

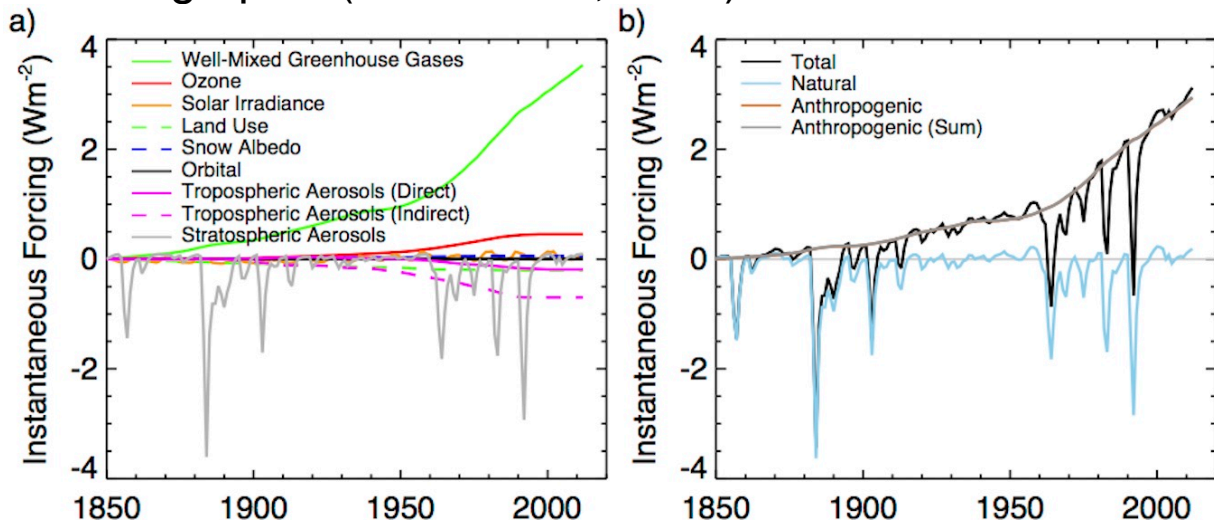
Likely, Kenji Sensei wants to talk about Buddhism and climate change, and not get entangled in the details of climate science. We can help that by understanding a few Noble Truths about the science and politics of Global Warming before our Buddhism 1, 2, 3 Meetup on ZOOM™ on July 15th.

THE NOBLE TRUTHS OF CLIMATE CHANGE

-- 1 -- The near-surface of our planet has a fever that is increasing exponentially. Several different types of instruments report a decades-long warming trend. (Please see the first graphic attached below, "Three instruments agree on warming.") Ultimately, exponential growth of anything in a finite world encounters limits, usually catastrophically. It's hard to tell what will break first. To my knowledge, no one has systematically inventoried all the effects of global warming. In my very humble opinion, and well outside my computer science specialization, the first widely noticed effects of global warming will be in agriculture. The globally warmed climate will be wrong to grow the usual food crops.

-- 2 -- The many causes of climate change, or "Climate Forcings," are measured in units of power per unit area, Watts per meter squared. (Think of it by asking yourself, "How much sunlight streams through a one meter square window over the course of a year?") Currently, the principal forcings are measured to about four decimal

places, often by satellites. This means that we know the major causes of the Earth's warming with a high degree of certainty. Climate science papers often present something like this graphic (Miller_et_al, 2014):



Individual causes are on the left side graph "a," while totals are on "b." Graph "b" shows that there is a large anthropogenic, or human made, component. However, graph "a" says, "The winner is, . . . Envelope, please." Drum roll. . . "The greatest measured cause of the recent observed surface warming of the Earth is, . . . the green line of graph "a," representing the well mixed greenhouse gases."

What are "Greenhouse Gases" and how do they warm the Earth's surface?

During the day, the Sun sends visible light through space to our Earth's atmosphere, heating our planet's surface. At night, the warmed surface reradiates that solar energy as infrared energy through the atmosphere back into space. The balance of solar energy coming in and infrared energy going out determines our Earth's average

temperature. If more energy comes in than out, then the Earth's temperature rises.

