

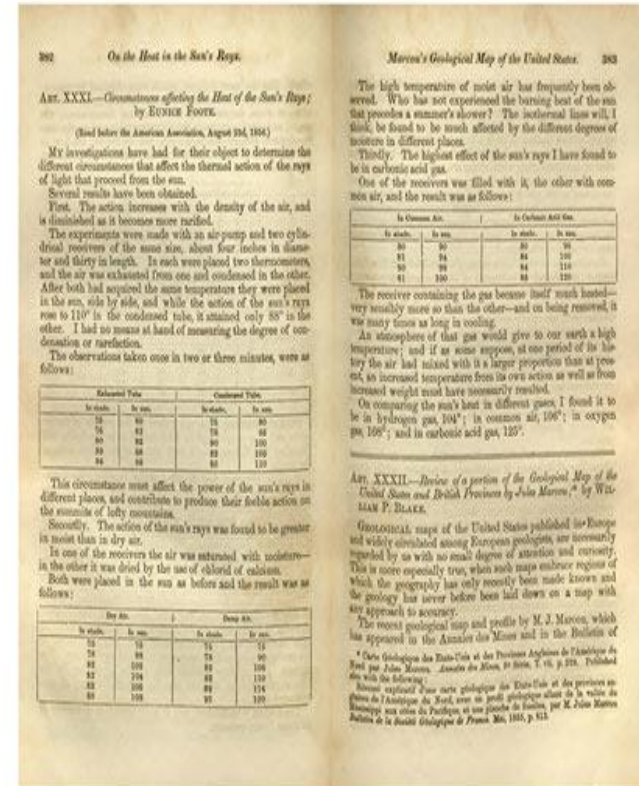
**K38f - A Very Brief History  
of Our Understanding of  
Human-Caused  
Greenhouse Warming of  
Earth**

Mathematician Joseph Fourier first realized that our atmosphere induces a Greenhouse Effect in 1830



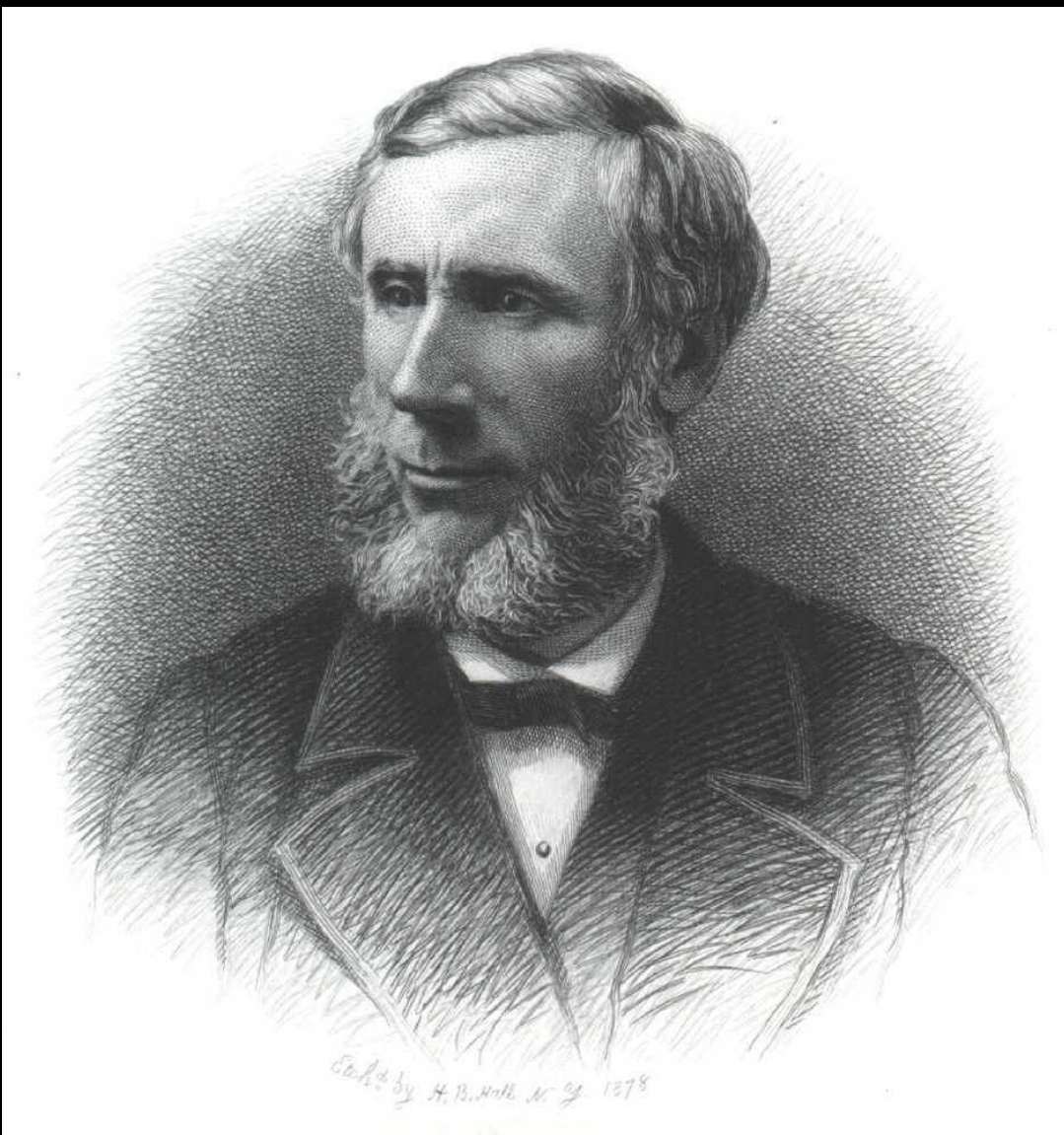
# 1856: Eunice Foote Discovers the Strong IR Absorption of CO2 and H2O

