

Title: Global Warming Is Real! Highlights from the Data

by Phil Morris PhD: retired Molecular Biologist and High School Science Teacher and concerned about Global Warming.

Contact Information: I live in Edmond, OK and want to meet people interested in supporting a Pro-Global Warming agenda. Contact me if I can get involved or be of assistance in any way. I can be reached at philmorris@cox.net

Topic 1: Human Impact on the Planet Earth

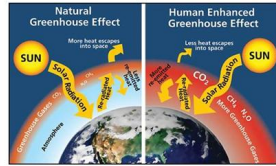


Figure 1: Humanity from Space: Western Europe

•The Human Race has a direct or indirect impact on 83% of the Earth's land surface and considerable impact on its Oceans.

Topic 2: The Greenhouse Effect—A Natural Phenomenon

•The principal source of energy to the Earth comes from the Sun



•Pre-Industrial Earth (1750) •The Earth Today
Figure 2: The Greenhouse Effect

Theory of the Greenhouse Effect:

•If outgoing infrared (heat) energy is blocked by gases in the Atmosphere, the temperature of the earth would rise.

•We first learned about the Greenhouse Effect in 1827 Joseph Fourier (1768-1830 French Mathematicians)

The three greenhouse gases, Carbon Dioxide, Methane and Nitrous Oxide are responsible for most of the Greenhouse Effect.

Topic 3: The Greenhouse Gases: Atmospheric Levels are Increasing!

Figure 3: Pre-Industrial and Trends in Atmospheric Levels of the Greenhouse Gases

GHGs	1755 Pre-Industrial (Ice Core Data)	1880 Good Temp Data (Ice Core Data)	1958 Satellites & MLO Data	2011*** MLO Data	% Change 1755-2011
CO ₂	277 ppm*	290 ppm	315 ppm	391 ppm	41%
CH ₄	723 ppb**	847 ppb	1239 ppb	1803 ppb	149%
N ₂ O	273 ppb	276 ppb	292 ppb	324 ppb	18.7%

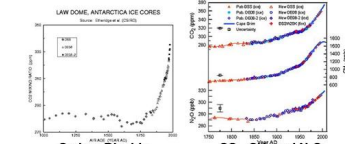
*ppm is the abbreviation for part per million
**ppb: parts per billion
***IPCC AR5 uses data up to 2011. More current data can be found here: <http://www.esrl.noaa.gov/gmd/ccgg/trends/index.html>

•The atmospheric levels of the Greenhouse Gases have increased over the last 240 years.
•2.03 trillion tons of Carbon Dioxide has been released into The Earth's Climate System since 1750
•Mean Atmospheric CO₂ levels at the End of 2015 were 402.2 ppm

Topic 4: Ice Core Proxies—Past Climate Conditions

Law Dome Atmospheric Carbon Dioxide

The Law Dome ice cores are very informative for climate research. Due to the high snow fall at Law Dome Antarctica the snow is compressed into ice on a shorter time scale. Atmospheric Greenhouse Gas (GHG) levels were obtained to about the year 2000. The data show that the levels of the major GHGs started to increase at about the same time as humans began using larger and larger amount of the fossil fuels for their source of energy. This was the result of the Industrial Revolution starting in 1750.



Carbon Dioxide A.D. 1000 to 2000
CO₂, CH₄, and N₂O A.D. 1750 to 2000
Figure 4: Air Age in Ice Cores

•Ice cores show that the increase in the Greenhouse Gases began with the start of the Industrial Revolution in about 1750.
•We are Responsible!

Topic 5: Current Temperatures—The Trend is Upward

Temperature Summary:



Figure 5: Global Mean Land-Ocean Surface Temperature: 1880 to 2014

Global mean surface temperatures relative to the 1951–1980 mean of 14°C or 57.2°F
•black line is the annual mean (year by year)
•red line is the 5-year running mean (5-year trend line)
•green bars show uncertainty estimates

•The trend is upward. Since 1880 the Earth's temperature has increased by 0.90°C or 1.62°F as of the end of 2015.

