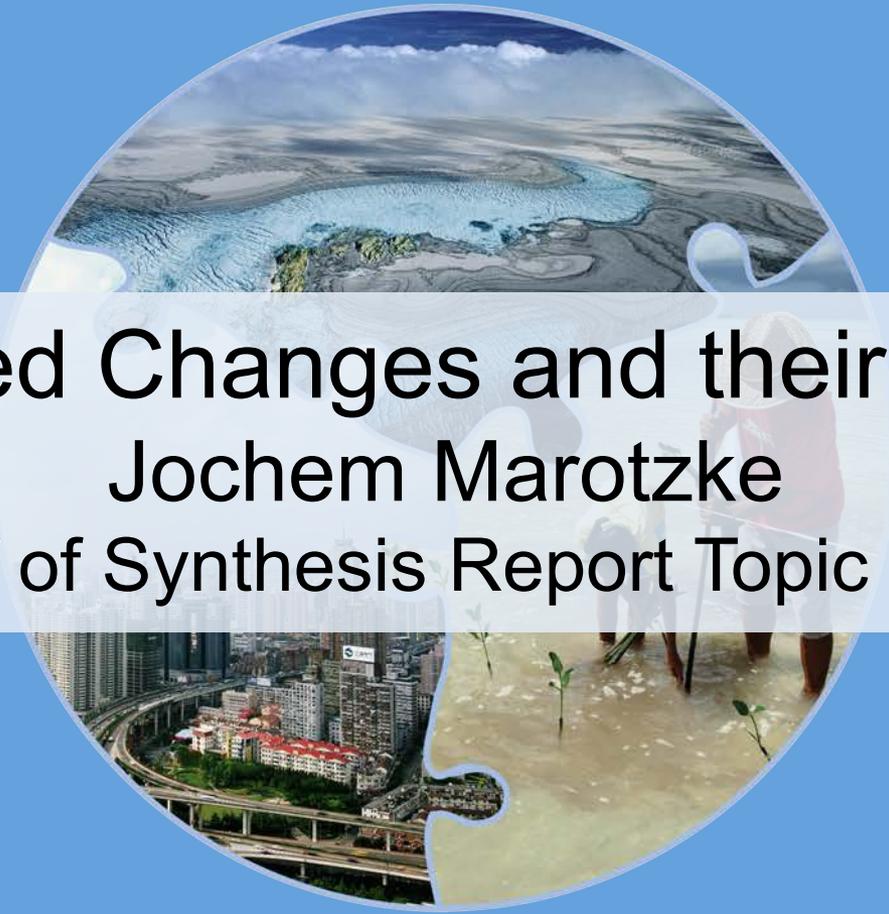


# CLIMATE CHANGE 2014

## *Synthesis Report*



# Observed Changes and their Causes

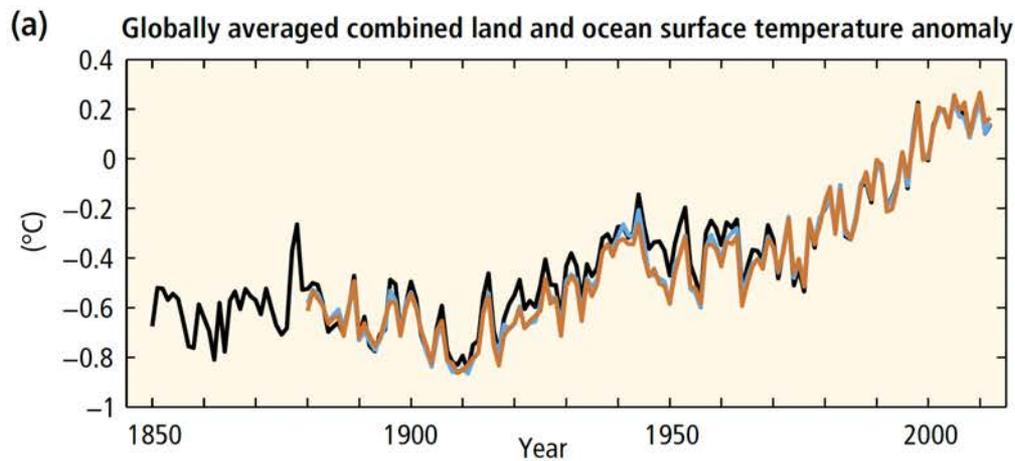
## Jochem Marotzke

(on behalf of Synthesis Report Topic 1 authors)

Synthesis Report of the  
Fifth Assessment Report of the  
Intergovernmental Panel on Climate Change