Certain greenhouse gases in our atmosphere are transparent to visible light, yet they are opaque to infrared. Thus, during the day the Sun's visible light passes right through them and warms the Earth's surface. At night, greenhouse gases scatter the infrared radiated energy from the ground keeping it from space, so they warm Earth's atmosphere. A bedspread does much the same on a cold winter night. The principal greenhouse gases are Water Vapor, Carbon Dioxide and Methane, or H₂O, CO₂, and CH₄. Currently, CO₂ and CH₄ amount to 2/3 and 1/6 of the forcing of the long-lived greenhouse gases. There are many other long-lived greenhouse gases making up the final 1/6 of the long-lived greenhouse gas forcing, which now totals about three Watts per meter squared. (Please see, <https://www.esrl.noaa.gov/gmd/aggi/aggi.html>, especially Table #2 at the end. Also please see, the second graphic attached below.)

Water vapor is something special. It is a "Climate Feedback Mechanism," magnifying the effects of other climate forcings. Unlike the long-lived greenhouse gases, which stay around for decades and centuries, the amount of water vapor in the Earth's air is proportional to the air's temperature. Warmer air can hold more water vapor. So, when the long-lived greenhouse gases warm the atmosphere, that hot air can hold more water vapor. Water vapor, a greenhouse gas, warms the atmosphere,

allowing more water vapor into the atmosphere, which warms the atmosphere, and the warming cycle repeats. When the cycle repeats too many times, one has a, "Run Away Greenhouse Effect." This happened on the Planet Venus, whose surface is hot enough to melt lead. Here on Planet Earth, two things save us from this Hell:

- our Earth's atmosphere is not as thick as the atmosphere of Venus, and
- Donald Trump will not serve for more than four years as President of the USA.

-- 3 -- So then, Little Grasshopper, "What is the Cessation of Exponential Warming?"

Greenhouse Gases are a large problem. One has to use large units and unusual constructs to attempt to grasp the size of it.

-- The energy scattered back at the earth by CO₂ averages the punch of about 1,400 million tons of TNT an hour. That's roughly the energy of 20 Hiroshima or Nagasaki bombs every second. This does not include the contributions of other greenhouse gases.

This is before climate feedback mechanisms multiply greenhouse gas warming by 2 or 3 times.

-- If frozen into a single block of dry ice, all the CO₂ in Earth's atmosphere would fill a cube about 8 miles on a side. Using landmarks you know, try to imagine a lot of local real estate that is 8 miles square. Then, imagine a mountain 8 miles high. Huge, isn't it?

Has anyone done anything about this? No! Please see the third graphic attached below, "CO2 is Rising Exponentially" "Is CO2's Rise Changing?" Study it carefully, please. It is likely the most important thing I ever will write. I've removed as much of the complex mathematics as I can. When I start talking about things like time series analysis, significance tests, and statistical distribution functions, I usually see my listeners' eyes glaze over.

What is the cessation of exponential warming? None is detectable. A downward deflection of the exponential rise of atmospheric CO2 as small as one part in ten-thousand over the last half-century could be detected. There has been nothing done since the first Earth Day half-a-century ago. That's quite a tragedy. It's the tragedy layered within the tragedy of global warming like a pair of Russian dolls.

What is stopping progress against global warming?

There are many reasons. I'll give my top three.

-- Industry Backlash

Reducing emissions of CO2 and other greenhouse gases means curtailing the use of carbon based fossil fuels like coal, oil, and natural gas. The fossil fuel industry wants everyone to use its products. Reasons for cutting the use of carbon fuels fall on deaf ears. The industry has organized a monstrously large and very well funded public relations campaign against greenhouse gas emission reductions. (There are many good references here, such as the works of Ross Gelbspan, like "The Heat is

On" (1997), and "Boiling Point" (2005). Jeremy Leggett's "The Carbon War" (1999) is a classic. Also see, Naomi Oreskes' and Erik Conway's work, "Merchants of Doubt" (2010) and watch the documentary video with the same name (2014)) That campaign includes industry funded pseudo-scientists spouting nonsense worthy of the creationists. Things widely known, like the measuring of and ranking of forcings in #2 above, are hidden, to be replaced with endless pseudo intellectual garbage. The cause of the warming of the last half-century is very well known, period, end of story.

