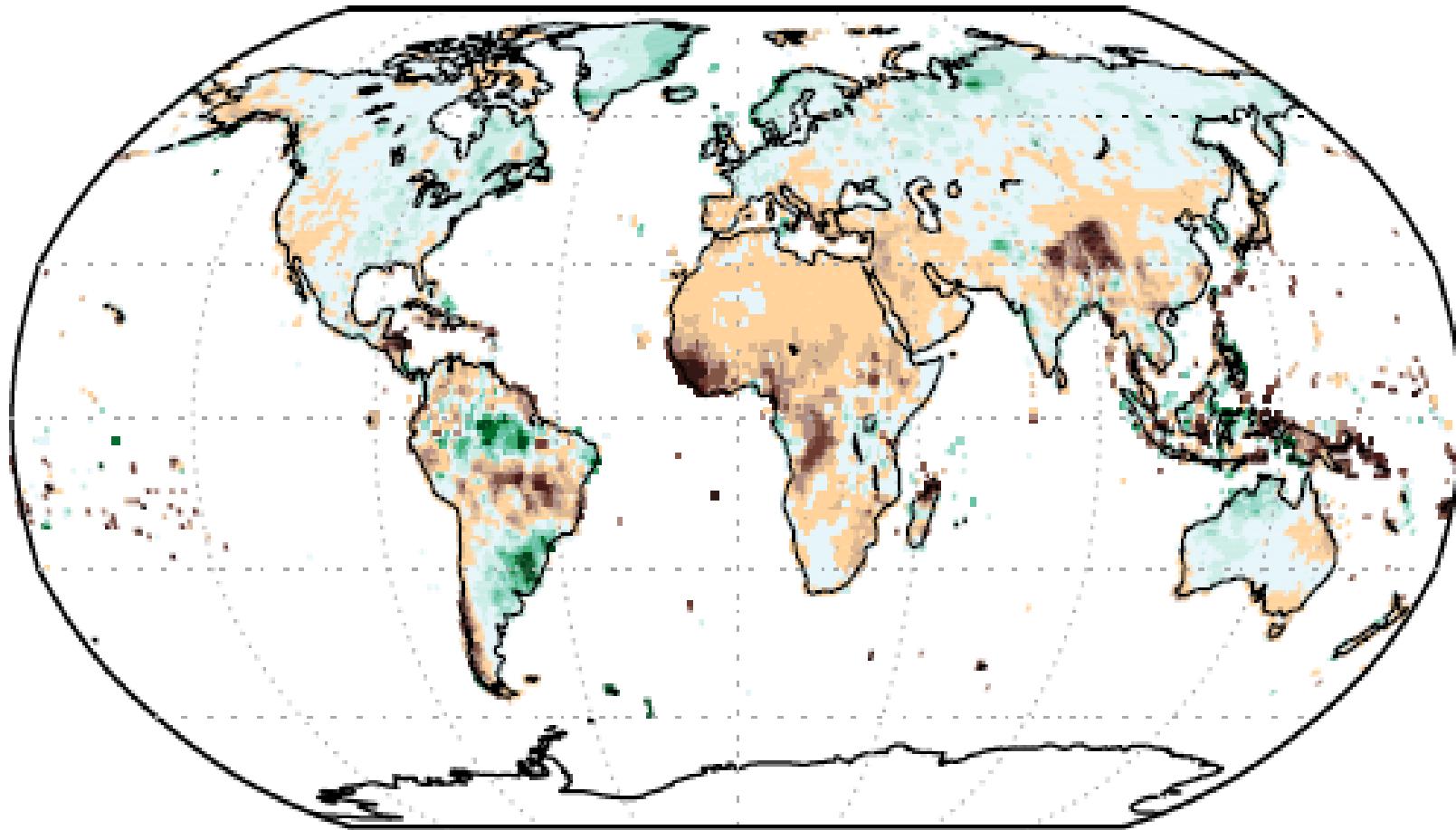
Global temperature 1850-2017



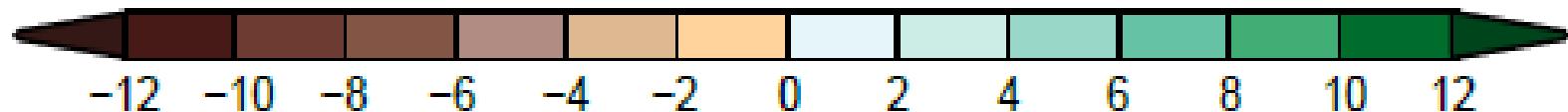
2017 – the warmest non-El Niño year on record



Global precipitation 1986–2015 vs. 1901–1960

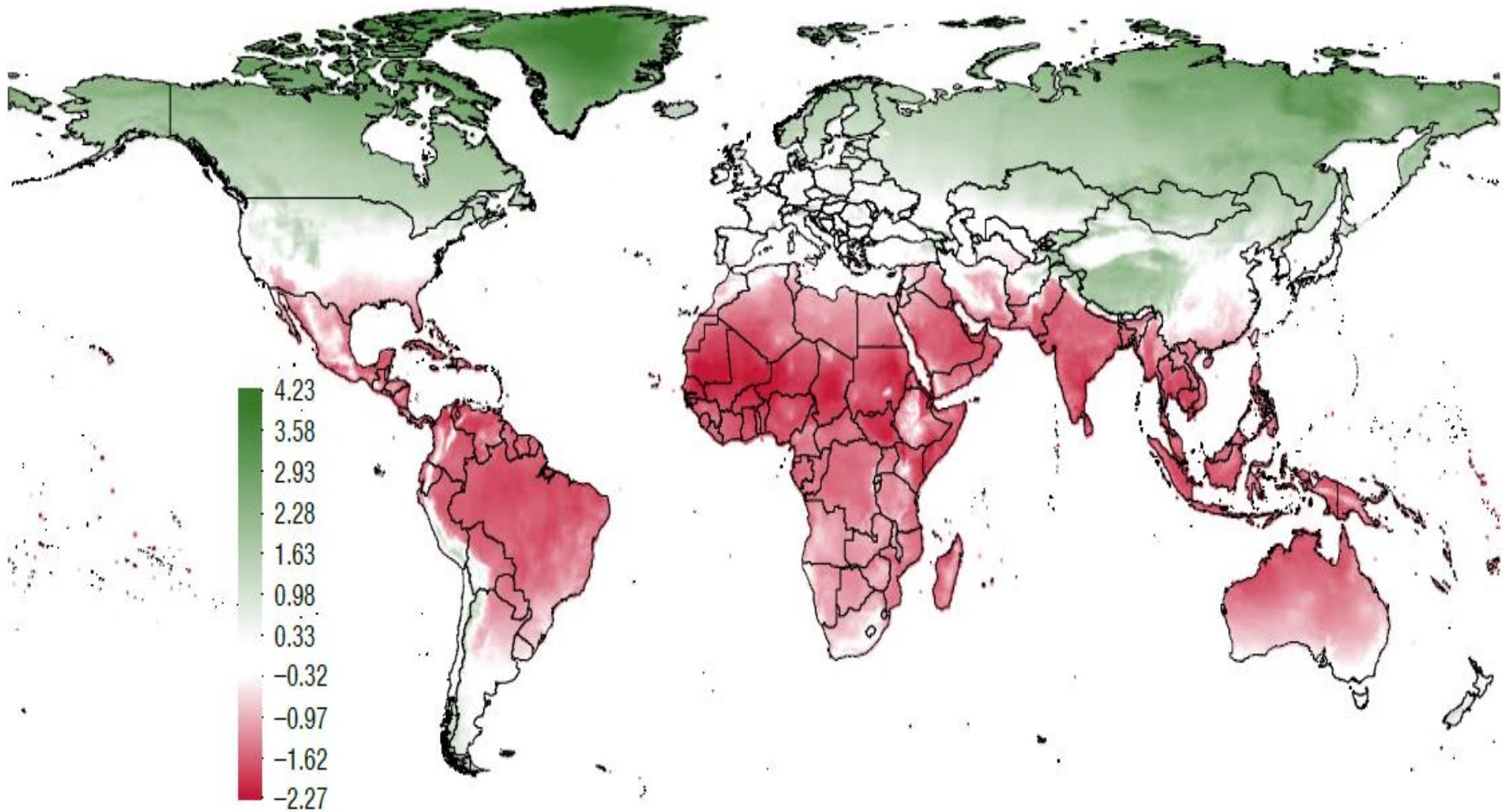


Change in Precipitation (inches)



WMO OMM

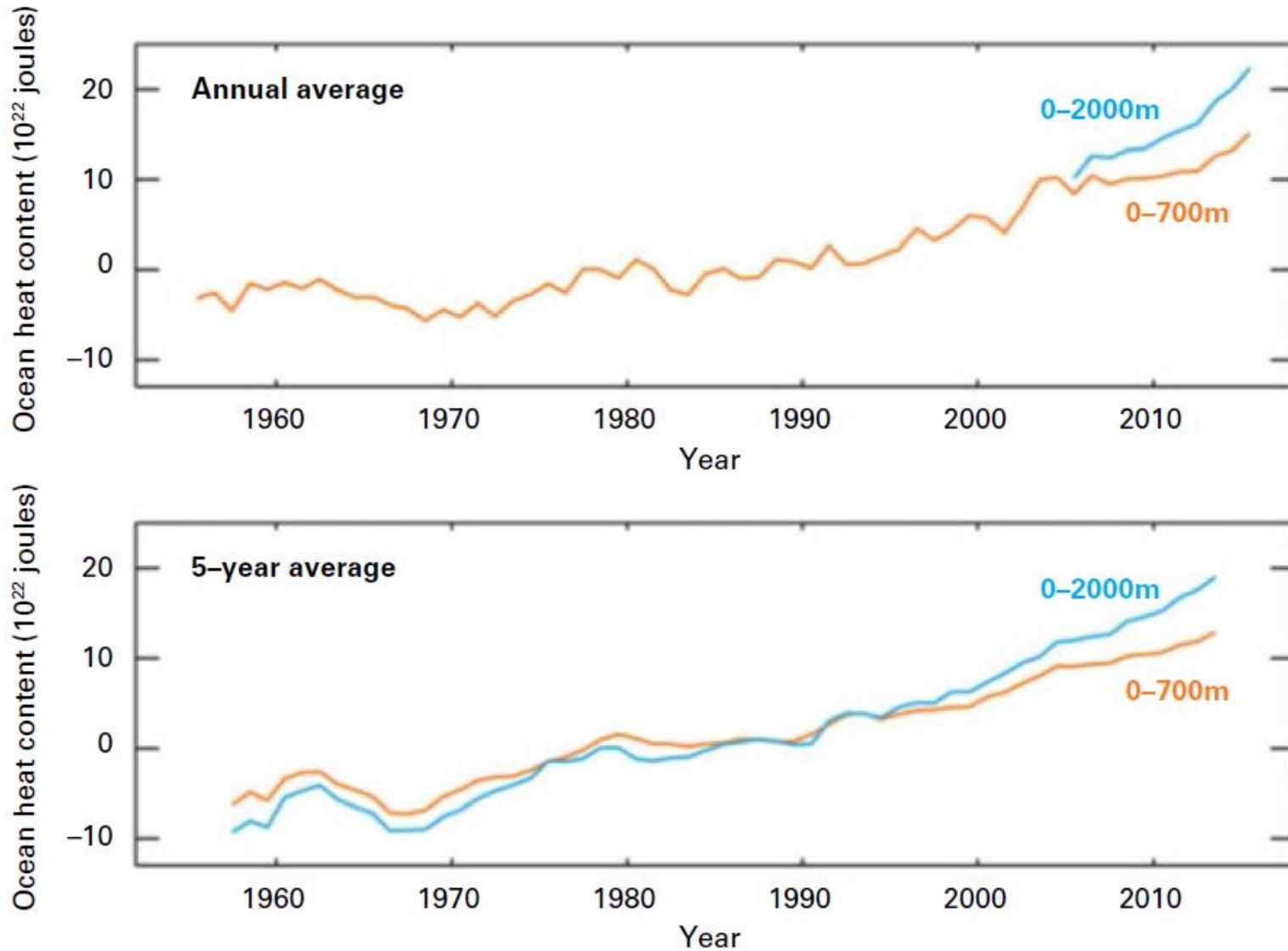
Effect of 1°C temperature increase on per capita output