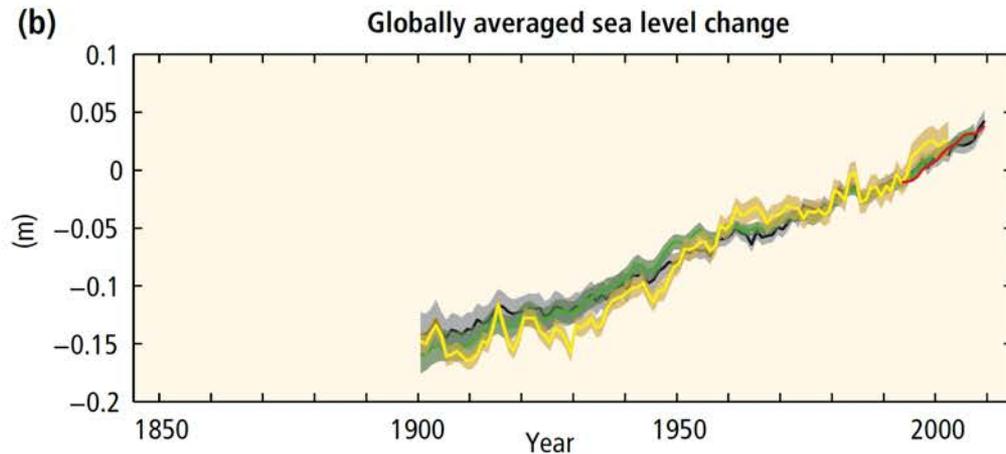
**ipcc**  
INTERGOVERNMENTAL PANEL ON climate change





Globally averaged temperature anomaly

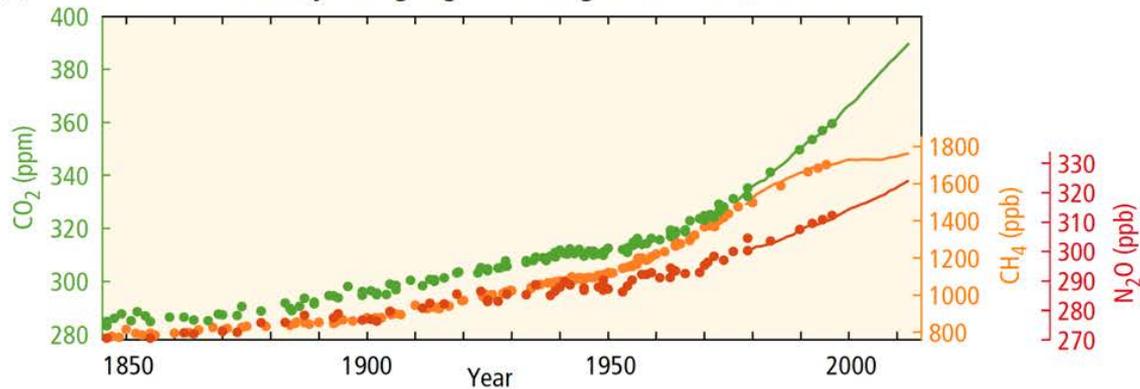
*AR5 SYR Figure SPM. 1a,b*



Globally averaged sea-level change

“Warming of the climate system is unequivocal, and since the 1950s, many of the observed changes are unprecedented over decades to millennia. The atmosphere and ocean have warmed, the amounts of snow and ice have diminished, and sea level has risen.” *AR5 SYR*

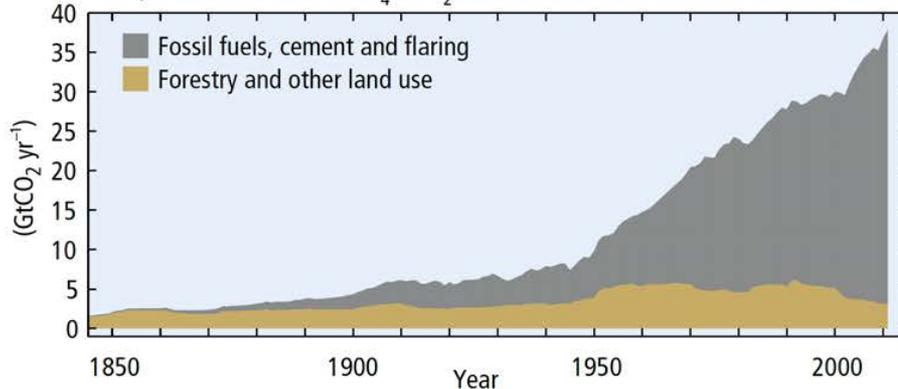
(c) Globally averaged greenhouse gas concentrations



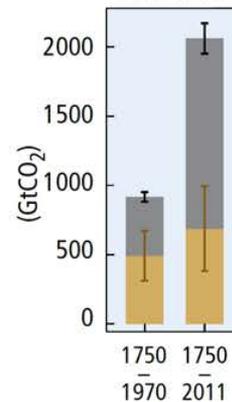
Globally averaged greenhouse gas concentrations

