Climate Change Examined by the Scientific Method

Scientific, Observational, and Historical Evidence Establishes There is No Climate Crisis

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Glossary of Terms

Absorbed Solar Radiation or ASR - The average global solar radiation received by the Earth's surface, when clouds are included, which is 240 W/m^2. If there were no clouds, this number would be 277 W/m^2.

Aerosols – Small particles or droplets such as dust or sulfates in the atmosphere which function as condensation nuclei in the formation of clouds.

Anthropogenic – human caused or induced.

Albedo – The reflectivity of a surface measured on a scale of from 0.0 to 1.0 with 1.0 being a perfect reflector of radiation and 0.0 being a perfect absorber of radiation.

Black Body – A theoretical body that absorbs all radiation and emits all of this radiation. As an object moves from black to white, the albedo changes. A Black Body has 0.0 albedo and reflects no light. The Planck black body curve is the distribution of electromagnetic radiation emitted by a black body at a given temperature.

Carbon Footprint – A term to describe the amount of carbon dioxide produced from various human activities.

Centigrade – A basic measure of temperature in the metric system where 0 degrees Centigrade is the freezing point of water and 100 degrees Centigrade is the boiling point of water. Often transcribed as degrees C.

Climate Feedbacks – Processes that can either increase or decrease the effects of climate forcing. For example, the sun is a climate forcing that warms the Earth. As the Earth warms, more water evaporates from the ocean forming more clouds, which reflects sunlight off the clouds back out to space and reduces the warming. This is a negative feedback because it counteracts warming from the sun. Clouds also have a positive feedback as they absorb and emit some heat back to Earth.

Climategate – An unauthorized release of thousands of emails in 2009 from the Climate Research Unit at the University of East Anglia. The emails suggested leading climate scientists associated with the IPCC manipulated data to confirm human induced climate warming and conspired to hide data that did not conform with the climate crisis narrative.

CO_2 – The chemical formula of carbon dioxide, which consists of one carbon atom and two oxygen atoms.

The Big Freeze – A term coined by Time magazine on December 3, 1973, to describe the cooling event between the mid-1940s to the mid-1970s. Some scientists predicted this period was the start of a new Ice Age.

Cosmic Rays – Highly energetic atomic particles, primarily protons, traveling through space at speeds approaching the speed of light. They are primarily created by exploding stars outside of our solar system.

Energy Budget – Also known as the Energy Balance, the Energy Budget is the principle that the same amount of energy introduced to the Earth, primarily from solar heating, is reflected and radiated out to space in the form of infrared radiation. Because the heat in equals the heat out, the energy budget keeps the climate stable. If the system is not in balance the net result is heating or cooling.

EPA – Environmental Protection Agency, a scientific and regulatory agency of the United States government tasked to protect human health and the environment by controlling pollution.

Equilibrium – In thermodynamics, equilibrium is a steady state of constant temperature after heat is transferred from one object to another resulting in the same temperature for each object.

ESG – Environmental Social and Governance, a framework to evaluate the practices and performance of companies and countries on sustainable and ethical issues, including anthropogenic climate change. ESG is used by the World Bank and other financial institutions as one measure in qualifying organizations to receive loans.

Extra-Tropics – The regions of the globe between the Tropics and the Polar Circles. The Extra-Tropics are located between 23.5 degrees north and south latitudes to 66.5 degrees north and south latitudes.

Ferris Cell – An atmospheric circulation pattern that moves heat from the Earth's surface to the poles from about 30 degrees latitude to 60 degrees latitude and moves the heat upward into the top of the troposphere at about 60 degrees latitude and back to 30 degrees latitude where it is returned to the surface. There is both a Northern Hemisphere Ferris Cell and a Southern Hemisphere Ferris Cell.

GDP – Gross Domestic Product, a monetary measure of economic growth or decline of a country's economy, measured as a percent of annual growth or decline from the total of all goods and services produced in such economy.

Greenhouse Gases – Gases in the atmosphere which absorb and emit radiation including water vapor, carbon dioxide, ozone, methane, nitrous oxide, and hydrofluorocarbons. Because greenhouse gases absorb infrared radiation and emit some of that radiation back to Earth, the net effect of greenhouse gases is to warm the Earth.

