

# Past, Present, Future .....Climate Change.....

*ESS 2017*

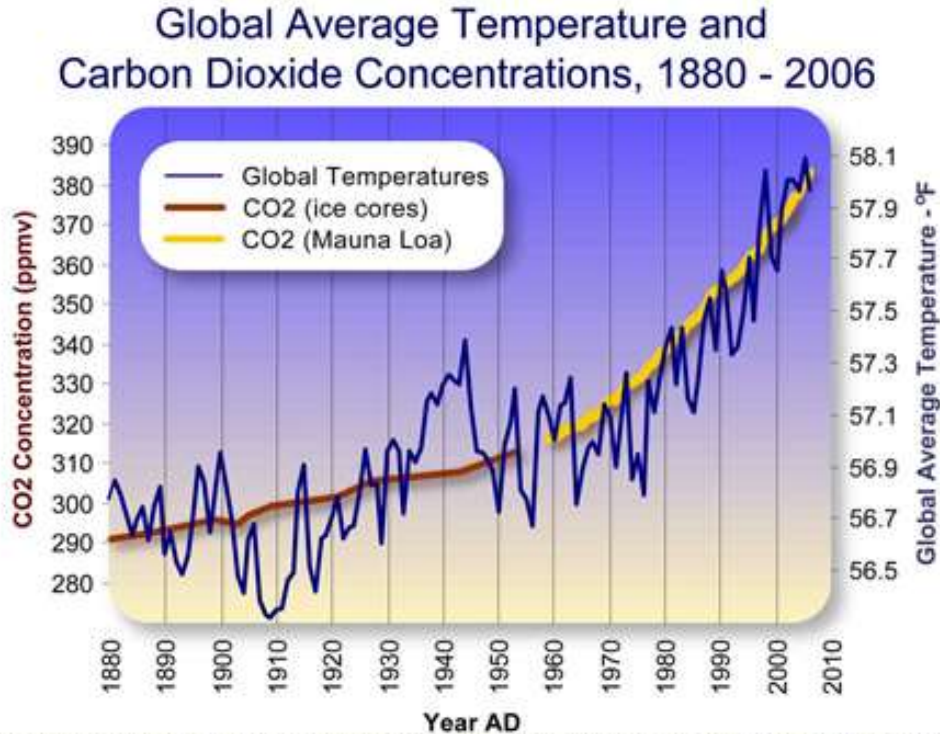


# Living planet...



<https://www.youtube.com/watch?v=r2yLSLmnsY4>

# The evidence for human-induced climate change



Data Source Temperature: [ftp://ftp.ncdc.noaa.gov/pub/data/anomalies/annual.land\\_and\\_ocean.90S.90N.df\\_1901-2000mean.dat](ftp://ftp.ncdc.noaa.gov/pub/data/anomalies/annual.land_and_ocean.90S.90N.df_1901-2000mean.dat)  
Data Source CO2 (Siple Ice Cores): <http://cdiac.esd.ornl.gov/ftp/trends/co2/siple2.013>  
Data Source CO2 (Mauna Loa): <http://cdiac.esd.ornl.gov/ftp/trends/co2/maunaloa.co2>  
& [http://www.esrl.noaa.gov/gmd/webdata/ccgg/trends/co2\\_mm\\_mlo.dat](http://www.esrl.noaa.gov/gmd/webdata/ccgg/trends/co2_mm_mlo.dat)

Graphic Design: Michael Ernst, The Woods Hole Research Center



Watch out for “cherry picking”...  
Selecting only some evidence in order to prove a point...  
E.g. 1900-1910...  
Temperature dropped

# PETM...

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## Palaeocene-Eocene Thermal Maximum