*AR5 SYR Figure SPM.1c,d*

(d) Global anthropogenic CO<sub>2</sub> emissions  
Quantitative information of CH<sub>4</sub> and N<sub>2</sub>O emission time series from 1850 to 1970 is limited



Cumulative CO<sub>2</sub> emissions



Global anthropogenic CO<sub>2</sub> emissions

“Anthropogenic greenhouse gas emissions have increased since the pre-industrial era, driven largely by economic and population growth, and are now higher than ever. This has led to atmospheric concentrations of carbon dioxide, methane and nitrous oxide that are unprecedented in at least the last 800,000 years.” *AR5 SYR*

**ipcc**

INTERGOVERNMENTAL PANEL ON climate change



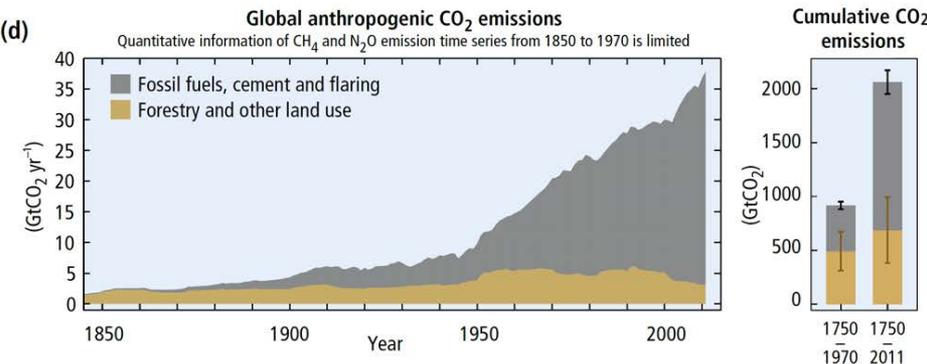
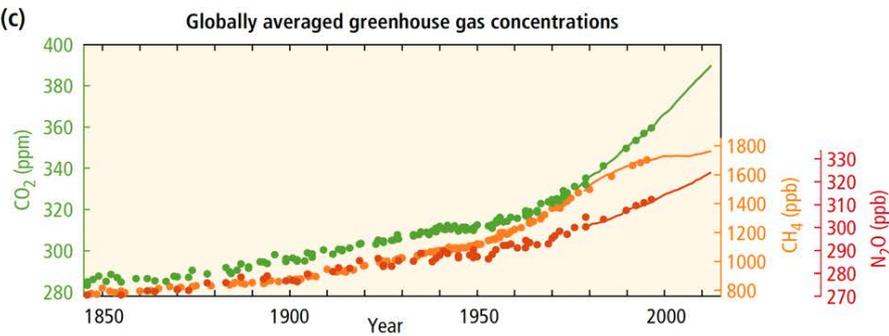
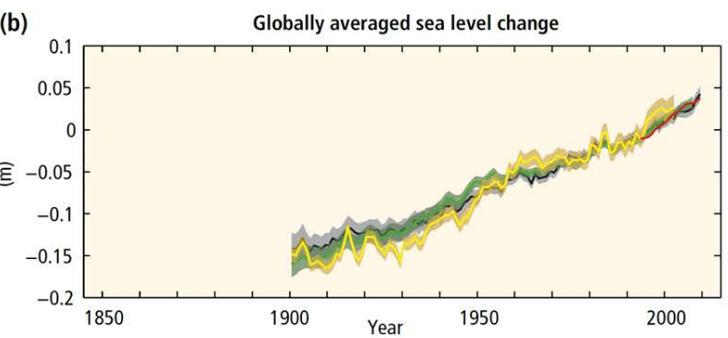
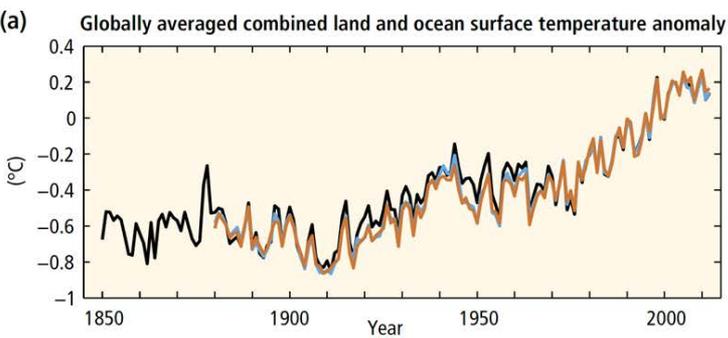
# AR5 SYR Figure SPM.1