Gulf Stream – A circular ocean current that carries warm water from the Caribbean seas to the North Atlantic.

Hadley Cell – An atmospheric circulation pattern that moves heat near the equator up to the top of the troposphere and moves it back to Earth at about 30 degrees latitude where it circulates on the surface back to the equator. There is both a Northern Hemisphere Hadley Cell and a Southern Hemisphere Hadley Cell.

Henry's Law – A law of nature that states the amount of gas that dissolves in a liquid is proportional to the pressure of the gas above the liquid and the temperature of the liquid. More gas dissolves in colder liquids and less gas dissolves in warmer liquids. As a liquid is heated, dissolved gas escapes from the liquid because the solubility of the gas in the liquid decreases.

Infrared Radiation – Electromagnetic radiation from a spectrum of relatively long wavelengths that radiates heat from the Earth to space.

IPCC – Intergovernmental Panel on Climate Change – A body of the United Nations whose mission is to advance the scientific knowledge about climate change caused by human activities.

ITCZ – Intertropical Convergence Zone, the region between the Northern Hadley Cell and the Southern Hadley Cell, usually near the equator.

Kelvin – Kelvin is a basic unit of measurement of temperature on the same per unit scale as Centigrade, but 0 degrees Kelvin is at absolute zero (-273.15C), whereas 0 degrees Centigrade is at the freezing point of water. Often transcribed as degrees K.

Kuroshio Current – A current that carries warm water from the Philippines up the coast past Japan and warms the North Pacific Ocean.

Like-likes-like – Since particles with the same charge repel each other and opposite charges attract, "like-likes-like" is a concept introduced by physicist Richard Feynman that allows negatively charged particles to use positively charged particles as intermediates to stick the negatively charged particles together.

Little Ice Age – A global cold period between 1450 CE to 1850 CE.

Medieval Warm Period – In interval of warmth of the globe, especially the North Atlantic, between the years 950 CE – 1250 CE.

Meridional Overturning Circulation (MOC) – Also known as the Thermohaline Ocean Circulation. An ocean current that carries warm water from the Tropics to the Polar regions of the globe, especially the North Atlantic.

Milankovitch Cycles – Changes in the Earth's orbital shape, axial tilt, and a rotational progression in the orientation of the Earth's axis which result in climate changes over tens of thousands of years. These cycles influence the amount of solar radiation received by the Earth, contributing to climatic changes on Earth over long periods. Over 100,000 years, the Earth's orbital shape cycles from more elliptical around the sun to less elliptical. Known as eccentricity, this orbital change is understood to be the biggest factor in generating ice ages. The tilt of the Earth changes every 41,000 years from 22.1 to 24.5 degrees. Known as obliquity, this further changes the climate. The third cycle impacting the climate, known as precession, is a rotation of the Earth's axis in a circular motion, which varies from 20,800 years to 29,000 years.

Minoan Warm Period – A period of warmth during the Bronze Age in the Eastern Mediterranean region.

NASA – National Aeronautics and Space Administration, a government agency of the United States whose mission is to investigate the unknown in air and space for the benefit of humanity.

NOAA – National Oceanic and Atmospheric Administration, a scientific and regulatory government agency of the United States whose mission is to understand and predict changes in climate, weather, oceans, and coastlines.

Paleoclimate – The science of using proxy measurements such as isotopes of carbon, oxygen, and beryllium, tree rings, and other geological measures to estimate temperature and other climate parameters of past ages.

Polar Cell - An atmospheric circulation pattern that moves heat around 60 degrees latitude up to the top of the troposphere and moves it back to Earth at the poles where it circulates on the surface back to about 60 degrees latitude. There is both a Northern Polar Cell and a Southern Polar Cell.

Quantum Physics – The science of physics of matter and energy at the atomic and subatomic level.

Radiative Forcing – The warming process of a climate driver, usually measured in watts per square meter.

Roman Warm Period – An interval of warmth of the globe between the years 250 BC to 400 CE.

Seed Clouds – The process where water condenses on solid and liquid aerosol particles to form clouds. Aerosols function as condensation nuclei, or seeds, for water vapor condensation.