- She measured in the lab that the strongest absorption of heat of the atmospheric gases she measured, was from CO2 and water vapor.
- Alas, as a woman, her work, while **published**, appeared **under-appreciated** at the time, and more tragically, John Tyndall failed to cite her work when he published related work several years later.



**THE FIRST WORD ON GLOBAL WARMING:** In 1856, in *American Journal of Art and Science*, Eunice Foote wrote, "The highest effect of the sun's rays I have found to be in carbonic acid gas." That prescient line was the result of her experiments showing the proportion of carbon dioxide (then "carbonic acid gas") in the atmosphere altered its temperature.

*American Journal of Art and Science*



**1859: John Tyndall published papers showing that our own fossil fuel CO<sub>2</sub> blocks outgoing IR and thereby raises the temperature of the Earth. The spectrum of water vapor and CO<sub>2</sub> in the far IR was not well known enough to calculate the exact amount of warming**

# Svante Arrhenius, Swedish physicist, first calculated in 1895 the amount of the temperature effect on climate of adding our CO2 emissions

## The First Computational Climate Model

---

1895: Svante Arrhenius constructs an energy balance model to test his hypothesis that the ice ages were caused by a drop in CO<sub>2</sub>;  
(Predicts global temperature rise of 5.7°C if we double CO<sub>2</sub>)





**Svante  
Arrhenius,  
wins Nobel  
Prize in  
Chemistry in  
1903 (not for  
CO<sub>2</sub> work)**

# 1938 - Guy Callendar Links Observed Rising Earth Temperatures to Fossil Fuel Burning and CO2

THE ARTIFICIAL PRODUCTION OF CARBON DIOXIDE 223

551.510.4 : 551.521.3 : 551.524.34

## THE ARTIFICIAL PRODUCTION OF CARBON DIOXIDE AND ITS INFLUENCE ON TEMPERATURE

By G. S. CALLENDAR

(Steam technologist to the British Electrical and Allied Industries  
Research Association.)

(Communicated by Dr. G. M. B. DOBSON, F.R.S.)

