IEA 5th Nexus Forum

International Energy Agency

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Paris, France

Climate change science

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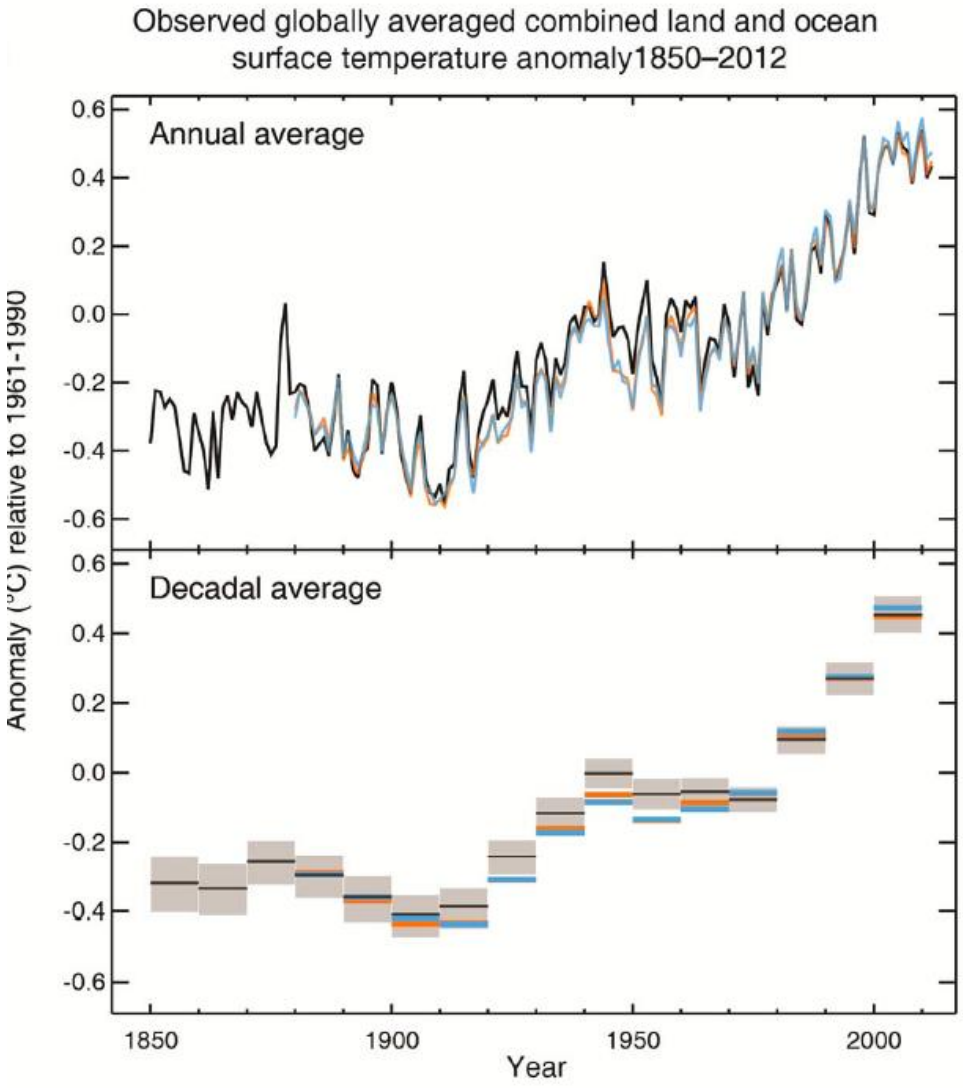
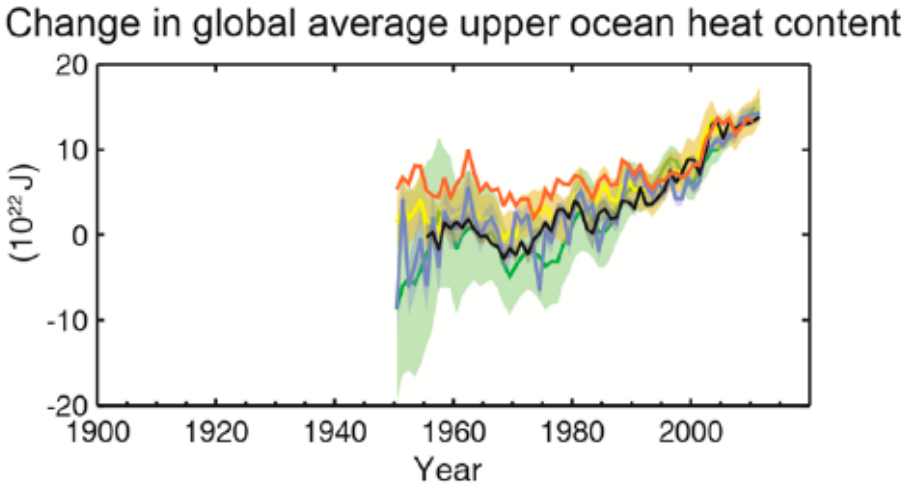
Warming of the climate system is unequivocal, and since the 1950s,

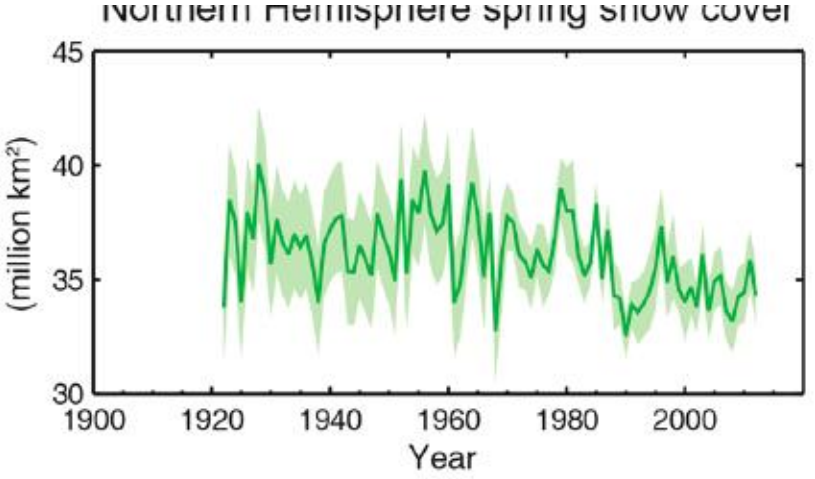
many of the observed changes are unprecedented over decades to millennia. The atmosphere and ocean have warmed, the amounts of snow and ice have diminished, sea level has risen, and the concentrations of greenhouse gases have increased