Stratosphere – The second layer of the atmosphere above the troposphere extending about 50 kilometers from the surface of the Earth. Ozone in the stratosphere blocks much of the ultraviolet radiation from the sun and prevents it from reaching the Earth's surface.

Stefan-Boltzmann Law – A natural law where the total energy radiated per unit surface area of a black body is directly proportional to the fourth power of its absolute temperature. Temperature is thus the fourth root of the energy divided by the Stefan Boltzmann constant. Therefore, it takes exponentially more energy to increase temperature linearly.

Thermohaline Current – An antiquated name for the Meridional Overturning Circulation or MOC. An ocean current that carries warm water from the Tropics to the Polar regions of the globe, especially the North Atlantic.

Tropics – The region of Earth surrounding the equator, roughly between the Tropic of Cancer (23.5 degrees north latitude) to the Tropic of Capricorn (23.5 degrees south latitude).

Troposphere – The first layer of the atmosphere that extends from the Earth's surface to a height of 6 to 10 kilometers. The troposphere is where most weather occurs.

Ultraviolet Radiation – Electromagnetic radiation from a spectrum of relatively short wavelengths that strikes the Earth primarily from the sun. Much of the ultraviolet spectrum of radiation is absorbed in the upper atmosphere, but some does reach the surface of Earth and results in warming the Earth.

Visible Light – Electromagnetic radiation from a spectrum of medium wavelength that is visible to the human eye. The spectrum between ultraviolet and infrared light.

Introduction

Recent global warming is a reality. To understand the appropriate response, we need to have a rational determination of the risks of climate change and the tradeoffs and impacts of potential solutions. I always enjoyed the outdoors and firmly believe in environmental protection of our Earth. There are several crucially important environmental and social goals which must be met to protect our environment, safeguard biodiversity, and ensure the health and the very existence of humanity. It is our sacred duty and our utmost priority to protect this Earth for our future generations and for the flourishing of life on Earth. The elimination of dangerous pollution of our land, sea, and air; control of the use and disposal of harmful materials; fixing the broken "recycling" systems; and the protection of ecosystems and endangered species are all imperative goals.

Additionally, bringing the populations of poor countries out of poverty is another crucially important objective. Not only is this the humane, but it is a critical step in protecting the environment. A person consumed with finding enough food to feed their children and avoid starvation is not someone who would be concerned with the environment. The loss of endangered species is greatest in developing countries. To have any hope of creating global engagement in the cause of conservation and to fight pollution and environmental destruction we must lift all people around the world out of dire poverty.

I believe it is our responsibility to find solutions to these issues. However, in recent years, I have seen the climate crisis hijack the environmental movement and the war on poverty. The climate crisis has diverted attention, media coverage, investment, research, and funding away from potentially more pressing and dangerous environmental and poverty problems. The Congressional Budget Office (CBO) released a summary of the inflation Reduction Act signed into law by President Biden. In this new legislation, the CBO reported that $391 billion has been allocated for climate and related energy initiatives. More than ever, we need to determine if mitigating climate change is worth this massive investment and, crucially, if it is more pressing than spending this money to solve other urgent environmental and social issues.

An example of the climate crisis diverting conservation efforts is the Audubon Society. The Audubon Society is an organization established to protect birds. The Audubon Society now states, “Audubon strongly supports wind power and recognizes that it will not be without some impact.” They also admit in this web page that the impact of wind energy is estimated to be 140,000 to 679,000 bird deaths per year from turbine collisions (see https://www.audubon.org/news/wind-power-and-birds). Birds killed by wind turbines include endangered species. I suppose this support is due to a claim that climate change will lead many species to extinction. Yet data on extinctions does not support this claim. Extinctions have been declining rapidly as temperatures have risen (see Figure 13 - The Red List of All Extinct Species by Decade, 1870 to 2009). The number of documented animal species that went extinct was over 50 in the decade that began in 1900. During the decade that started in 2000, a period of global warming, the documented number of animal extinctions had fallen by 10-fold to about 5. Scientific studies have confirmed that colder climates, not warmer climates, were responsible for past extinctions. Furthermore, it is well-known that there is generally greater biodiversity in warmer climates. The Audubon Society is choosing the certain slaughter of hundreds of thousands of birds, including endangered species, to support a theory of mass extinction from warming that is not supported by observational data or paleontological studies.