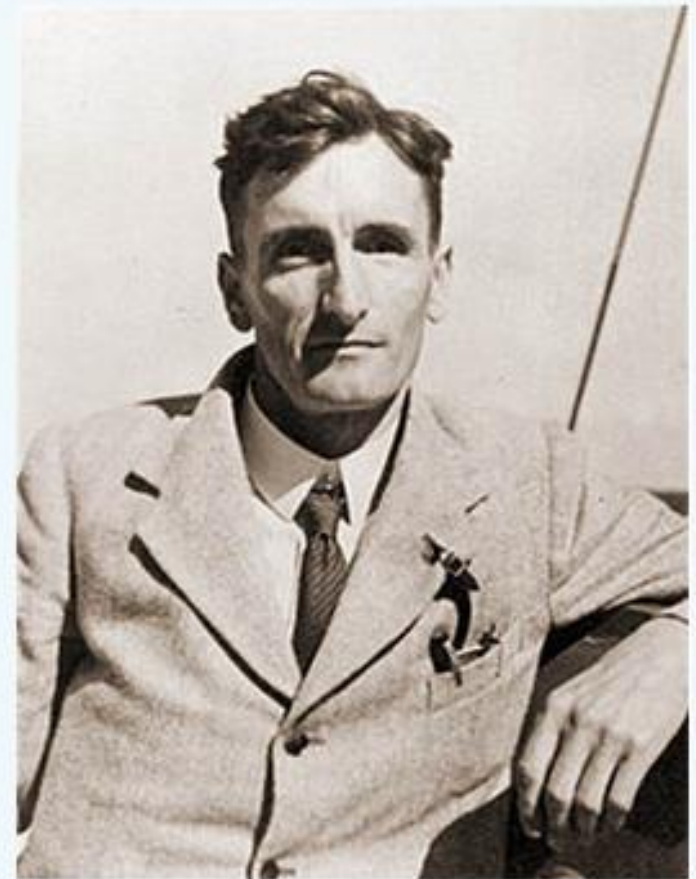
[Manuscript received May 19, 1937—read February 16, 1938.]

### SUMMARY

By fuel combustion man has added about 150,000 million tons of carbon dioxide to the air during the past half century. The author estimates from the best available data that approximately three quarters of this has remained in the atmosphere.

The radiation absorption coefficients of carbon dioxide and water vapour are used to show the effect of carbon dioxide on "sky radiation." From this the increase in mean temperature, due to the artificial production of carbon dioxide, is estimated to be at the rate of  $0.003^{\circ}\text{C}$ . per year at the present time.