## Globally averaged temperature anomaly

## Globally averaged sea-level change

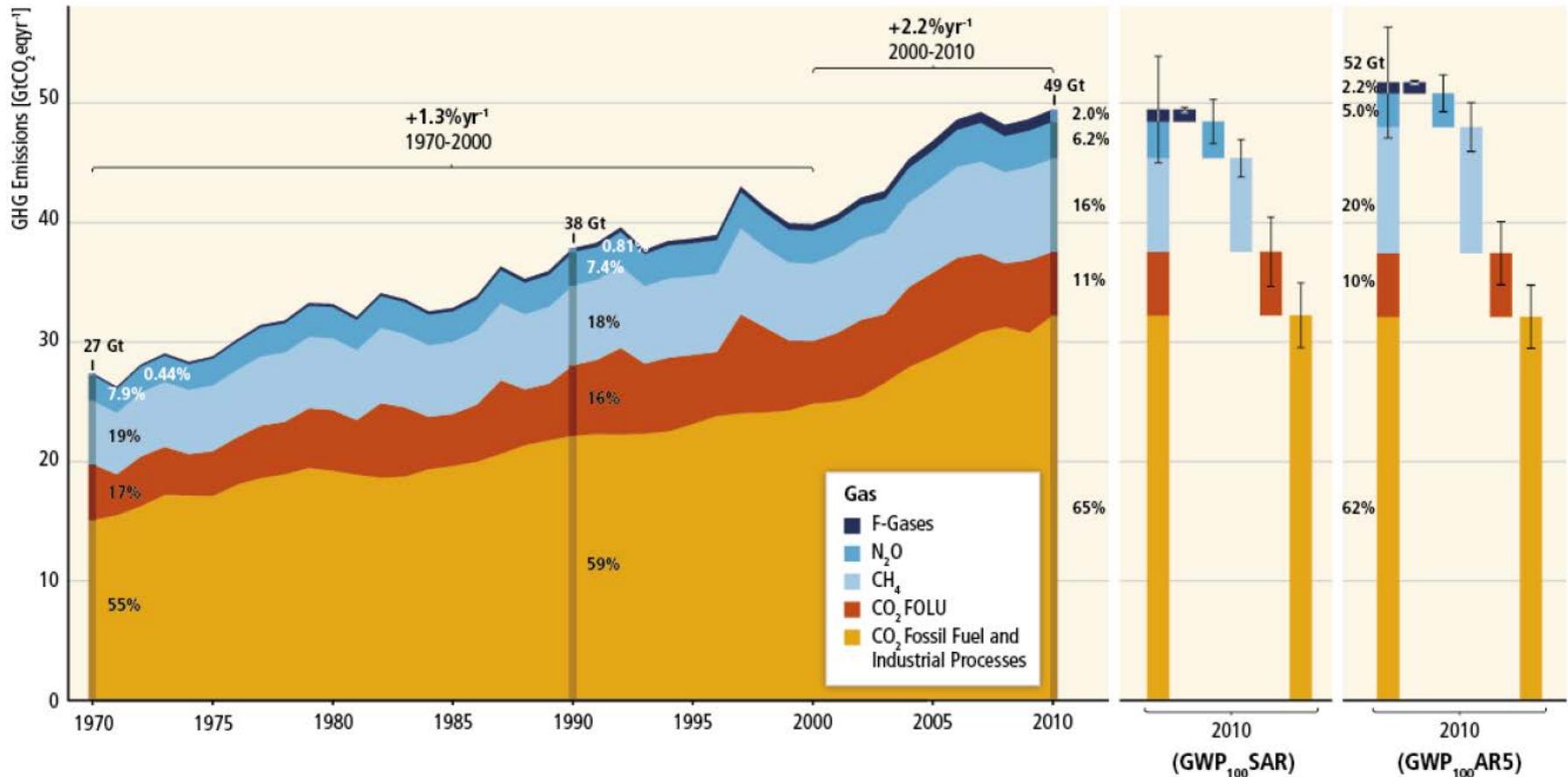
## Globally averaged greenhouse gas concentrations