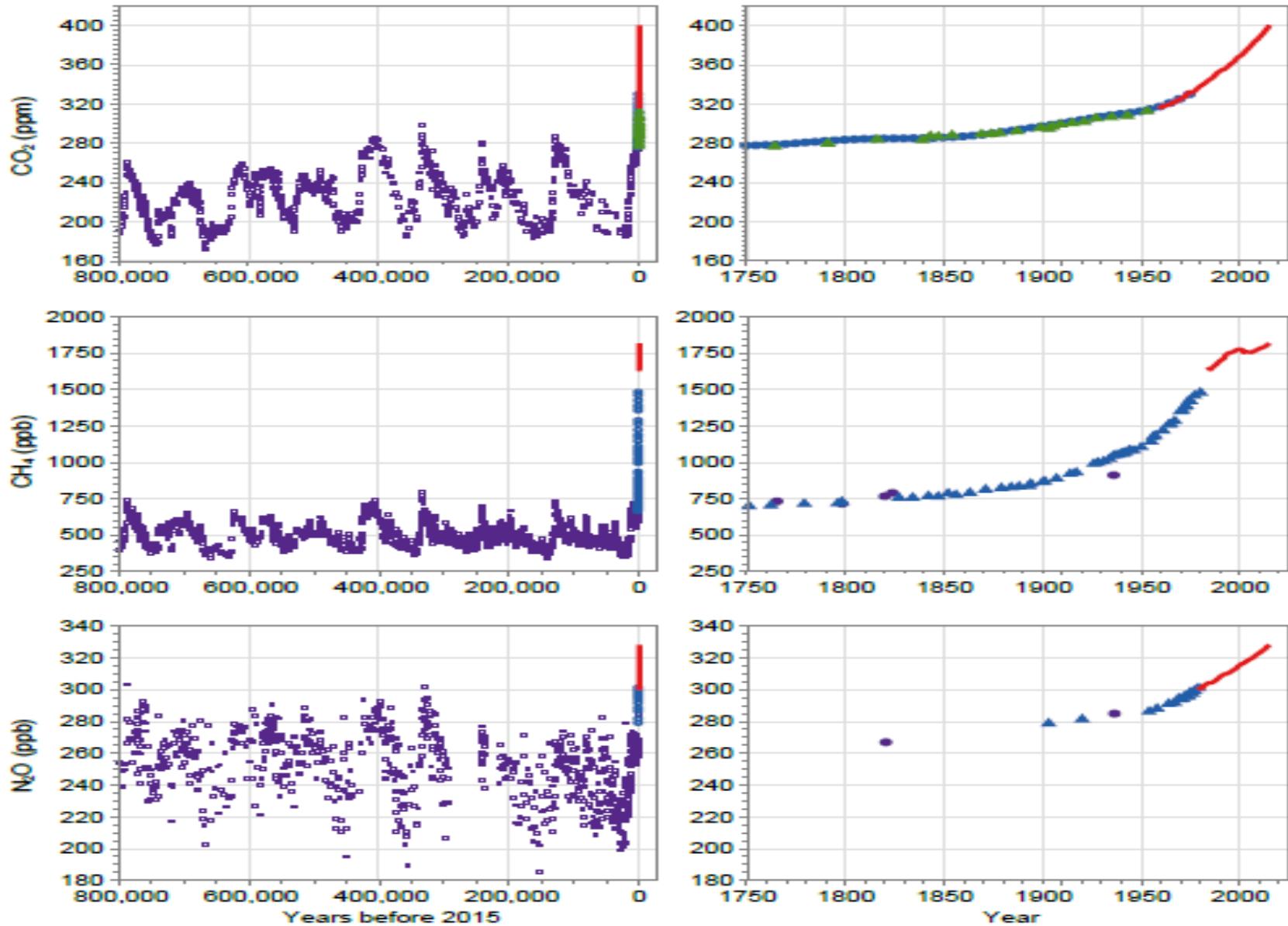
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Source: International Monetary Fund (IMF) World Economic Outlook

Ocean heat content

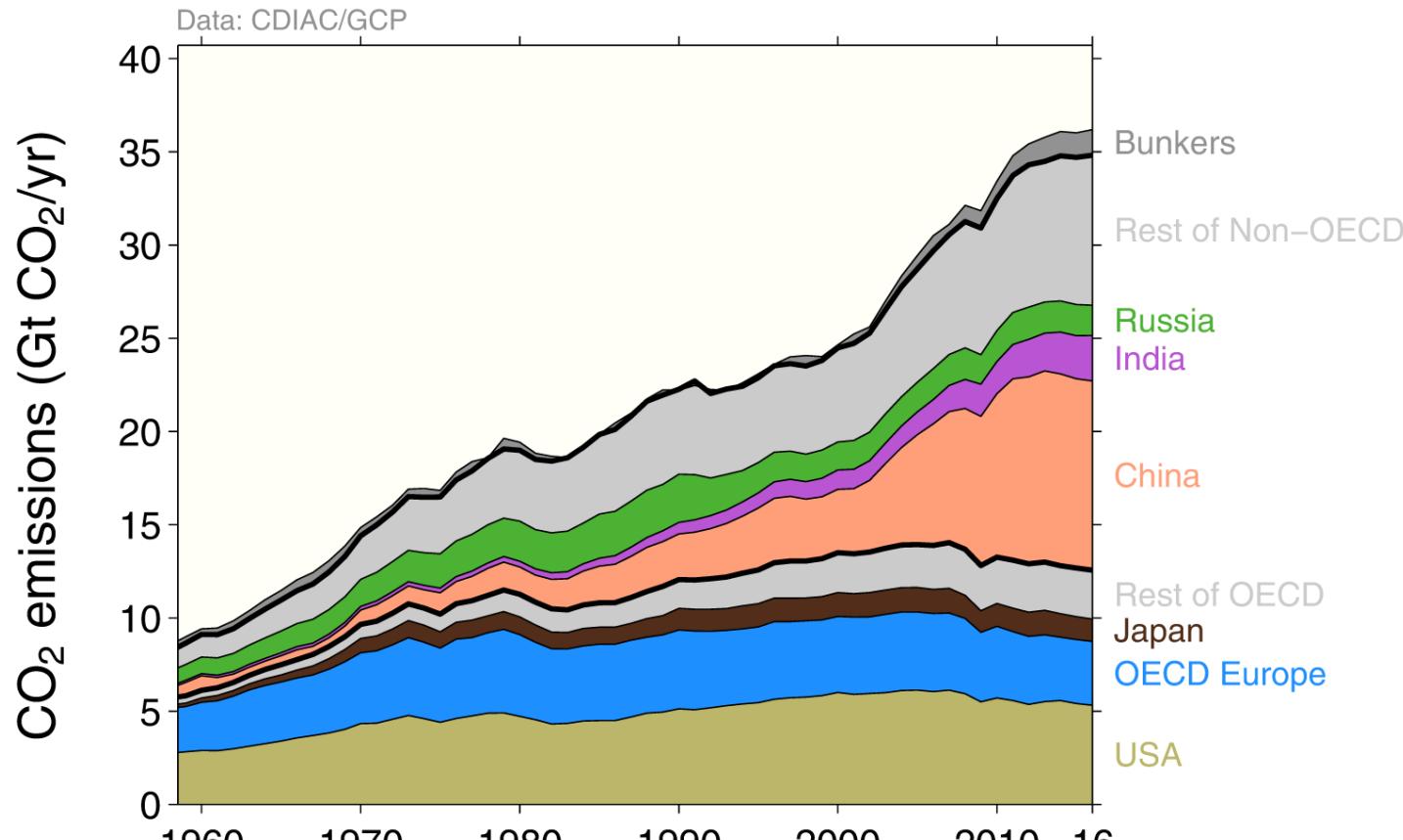


CO_2 , CH_4 & N_2O 800 000 BC-2016 AD



Global CO₂ emissions by country

Emissions from OECD countries are about the same as in 1990
Emissions from non-OECD countries have increased rapidly in the last decade



Fate of anthropogenic CO₂ emissions (2007–2016)