The temperature observations at 200 meteorological stations are used to show that world temperatures have actually increased at an average rate of  $0.005^{\circ}\text{C}$ . per year during the past half century.



# 1958 – Charles Keeling Begins Landmark Recordings of Atmospheric CO<sub>2</sub> with Unprecedented Precision





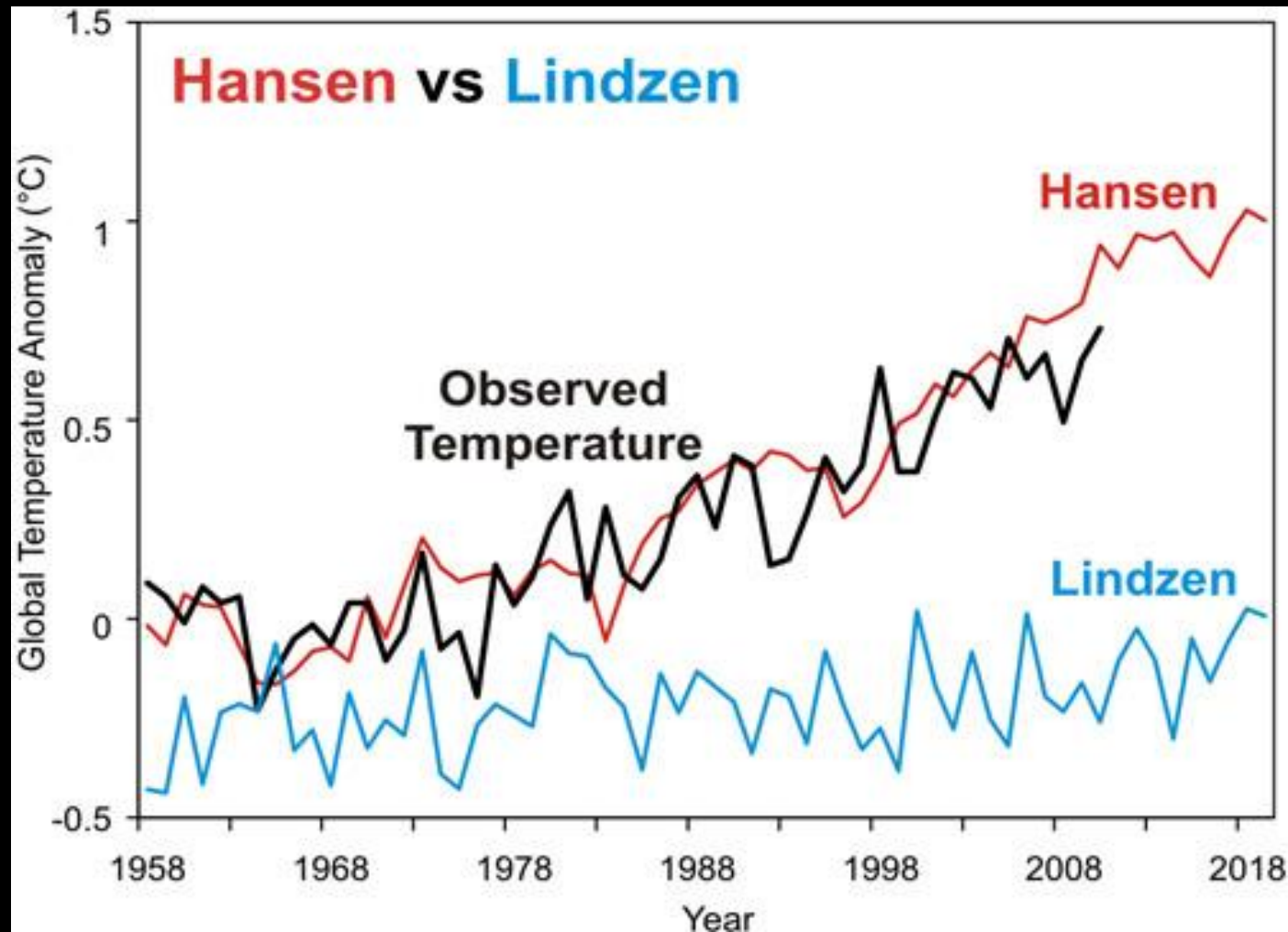
**1988: NASA Goddard Institute Head Dr. James Hansen Warns Congress that the Evidence is Compelling for Taking Action to Halt Human-caused Climate Change**