## Global anthropogenic CO<sub>2</sub> emissions



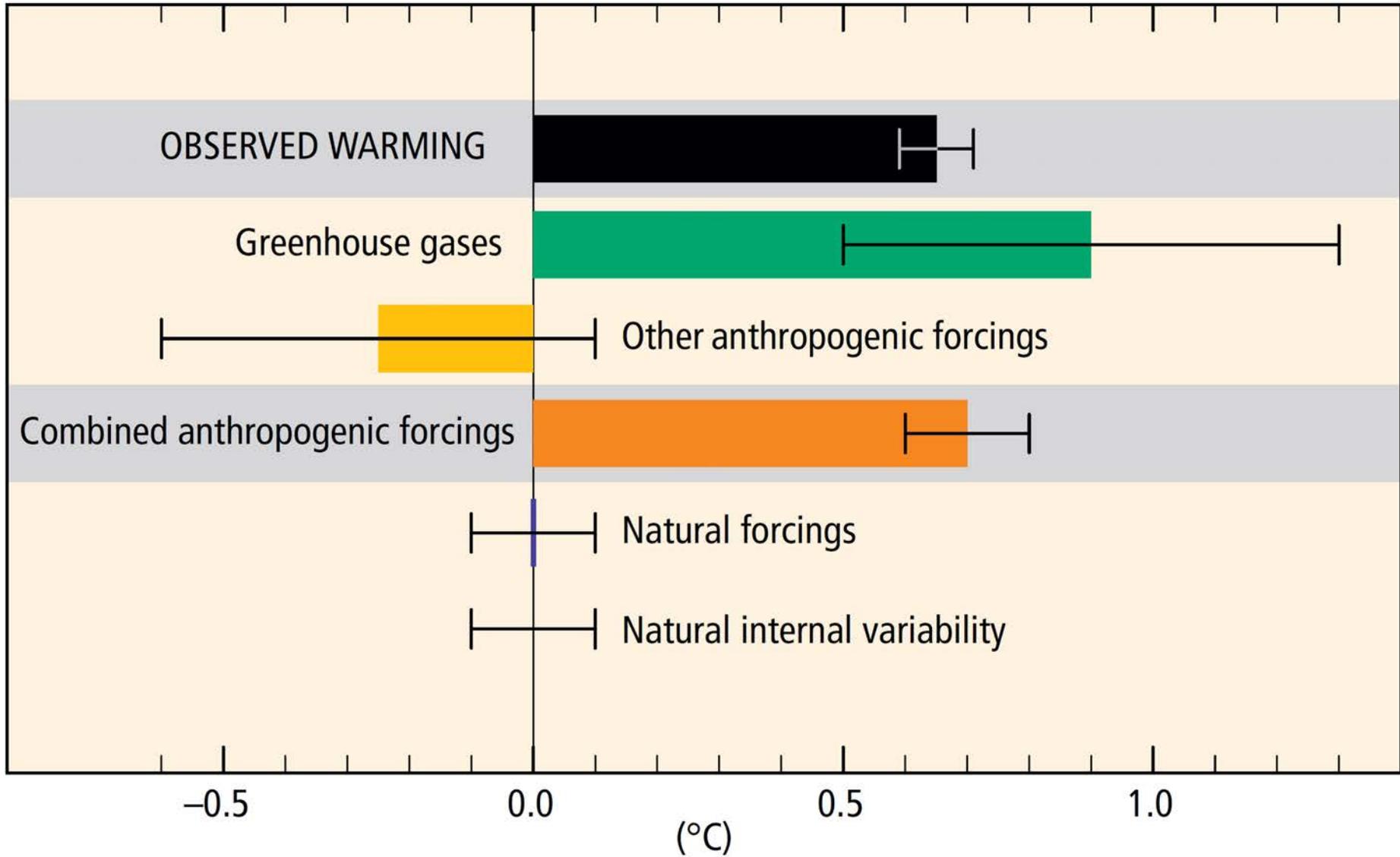
# Global Annual Anthropogenic Greenhouse Gas Emissions by Gases, 1970 to 2010 (Figure SPM.2, AR5 Synthesis Report)