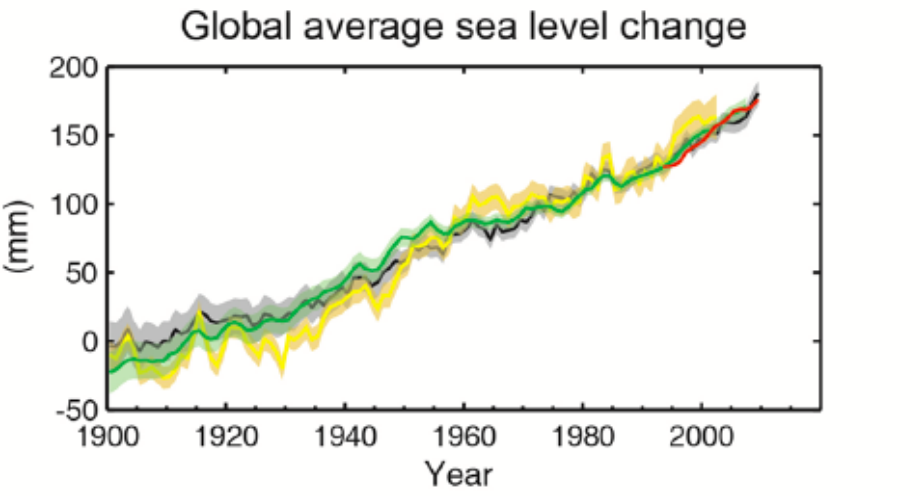


Upper Ocean heat Content

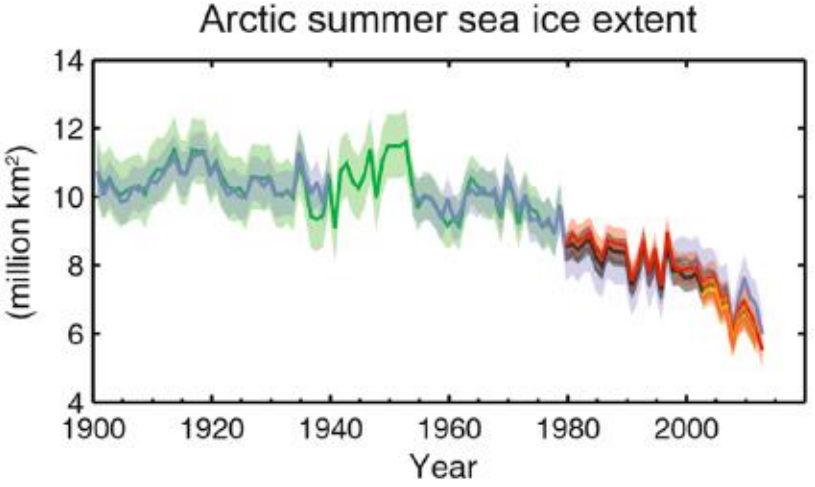


N.H. Spring snow cover

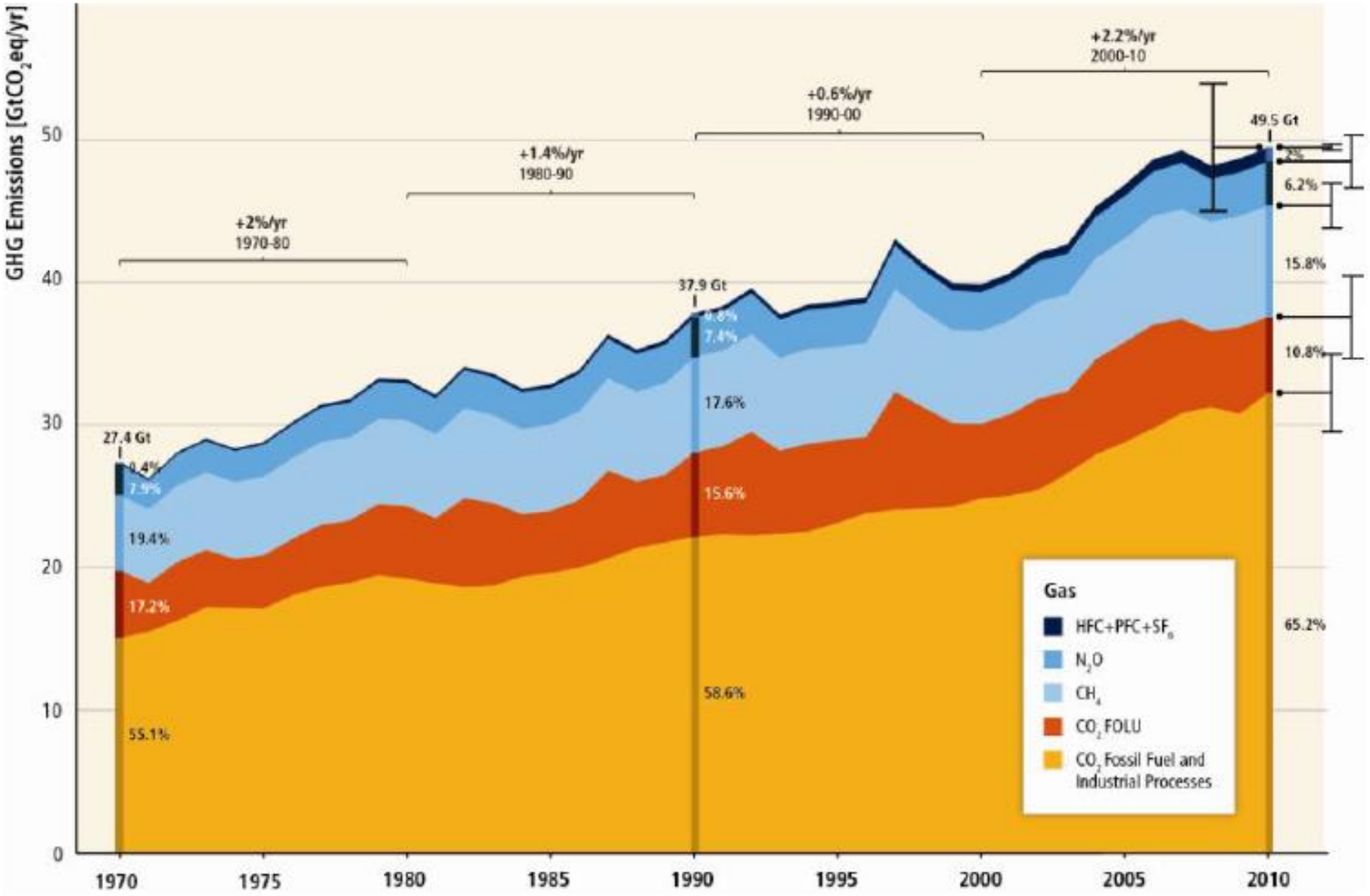




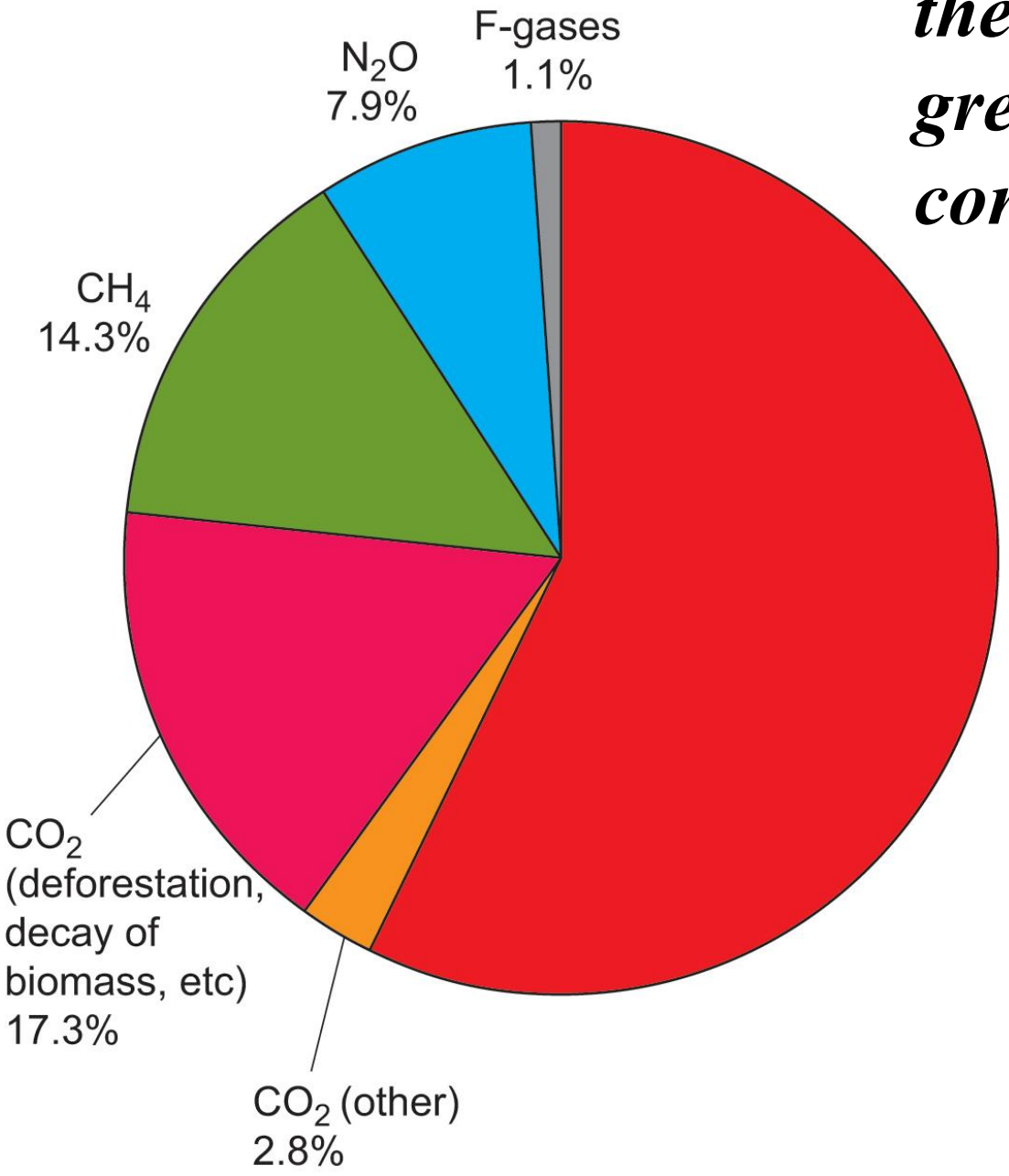
Global average sea level



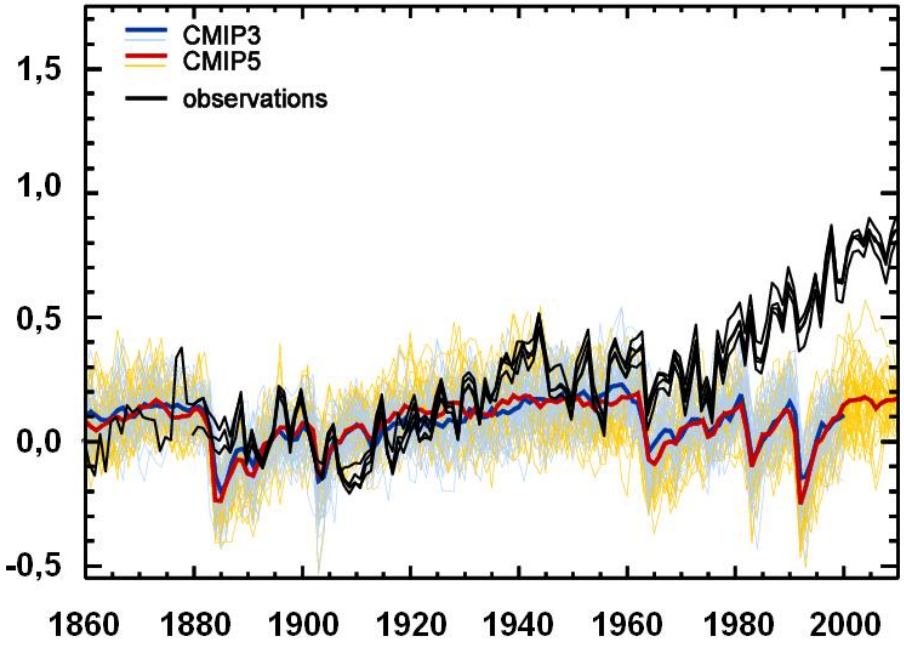
Arctic sea ice minimum extent

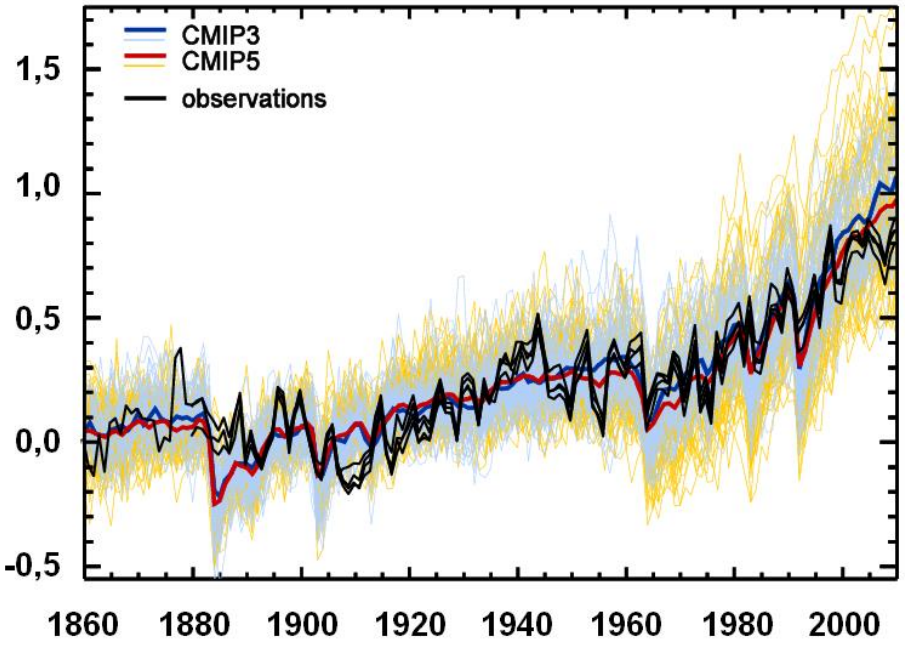

GHG Emissions [GtCO2eq/yr]
+2%/yr
1970-80
+1.4%/yr
1980-90
+0.6%/yr
1990-00
+2.2%/yr
2000-10
27.4 Gt
37.9 Gt
49.5 Gt
0.4%
7.9%
19.4%
17.2%
55.1%
7.4%
17.6%
15.6%
58.6%
6.2%
15.8%
10.8%
65.2%
Gas
HFC+PFC+SF6
N2O
CH4
CO2 FOLU
CO2 Fossil Fuel and Industrial Processes
0
10
20
30
40
50
1970
1975
1980
1985
1990
1995
2000
2005
2010

In 2013, about 70% of the increase in greenhouse gas concentration is due to our comsumption of fossil fuels