~1990 – Formation of the IPCC (UN Intergovernmental Panel on Climate Change) and Plan to Issue Assessment Reports (**AR**) Roughly Every 5 years

- AR1 in 1990
- AR4 published in 2007
- AR5 published in 2013
- Each report shows climate dangers more serious and scientists more convinced, even given the political fingerprints from the UN government reps and “volunteers” who must sign off on all AR’s

**Late 20<sup>th</sup> Century – Climate denialism and smear campaigns against climate scientists begin.**  
**Meanwhile – Hansen’s work vindicated, climate “contrarian” Richard Lindzen’s predictions: Fail**



**Hansen's Family. Sophie (lower left) had the greatest influence on Hansen's decision to leave GISS in order to take up climate activism, given Corporate/Govt anti-science. He still does science, at Columbia University**



**Hansen's been arrested a half-dozen times since 2009, at protests**



# 2006: Al Gore's film "An Inconvenient Truth" brings Global Warming to high-profile mainstream media



# 2008: Heavy Funding of Climate Denial Groups Ramps up after Gore's Film

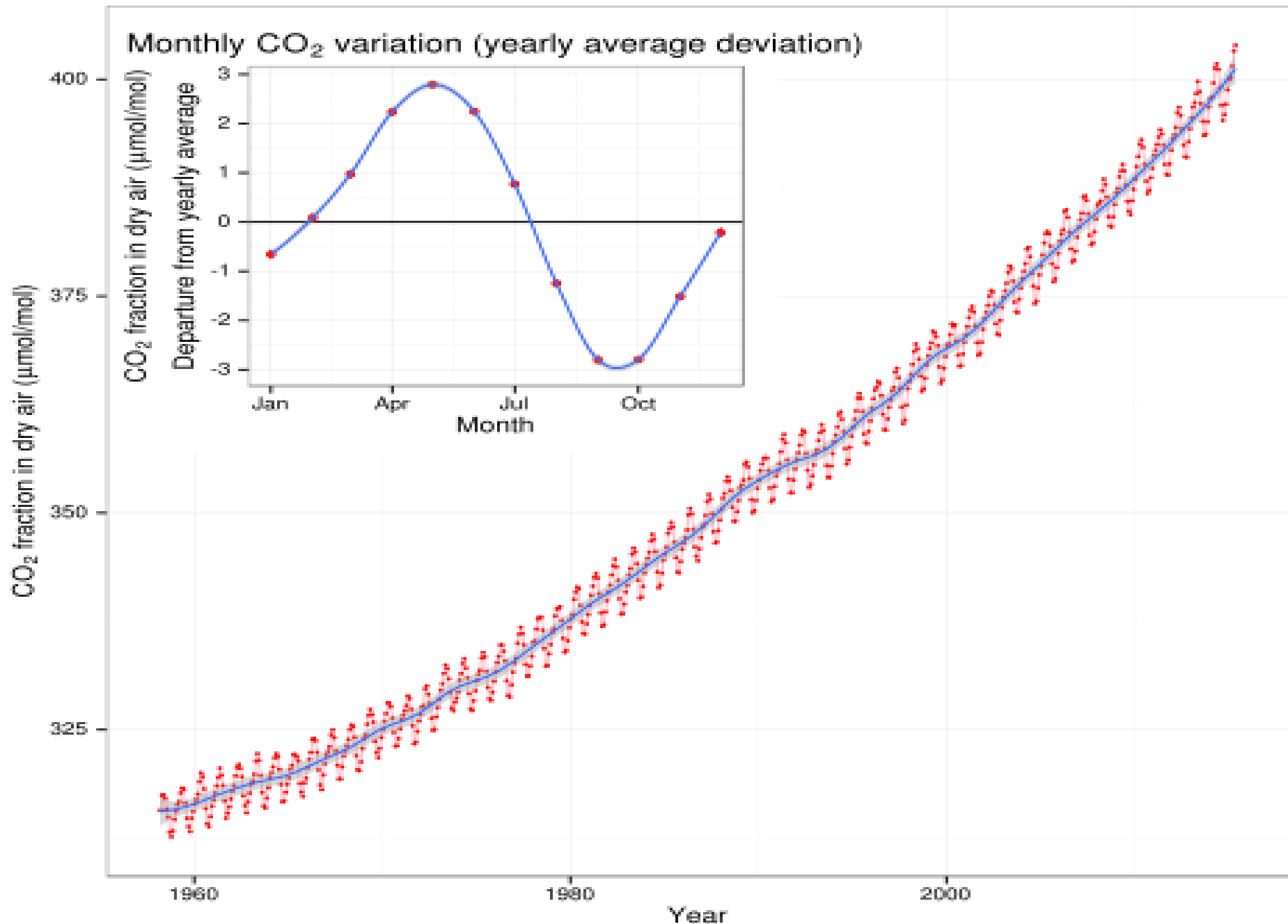
- Right wing ideologues realize that dealing with Climate Change requires strong government action. (They're right; it appears the Progressives don't understand this as well).