-- Those trying to stop global warming, the 'Climate Activists' themselves, are ineffective.

People, particularly those who call themselves "Climate Activists," find the narrative of the third graphic hard to grasp. For the half-a-century since the first Earth Day in 1970, all kinds of protests have accomplished nothing. A major problem is that many of the activists and their groups are science phobic. The thought of any objective standard for progress against climate change is heresy to them. Imagine how much progress could have been made if the activists started looking at Keeling's Atmospheric CO₂ Curve 50 years ago!

-- The failure of science education

America has a problem with science education. Attempts to teach science in our public schools encounter "Science Friction" from religious, political, and industry groups. Many of the new private religious "school choice" institutions hardly teach science at all. For example, the Physics required to fully understand the description of

greenhouse gases given above is not available in most high school science programs. Sir Issac Newton wrote two volumes: one on "Mechanics" and another on "Optics." The subjects of the first volume are taught in America's public high schools. "Optics," and the studies that Newton's great work started, are only taught to those of us who study for a four-year degree in science or engineering. Unfortunately, that's way too small a fraction of the population with tools to even understand global warming, let alone defeat it. (One could make a very similar argument for the lack of the teaching of "Probability and Statistics," a branch of mathematics required to defeat global warming. Ditto for the study of foreign languages and cultures, the skills needed to implement solutions to a global problem.)

-- 4 -- So then, what steps should we take now? Not all the steps on this Noble Path are known. (Hey! I am not a Buddha. You only get two steps, not eight, from me.)

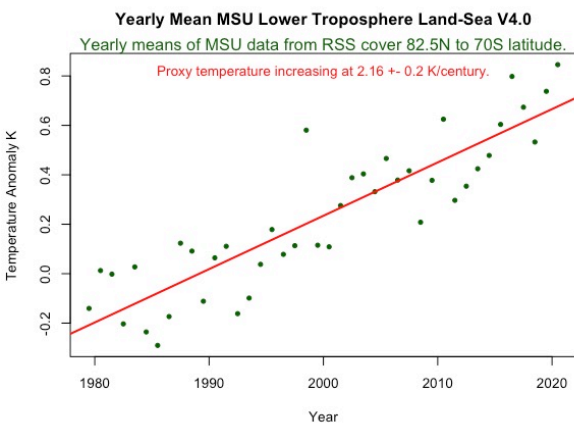
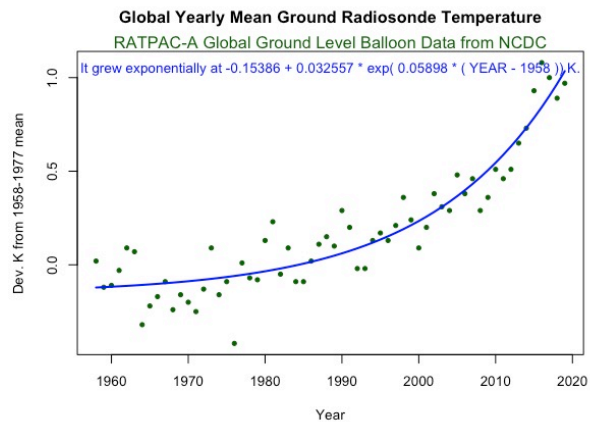
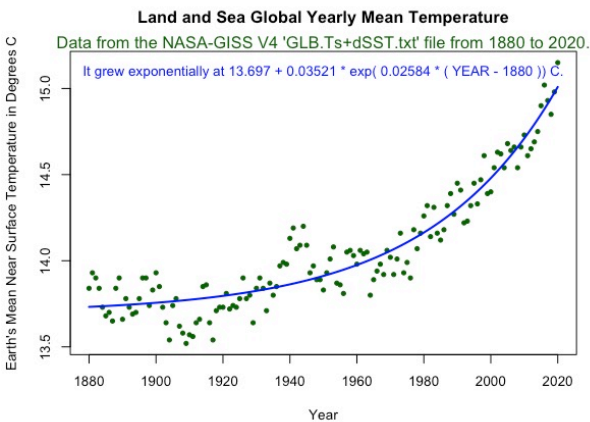
-- Measure climate change's causes and results. Notice how many statements in the three sections above and the three attached graphics are based on measurements. Measurement is the only way to prevent another half century long tragedy of wasted opportunity. Every proposed action against climate change should be measured in Watts per meter squared of reduced climate forcing.