In 2009, the EPA classified carbon dioxide (CO^2) as a form of pollution under the Clean Air Act, thereby diverting attention, staffing, and funding away from mitigating toxins and real pollutants. CO^2 is invisible, odorless, non-toxic, part of our breath which we exhale, and is an essential gas for plants and life on Earth. If CO^2 levels dropped below 150 parts per million (ppm), plants would stop growing and there would be no food for all of humanity. CO^2 is an essential gas for life, and it is not a pollutant. Instead, we need solutions to air pollution. In cities like Beijing and Los Angeles, which trap smog by surrounding mountains or temperature inversions, you can readily see air pollution, which causes serious adverse health effects. This isn't CO_2. If you can see it, or smell it, it isn't CO_2. We should be asking companies about their "pollution footprint," but instead we ask about their "carbon footprint." Even the term "carbon footprint" is misleading as it sounds black and dirty like soot, but CO_2 is not dirty, it is the clean, harmless, and transparent bubbles in carbonated beverages that we drink. On September 20, 2023, the EPA announced $4.6 billion in grants to cut "Climate Pollution." The announcement says, "As part of its evaluation of applications, EPA will prioritize measures that achieve the greatest amount of GHG (greenhouse gas) emissions reductions." This represents $4.6 billion not spent on the reduction of toxic pollutants, which is the true mission of the EPA.

The former president of Sri Lanka eliminated synthetic fertilizers to reduce greenhouse gases and improve the country's Environmental Societal Governance (ESG) score. The production of synthetic fertilizers has a high "carbon footprint" and its application releases nitrous oxide, a powerful greenhouse gas. The Sri Lanka president banned synthetic fertilizers to enhance the country's ESG score to receive loans from western banks. He succeeded in obtaining a high score of 98 (above 70 is considered good). However, the result was a decrease in agricultural yields of up to 50%, which led to starvation, severe food price inflation, and devastation to the economy. Much suffering was caused by this climate change mitigation action.

Much of the world is energy poor and residents rely on burning wood, charcoal or dung-fired stoves for cooking and heating. It is estimated that three million people die each year in developing countries due to the health effects of indoor air pollution from these fuel sources, primarily from respiratory diseases. Expanded use of fossil fuels in these countries could save many lives, but climate change initiatives are discouraging the deployment of fossil fuels. Using fossil fuels would also help the environment in these areas as the use of wood for heating and cooking leads to deforestation. Such deforestation has adverse impacts on the ecosystem and endangered species. Deforestation is a primary reason poor countries have the highest rate of endangered and threatened wildlife. Such deforestation is clearly seen in aerial views of Haiti where wood continues to be a major source of heating and cooking for the populace.

Figure 1 – Aerial View of the Deforestation in Haiti. *The aerial view of the border of Haiti on the left and the Dominican Republic on the right demonstrates the contrast between Haiti that relies heavily on wood as fuel for heating and cooking and the Dominican Republic that primarily uses fossil fuels. Poor countries with limited energy pollute more and cause more environmental damage than energy rich countries. Source: Brian Gitt, author of the book In the Dark, Fixing Energy Policies That Hurt People and the Planet*

According to the International Energy Association, about half of the Earth's population lives in energy poverty. 1.3 billion have no electricity and three billion people in the third world live on less electricity per year per capita than would run a refrigerator. Coal and natural gas power plants could raise the standard of living of the poor significantly, but western banks refuse to issue loans to third world countries for coal or natural gas power plants over concerns about climate change. Consequently, these people continue to live in energy poverty. Such power plants would move the fuel burning out of peoples' homes thereby saving millions of lives. A central power plant is also more energy efficient, meaning it produces less overall pollution and lowers costs. Kathryn Hall tells the sad story of how premature babies died needlessly in a hospital in the west African country of Gambia because they did not have enough electricity to run an incubator or provide sufficient ultrasound diagnostics (see bibliography, Epstein, pg. 38, Kathryn Hall, "Kathryn's Story," Power Up Gambia). The reality of energy poverty is often tragic. Natural gas power plants have a low pollution footprint and even coal power plants with proper pollution control technology produce low levels of pollution. In a report issued by the United Nations OECD Secretary-General on November 16, 2023, it was reported that developed countries financed $89.6 billion in developing countries for climate action in 2021. One fifth of aide to developing countries is for climate mitigation (see Tol, Richard, "The Economic Impacts of Climate Change," Review of Environmental Economics and Policy, 2018, 12(1), pg. 11). We need to ask the question as to whether this massive investment could have been better used to help the poor in developing nations with financial aid and solving energy poverty.