Total Annual Anthropogenic GHG Emissions by Gases 1970-2010

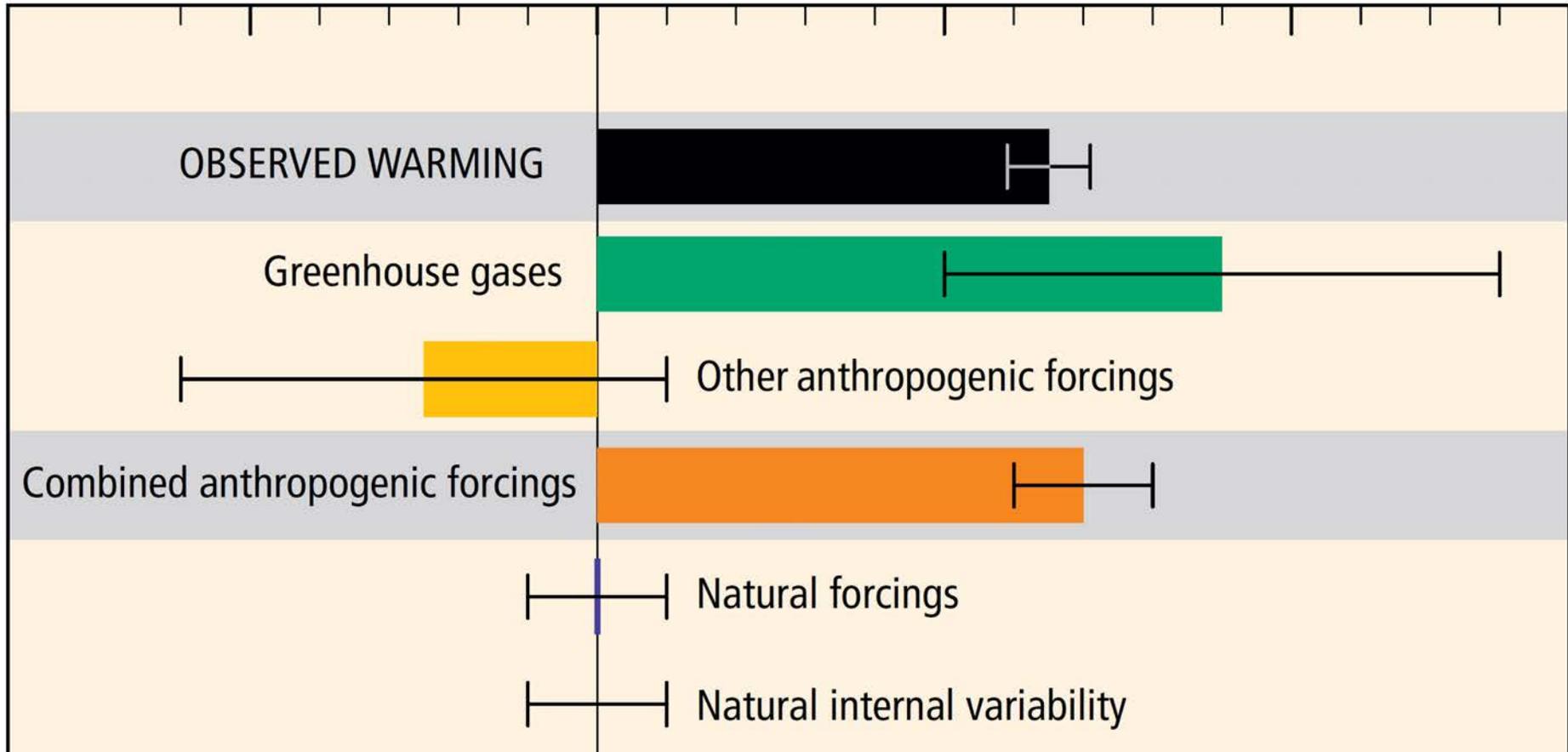


Emissions of other gases are shown as their contributions to “CO<sub>2</sub>-equivalent” – common “currency” established by considering what the radiative effect would be over 100 years

# Contributions to observed surface temperature change over the period 1951-2010



## Contributions to observed surface temperature change over the period 1951-2010



“Their [high concentrations of greenhouse gases] effects, together with those of other anthropogenic drivers, have been detected throughout the climate system and are *extremely likely* to have been the dominant cause of the observed warming since the mid-20th century.” [AR5 SYR](#)

