Disasters, climate change mountain areas

Prof. Petteri Taalas
Secretary-General

WEATHER CLIMATE WATER
TEMPS CLIMAT EAU

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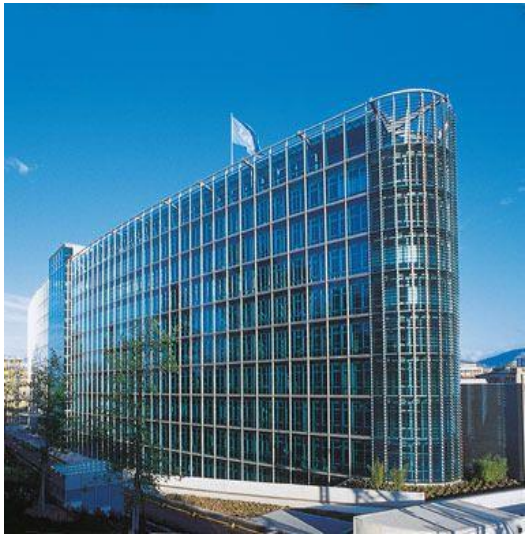

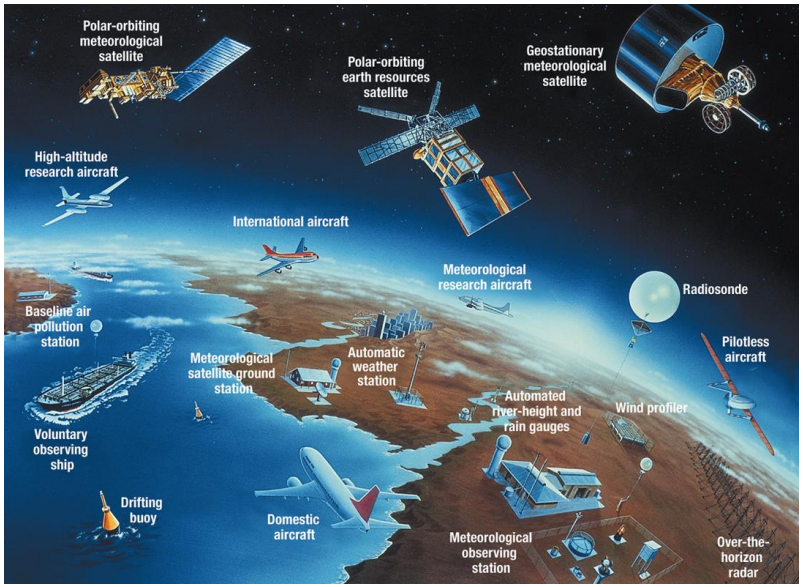

- UN Specialized Agency on weather, climate & water
- 191 Members, HQ in Geneva
- 2nd oldest UN Agency, 1873-
- Coordinates work of 200 000 national experts from meteorological & hydrological services and academia
- Co-Founder and host agency of IPCC (1st World Climate Conference)
- Co-Founder of UNFCCC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

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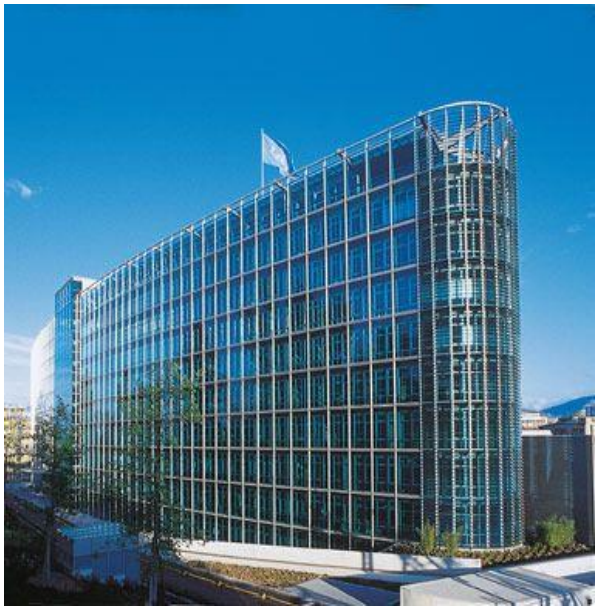
WMO Mission/key activities



1. World climate
2. Weather, disasters & safety
3. Oceans and water resources
4. Data & technology
5. Strengthening of the national service capabilities
6. Atmospheric research
7. Efficient governance

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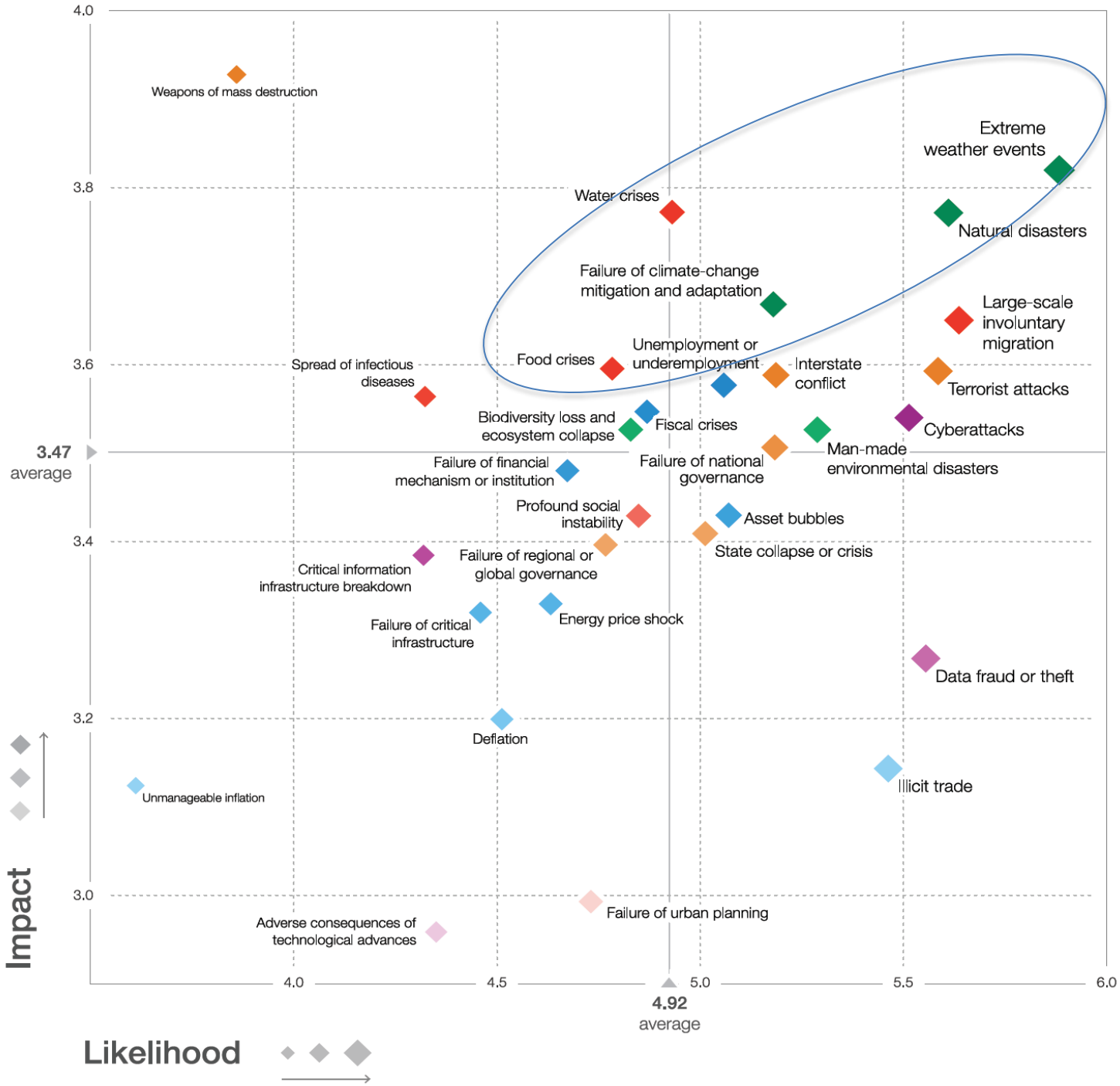
Global risks landscape 2017

World Economic Forum



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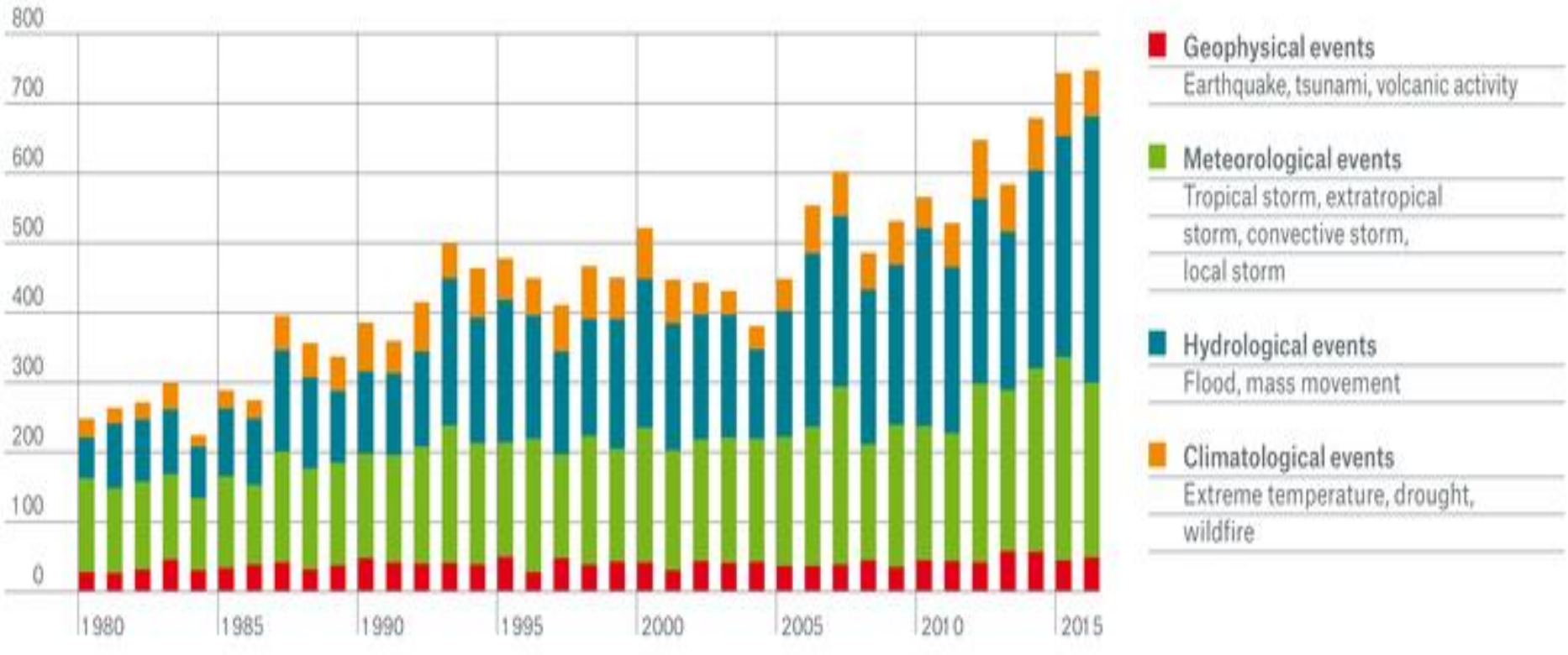
Growing number of weather related disasters 1980-2016