Given that the Greenhouse Effect is real and that it is caused by gases such as Carbon Dioxide, doesn't common sense tell you that the planet Earth must be warming?

Topic 6: Radiative Forcing Data—The Earth is in an Energy Imbalance!

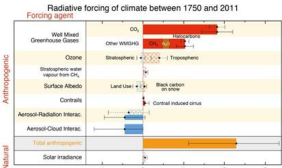


Figure 6: Radiative Forcing of Climate

•Agents in red and to the right (Greenhouse Gases etc.) are those that increase the trapping of the sun's energy and cause an increase in temperature.

•Agents in blue and to the left (clouds, aerosols) are those that decrease the trapping of the sun's energy and cause a decrease in temperature.

•The current energy imbalance is +2.3 W/m².
•This indicates that the Earth is Warming.

The Greenhouse Gases; CO₂, CH₄ and N₂O are the major cause of the Earth's Energy Imbalance.

Topic 7: Carbon Dioxide Emission by Humans: They are Increasing!

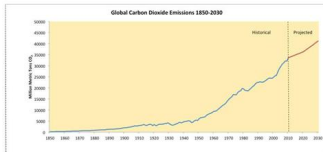


Figure 7A: CO₂ Emissions from 1850 & Projections to 2030

- As shown on the graph, human CO₂ emissions from the burning of fossil has increased at a fairly steady rate since 1850 with larger increases since 1950.
- In 2010 we emitted 37 billion metric tons of CO₂.
- In 2030, based on current projected increases, CO₂ emissions could reach 45 billion metric tons/year.
- Over 20 years that is an average increase of about 400 million or 0.40 billion tons per year. This projection is consistent with projected growth in the human population.

How Much is 40 Billion Tons of Carbon Dioxide?

Let me put this in human terms. I chose a nice round number of 40 billion tons per year. What does that look like in human terms?

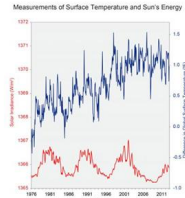


Figure 7B: Huamn Beings

- There are over 7 billion people on the planet. For the sake of simplicity let's assume that the average person weighs about 100 pounds. What would be the total weight?
 - In 2010 we emitted 37 billion metric tons of CO₂.
 - In 2030, based on current projected increases, CO₂ emissions could reach 45 billion metric tons/year.
 - Over 20 years that is an average increase of about 400 million or 0.40 billion tons per year. This projection is consistent with projected growth in the human population.
- 7 billion people weigh about 700 billion pounds
•40 billion tons = 80,000 billion pounds
- This means that the amount of CO₂ we are putting into the Earth's climate system every year is about 114 times larger than the total weight of the human race.

Topic 10: Could Natural Causes be Responsible? Sun, Orbital Forcing & Volcanoes

Figure 10A: The Sun:



Solar Irradiance and Global Mean Surface Temperature 1978 to about 2013

•The sun's energy received at the top of Earth's atmosphere has been measured by satellites since 1978. It has followed its natural 11-year cycle of small ups and downs, but with no net increase (red). Over the same period, global temperature has risen markedly (blue).

Summary:
While solar irradiance has not increased over the past 30 to 40 years the global mean surface temperature has continued to rise.

Figure 10B: Orbital Forcing: Is it the cause of Global Warming?

Figure 10B.1: Axial tilt (Obliquity)
Over a period of 41,000 years the Earth's tilt varies from 22.5° to 24.5° and back again. Currently the Earth is tilted at 23.44° from its orbital plane, roughly halfway between its extreme values. While it is well known that the tilt of the earth can have effects on global temperature, the current tilt of the earth should not have any notable effect on global temperature.

Figure 10B.2: Earth's Orbit around the Sun (Eccentricity)
The shape of Earth's orbit varies from nearly circular to a more oval shape and back to nearly circular and takes about 100,000 years to complete this cycle. Currently, we are in an orbit of near circular which does not bring the Earth closer to the sun and will not do so for several thousand years. We are in a neutral orbit, one that is not heading for an ice age and one that is not heading for global warming in several thousand years.