Countries including China and India have been moving out of poverty as they industrialize. The economic miracle has been amazing, but the pollution in these countries is a problem. The smog in Beijing, Shanghai, Delhi, and other Chinese and Indian cities is unacceptable. According to the World Health Organization, 1.6 million people have died from air pollution in China and 1.4 million have died in

India. But instead of focusing political pressure and research in technologies such as catalytic converters, scrubbers, filtration systems, and chemical processes to reduce pollution, the West is encouraging these countries to reduce non-toxic CO_2 emissions. The air quality in Delhi is 15 times worse than World Health Organization guidelines. In the Chinese city of Datong, air pollution is so bad that residences at times need to drive with their headlights on during the day (see Epstein, pg. 152). Although reducing coal and oil emissions will help lower particulates, which are real pollution, the trillions of dollars spent to reduce and sequester CO_2 emissions would be better spent directly on technologies to reduce real and dangerous air pollution. China is implementing pollution controls on its new coal plants but has not upgraded the large installed base of older coal plants. India has not yet focused on pollution controls in its power industry.

The United States has demonstrated the power of implementing pollution control measures. Since 1970, the amount of fossil fuel emissions has increased significantly. However, in this same period, air pollution from fossil fuel burning including NH_3, PM 2.5, SO_2, NO_x VOC, PM 10, and CO has been reduced from 300 million tons per year to less than 150 million tons per year, according to the U.S. EPA (see Epstein, pg. 153). But we can do more if we focus investment on the development and deployment of innovative technologies in this area. This investment needs to be greater in the developing world, yet we focus our efforts setting up treaties to reduce the carbon footprint of these nations rather than their pollution footprint. We need to determine whether this is the appropriate priority.

The climate crisis urgency has also led to the investment and deployment of countless numbers of solar panels and windmills. The mining intensity of these technologies is a major source of pollution. A windmill requires 542 tons of steel and concrete for each megawatt of electricity. This compares with 5.2 tons of steel and concrete to produce one megawatt of electricity from a natural gas power plant (see Epstein, pg. 49). According to solar.lowtechmagazine.com, it takes 10,000 to 20,000 watt-hours to produce one kilogram of steel from iron ore; and it takes 2.1 million to 2.2 million watt-hours of energy to produce 1 kilogram of electronic grade silicon (Si). According to sinovoltaics.com, “Electronic grade Si is generally 99.99% pure. The Si used in the manufacturing of solar cells and solar components must be even more pure. A purity of 99.9999999% is required for the most advanced solar cells. This is often referred to as 9N for 9 nines, a process which requires repeated refining.” Most windmills and solar panels are made in China using electricity made predominately from coal generated power, which often lacks the anti-pollution technologies used in the United States.

Although new coal plants in China generally do have anti-pollution scrubbers, most of China’s electricity comes from older coal plants that do not have these technologies. China is the largest producer of coal in the world and most of the power plants in China use local coal. It is also known that coal from China is of low quality and contains elevated levels of impurities such as sulfur and ash. These impurities contribute to increased pollution when coal is burned, and they have less combustion efficiency. Because of the lower combustion efficiency of Chinese coal, compared with coal from other countries, more needs to be burnt to produce equivalent energy. This additional burning of poor-quality coal contributes even further to air pollution. Therefore, the production of solar panels and windmills indirectly leads to increased pollution in China.