- Gore's film therefore seen as now a serious threat to their business models. Prior to this, they'd decided that scientists worrying among themselves in journals no one reads was not worth spending millions to derail.

# And Today... (from the Mauna Loa Observatory for CO<sub>2</sub>, Apr '16)

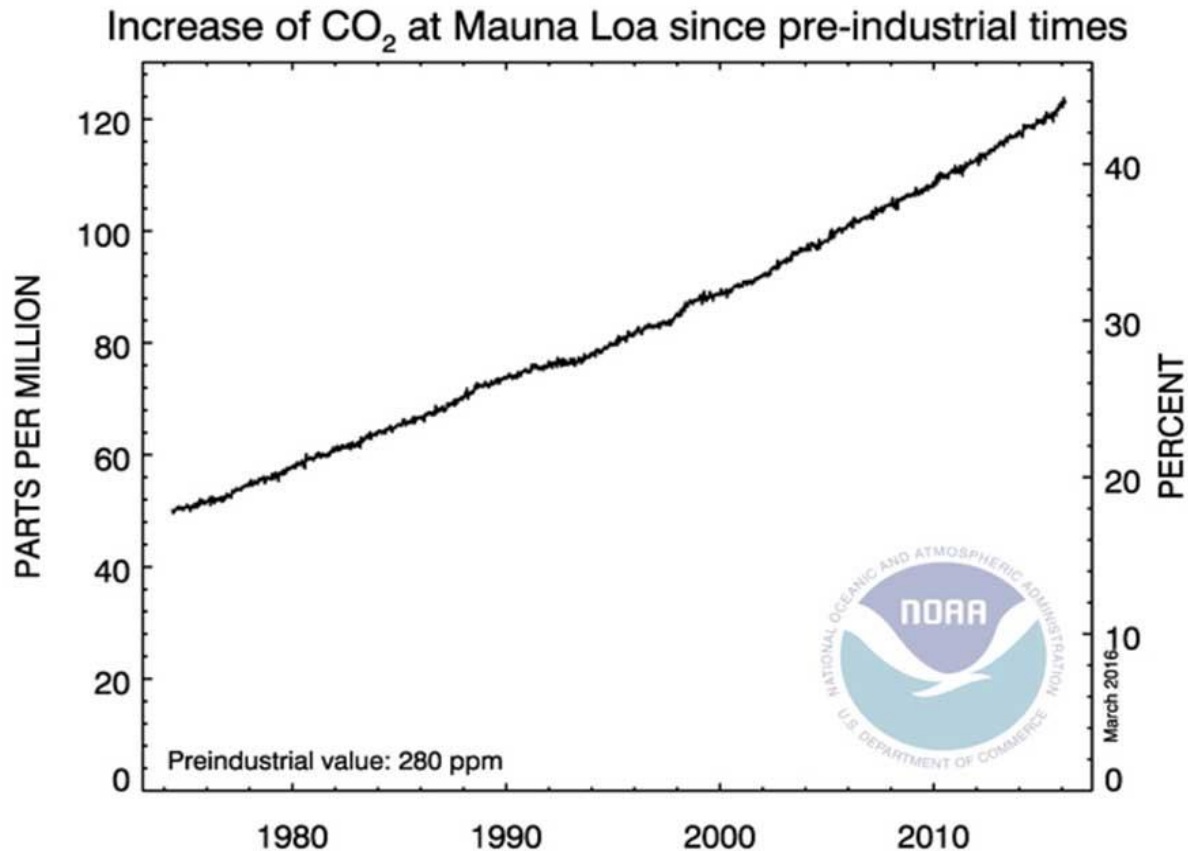
- *“We are now witnessing the fastest growth rates of the entire record of CO<sub>2</sub> measurements. This record-breaking growth is an expected consequence of the near record-breaking fossil fuel usage combined with the largest El Niño event in several decades.*
- *The very recent bump up in CO<sub>2</sub> levels recorded at Mauna Loa Observatory is not entirely unexpected because there is often significant uptick in CO<sub>2</sub> near the beginning of April before concentrations peak in May. This bump presumably reflects the fact that soils start to warm well before vegetation greens up in spring. The soil warming allows CO<sub>2</sub> to be emitted as organic matter such as compost decomposes. In a matter of weeks this soil emission will be offset by photosynthetic uptake, as the vegetation starts to turn on.”*