One of the most **rapid** instances of climate change

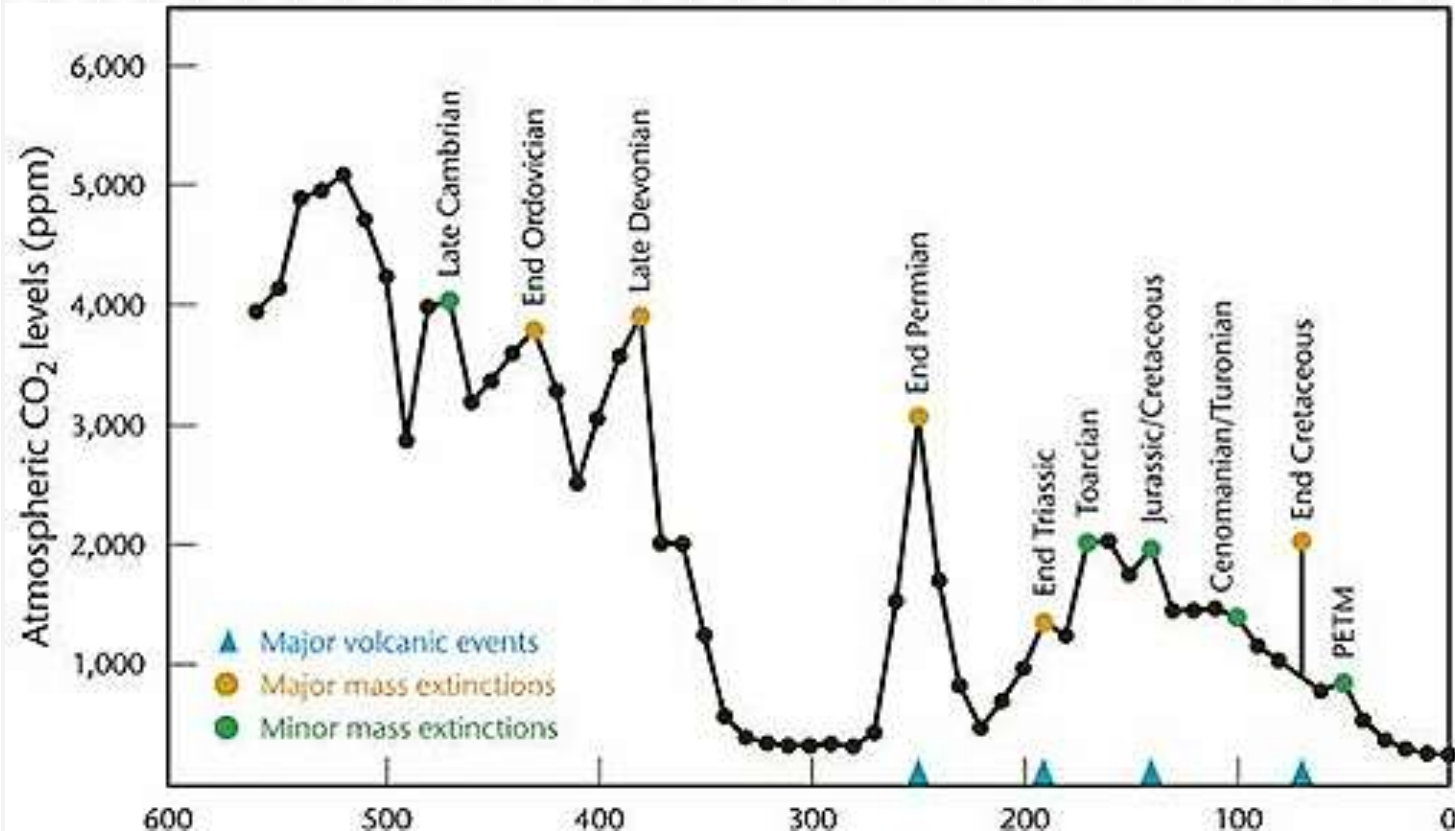
- 55 million years ago
- Sea levels rose
- Oceans acidified
- Extinctions
- Altered course of life on Earth

# Evidence?

Shells of fossil plankton at 55-million-year-mark in sea bed

- higher oxygen-18 levels than oxygen-16 levels
  - lighter oxygen-16 evaporated with rising temperatures
- higher carbon-12 levels than carbon-13 levels
  - increase of  $\text{CO}_2$  and  $\text{CH}_4$  in atmosphere

# Earth - CO<sub>2</sub> and Extinctions



# How has Earth avoided global warming and climate change before?

Last 80 million years

Huge rise in atmospheric CO<sub>2</sub> was avoided by the formation of a vast mountain range - middle of Pangea

Formation of mountains → rock weathering → removing CO<sub>2</sub> from the atmosphere

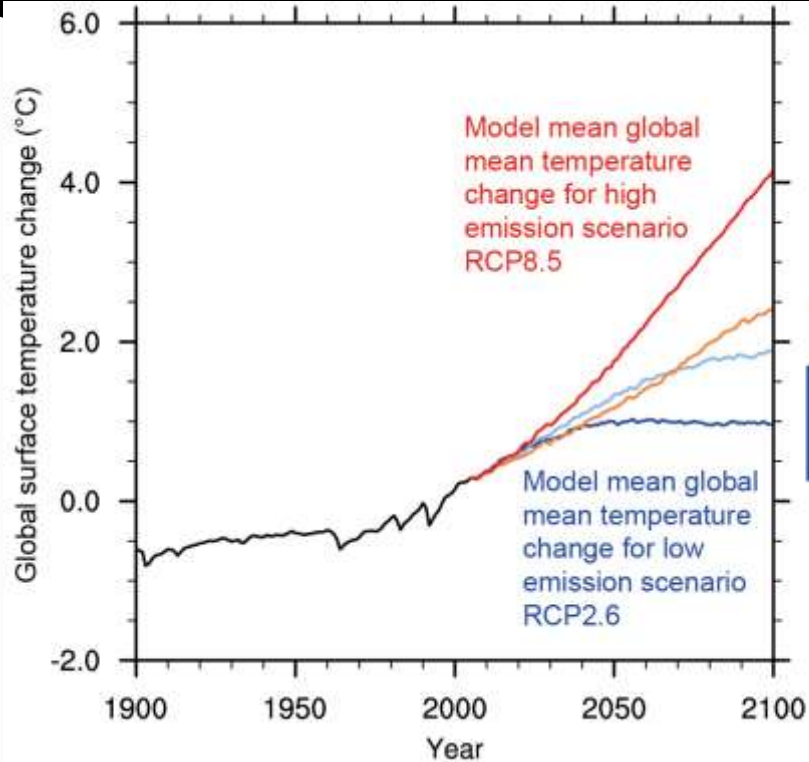
# So, what makes climate change .....happen?.....

## Greenhouse effect

<https://www.youtube.com/watch?v=ZzCA60WnoMk>



# Climate change forecasts/extrapolations



Based on amounts and rates of using/burning fossil fuels and release from agricultural land (Ecological footprint)

# Increased CO<sub>2</sub> concentrations...

## **The Potential Good**

Climate change can lead to water scarcity

However, more CO<sub>2</sub> in atmosphere so...

Plants use and lose less water so...

Less water shortages

<https://arstechnica.co.uk/science/2016/04/rising-carbon-dioxide-levels-could-actually-help-reduce-water-scarcity/>

# Increased CO<sub>2</sub> concentrations...

## **The Bad**

### Increased rate of climate change

More heat energy trapped in atmosphere...

More and bigger storms, winds, floods,...

### Ocean acidification

CO<sub>2</sub> dissolves in sea water to form carbonic acid...

This acid dissolves shells of shellfish and coral