# Widespread impacts attributed to climate change based on the available scientific literature since the AR4

## POLAR REGIONS (Arctic and Antarctic)



## NORTH AMERICA



## EUROPE



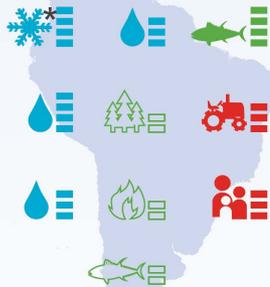
## ASIA



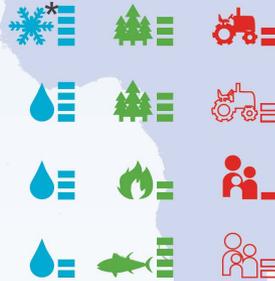
## SMALL ISLANDS



## CENTRAL AND SOUTH AMERICA



## AFRICA



## AUSTRALASIA



9329

10544

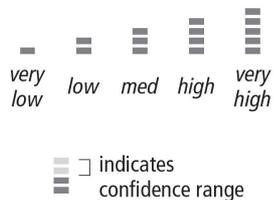
8101

1987

2982

3255

### Confidence in attribution to climate change

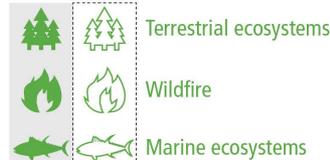


### Observed impacts attributed to climate change for

#### Physical systems



#### Biological systems



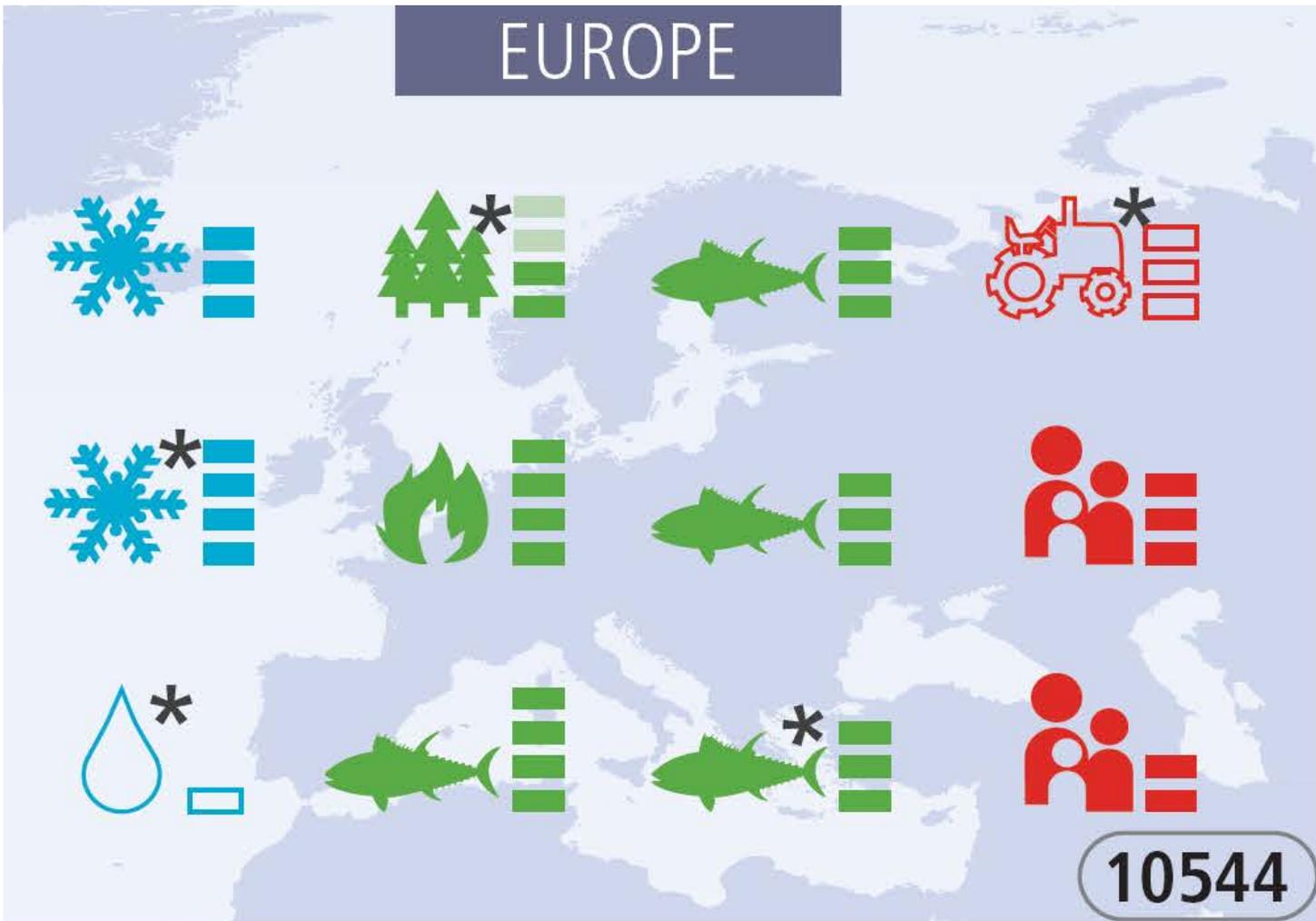
#### Human and managed systems



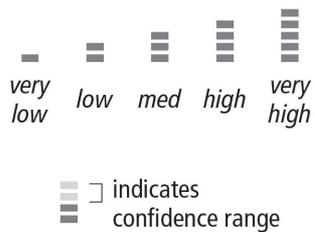
\* Impacts identified based on availability of studies across a region

Outlined symbols = Minor contribution of climate change  
Filled symbols = Major contribution of climate change

# EUROPE



## Confidence in attribution to climate change



## Observed impacts attributed to climate change for

### Physical systems



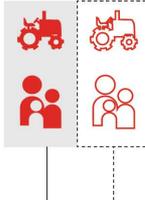
Glaciers, snow, ice, and/or permafrost  
Rivers, lakes, floods, and/or drought  
Coastal erosion and/or sea level effects