# Mauna Loa monthly mean CO<sub>2</sub> concentration 1958-2015



**Atmospheric CO<sub>2</sub> with seasonal oscillation removed, as of February 2016. We have a new record in the ACCELERATION rate of rising atmospheric CO<sub>2</sub> concentration ([New Scientist 2016](#))**



*Atmospheric increase of CO<sub>2</sub> over 280 ppm in weekly averages of CO<sub>2</sub> observed at Mauna Loa.*

# And the trend in listening to the scientists?...

1990

SO, THIS CLIMATE CHANGE THING COULD BE A PROBLEM...



1995

CLIMATE CHANGE: DEFINITELY A PROBLEM.



2001

YEP, WE SHOULD REALLY BE GETTING ON WITH SORTING THIS OUT PRETTY SOON...



2007

LOOK, SORRY TO SOUND LIKE A BROKEN RECORD HERE...



2013

WE REALLY HAVE CHECKED AND WE'RE NOT MAKING THIS UP.

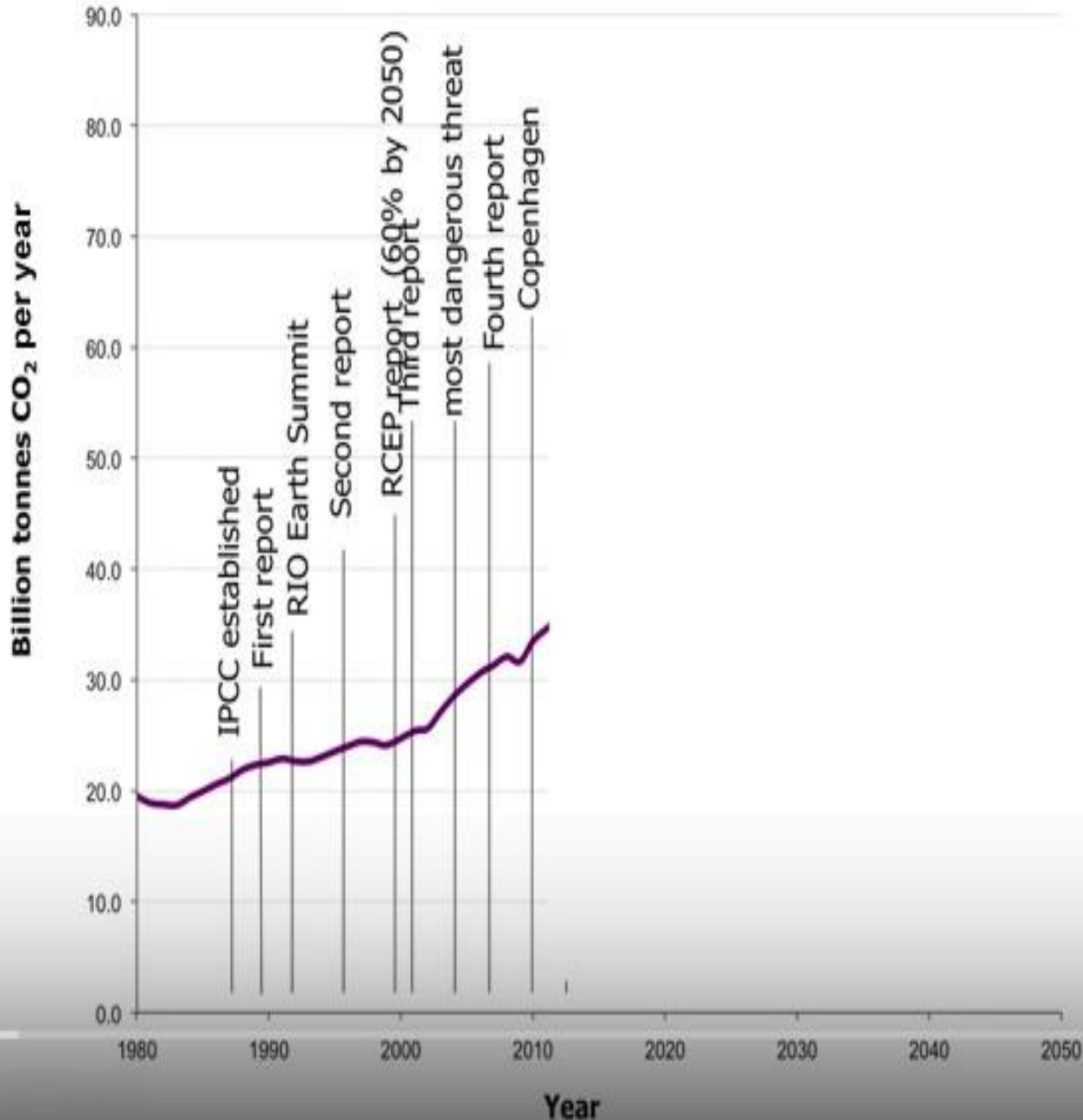


2019

IS THIS THING ON?



# Global emission of fossil fuel CO<sub>2</sub> (inc. cement)



**2010 – Tim Garrett publishes the first in a series of papers linking energy consumption and global GDP using thermodynamic principles. Shows lowering atmospheric CO<sub>2</sub> through realistic decarbonizing is incompatible with economic growth**

# We're going backwards, intellectually

MARCO RUBIO ON CLIMATE CHANGE...