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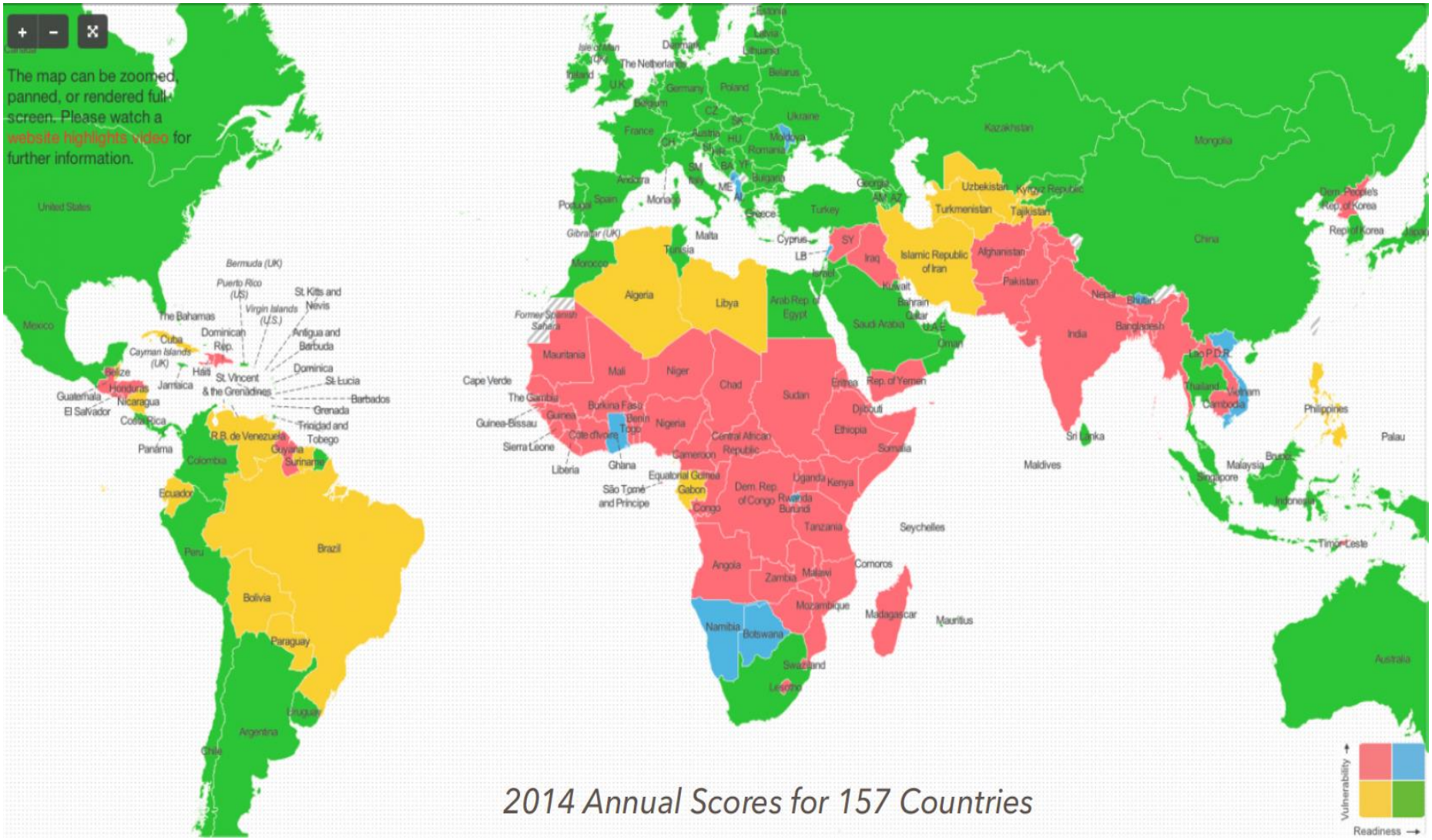
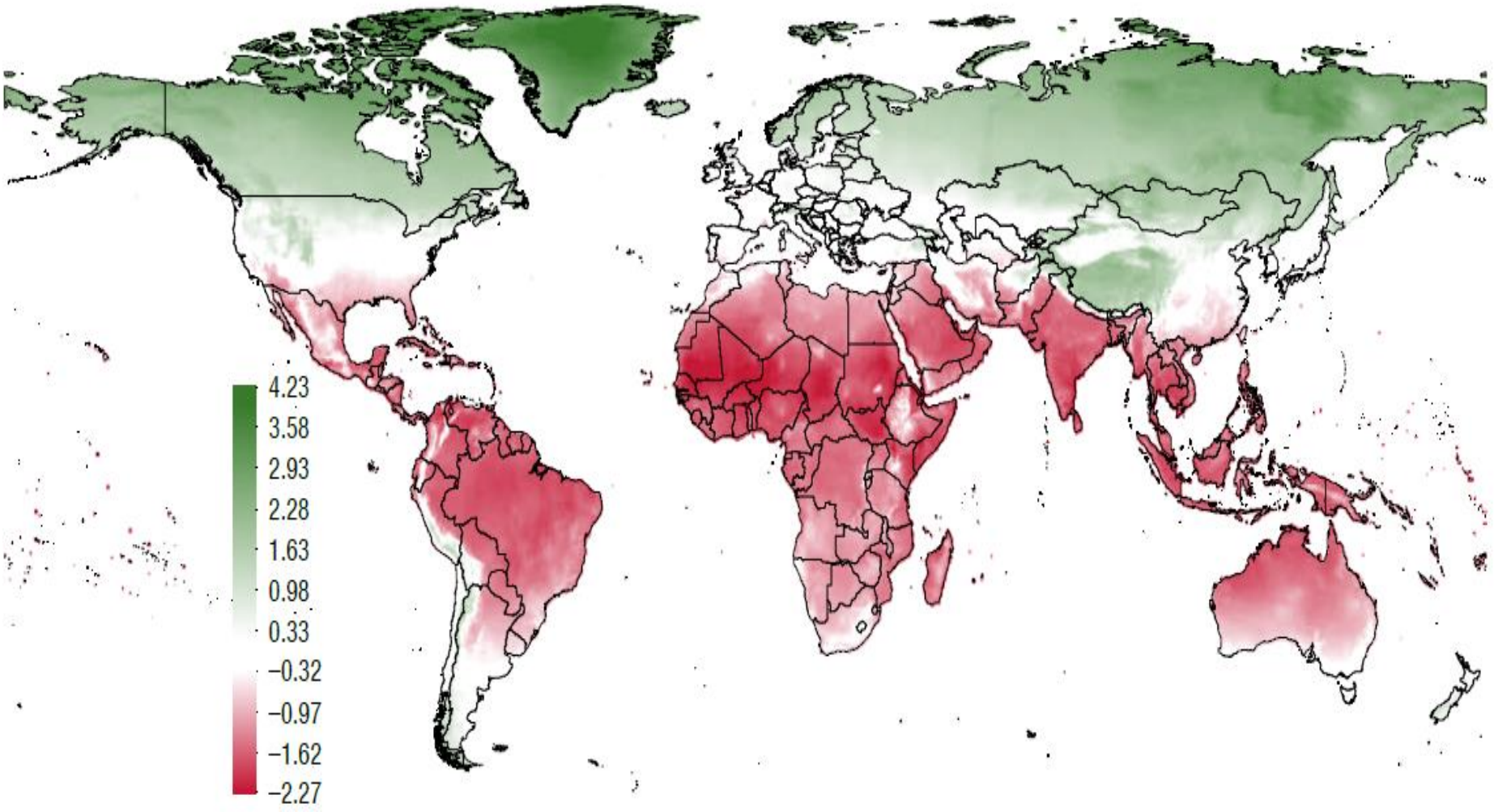
Global adaptation index



Univ. Notre Dame

Effect of 1°C temperature increase on per capita output



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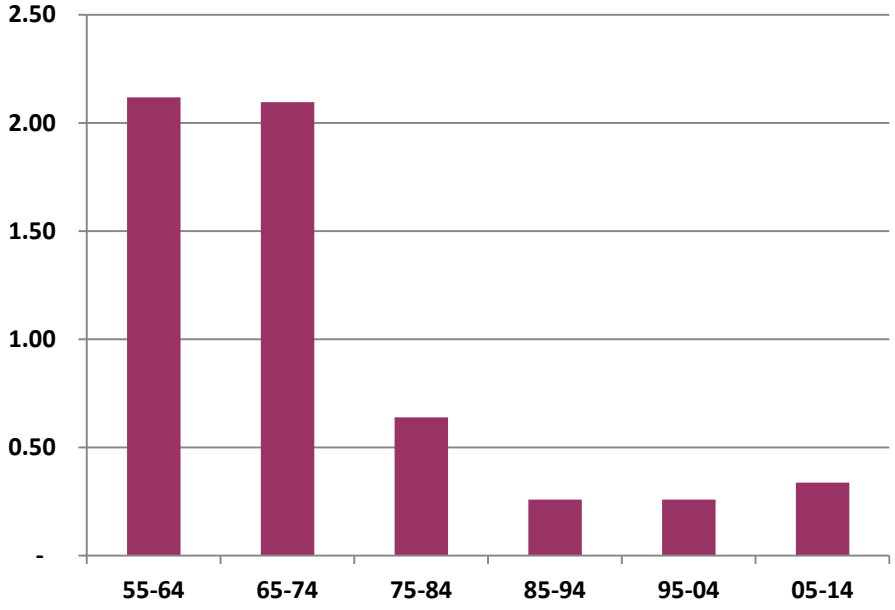
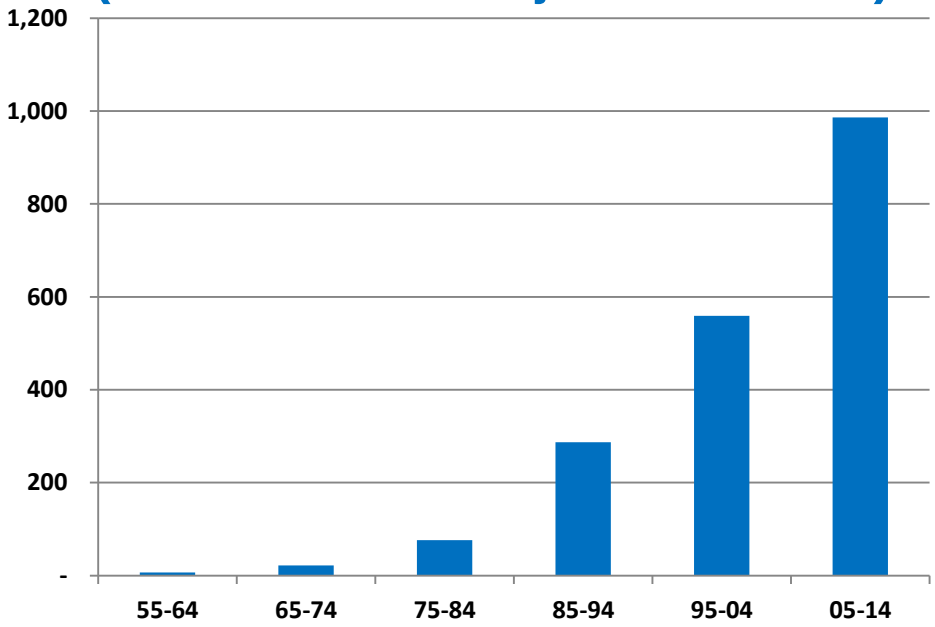
Source: International Monetary Fund (IMF) World Economic Outlook

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

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Hurricanes break records

Hurricanes Irma and Harvey - first time two Category 4 storms made landfall in USA in the same year.

Irma: 300 km/h winds for 37 hours – longest on record at that intensity

Irma: Three consecutive days as category 5 hurricane – longest on satellite record