Figure 10B.3: Axial precession (Wobble)
Precession is the trend in the direction of the Earth's axis of rotation relative to the fixed stars, with a period of roughly 26,000 years. The current orientation of the Earth's Axial Precessions is not such as it would contribute to global temperature.

Summary: The experts state that the current positions of the Earth's orbit should result in cooler temperatures, but instead the average temperature of the planet is on the rise.

10C: Volcanoes: Are they emitting large amounts of CO₂?

What about volcanoes? When one looks at a volcanic plumb one can easily imagine bad things happening. Here we see the eruption of Mount Pinatubo in the Philippine Islands in 1991. It was one of the largest eruptions of the twentieth century. But what is that plumb cloud made of? Most of the plumb is water vapor, not CO₂. For this volcano the other major gas was sulfur dioxide (SO₂). It is not a GHG but actually causes global cooling. In addition, sulfur dioxide does produce "acid rain" which is very harmful to the environment.



Volcanic Eruption of Mount Pinatubo on June 1991.

Yearly CO ₂ emitters 2010 Data	Billion metric tons per year
Global volcanic emissions (highest preferred estimate)	0.26
Anthropogenic CO ₂ in 2010	33.6
Light-duty vehicles (cars/trucks)	3.0

Summary: The experts point out that human CO₂ emissions for 2010 were about 130 times that of CO₂ emissions from volcanoes, 33.6 billion tons/year vs. 0.26 billion tons/year.

Topic 11: The IPCC's RCP Projections for 2050 and 2100

The Details for RCP 2.6

RCP 2.6 is the most stringent RCP Scenario. On the left is a table by decade showing how our CO₂ emissions from fossil fuels must change and that data is in graph form on the right.

•We will have to reduce our fossil fuel dependence below zero by 2100 if we want to keep the global mean surface temperature below 2.0°C.

Year	RCP 2.6	% Change
2010	31.6Gt	-
2020	33.0	+4.4%
2030	26.4	-20%
2040	17.6	-33%
2050	11.8	-33%
2060	5.7	-52%
2070	0.95	-83%
2080	-1.43	-250%
2090	-2.97	-108%
2100	-3.37	-14%

Cumulative Emission: 990 Gt

Summary: RCP 2.6
Projected Atmospheric CO₂ 2050 2100
440ppm 420 ppm
Global Mean Surface Temperature °C Temp Anomalies & (mean in actual °F) 2050 2100 2300
1.0°C (58.64°F) 1.0°C (1.0°C) 1.0°C

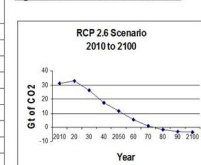


Figure 11B: The Details for RCP 8.5

RCP 8.5 is the really bad news; it is the business as usual scenario with increased usage of fossil fuels. If we follow the RCP 8.5 scenario by 2100 the energy imbalance (RF) will reach about 8.5 W/m² which is 3-4 times higher than today. GI: Billions of tons of CO₂

Year	RCP 8.5	% Change
2010	32.6 Gt	-
2020	41.7	+28%
2030	50.6	+21%
2040	61.2	+21%
2050	73.5	+20%
2060	85.5	+16%
2070	94.4	+10%
2080	100.0	+6%
2090	103.6	+3.6%
2100	105.2	+1.6%

Cumulative Emissions: 6,180 Gt

Summary: RCP 8.5
Projected Atmospheric CO₂ 2050 2100
540 ppm 935 ppm
Global Mean Surface Temperature °C Temp Anomalies & (mean in actual °F) 2050 2100 2300
3.7°C (60.44°F) 7.0°C (63.6°F) ≥ 8.0°C (71.24°F)
Warning Zone Danger Zone

•In 2050 the temperature could reach 2°C (3.6°F) which puts us in the warning zone and it will continue to increase to about 3.7°C (6.3°F), the danger zone, by 2100. By 2300 it could reach 8 to 12°C (14 to 22°F) above the pre-industrial age. These temperatures will have a major impact on the Earth's climate and life forms.