Sources = Sinks

34.4 GtCO₂/yr

88%



12%

4.8 GtCO₂/yr

17.2 GtCO₂/yr

46%

30%

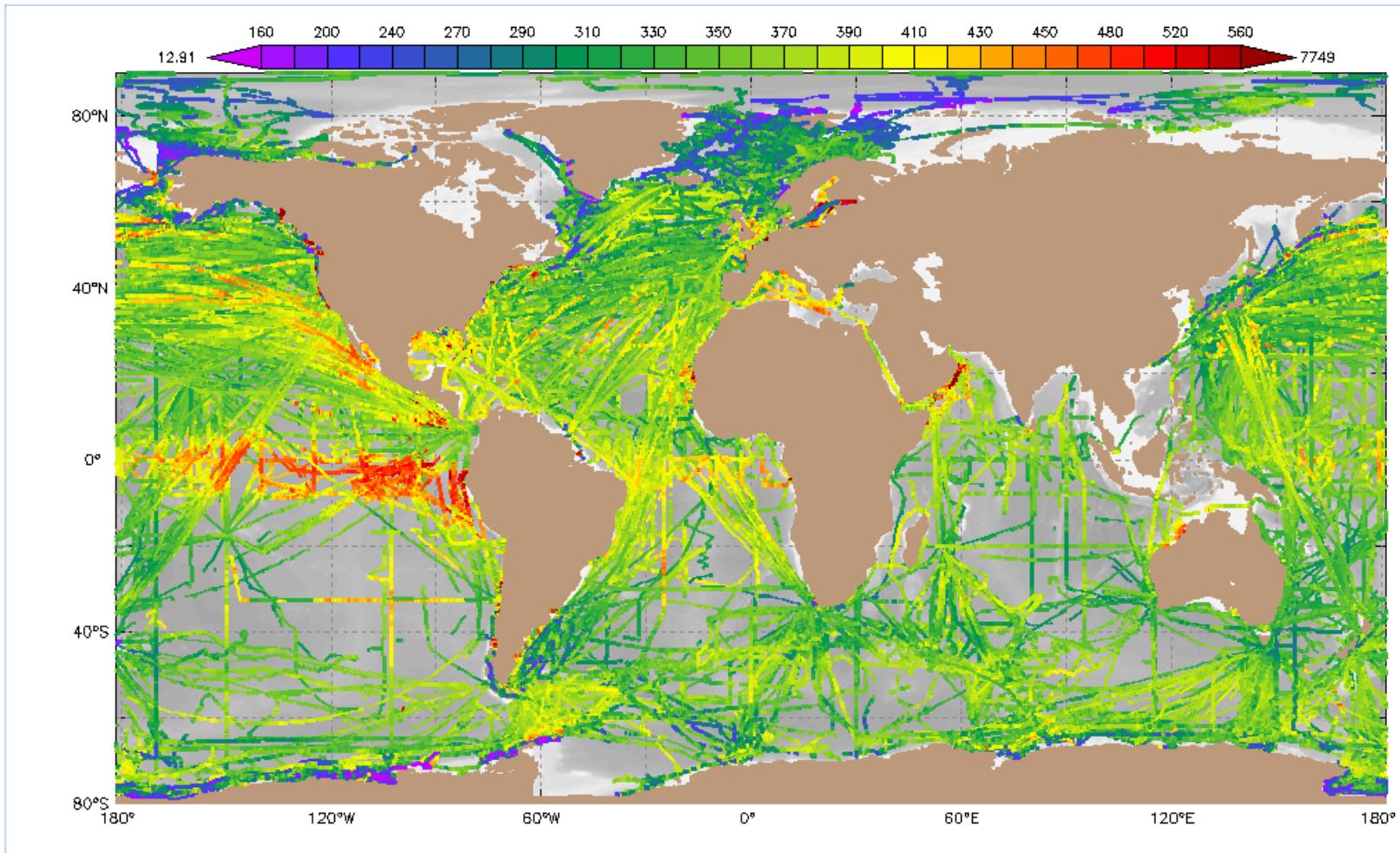
11.0 GtCO₂/yr

24%

8.8 GtCO₂/yr



Ocean Acidification



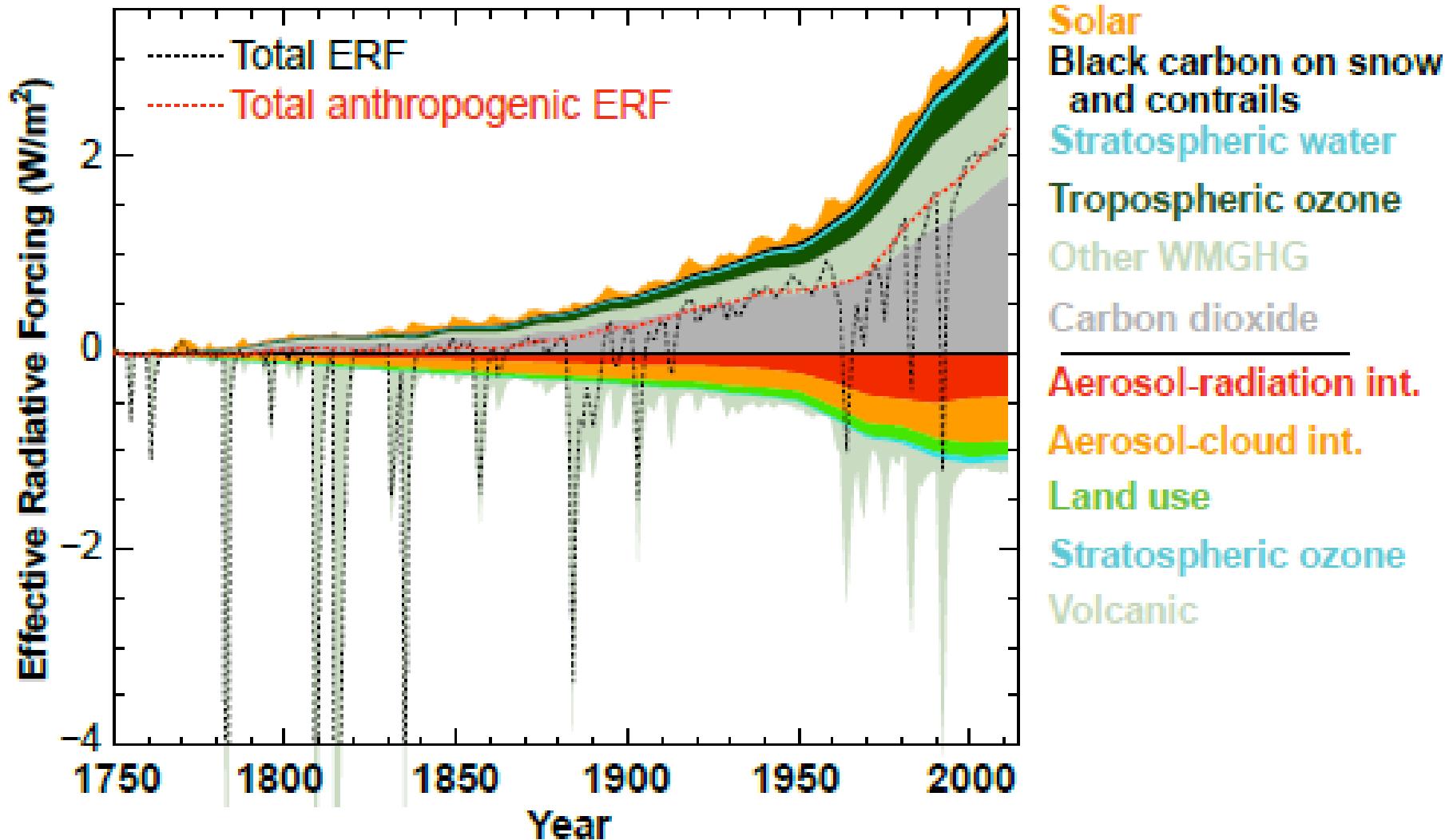
Ocean acidification is a global problem that threatens marine organisms, ecosystems, services and resources and that has potentially considerable ecological and socio-economic consequences (food security, livelihood of fishing communities)



WMO OMM

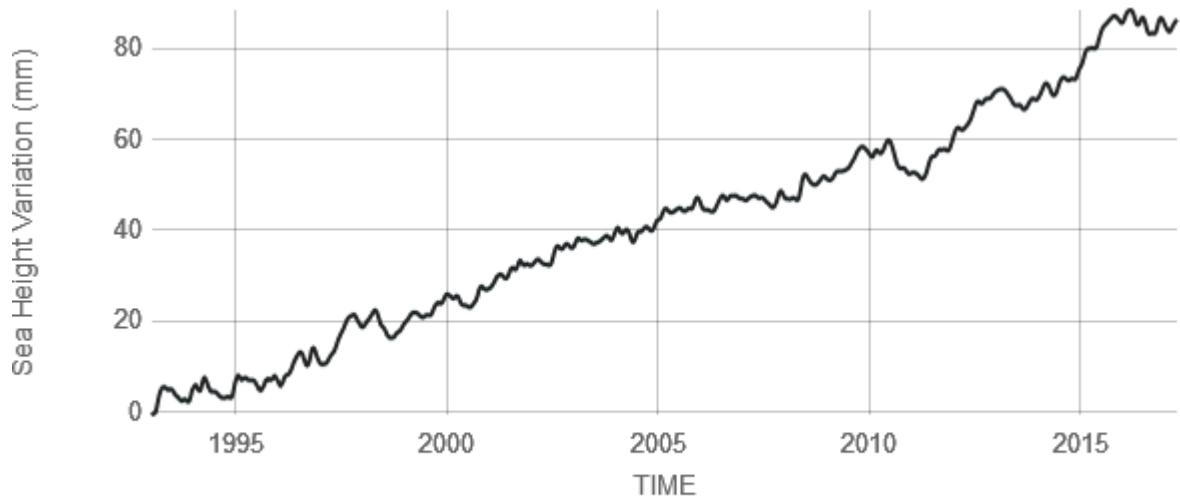
DATA SET: SOCAT v4 Data Collection
VARIABLE: fCO₂ recommended (µatm)
01-Jan-1957 00:00 to 31-Dec-2016 00:00