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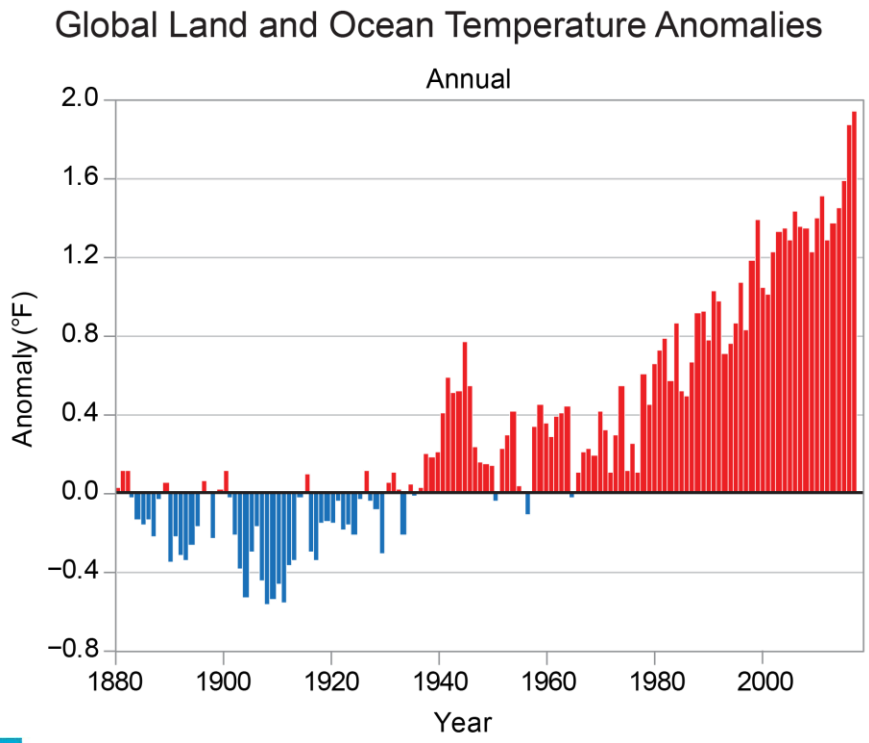
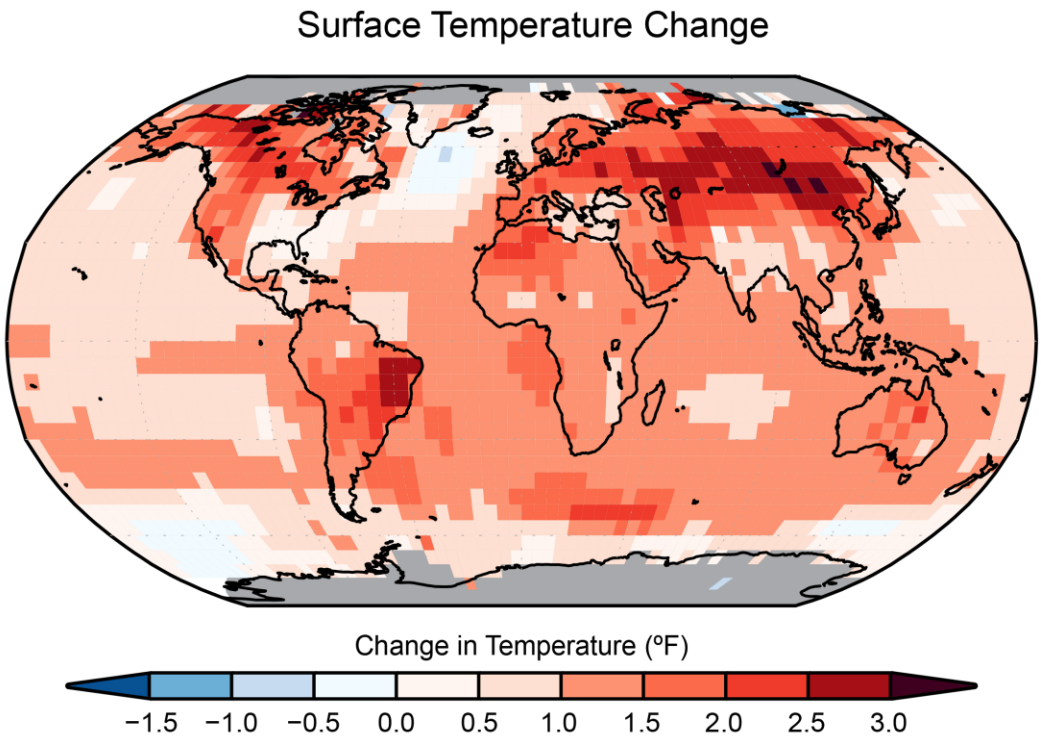
Global temperature deviations 1880-2016





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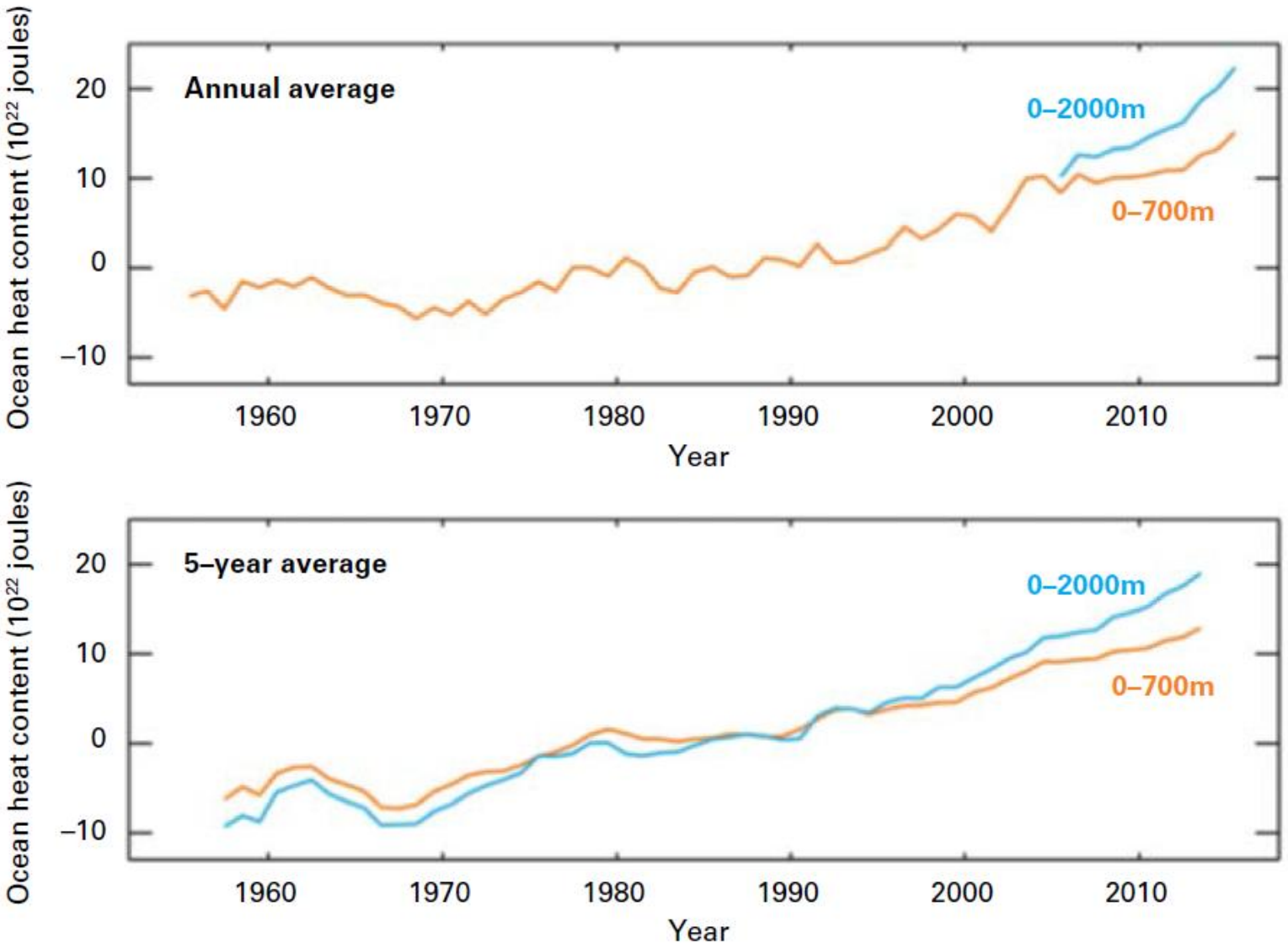
Ocean heat content



Source: Data from NOAA/NESDIS/NODC Ocean Climate Laboratory, United States, updated from Levitus et al. (2012)

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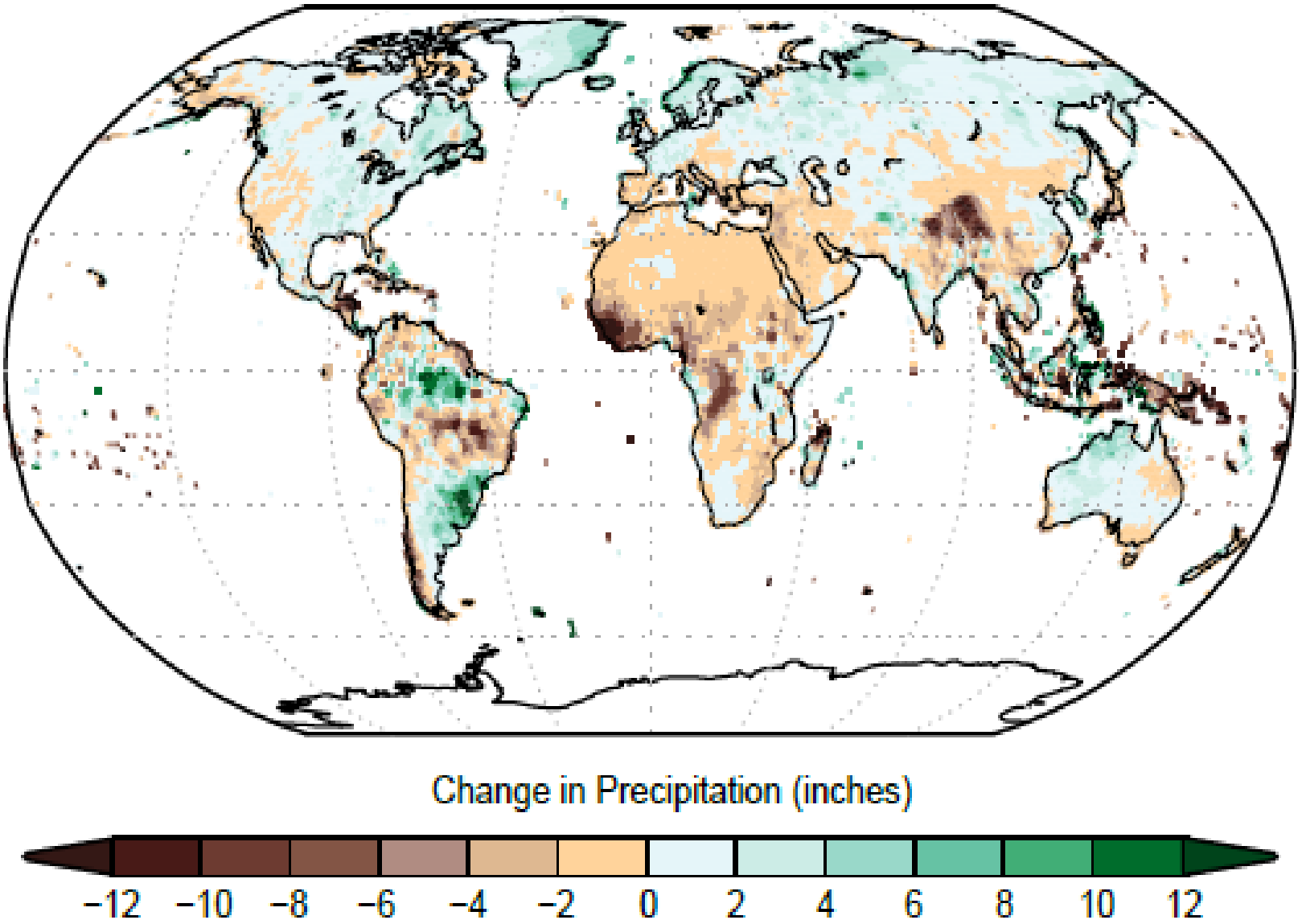
Global precipitation 1986–2015 vs. 1901–1960



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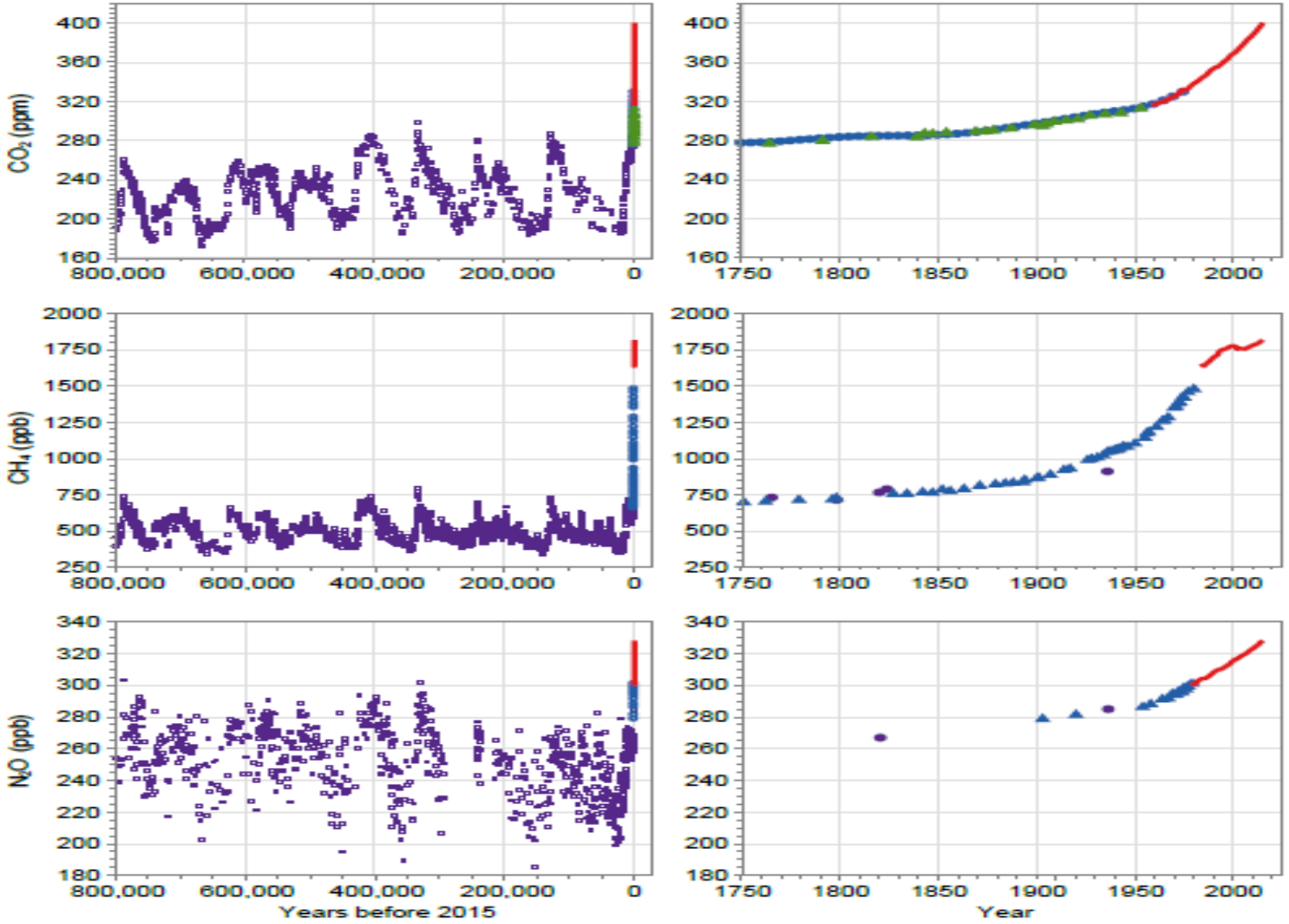
CO_2, CH_4 & N_2O 800 000 BC-2016 AD