-- Innovate! None of the currently used strategies against global warming have accomplished anything perceptible in 50 years. Don't waste your time with any of the existing climate activist groups. Study their history of failure. Do your own thinking. Devise your own plans and strategies. Organize your own group.

Humble Gassho,

Roger Coppock, AKA "Mr. Climate T-shirt"

---The First Graphic: Three instruments agree that our planet is warming.



Three instruments agree on warming.

UL: Thermometers in ground weather stations see warming.

The average ground-level temperature of our home planet is warming faster and faster. Life can't keep up with the pace. Eventually, something must break.
See: <https://data.giss.nasa.gov/gistemp/>

UR: Weather balloons see warming when they are launched.

Weather balloons, or Radiosondes, say the surface of the Earth is warming. Balloons and ground stations agree that the surface warming is exponential. For these data see:

www.ncdc.noaa.gov/data-access/weather-balloon/radiosonde-atmospheric-temperature-products-accessing-climate/ratpac-a

LL: Satellites with Microwave Sounding Units see warming.

Microwave equipment in satellites listens to spinning O2 atoms to measure warming by proxy. For background on the satellite temperature proxy, please see:
https://en.wikipedia.org/wiki/MSU_temperature_measurements
For these data see:

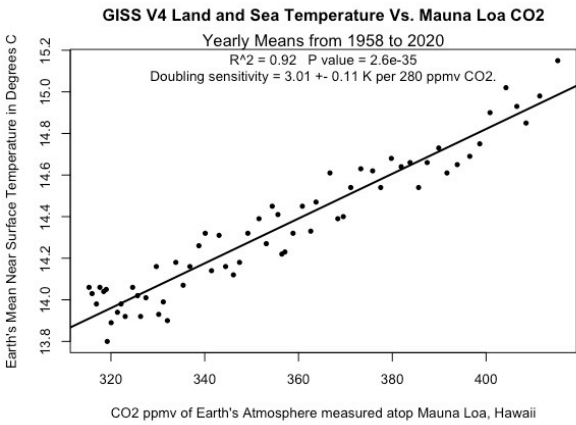
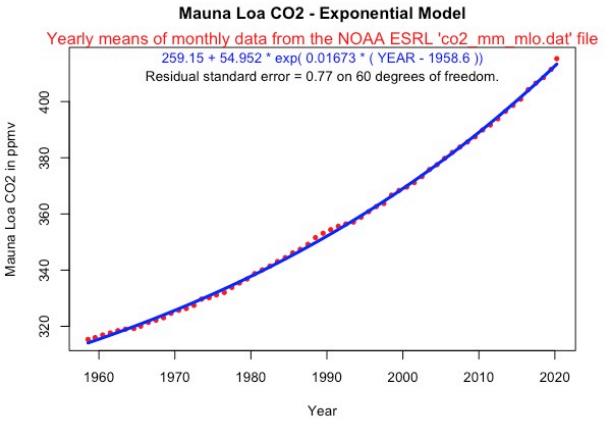
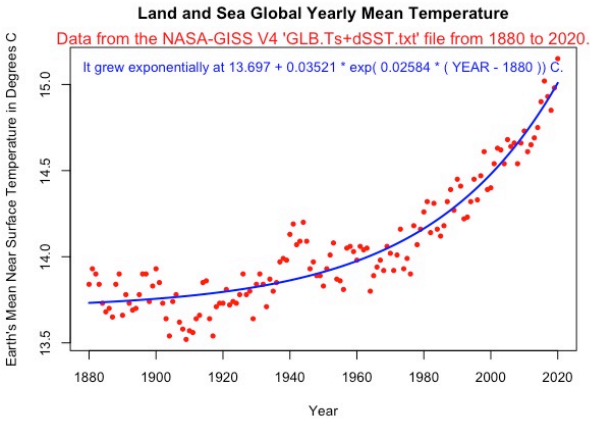
http://data.remss.com/msu/monthly_time_series/RSS_Monthly_MSU_AMSU_Channel_TLT_Anomalies_Land_and_Ocean_v04_0.txt