5-13

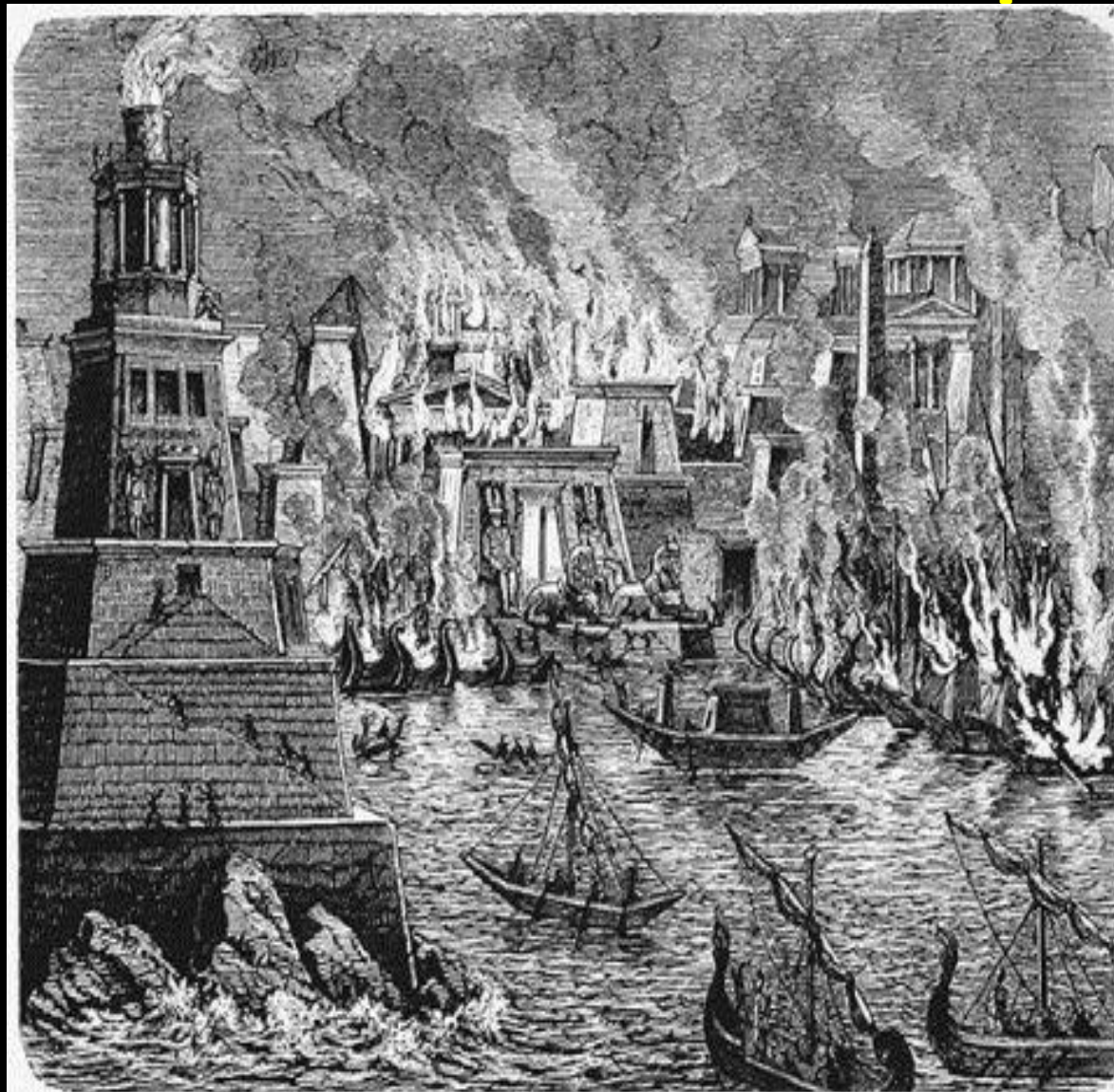


SOUTH FLORIDA SUN SENTINEL



THE GOOD NEWS FOR FLORIDA IS, IF THE SEA LEVEL DOES RISE, IT'LL JUST SPILL OVER THE EDGE.

# The Return of the Dark Ages, Under Dark Lord Trump



BURNING OF THE LIBRARY AT ALEXANDRIA.

- In the weeks, days, and hours ahead of the Trump Administration taking over, scientists and especially climate scientists, were scrambling to copy and store to safe locations the precious collected data of NASA, NOAA, and other scientific institutions ([source](#)).
- Indeed, at the hour of take-over, all mention of “global warming” was removed from the links at **Whitehouse.gov**. and “climate change” links all went dead.
- Now, [Government scientists are in terror](#)

**The list of Trump Empire assaults on science in general, and climate science and scientists in particular, is far too long to list here. But here's a few...**

- Trump seeks to [shut down existing, and on-the-drawing-board, satellite systems monitoring climate change](#)
- [Massive cuts](#) to the EPA enforcement division, rendering environmental laws useless.
- The latest [EPA purge](#) – the science advisory boards
- [Methane emission laws, gutted.](#)
- EPA in the process of being completely neutered in protecting the environment.

# Key Points: K38f – A Very Brief History of Understanding of Human-Caused Climate Change

- Greenhouse Effect first realized in early 1800's by Fourier
- First quantitative calculation of GH warming by Arrhenius in 1895
- Callendar links fossil fuel burning, CO<sub>2</sub> and Observed Rising Global Temperatures in 1938
- 1950's US Military research supporting heat-seeking missile technology defines precise absorption spectra of CO<sub>2</sub> and water vapor throughout Earth's atmosphere, allowing more precise climate calculations thereafter
- 1990 IPCC AR1, Kyoto Accords first global summit to lower GHG's
- Since then, corporate/political climate denialism continues to stymie any serious efforts, despite much improved science and vastly more dire predictions for the future
- For a more detailed and well-linked history of our understanding of Greenhouse Warming by CO<sub>2</sub>, see [here](#)