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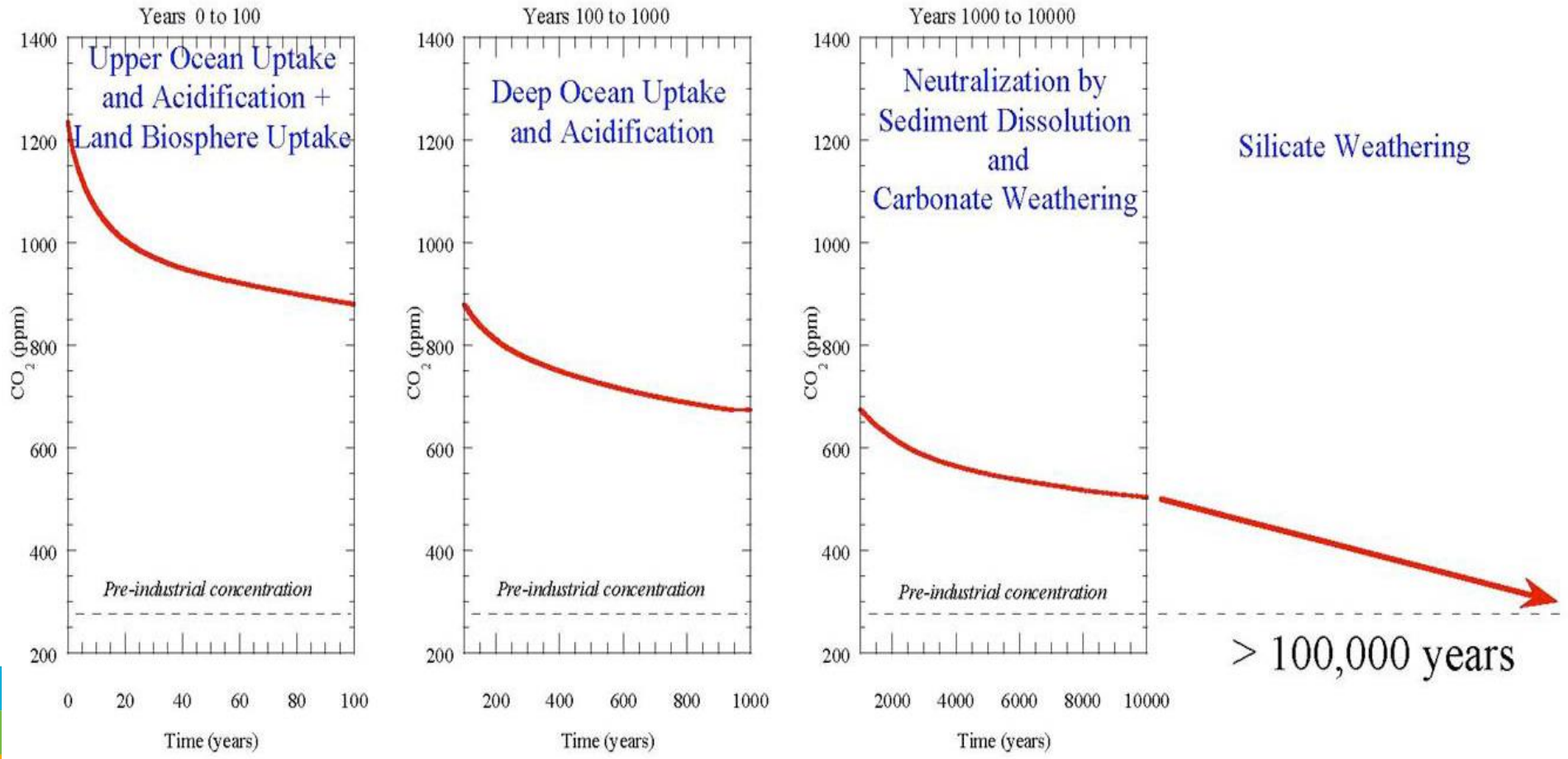
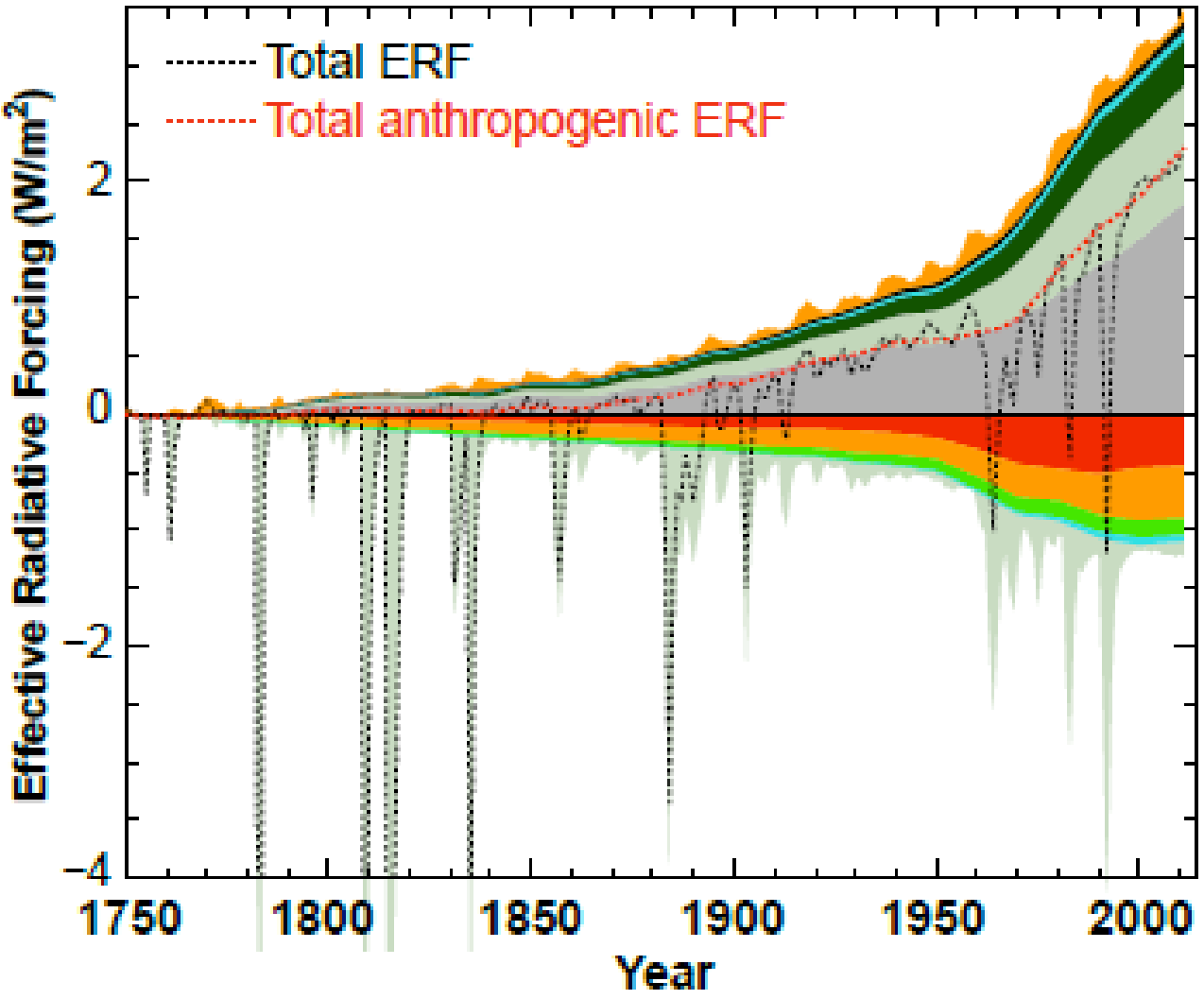
How long time the return of CO_2 to ”normal” takes?



Time Evolution of Forcings



Solar
Black carbon on snow and contrails
Stratospheric water
Tropospheric ozone
Other WMGHG
Carbon dioxide

Aerosol-radiation int.
Aerosol-cloud int.
Land use
Stratospheric ozone
Volcanic

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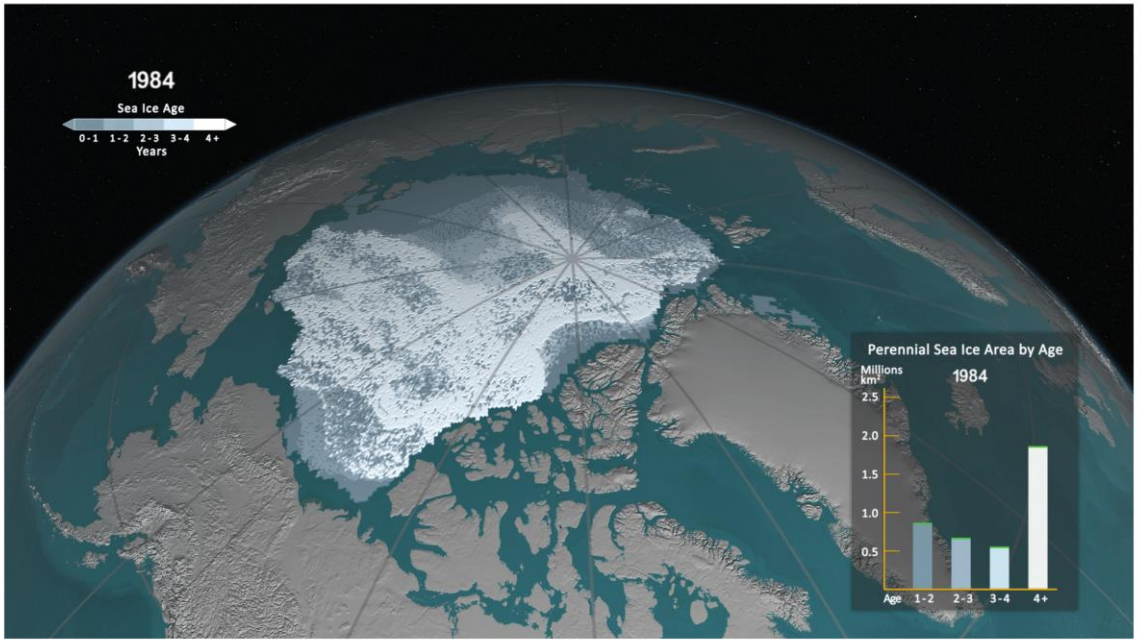
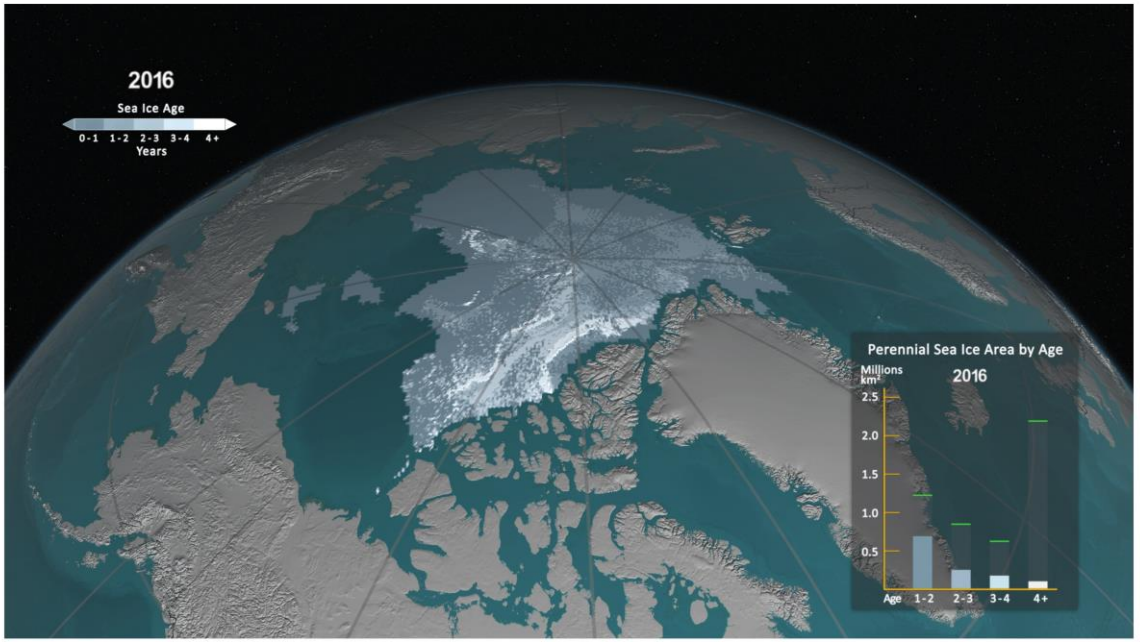
Multi-year ice 1984 and 2016