### Biological systems



Terrestrial ecosystems  
Wildfire  
Marine ecosystems

### Human and managed systems

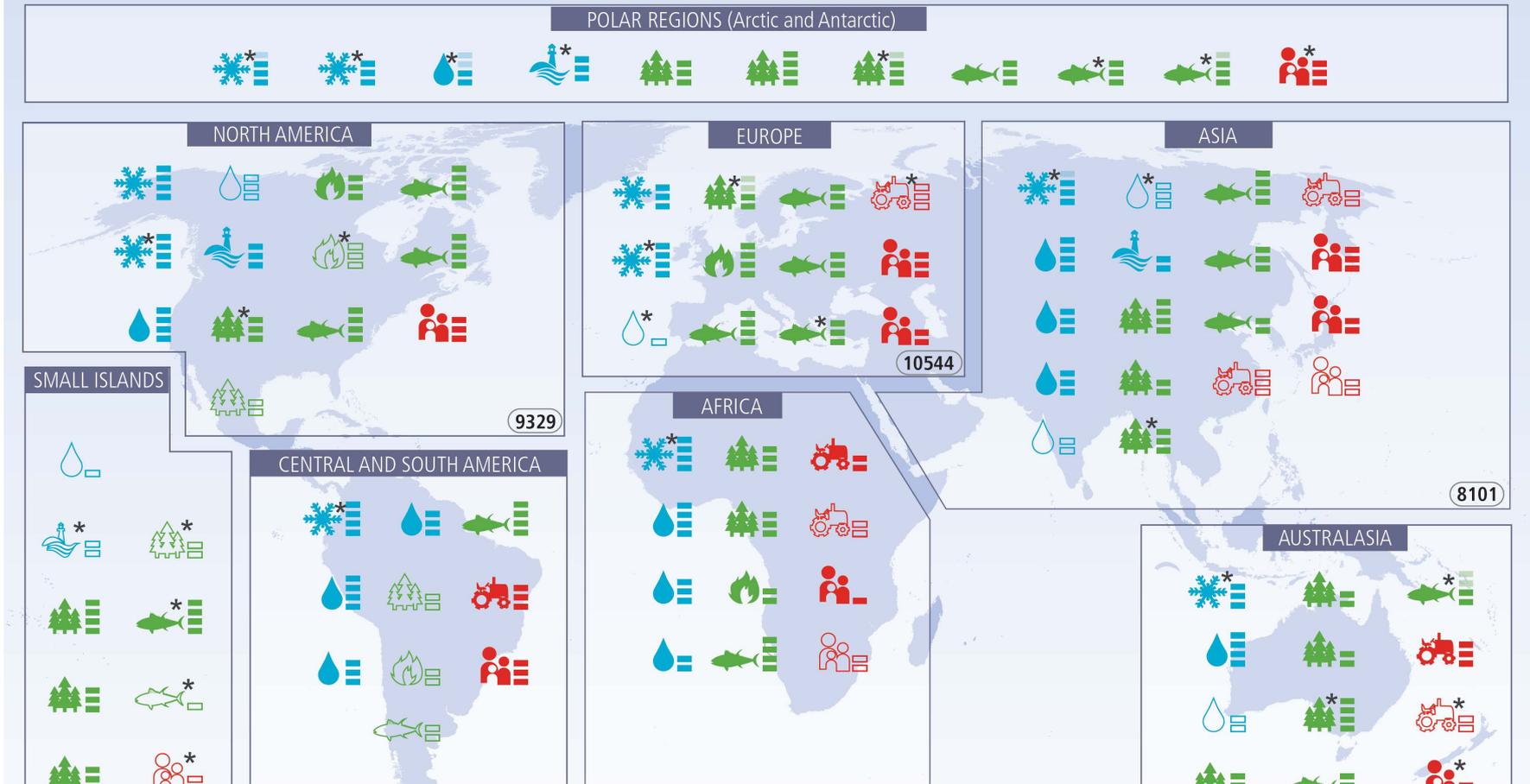


Food production  
Livelihoods, health, and/or economics

\* Impacts identified based on availability of studies across a region

**Outlined symbols** = Minor contribution of climate change  
**Filled symbols** = Major contribution of climate change

# Widespread impacts attributed to climate change based on the available scientific literature since the AR4



“In recent decades, changes in climate have caused impacts on natural and human systems on all continents and across the oceans. Impacts are due to observed climate change, irrespective of its cause, indicating the sensitivity of natural and human systems to changing climate.” *AR5 SYR*

# Résumé of Synthesis Report Topic 1, “Observed Changes and their Causes

“Human influence on the climate system is clear, and recent anthropogenic emissions of greenhouse gases are the highest in history. Recent climate changes have had widespread impacts on human and natural systems.”