Time Evolution of Forcings

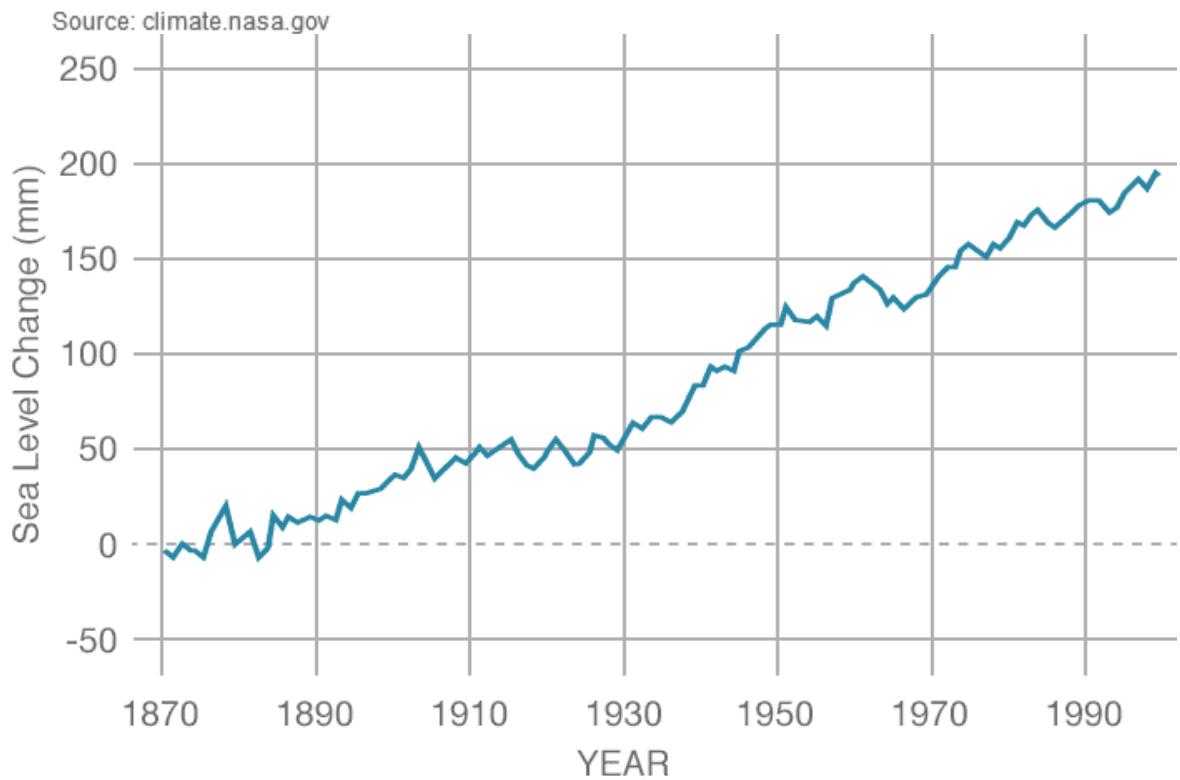


Global sea level rise: + 26 cm 1870-2017

NASA-EUMETSAT
Satellites
(1993-present)



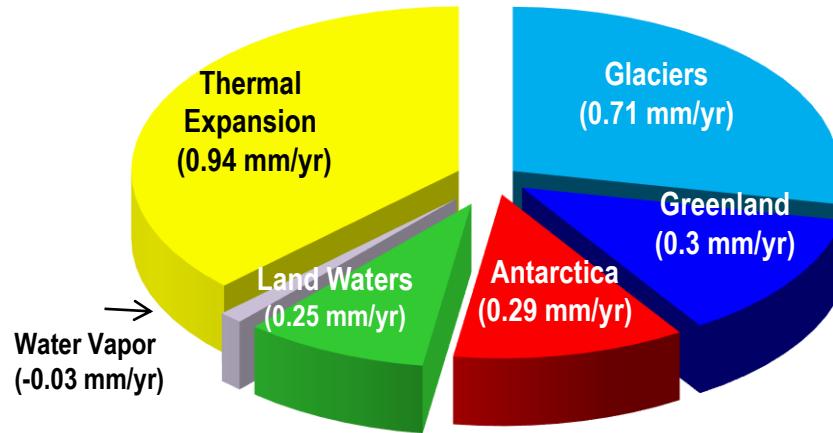
Tide gauges
(1870-2000)



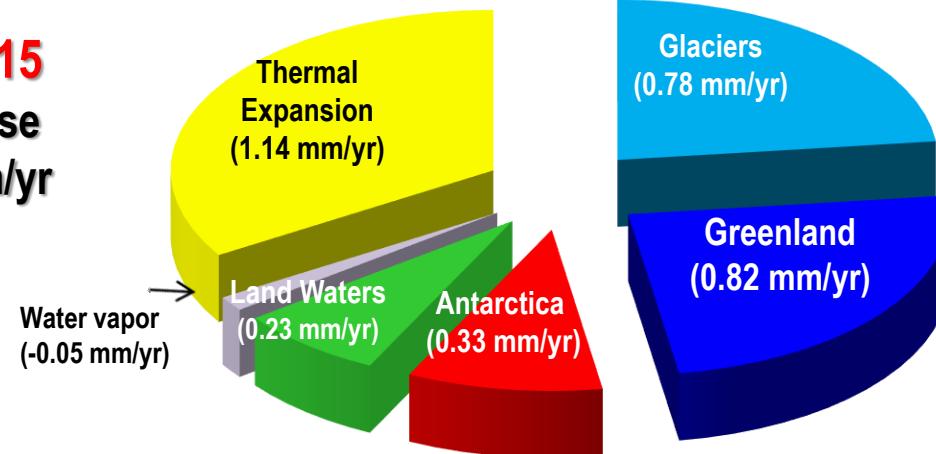
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Contributions to global sea level rise

1993-2004
GMSL rise
= 2.7 mm/yr



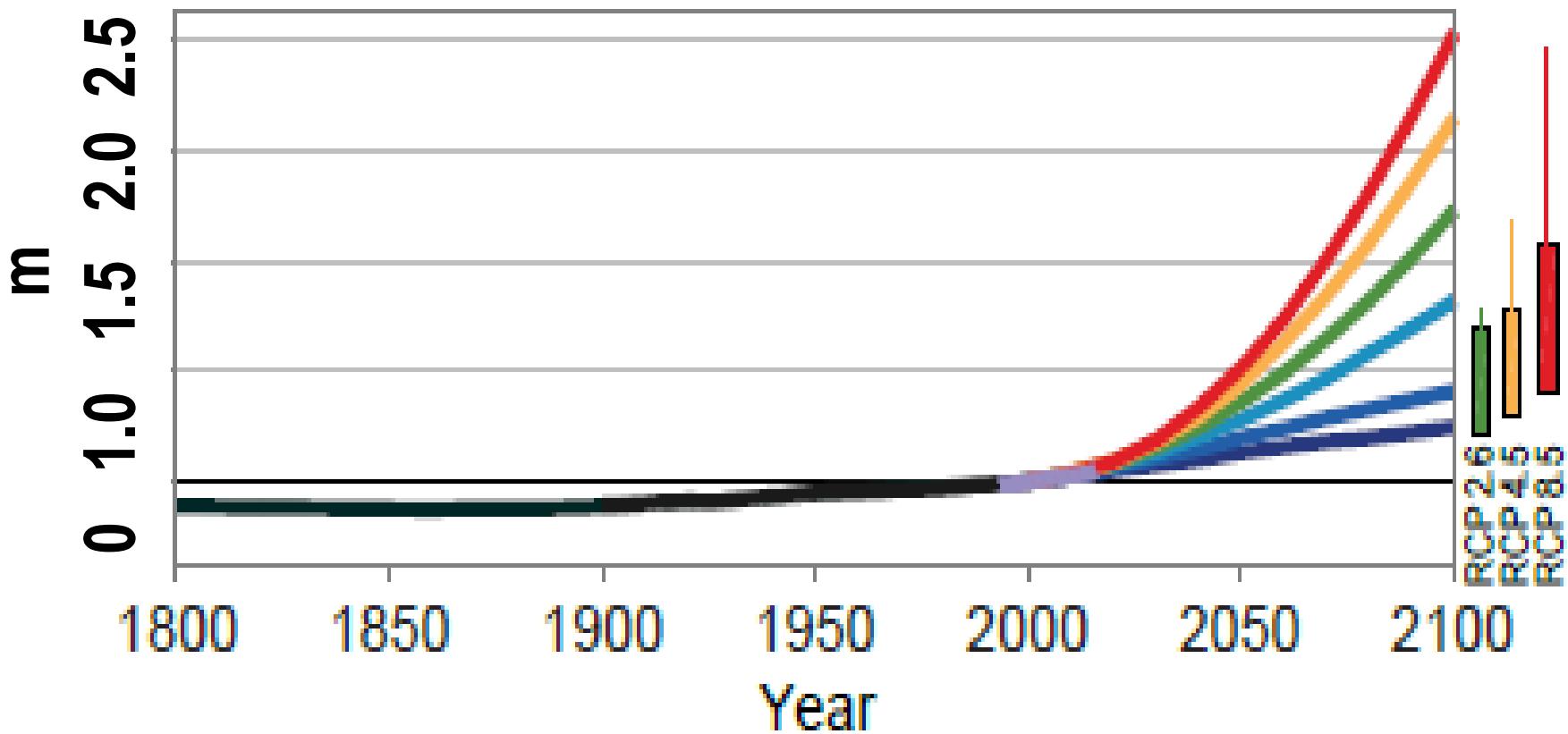
2004-2015
GMSL rise
= 3.5 mm/yr



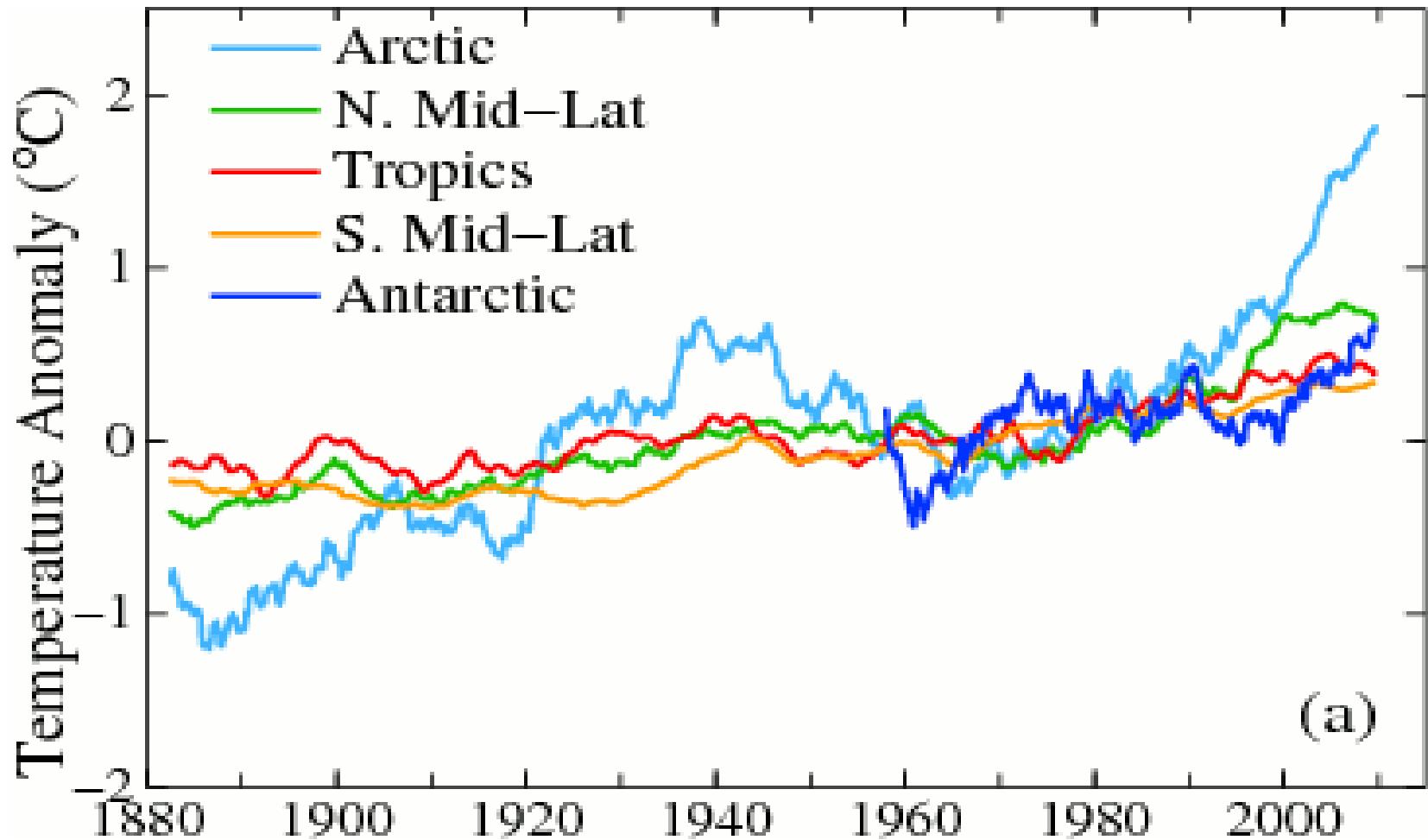
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Source: LEGOS