Both solar panels and windmills also require rare Earth metals. Most of these resources are from China. Near the Chinese city of Baotau, what was once fields of wheat and corn is now the largest rare Earth metals mines in the world. Beyond the city is a five-mile tailings lake. Seven million tons of rare Earth metal tailings are dumped into this lake each year. The rare Earth metals extraction process uses hazardous substances such as hydrofluoric acid. In visiting the tailing lake near Baotau, Simon Parry,

reported. “The lake instantly assaults your senses. Stand on the black crust for just seconds and your eyes water and a powerful acrid stench fills your lungs…villages around breathe in the same poison every day.” Nearby villagers have suffered severe skin and respiratory diseases and cancer rates have exploded (see Epstein, pgs. 155-160).

The life of windmills and solar panels is about 25 years. Windmills are made of durable aerospace materials that are difficult if not impossible to recycle and solar panels typically contain small amounts of toxic heavy metals including cadmium, lead, and gallium arsenide. The deployment of solar panels and windmills to fight climate change today may result in an environmental recycling challenge within a generation, as these installations reach the end of their useful life.

As a lover of the outdoors, I find no greater beauty than can be found in nature. Artist Andy Warhol said, “I think having land and not ruining it is the most beautiful art that anyone could ever want.” I have always enjoyed the beautiful countryside of England where the stone walls and stone cottages with slate roofs are in beautiful harmony with the green rolling hills. However, in my recent trips to England, I have been annoyed by the visual “sour notes” in the landscape of windmills and solar farms. Offshore windmills are also destroying beautiful seascapes. As stewards of the Earth, we should also protect its beauty. Extreme examples of the blight of wind and solar energy can be seen in the wind farm of San Gorgonio Pass, California, near Palm Springs and the solar farm on Taihang mountain in China. The naturalist John Muir said, “Going to the mountains is like going home.” This can no longer be said about Taihang mountain. I can only image what Emerson or Thoreau would have to say about such destruction of the beauty of nature. Is climate change so urgent that we should destroy the natural beauty of our landscapes and seascapes?

The Blight of Wind and Solar Energy on the Natural Landscape

Figure 2 – The Blight of Wind and Solar Energy on the Natural Landscape. *Solar farms and windmills are like “sour notes” which destroy the beauty of our landscapes and seascapes. Extreme examples of destroying natural beauty include the solar farm on the Taihang mountain in China and the wind farm on the San Gorgonio Pass in California. The naturalist John Muir said, “Going to the mountains is like going home.” This can no longer be said of Taihang mountain. The question we should ask is if climate change is so urgent that we should destroy the natural beauty of our landscapes.*

The wind and solar energy transition has also disproportionally hurt the poor. The promise of green energy has been to lower costs since there is no fuel required to generate electricity from a wind or

solar farm. It turns out, fuel cost is not the main expense-driver. The modern world is dependent on reliable power 24 hours every day without interruption. However, the sun only shines in the day and wind generally falls sharply during the night and at random intervals. Power is needed throughout the night and the charging of electric vehicles, primarily overnight, will significantly increase night electricity demand. Consequently, wind and solar power needs to be backed up with either expensive energy storage solutions or redundant nuclear or fossil fuel power stations. Investment in such redundant power sources drives up costs. The cost to connect the electrical grid to distant solar and wind farms has also driven up the price significantly.

Germany has been the most aggressive nation in transitioning to wind and solar energy, approaching 50% of their total electric generation. The result has been a massive increase in the cost of electricity. Around the year 2000, the cost per kilowatt of electricity in Germany was about .05 to .06 Euros, by 2020, the cost had skyrocketed to over 0.40 Euros. This compares to just above 0.10 Euros in the United States and less than 0.20 Euros in the nuclear power dominant power grid of France (Wallace Manheimer, Tom Nelson Podcast # 143). The result has been the closure of energy-intensive industries in Germany and the loss of associated blue-collar jobs. According to numbers from the Statistisches Bundesamt, energy-intensive industrial production in Germany has declined by about 18% since 2019. Some of this cost increase is no doubt due to the cost of natural gas after the Russian invasion of Ukraine. However, much of the cost increase is due to green energy. The cost of California electricity has increased by 98.2% over the last 15 years, the highest rise in the nation. Average energy prices increased by 30.6% in other states. California is the most aggressive green energy state with 17.5 GW of utility-scale solar, 6 GW of wind, and 14 GW of residential rooftop solar (Steve Goreham, "Exploding Energy Prices in California," MasterResource," March 12, 2024).