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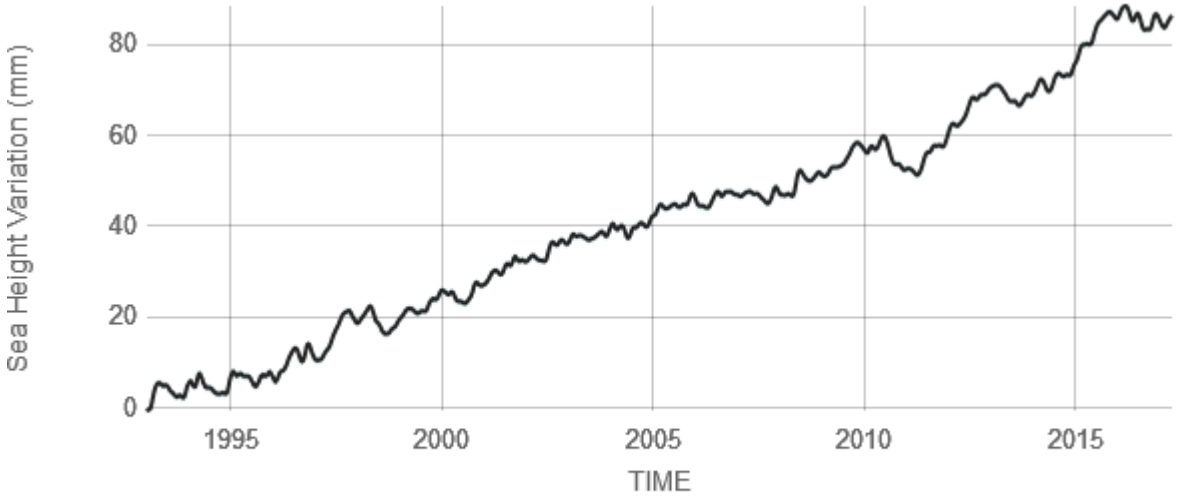
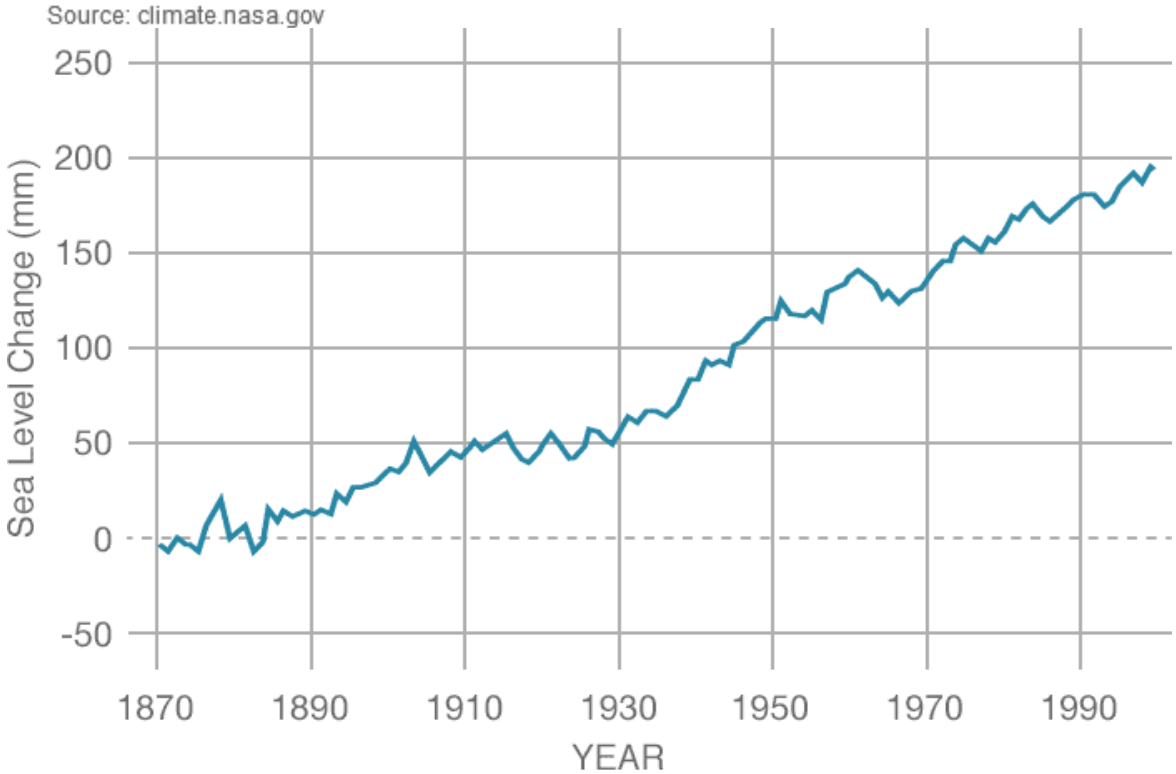
Global sea level rise: + 26 cm 1870-2017

NASA-EUMETSAT Satellites (1993-present)



Tide gauges (1870-2000)



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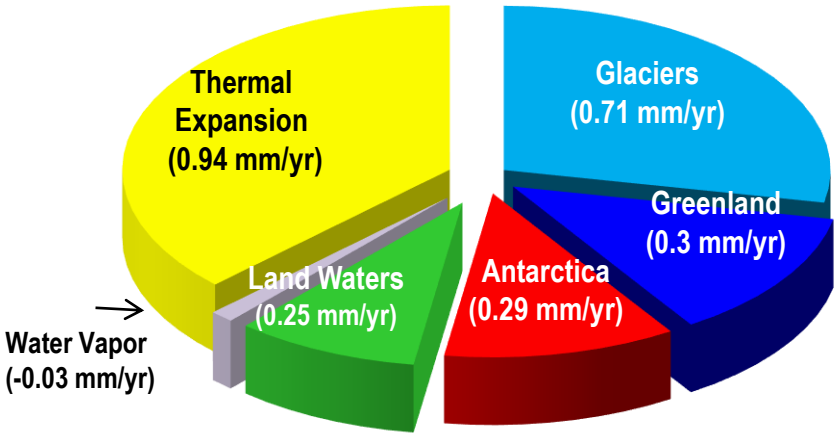
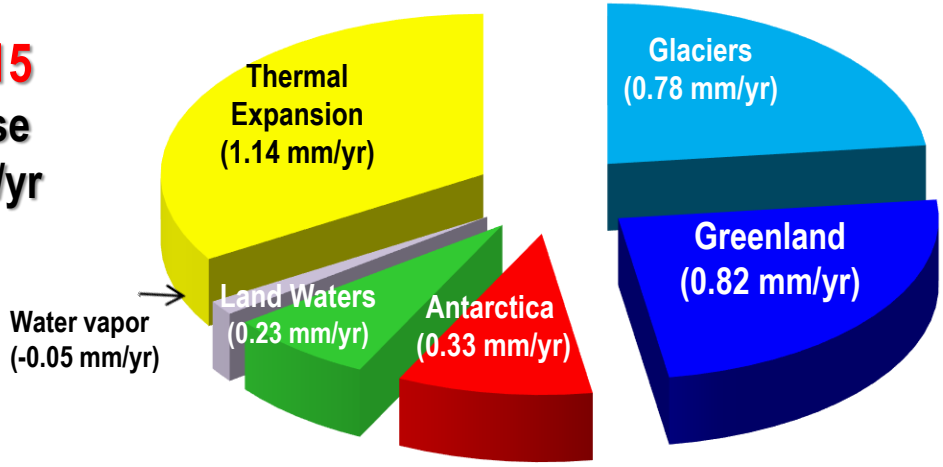
Contributions to global sea level rise

1993-2004
GMSL rise
= 2.7 mm/yr



→ *Total land ice: 47%*

2004-2015
GMSL rise
= 3.5 mm/yr



→ *Total land ice: 55%*

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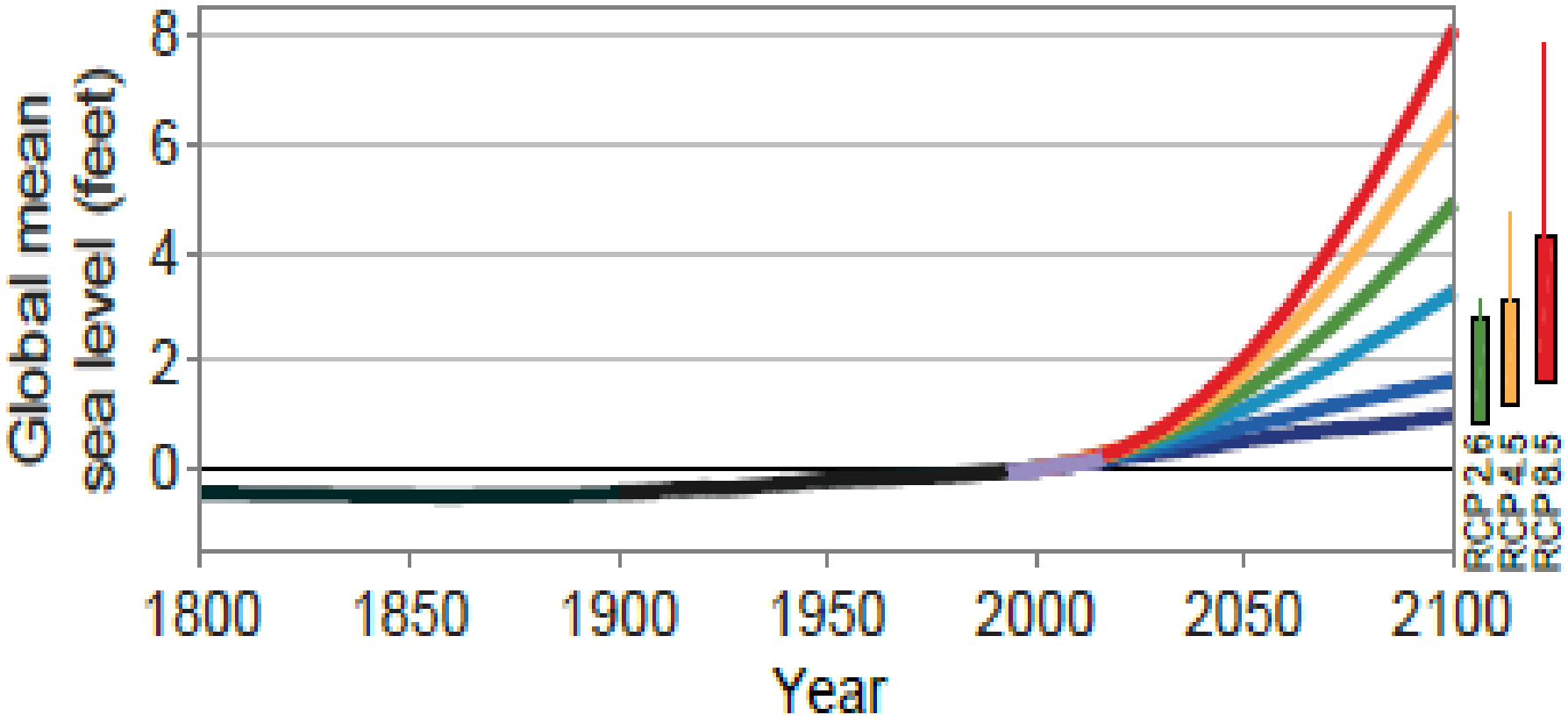
Source: LEGOS