Sea level 1800-2100

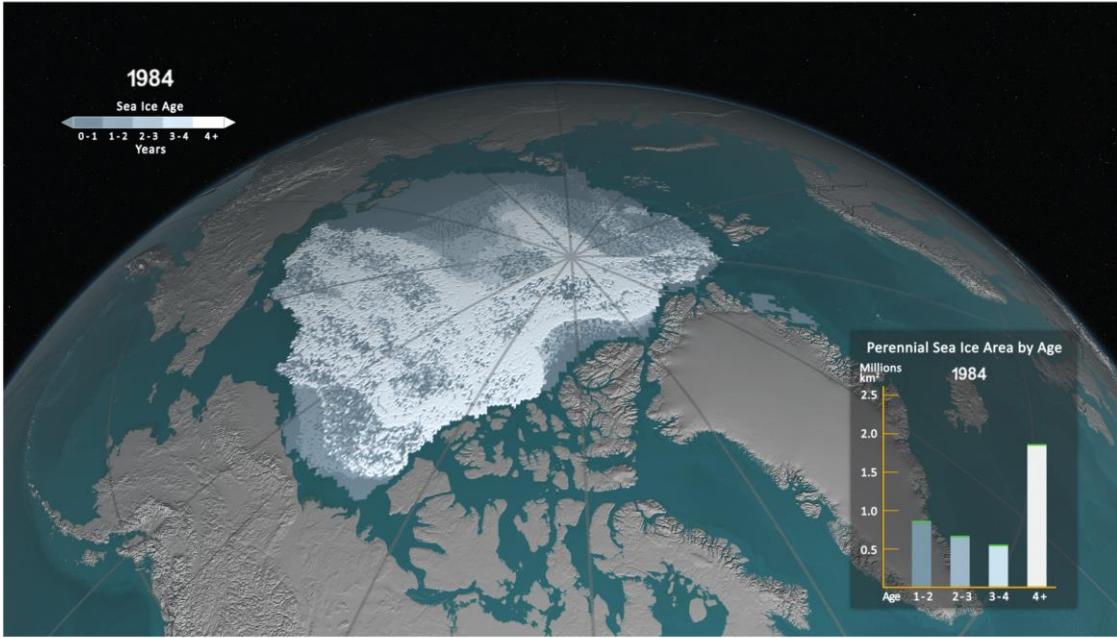


Arctic has warmed twice as fast as the global mean



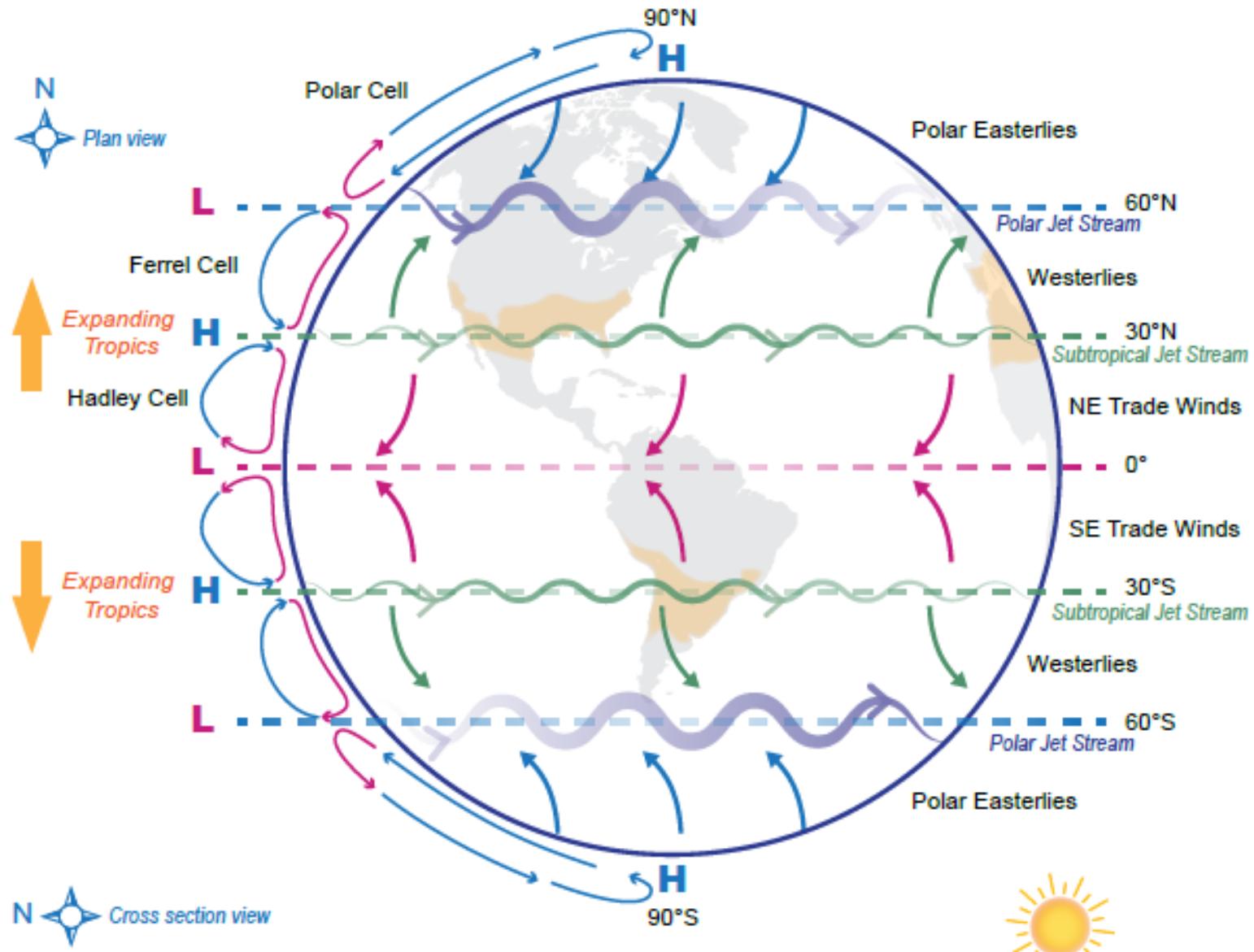
Sato and Hansen (2016)

Multi-year ice 1984 and 2016



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Changes in the Arctic affect weather globally