These green energy price increases hurt the poor and middle class. Those families with incomes of over $50,000 spend 10% or less of their income on energy. The wealthy spend a negligible amount of their earnings on energy. Those with incomes below $20,00 spend more than 40% of their earnings on energy. (see Eschenbach, The Unpopular Truth about Electricity and the Future of Energy, 2017). The deployment of wind and solar energy is thus disproportionately hurting the poor and middle class.

We do live in an era of a warming climate. Crucial questions include, will this warming be significant, is the warming dangerous, and is it more important than these other pressing environmental, social, and natural preservation issues. Many politicians and news outlets state "climate change" is **THE** existential threat of our time. President Joe Biden said, "The only existential threat humanity faces, even things more frightening than a nuclear war, is global warming." A friend of mine, a university professor, told his children not to have children because of CO_2 induced global warming. This all sounds so serious. I wanted to know if climate change is such a critical and urgent issue that these other immensely important environmental and social issues should become secondary. Climate alarmist politicians and news outlets repeatedly said the science is settled and "97% of scientists agree." If true, such a large consensus sounds convincing, but as Mark Twain said, "The best way to get a sure thing on a fact is to go and examine it for yourself, and not take anybody's say-so." I decided to study climate change to determine the truth of the matter using an evidence-based scientific method. I believe an investigation of climate change is important to ensure we direct all attention, spending, and research to address the most devastating and urgent environmental and related social issues facing our planet.

The foundation of the accepted scientific method is to postulate a hypothesis and then perform experiments using acceptable methods to prove or disprove the hypothesis. This is the scientific method. Richard Phillips Feynman provided a brilliant description of the scientific method. Professor.

Feynman was an American theoretical physicist, known for his work in the path integral formulation of quantum mechanics, the theory of quantum electrodynamics, the physics of the superfluidity of supercooled liquid helium, as well as his work in particle physics for which he proposed the Parton model. For his contributions to the development of quantum electrodynamics, Feynman received the Nobel Prize in Physics in 1965 jointly with Julian Schwinger and Shin'ichirō Tomonaga. In a lecture at Cornell University, this great physicist said, "In general we look for a new law by the following process. First, we guess it, no don't laugh, that is the truth. Then we compute the consequences of the guess, to see if this is right, if this law we guess is right, to see what it would imply and then we compare the computation results to nature or we say, compare to experiment or experience, compare it directly with observations to see if it works. If it disagrees with experiment, it's wrong. In that simple statement is the key to science. It doesn't make any difference how beautiful your guess is, it doesn't matter how smart you are, who made the guess, or what his name is… if it disagrees with experiment, it is wrong."

In the following pages, I present reputable observational data, historical records, paleoclimate reconstructions and archeological findings of previous climate cycles. I have used accepted physical principles and proven formulas to calculate greenhouse gas warming. I think you will find this data as surprising as I did. Nearly everything I was told about climate change and the climate crisis was wrong. Mark Twain wisely said, "It ain't what you don't know that gets you into trouble, it's what you know for sure that just ain't so."

I think you will also be shocked to learn that: 1) observational data demonstrates there is no trend or a declining trend in severe weather in recent years as the climate has warmed, 2) sea level rise is less than a foot per century and today's trend is in line with historical records over the past 150 years, 3) as the temperature has warmed in recent years, the extinction of species has plummeted, polar bear populations have grown, and the Great Coral Reef has witnessed record growth, 4) the current warming is not unprecedented as climate has always been cyclical, 5) quantum physics of greenhouse gas radiative forcing (warming) calculations have the temperature by end of the 21st century of less than 1C warmer than today, which will be more beneficial than harmful, 6) the oceans are on average, 2C warmer than the atmosphere, 7) the warming and increased CO_2 in the atmosphere has been greening, not browning, the Earth which has led to growing harvests to feed an expanding population, and 8) cold is far more harmful to humankind than warmth, and we should welcome, not fear, a warming climate. The perspective that anthropogenic (human-caused) increases of greenhouse gases leads to a "Climate Crisis" is counter to what science, history and measured observational data tell us. Applying Feynman's definition of the scientific method, it doesn't matter who tells you there is a climate crisis, it disagrees with observations and is therefore wrong.