(c) Roger Coppock -- climatetshirt@gmail.com -- Jul. 6, 2020

The two lines of fine print at the lower left of the first graphic are:

www.ncdc.noaa.gov/data-access/weather-balloon/radiosonde-atmospheric-temperature-products-accessing-climate/ratpac-a
http://data.remss.com/msu/monthly_time_series/RSS_Monthly_MSU_AMSU_Channel_TLT_Anomalies_Land_and_Ocean_v04_0.txt

--- The Second Graphic:



Legend

UL: The World Going to Hell & Speeding Up Getting There.

The average ground-level temperature of our home planet is warming faster and faster. Life can't keep up with the pace. Eventually, something must break.
 See: <https://data.giss.nasa.gov/gistemp/>

UR: Man's CO2 emissions accumulate in Earth's atmosphere.

Mankind's burning fossil fuels, like oil, coal, and natural gas, add Carbon Dioxide, or CO2, to Earth's atmosphere faster than nature can remove it. The excess accumulates year after year.
 See: <https://www.esrl.noaa.gov/gmd/ccgg/trends/data.html>

LL: Rising Earth temperatures & accumulating CO2 go together.

Correlation tells us that the Earth's global mean near surface temperature and CO2 in the atmosphere are tightly bound together as they both exponentially increase. This is expected. Hundred-year-old theory explains it. Satellites actually see CO2 trapping heat radiation like a warm jacket on a cold day.
 See: https://en.wikipedia.org/wiki/Orbiting_Carbon_Observatory_2

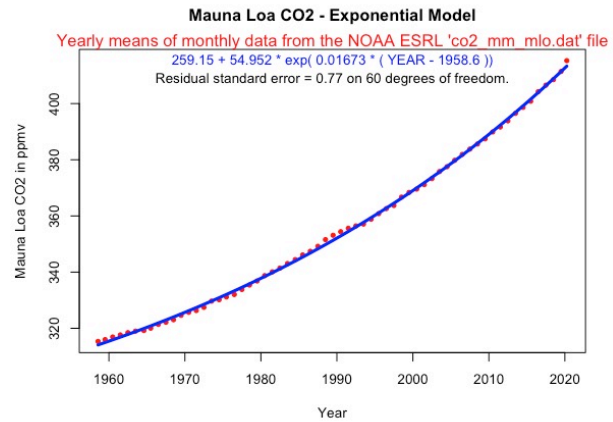
--- The Third Graphic: "CO2 is Rising Exponentially" "Is CO2's Rise Changing?"

CO2 is Rising Exponentially

Man's CO2 emissions accumulating in Earth's atmosphere.

Mankind's burning fossil fuels, like oil, coal, and natural gas, add Carbon Dioxide, or CO2, to Earth's atmosphere faster than nature can remove it. The excess accumulates year after year. The rise of CO2, as graphed at the right, is exponential, with the rate accelerating.

See: <https://www.esrl.noaa.gov/gmd/ccgg/trends/data.html>



Is CO2's Rise Changing?

Let's 'Do the Math.'

Subtracting the actual data, points on the graph at top right, from the fitted exponential model, the curved line, creates what mathematicians call, 'Residuals.' A positive residual indicates that CO2 grew faster than expected, while a negative residual shows slower growth than the model predicts.

So, to reduce both CO2 and the Earth's greenhouse fever . . . make significant negative residuals on the graph at the right. These would have values of negative two standard errors or less. **But, the history is dismal. Nothing has been done this century!**

'The Movement' has done nothing?!

Yes, the movement has not altered the growth of CO2 at all.