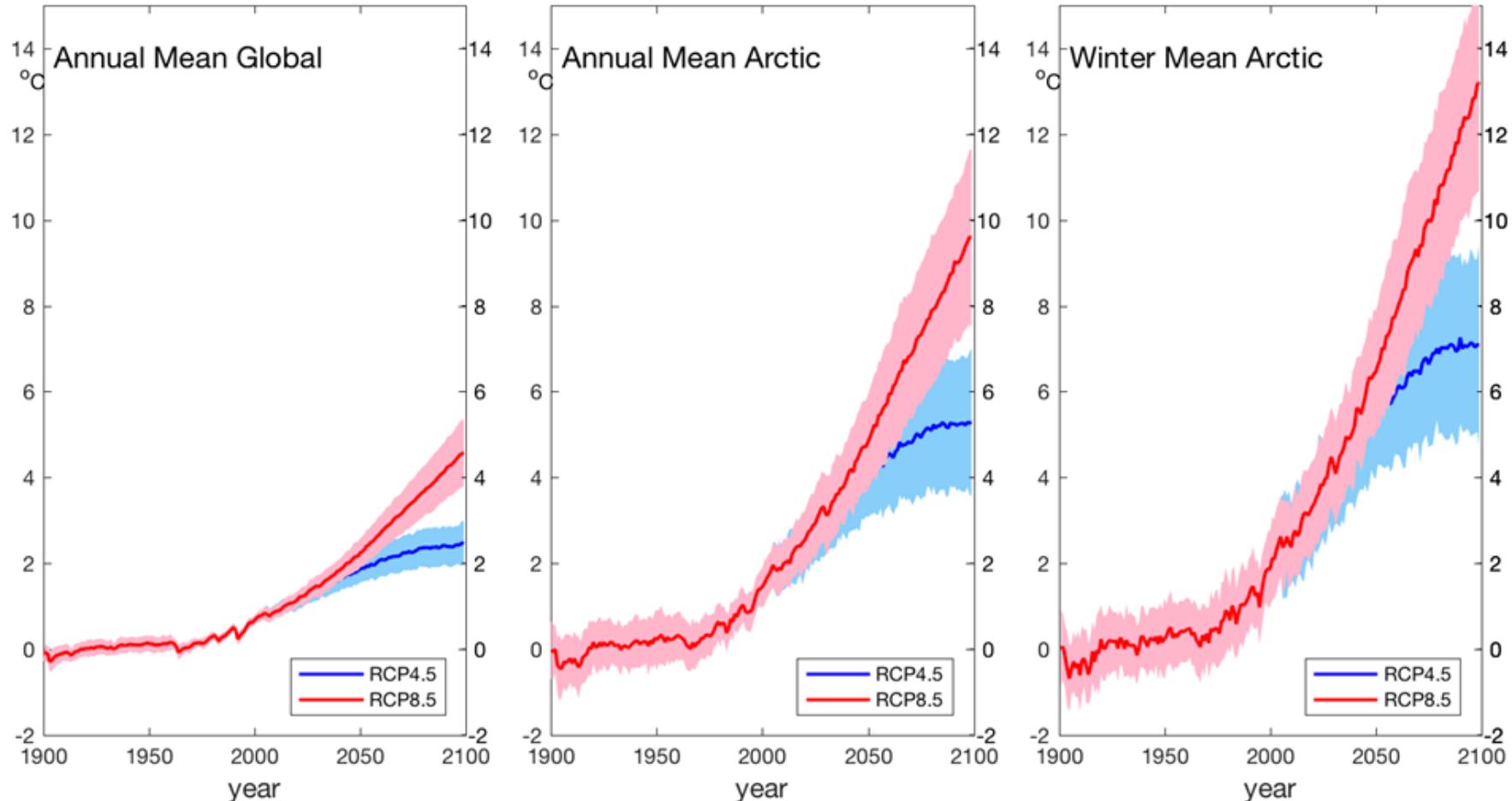


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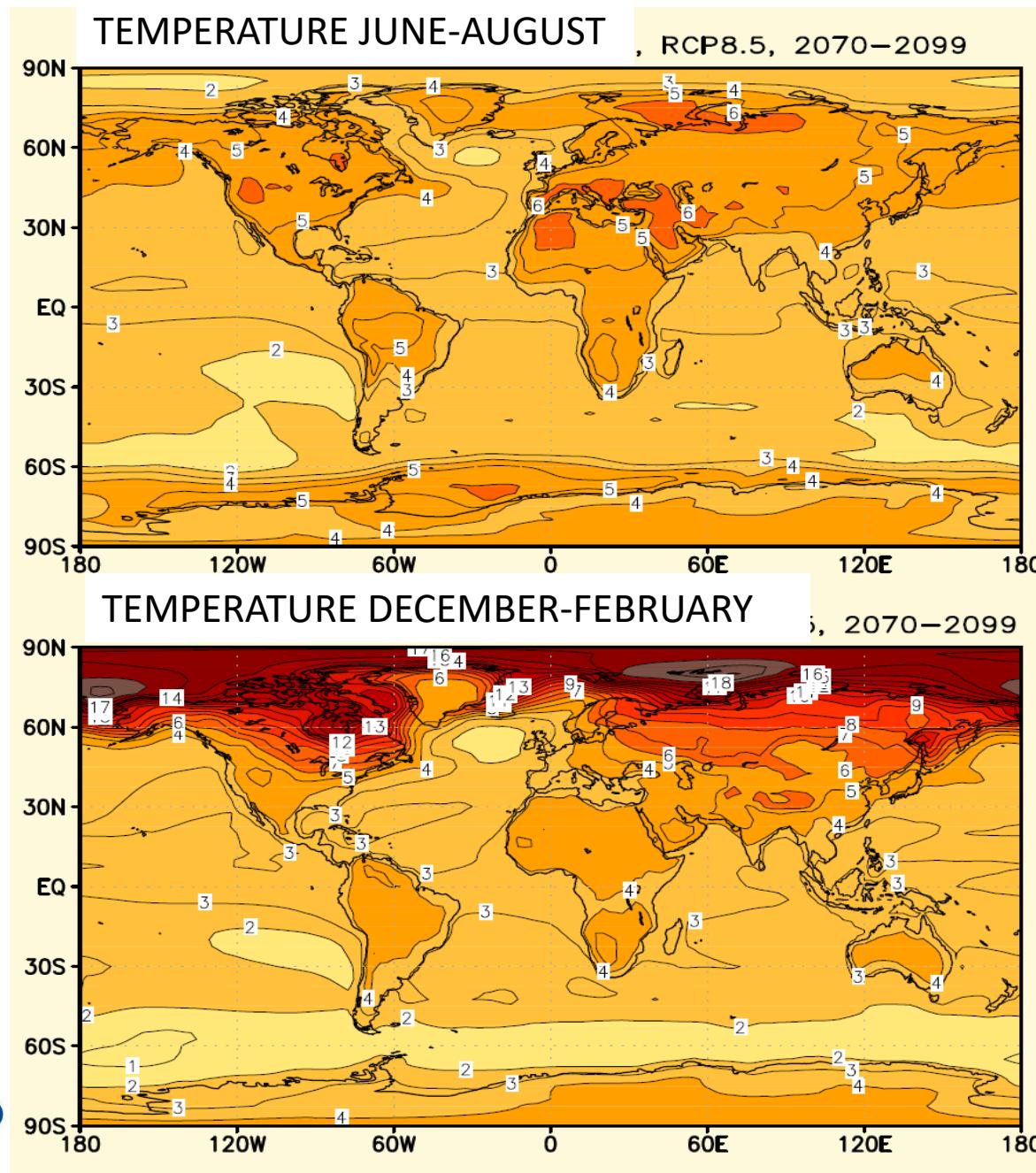
Arctic and global temperatures 1900-2100

Averaged over 36 global climate models

RCP 4.5 (blue)= upper end of Paris COP21 Agreement , RCP 8.5 (red)= business as usual