Sea level 1800-2100



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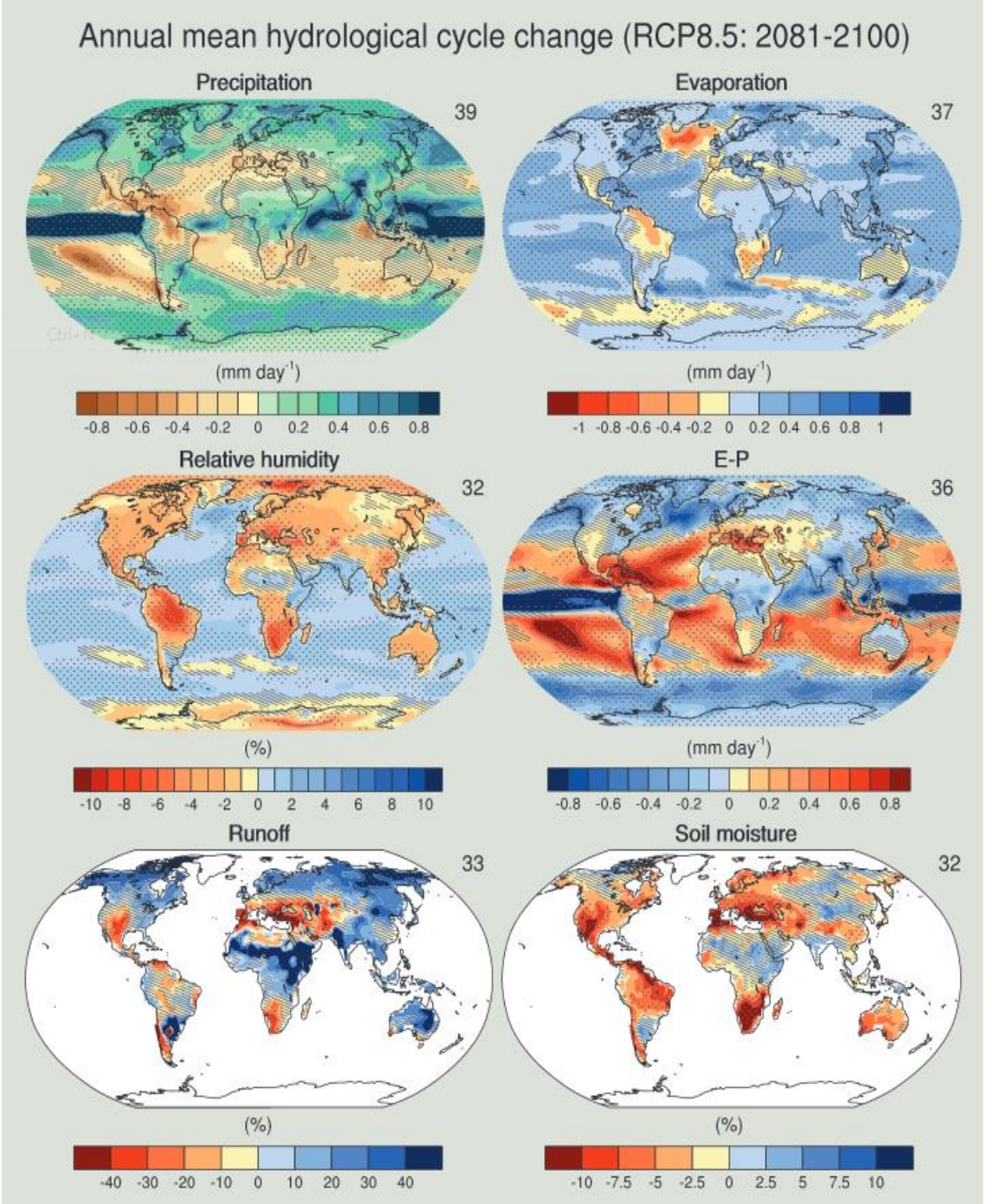
NO EMISSION CUTS

NOW => 2081-2100



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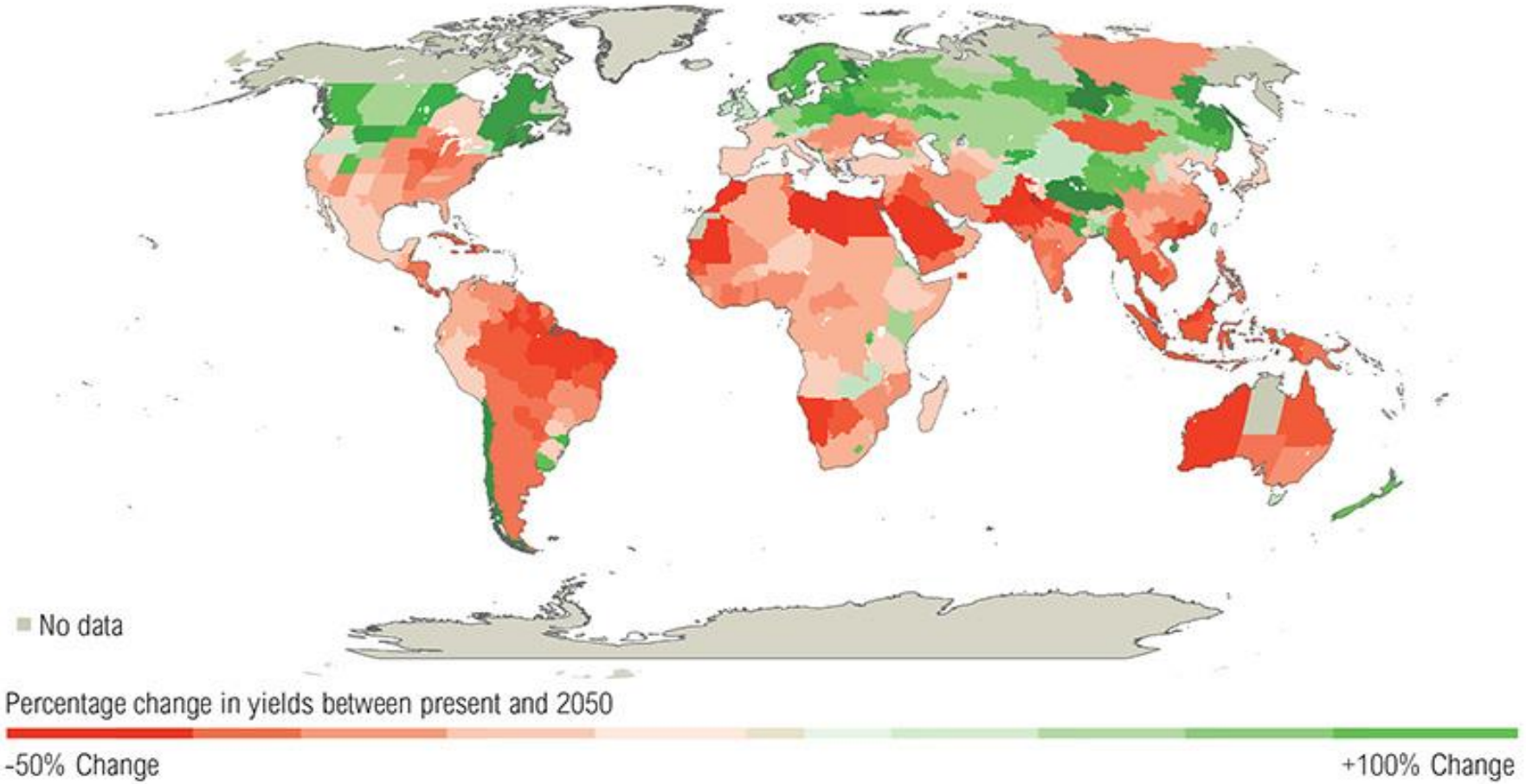
Impact of 3 C warming on crop yields



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Sources: http://ow.ly/rpfMN

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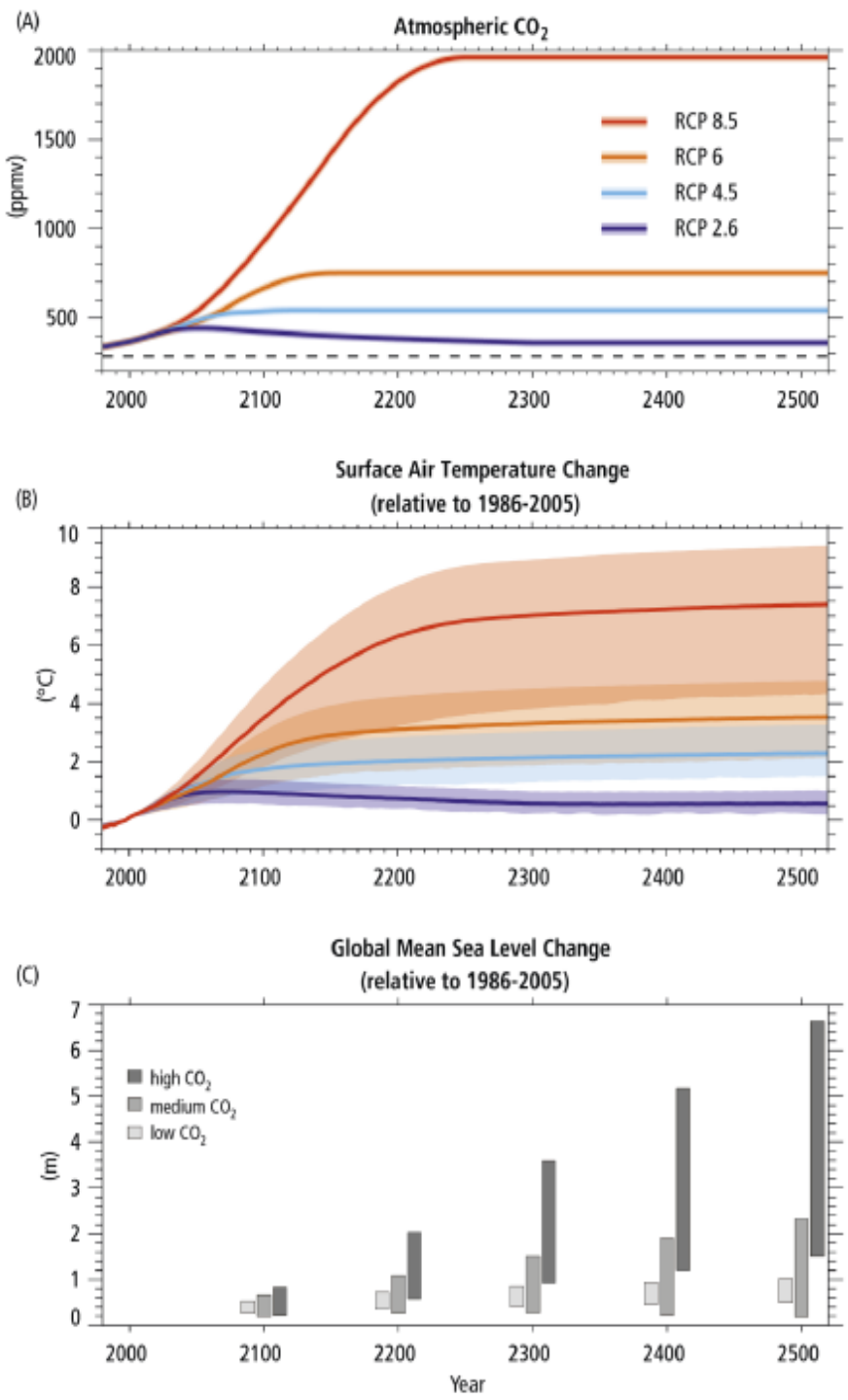
2000-2500? Various emission pathways:



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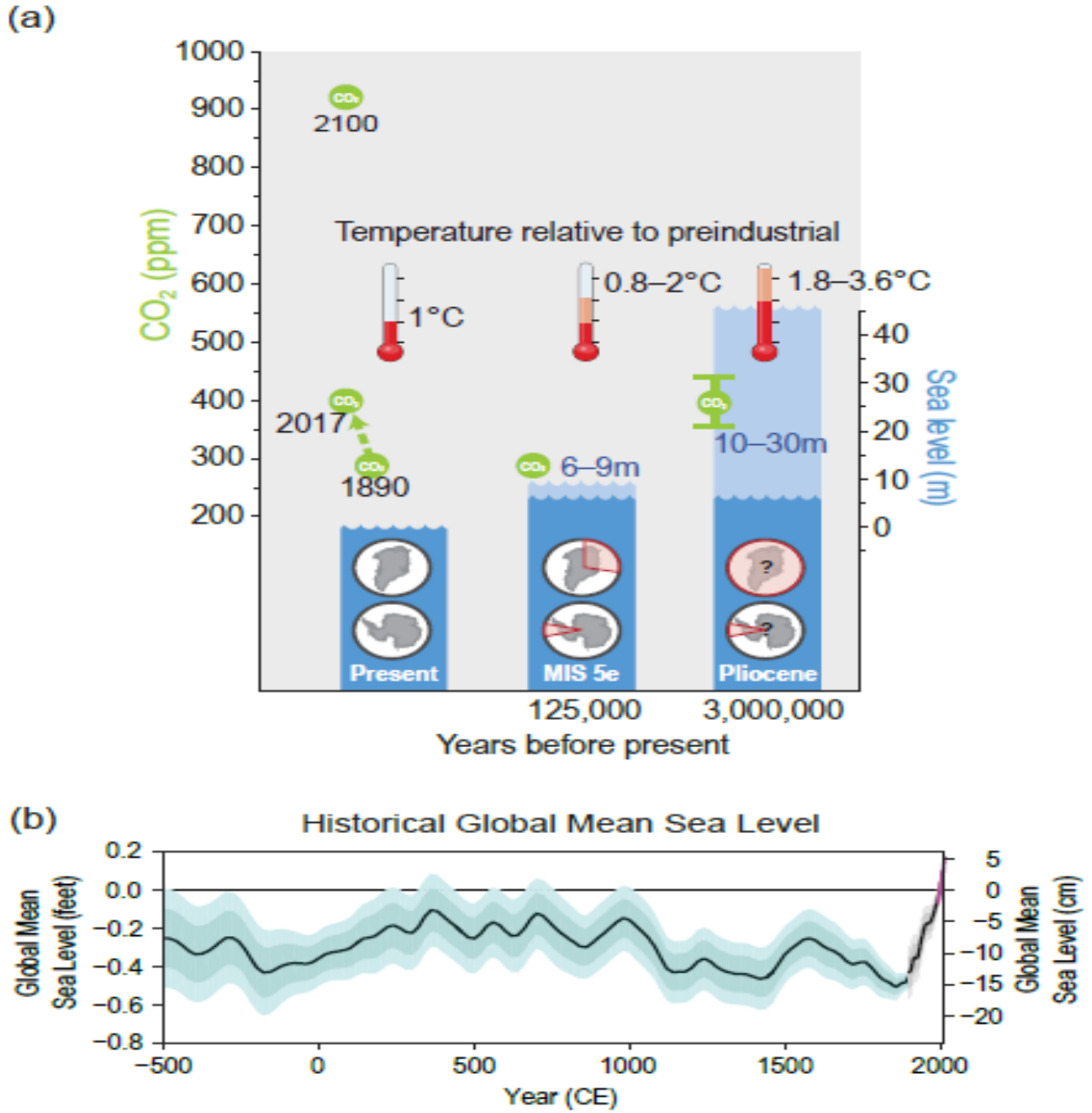
Historical CO_2-temperature-sea level



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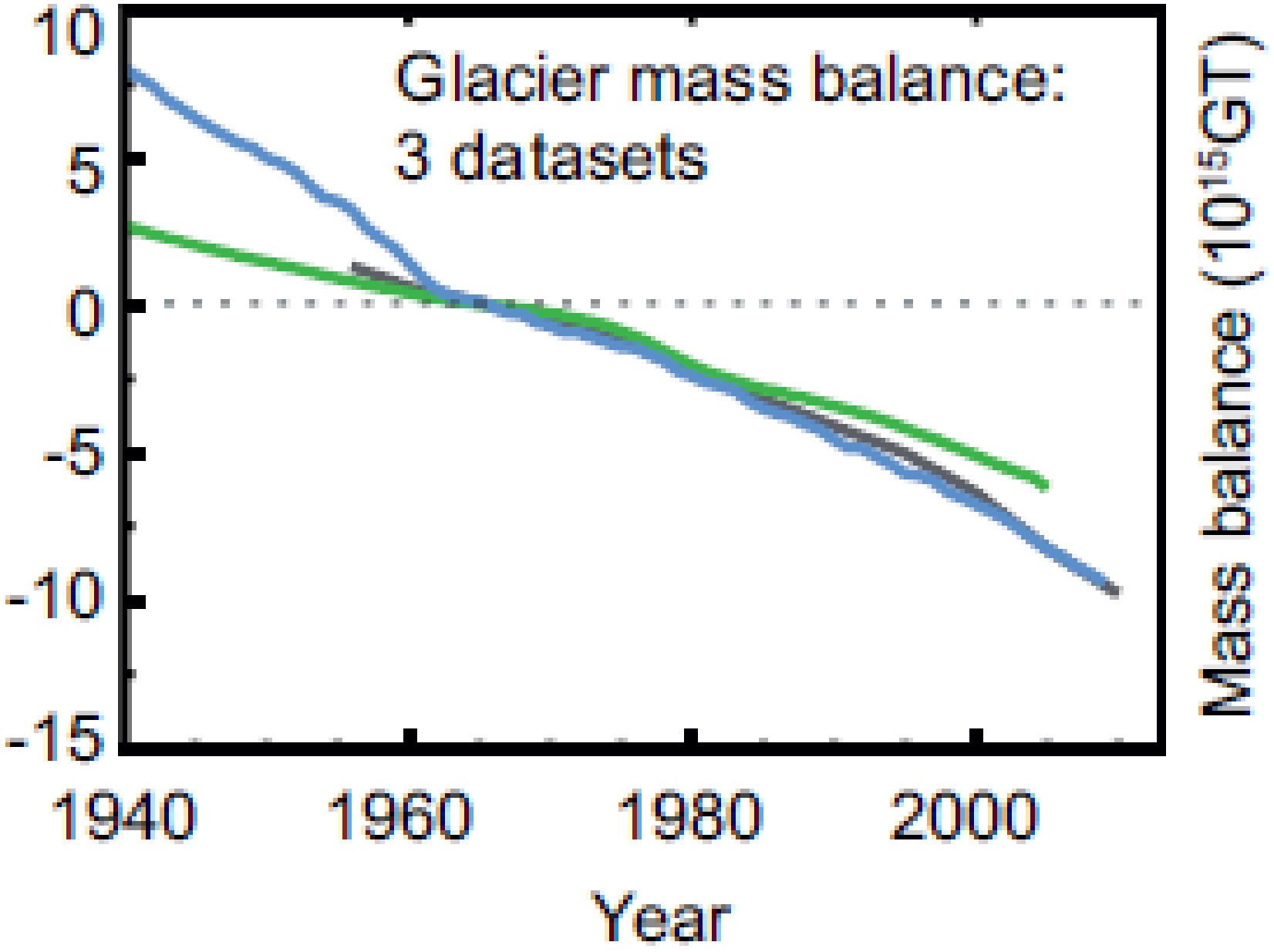
Glacier mass loss 1940-



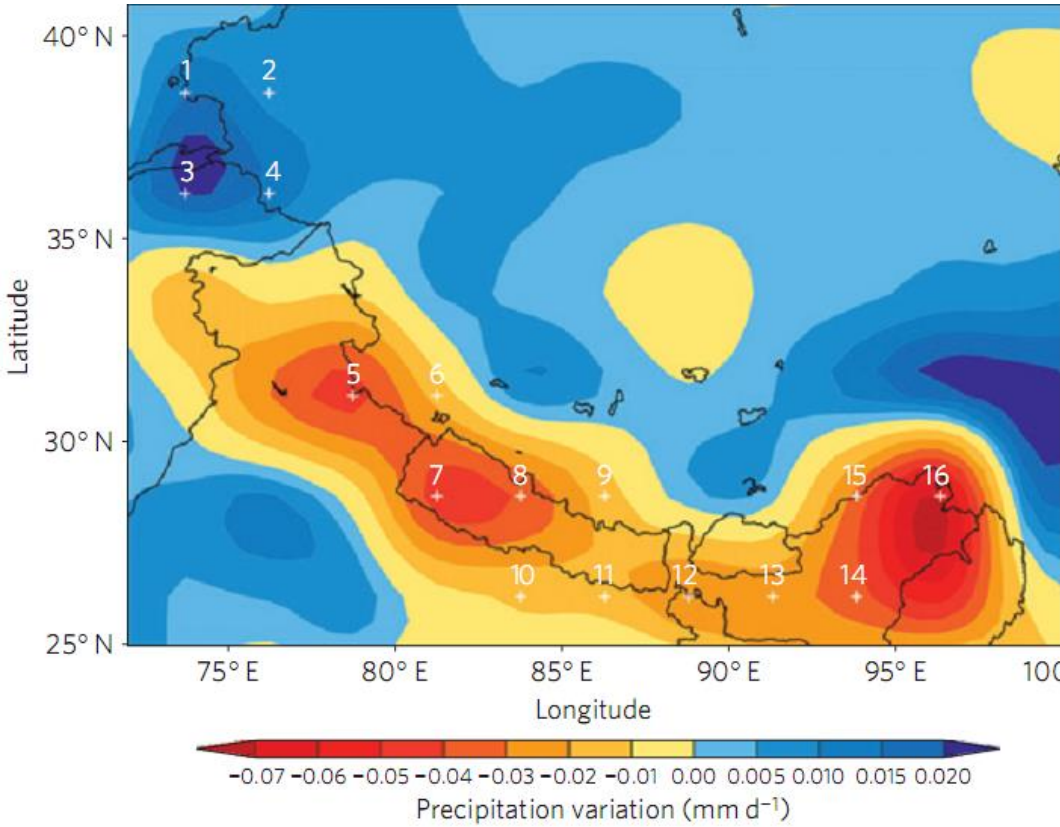
Impact of climate change on water resources

- 50% of world's drinking water comes from rivers;
- Mountain runoff contributes 40% to 95% to rivers, depending on region;
- Runoff from mountains is controlled mainly by precipitation and temperature (snowfall, snowmelt).

- Populations at all elevations are affected by changes in the snow-precipitation cycle in the mountains and the melting of glaciers.

E.g.

- Asian mountains show a negative trend of snow-covered area above 3000m – 4000m (-3.22% to -4.06% per decade).
- During dry periods 27% of water resources for La Paz City (Bolivia) originate from glaciers.



Precipitation trend: decreasing in the Himalayas, while increasing in the eastern Pamir region (Yao et al., Nature Clim. Change., 2012)

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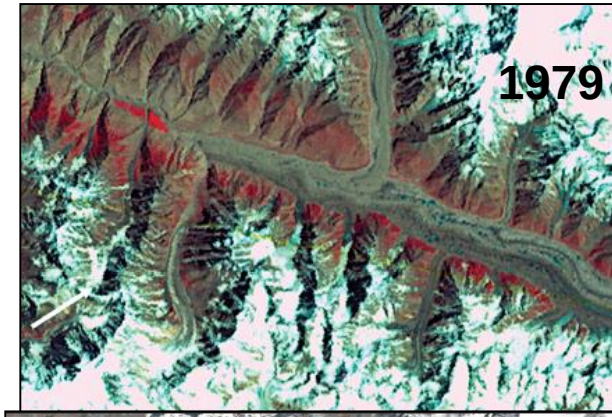
Mountains under the pressure of climate change

- **Severe shortage of water resources (diminishing seasonal snow cover and glaciers):**
  - Affecting the livelihood of millions of already vulnerable people;
- **Increase in the severity/frequency of spring flash flooding, landslides, mudflows**
  - intensification of snow and glacier melt,
  - increase in liquid precipitation at elevations where traditionally the precipitation was snowfall.
- **Increase in the severity, duration, and frequency of drought**
  - Receding of the seasonal snow cover and glaciers.
  - Over 600 glaciers have disappeared over the past decades, worldwide.
- **Risks to infrastructure** (e.g. permafrost melting)
- **Loss of economic opportunities** (e.g. from agriculture, tourism)