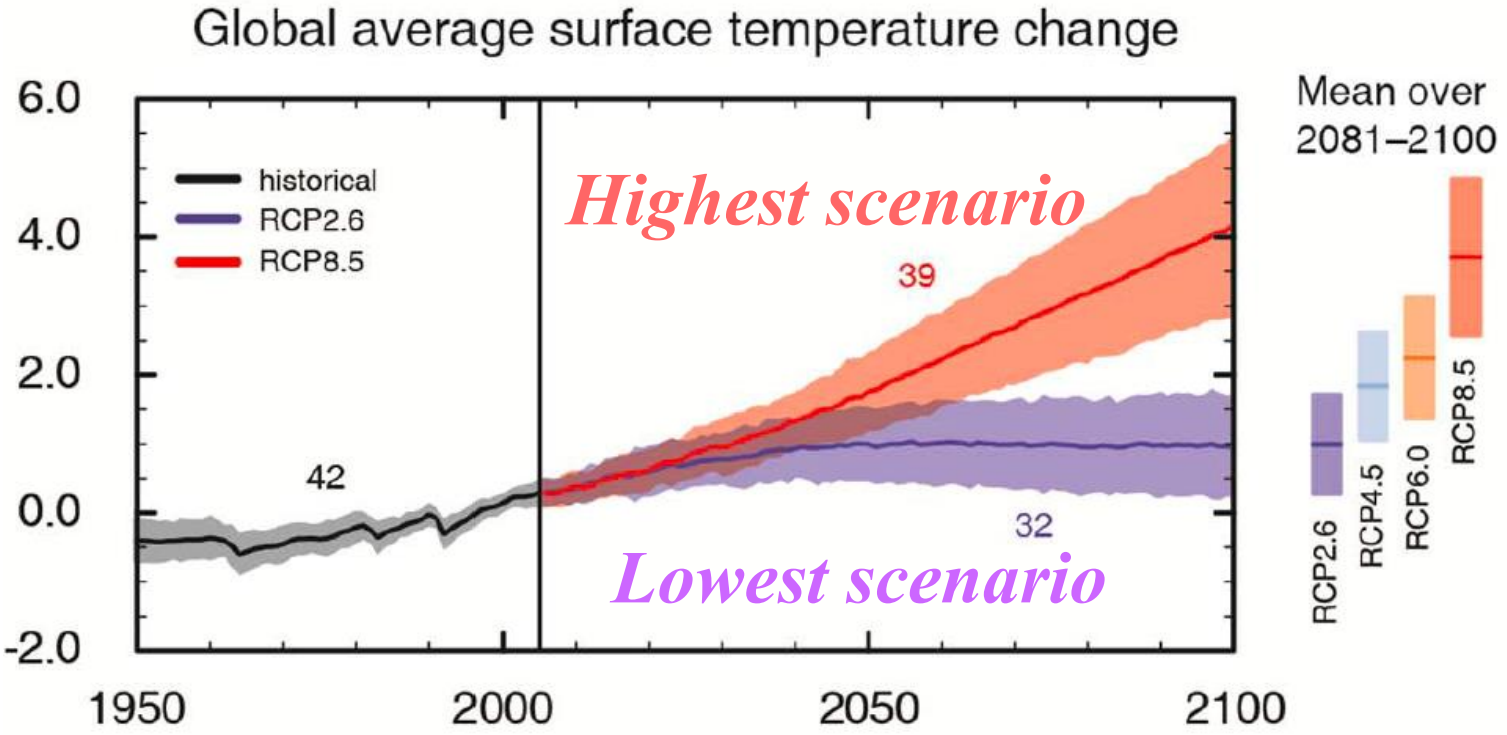


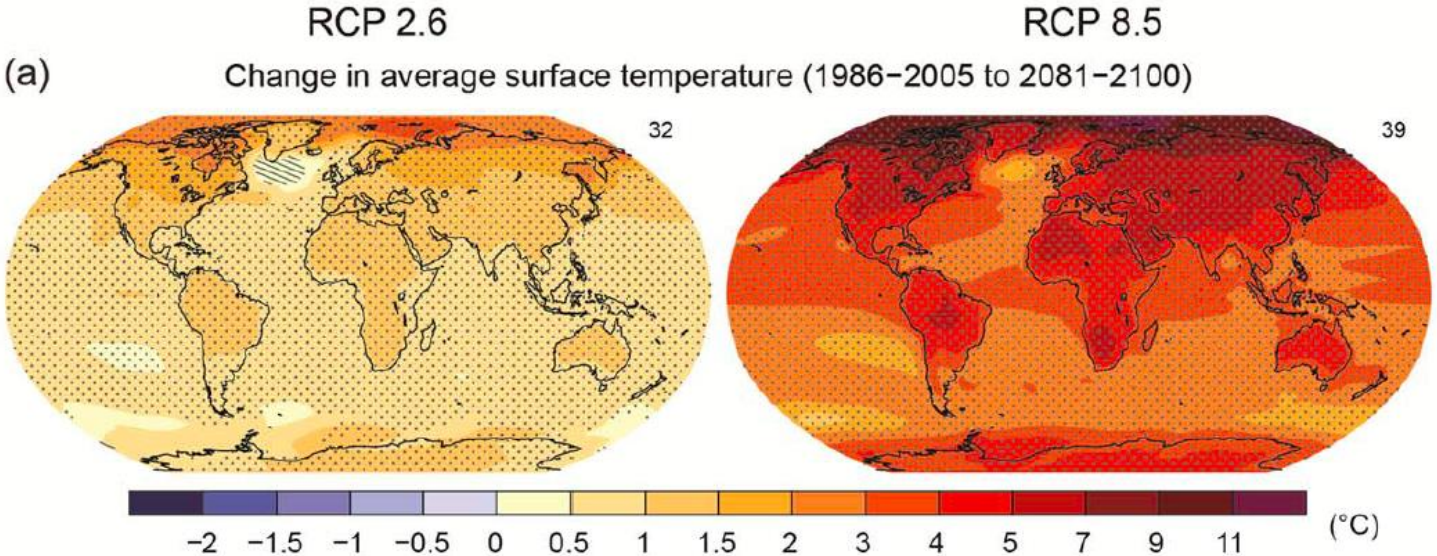
Gas
Oil
Coal

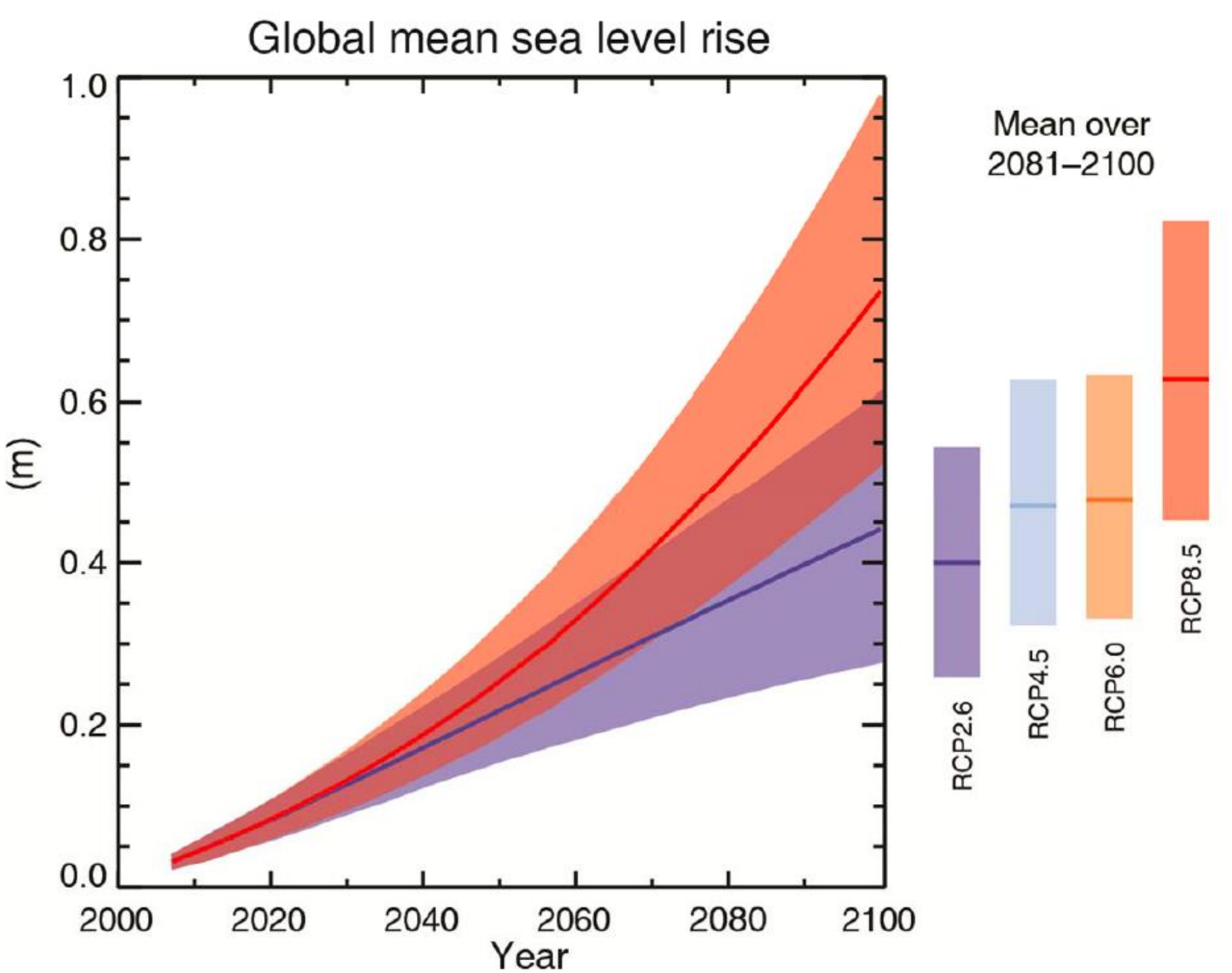


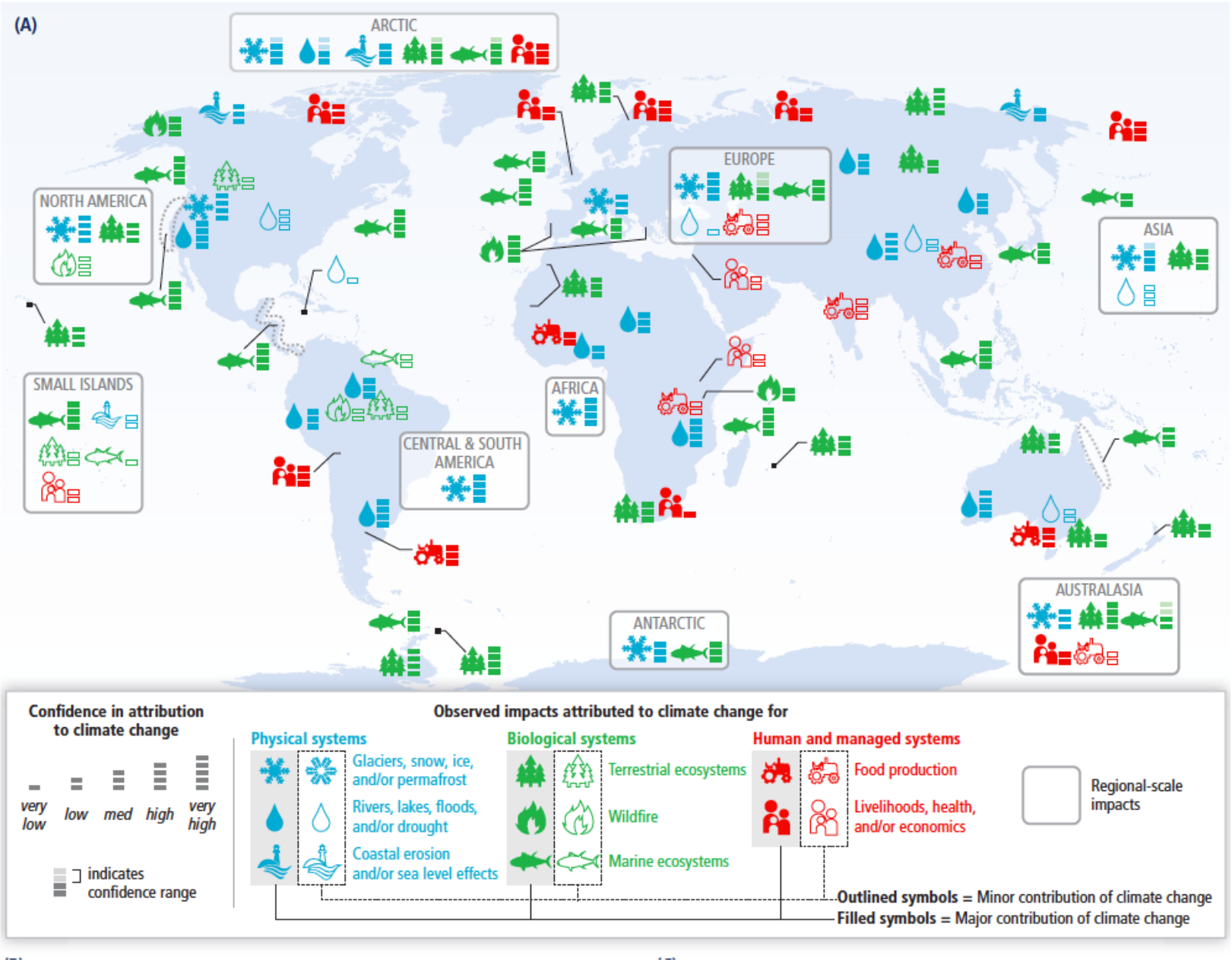


It is extremely likely that human influence