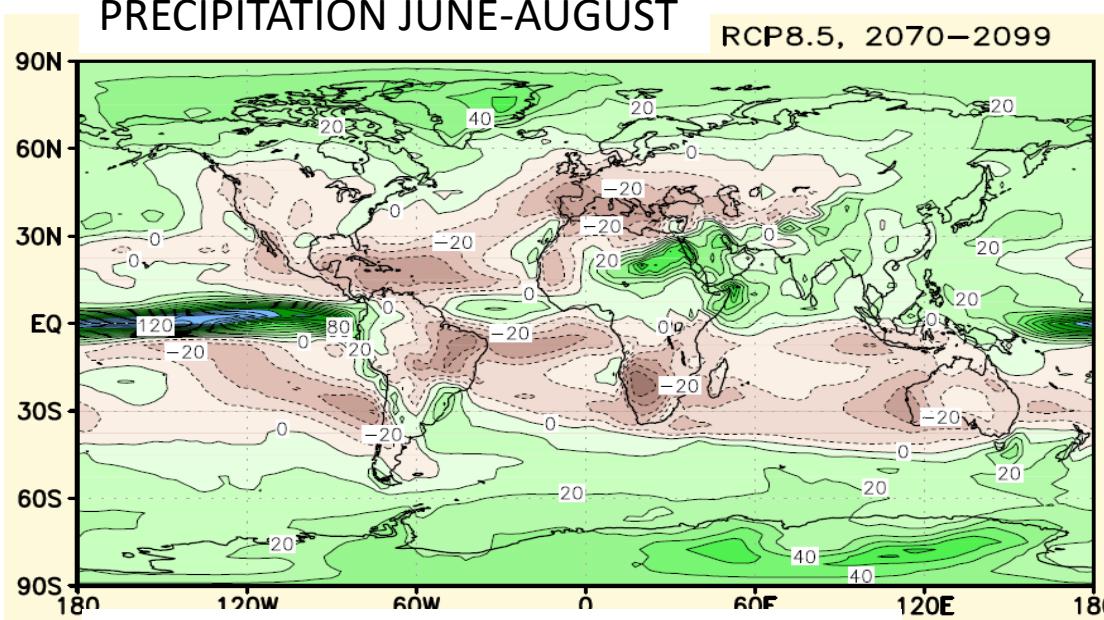


Temperature change =>2070-99, RCP 8.5

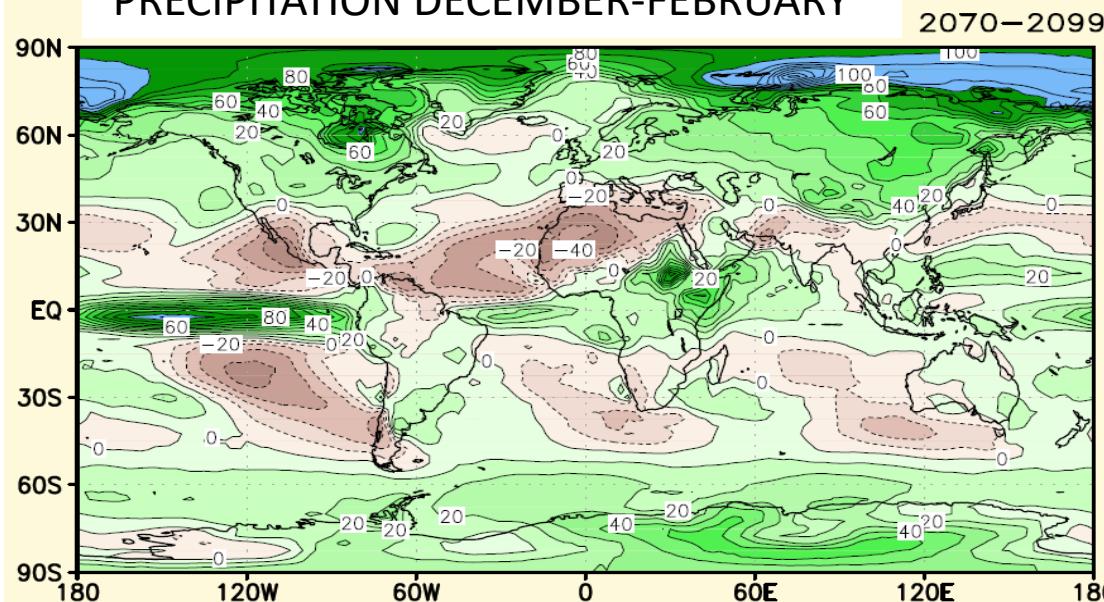


Precipitation change =>2070-99, RCP 8.5

PRECIPITATION JUNE-AUGUST



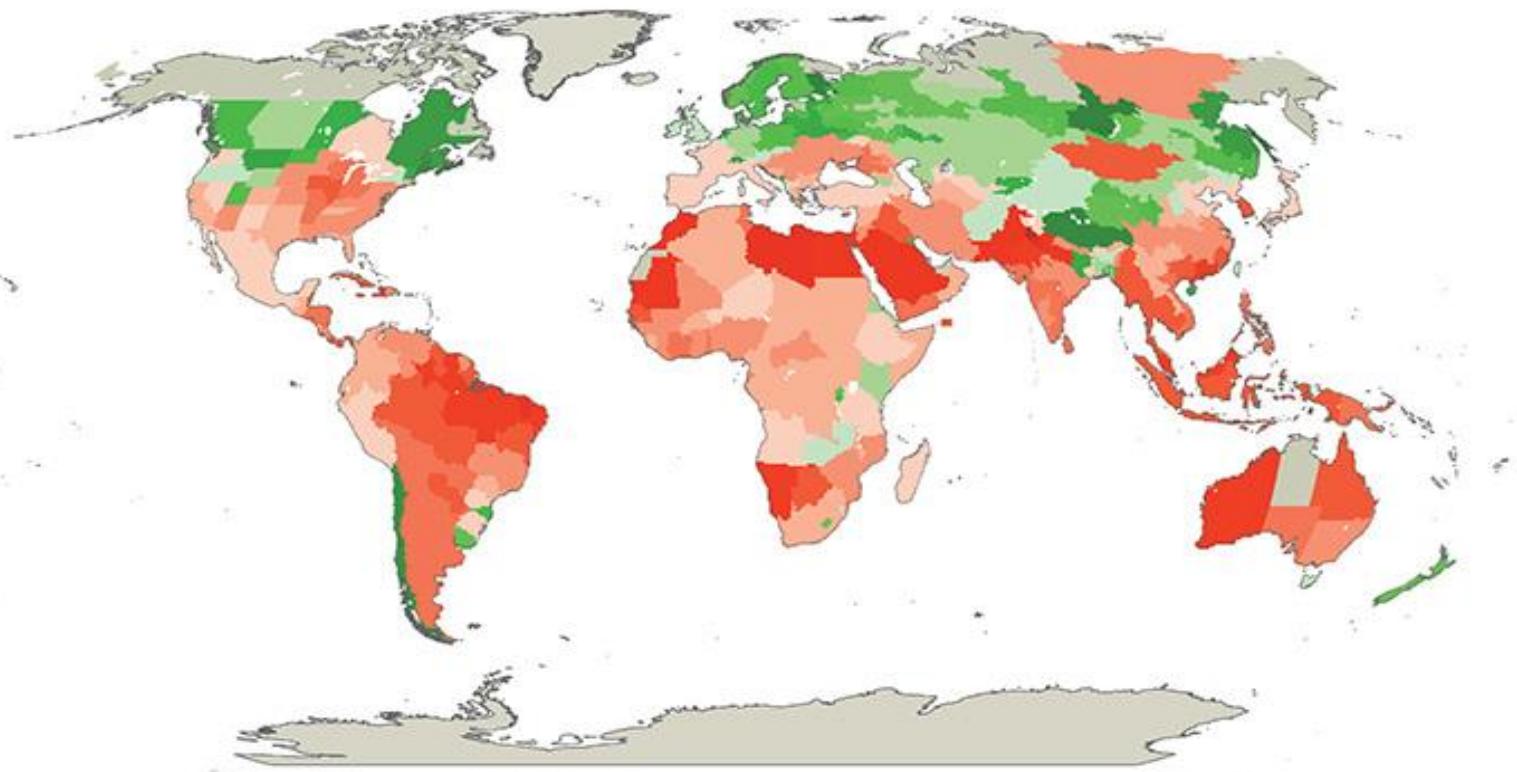
PRECIPITATION DECEMBER-FEBRUARY



WMO

Impact of 3 C warming on crop yields

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



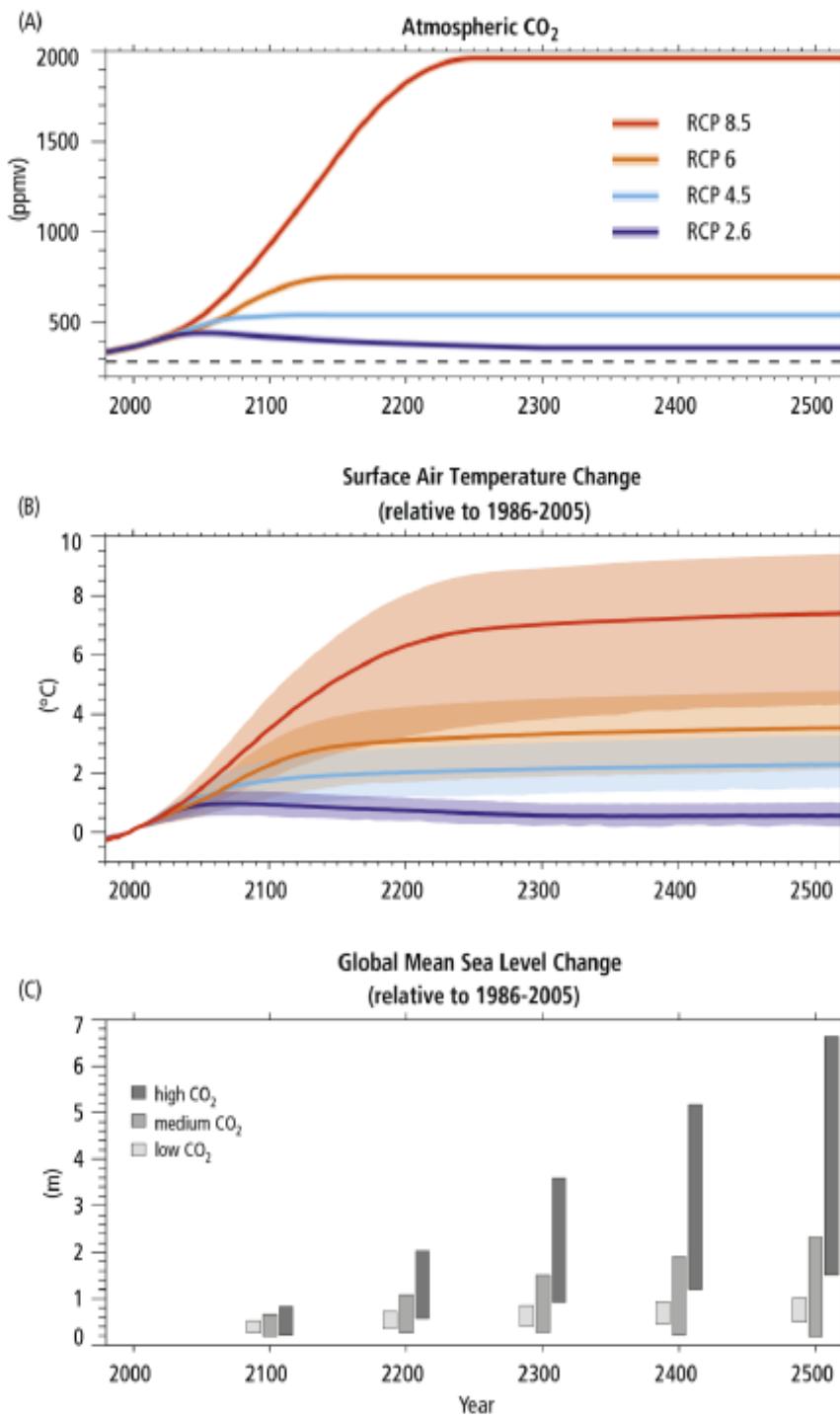
WORLD RESOURCES INSTITUTE



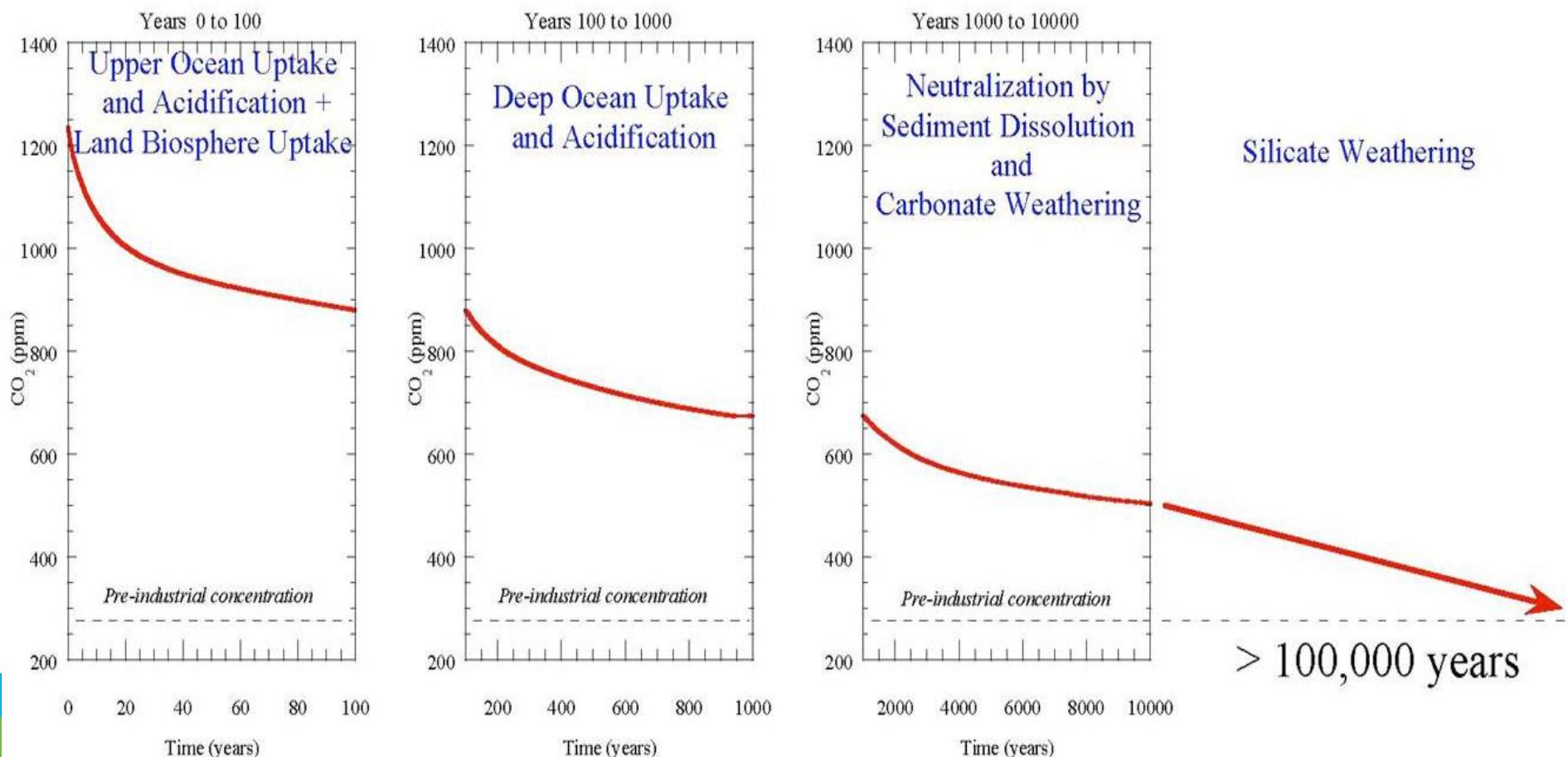
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Sources: <http://ow.ly/rpfMN>

2000-2500? Various emission pathways:

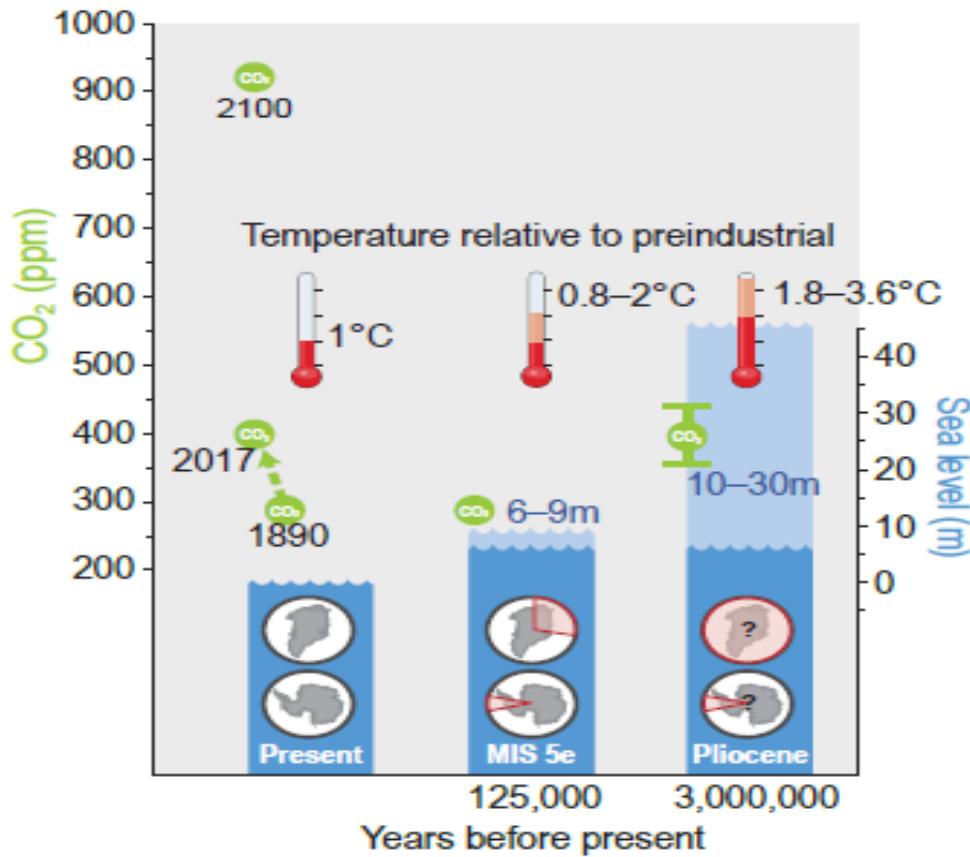


How long time the return of CO₂ to "normal" takes?

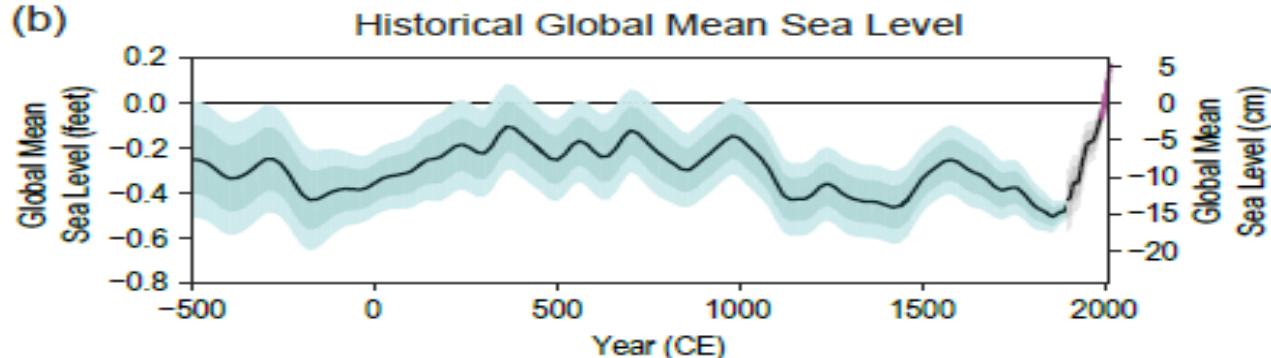


Historical CO₂-temperature-sea level

(a)

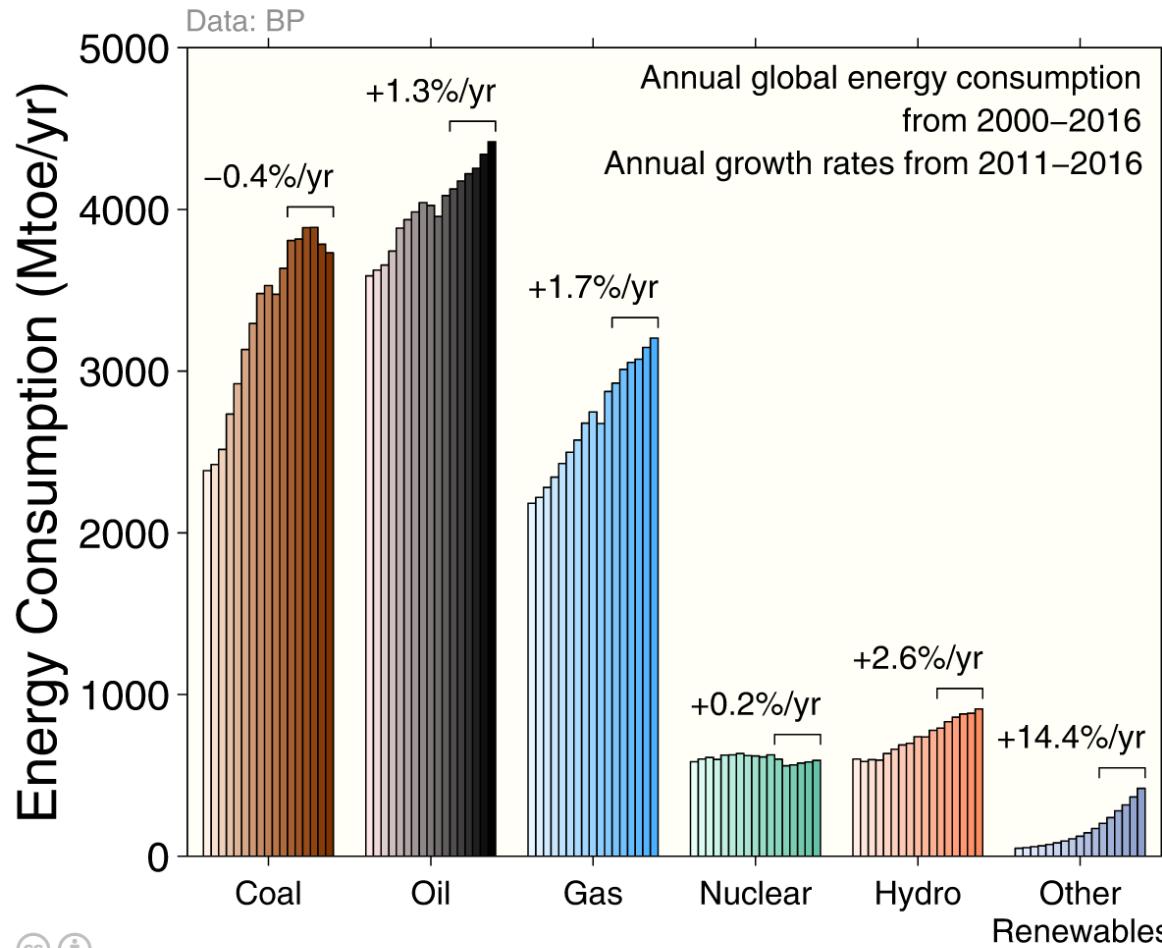


(b)



Energy consumption by energy type

Energy consumption by fuel source from 2000 to 2016, with growth rates indicated for the more recent period of 2011 to 2016



Global Carbon Project

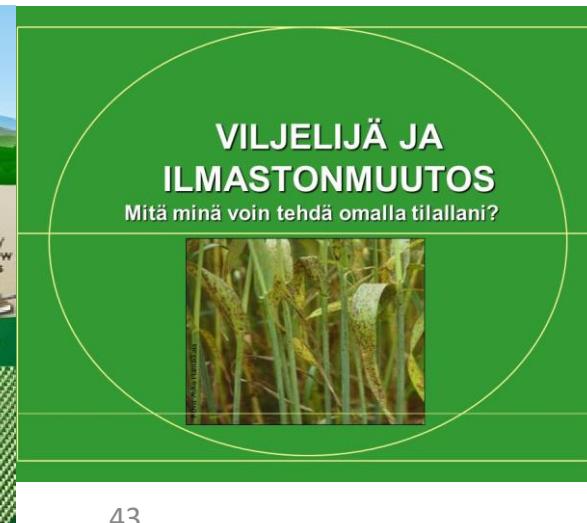
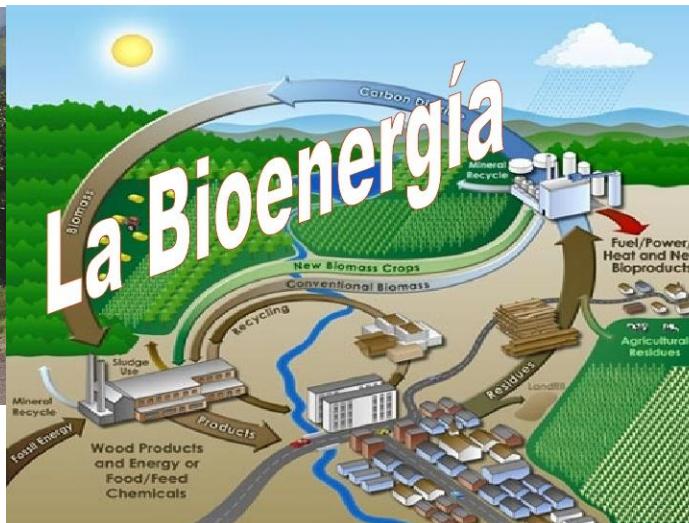


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Source: [BP 2017](#); [Jackson et al 2017](#); [Global Carbon Budget 2017](#)

Ilmastonmuutos/Suomi

- Kasvukausi on jo pidentynyt
- Metsien kasvu jo kiihtynyt
- Lumi- ja jääkausi lyhenemässä
- Arktinen jäätipeite huvennut, Arktinen hype?
- Metsien hiilinielukeskustelu osin hakoteillä
- Ilmastonmuutoksen torjunta ja sopeutuminen uusia businessmahdollisuuksia
- Vaikutukset maailmantalouteen, kriiseihin & pakolaistulviin => Suomikaan ei ole voittaja



WMO OMM



WORLD
METEOROLOGICAL
ORGANIZATION