Aneto and Maladeta glaciers in the Pyrenees



Hispar glacier in Pakistan

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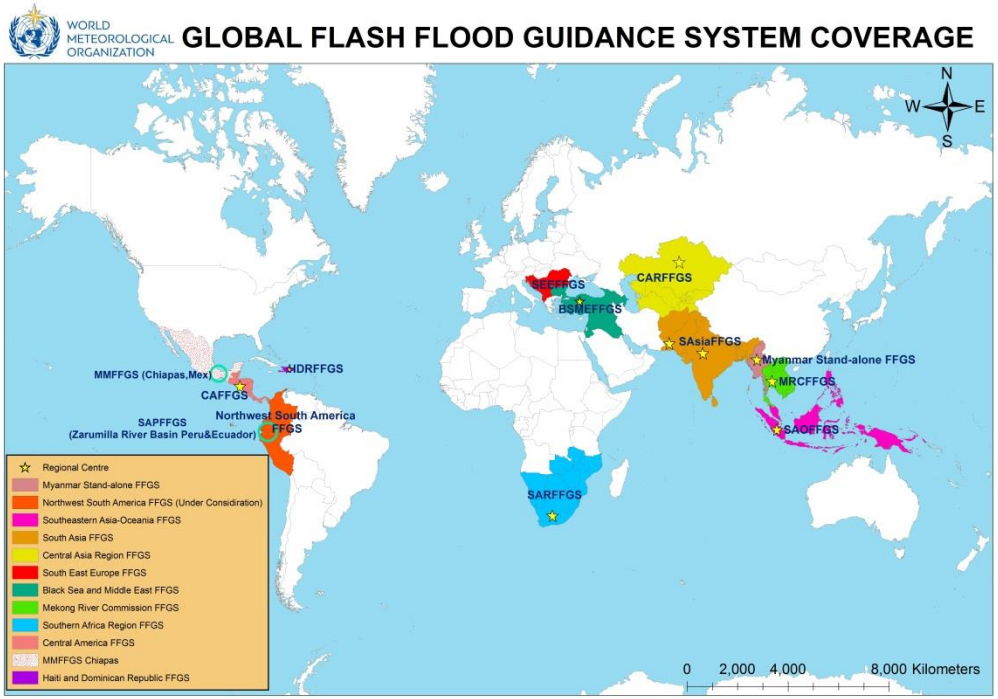
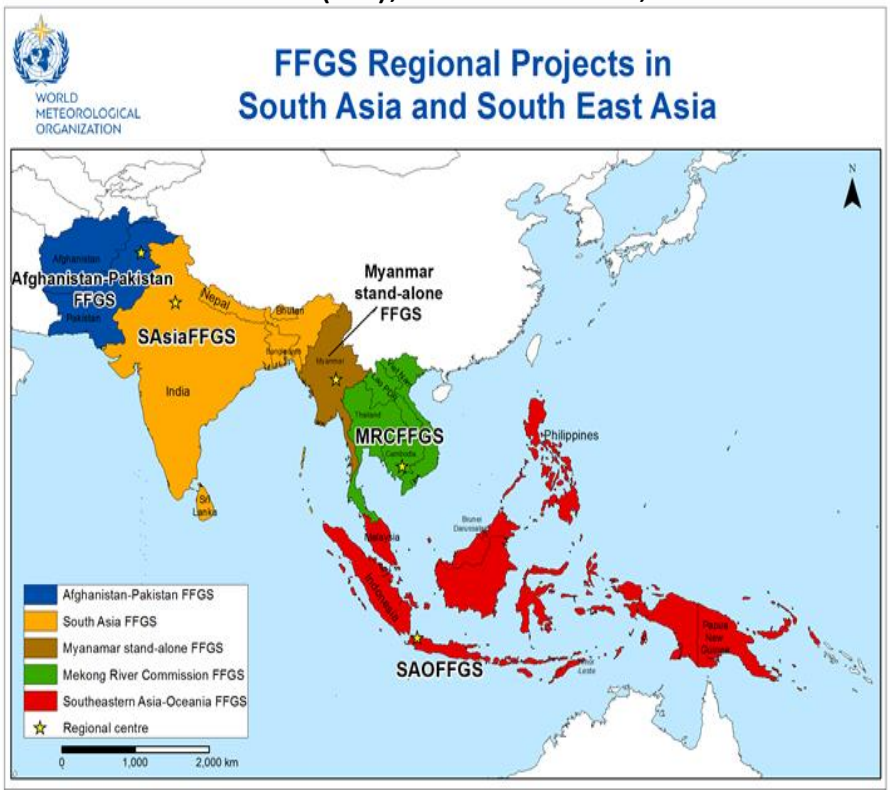
Development of Early Warning System capabilities



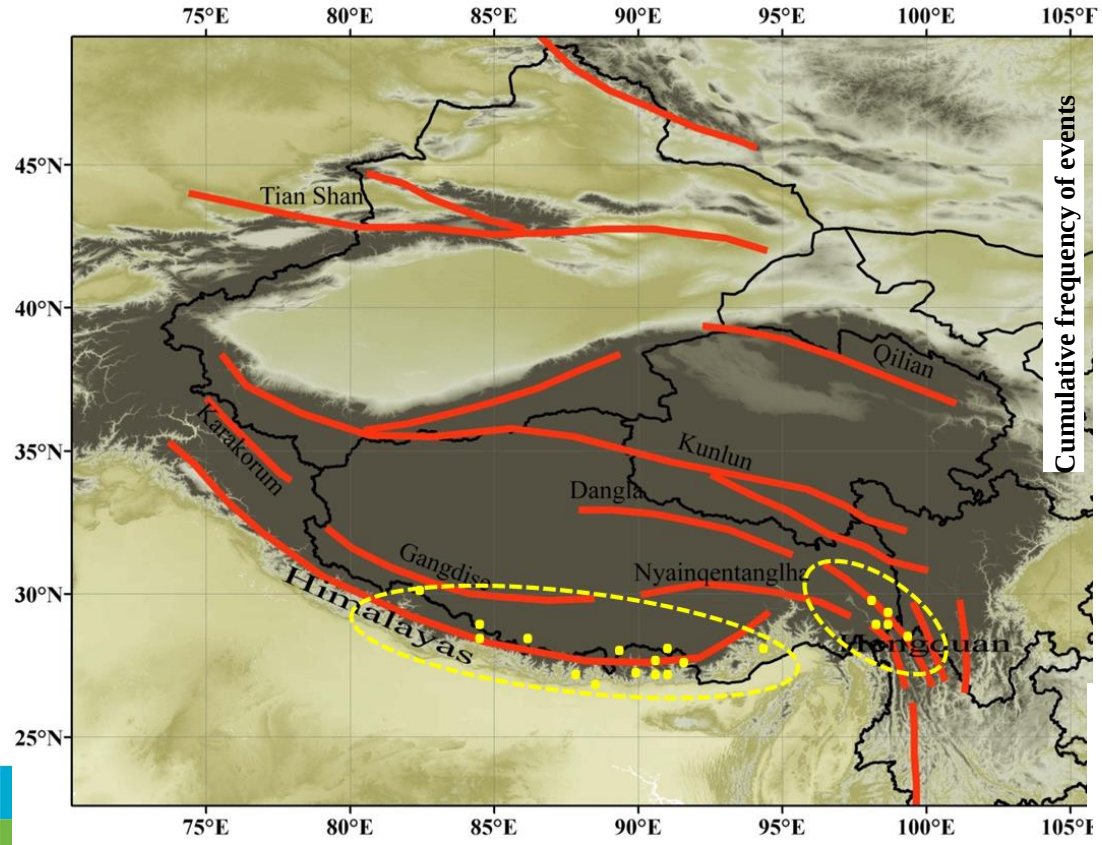
Resolution of World Meteorological Congress-15 (2011): **Flash Flood Guidance System** with global coverage enhances early warning capabilities of the NMHSs, currently covers 52 countries and more than two billion people around the world saving lives and decreasing economic losses**.**

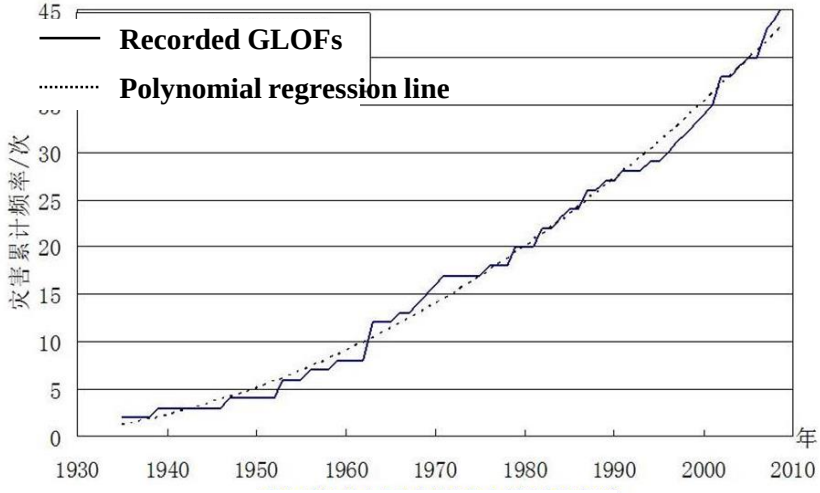
South Asia FFG (SAsiaFFG) (under implementation) includes Afghanistan, Bangladesh, Bhutan, India (RC), Nepal, Pakistan (RC), and Sri Lanka;



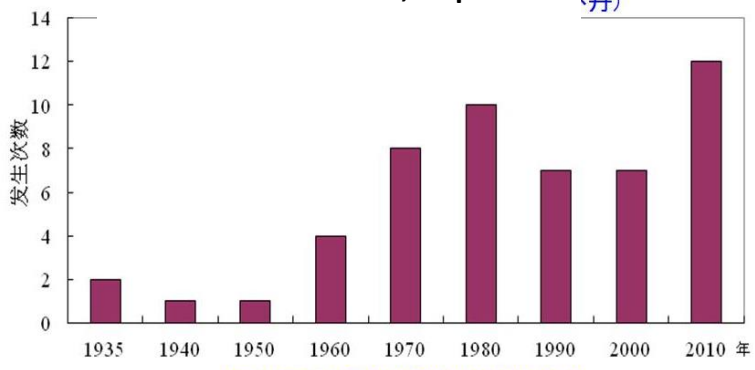
Glacial lake outbursts (GLOF)

With climate change and glacial retreat, the frequency of GLOFs has increased in recent years presenting new risks to upstream and downstream communities





Cumulative GLOFs in China, Nepal and Bhutan



GLOFs in the Himalayas

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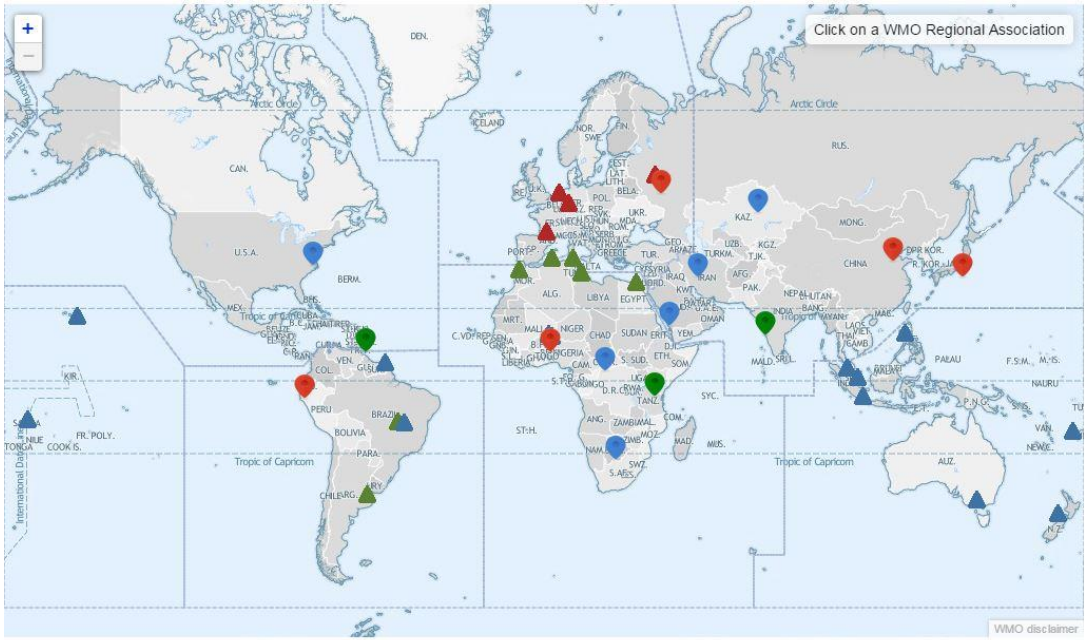
Yao et al., Assessment of Environment Change on the Tibetan Plateau, 2015

WMO Regional Climate Centres

- Provide regional climate products in **support of regional and national climate activities**
- strengthen the capacity of WMO Members to deliver better climate services to national Users

Under development:

- Arctic- RCC
- Asia High Mountain RCC
- Antarctic RCC



GOALS:

- Improved seasonal climate prediction;
- Improved water availability prediction;
- Hazard prevention;
- Infrastructural protection;
- Ecology protection and pasture maintenance.

Long-term climate and meltwater projections to be merged into the adaptation strategy of socio-economic development of lower basins.

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WMO contribution to sustainable mountain development

- Facilitate the development of weather, water and climate services and information to support decisions and policies on adaptation strategies in mountain areas;

- Stimulate innovation and experience in transferring research results to operational services;

- Provide a framework for broad engagement at regional level on weather, water, cryosphere, and climate. Planned events:
  - Water Conference, May 2018;
  - High Mountain Summit, Q4 2018.

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