has been the dominant cause of the observed warming since the mid 20th

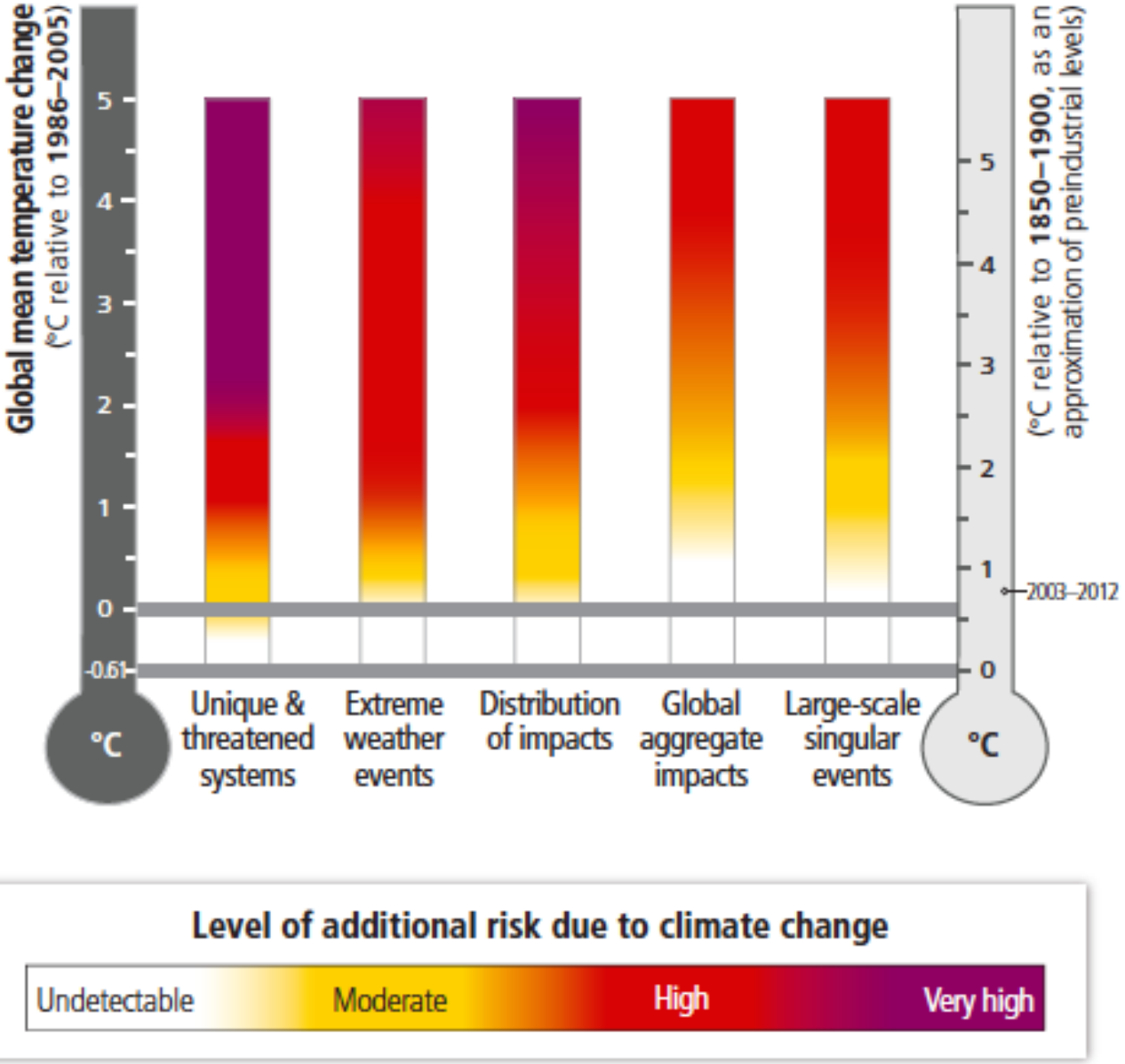

Global average surface temperature change
6.0
4.0
2.0
0.0
-2.0
1950
2000
2050
2100
historical
RCP2.6
RCP8.5
42
39
32
Highest scenario
Lowest scenario
Mean over
2081–2100
RCP2.6
RCP4.5
RCP6.0
RCP8.5


RCP 2.6
RCP 8.5
(a)
Change in average surface temperature (1986–2005 to 2081–2100)
32
39
−2
−1.5
−1
−0.5
0
0.5
1
1.5
2
3
4
5
7
9
11
(°C)

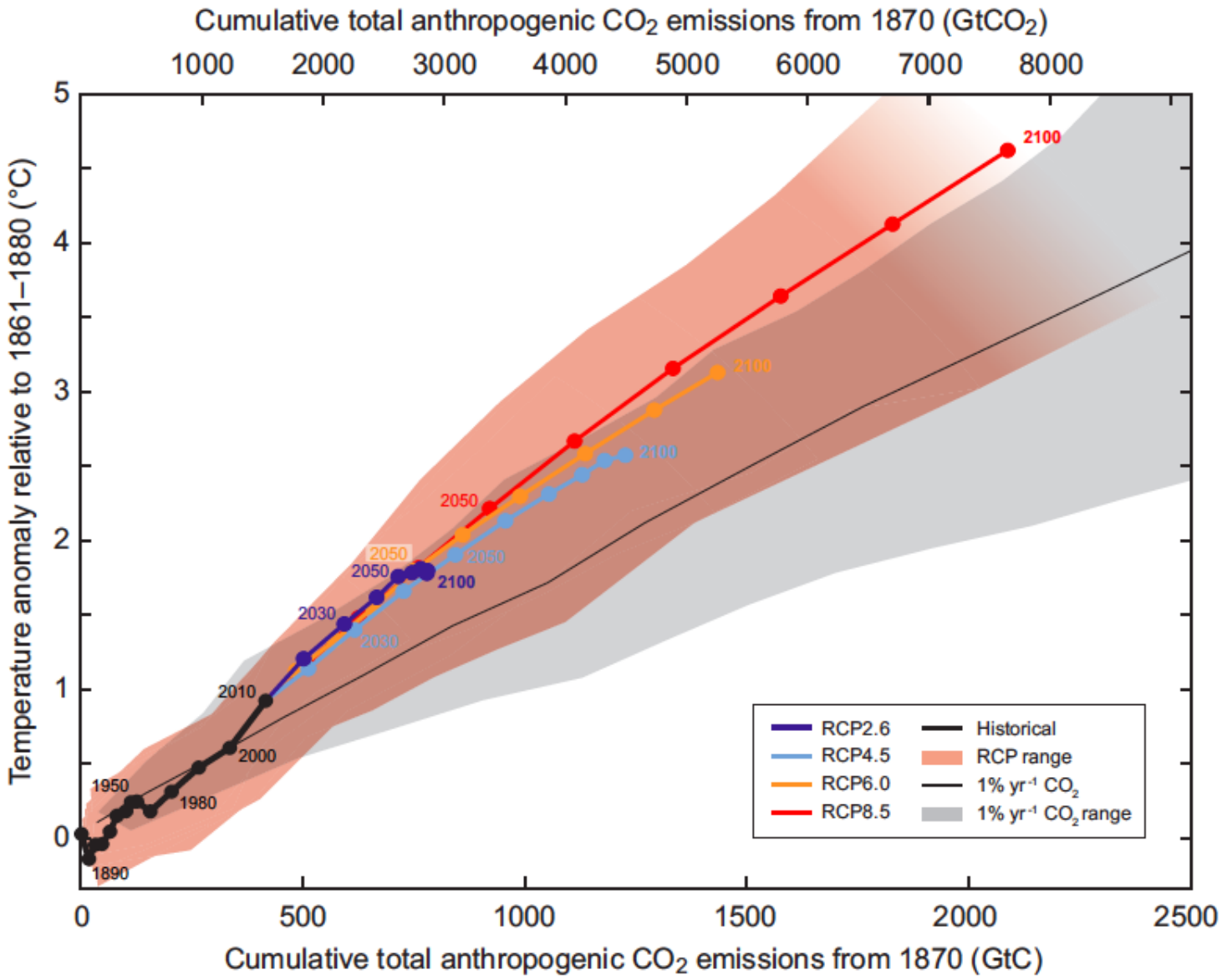

Global mean sea level rise
1.0
0.8
0.6
0.4
0.2
0.0
(m)
2000
2020
2040
2060
2080
2100
Year
Mean over
2081–2100
RCP2.6
RCP4.5
RCP6.0
RCP8.5



In recent decades, changes in climate have caused impacts on natural and human systems on all continents and across the oceans.

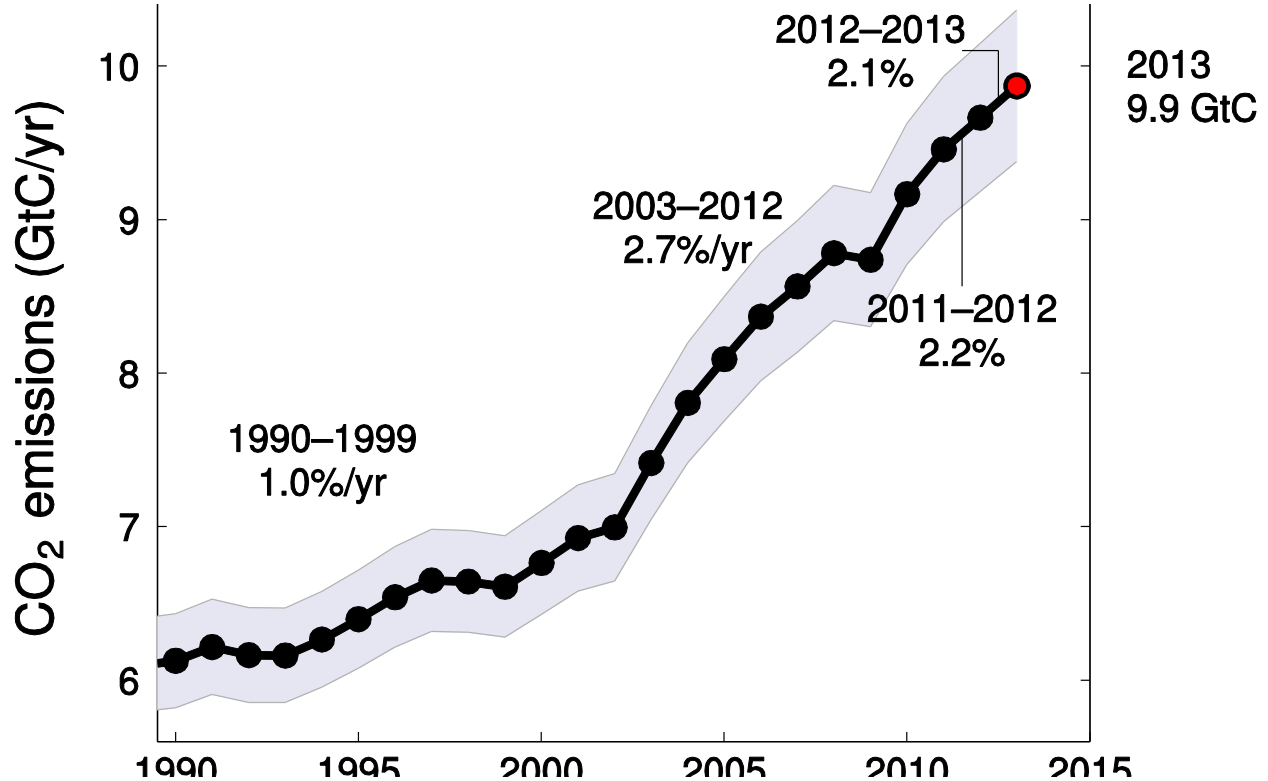


Increasing magnitudes of warming increase the likelihood of severe, pervasive, and irreversible impacts.

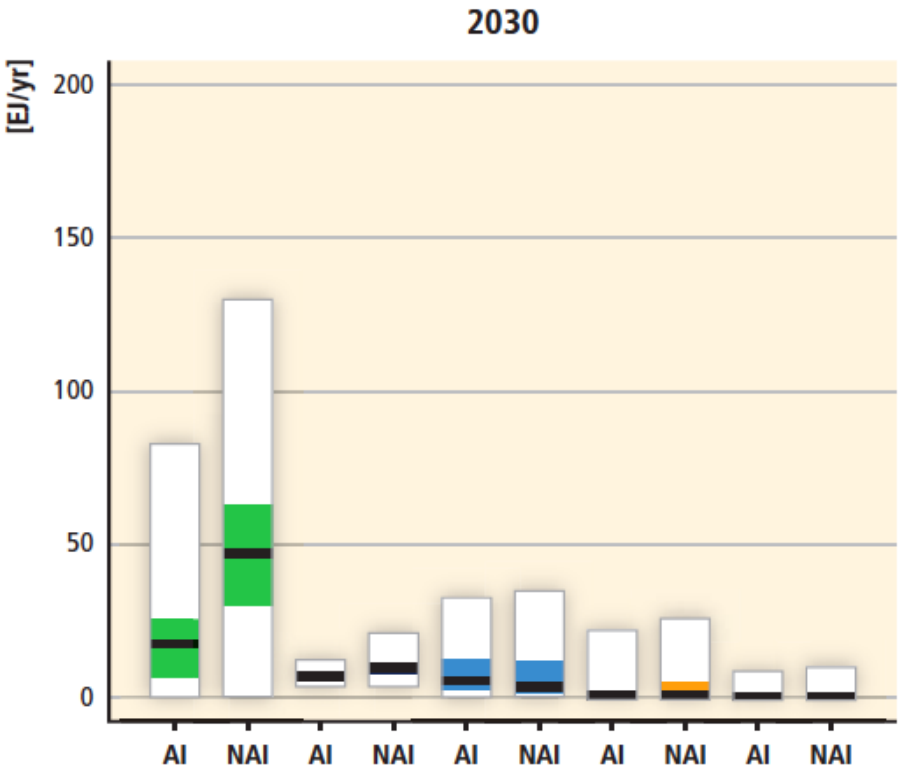


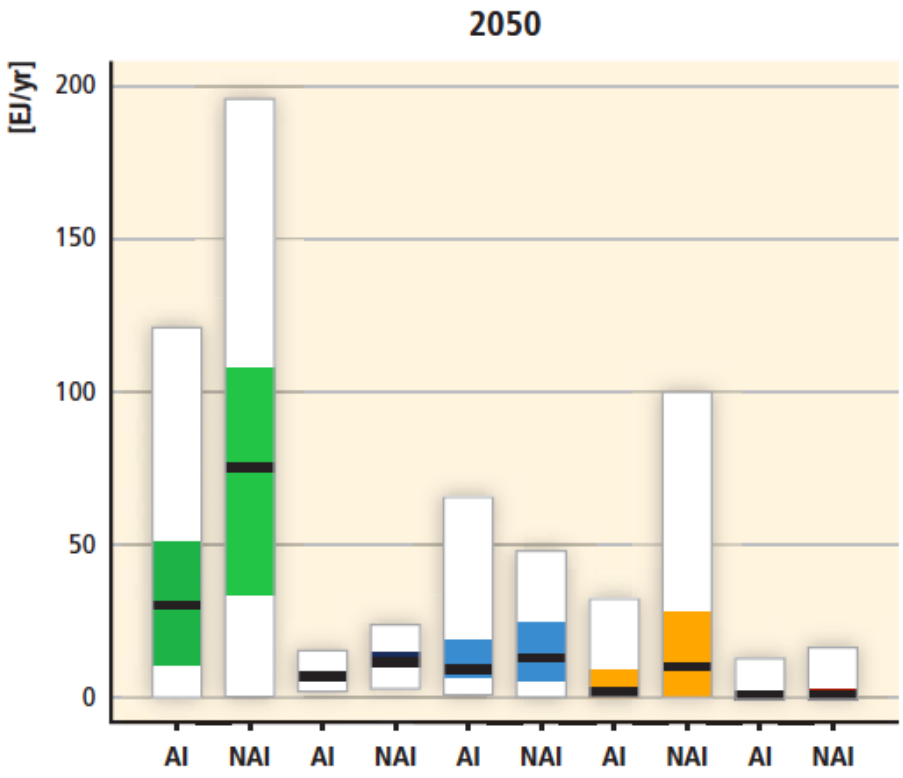
Cumulative emissions of CO_2 largely determine global mean surface warming by the late 21st century and beyond

- **Limiting the warming caused by anthropogenic CO_2 emissions alone with a probability of >66% to less than 2° C since the period 1861–1880, will require cumulative CO_2 emissions from all anthropogenic sources to stay below about 790 GtC (2900 $GtCO_2$).**
- **About 2/3 (515 GtC) were already emitted by 2011; ~ 540 by 2014**
- **The 250 GtC left correspond to ~ 25 years at the current rate of emissions while fossil fuel reserves are estimated around 1500 GtC**



- **Reaching atmospheric concentrations levels of 430 to 530 ppm CO2eq by 2100 will require large scale changes of the global energy system as well as cuts in GHG emissions over the coming decades.**
- **The majority of scenarios reaching these atmospheric concentration levels are characterized by a tripling to nearly a quadrupling of the share of zero- and low-carbon energy supply from renewables, nuclear energy and fossil energy with CCS by the year 2050 relative to 2010**
- **The majority of scenarios in which concentrations remain below 530ppm $CO2_{eq}$ throughout the 21st century are associated with GHG emissions reductions between 40% to 70% by 2050 compared to 2010 (and further decrease after 2050)**
- **Combining bioenergy and CCS (BECCS) could result in net removal of CO2 from the atmosphere**





The potential of renewable energies :

Between 27 and 77 % in 2050

1) **Bioenergy**
2) **Direct solar energy**
3) **Wind energy**