Climate is complex and influenced by a multitude of factors including solar cycles, cosmic rays, cloud cover, ocean temperature oscillations, atmospheric and oceanic heat transfer, volcanoes, aerosols, and greenhouse gases. All these need to be considered in the investigation of climate change. Recent warming is due to a combination of these and other factors. Overwhelming scientific evidence establishes that half or more of the warming in recent years is from natural causes leaving half or less of the warming from increased levels of CO_2. Scientists who cite this evidence and challenge the climate alarmist narrative that an increase in CO_2 levels is the primary driver of climate are villainized as "climate deniers." This should be appalling to anyone who relies on scientists and the scientific method to discover truth. All evidence must be examined; hypotheses need to be challenged and evaluated using appropriate scientific methods.

Respected scientists who report evidence not in alignment with the climate alarmist narrative have had their research funding reduced or eliminated and consequently careers destroyed. Some of these scientists include Richard Lindzen, Judith Curry, Willie Soon, Hendrik Svensmark, Peter Ridd, Susan Crockford, and William Gray. On the other hand, other researchers who are supporters of the climate alarmist narrative have received generous funding and appointments to prestigious positions which facilitate their exposure and narratives. Promoting climate alarmists while "cancelling" climate alarm skeptics is perhaps the most egregious episode in the history of modern science. Publishing scientific papers in peer reviewed journals is the life blood of an academic career. Climate scientist Patrick T. Brown from John Hopkins has admitted he had to distort the findings of his studies to appeal to the editors of prestigious science journals including Nature and Science. Referring to the climate alarmist narrative he said, "… editors of these journals have made it abundantly clear, both by what they publish and what they reject, that they want climate papers to support a certain preapproved narrative…" Such actions feed a dysfunctional culture where scientists are afraid to speak out, thus manufacturing an illusionary "consensus."

Climatologist Judith Curry was a professor and chair of the School of Earth and Atmospheric Sciences at Georgia Institute of Technology. Professor Curry supported the climate change narrative. In 2009, she began to question the narrative after leaked "Climategate" emails revealed the manipulation that went into building a climate crisis consensus. She labeled belief in an existential threat from global warming caused primarily from anthropogenic greenhouse gases, "a manufactured consensus." She criticized the narrative that recent climate change has been dominated by human causes verses natural variability. She said, "…we have been misled in our quest to understand climate change, by not paying sufficient attention to natural causes of climate change, in particular from the Sun and from the long-term oscillations in ocean circulations." For taking this fact-based position, she was labeled as a "climate denier" and was ostracized by her university and attacked by climate alarmists. The resulting negative environment in her academia career led to her eventual resignation.

Physicist Hendrik Svensmark is a professor in the Division of Solar Physics at the Danish National Space Institute in Copenhagen. His experimental research on cloud formation and the impact of clouds on climate has uncovered what is probably the dominant driver of climate change today and in past ages of the Earth (see Chapter 12). Because Professor Svensmark's research does not support greenhouse gases as the control knob of climate change, he has found it nearly impossible to find funding for his research, despite the great insights on climate change derived from his work. William Gray was a professor at Colorado State University and one of the world's leaders in hurricane research. Al Gore invited him to attend a climate conference. After Professor Gray responded that he did not support the climate crisis narrative, he never again received funding from government grants. Professor Gray had to donate $500,000 of his own money to keep the hurricane forecast program, known as the Tropical Meteorology Project, from shutting down (see "Colorado State hurricane forecasts may end due to lack of funds," USA Today, November 27, 2013).

I had naively assumed that the mission of universities was to pursue truth. I was puzzled why respected scientists, like Judith Curry, would be maligned by their own institutions for presenting credible data that did not support the climate crisis narrative. Universities depend heavily upon research grants and on those professors who can secure grant funding. In a paper written by Indra Overland and Benjamin K. Sovacool, "The misallocation of climate research funding," Energy & Social Science, Volume 62, April 2020, 101349, the authors estimate $44.6 billion has been granted on climate research between 1990 to 2018. That figure has likely gone up significantly since then. Universities and professors benefit from research that supports the climate crisis narrative, while professors like Henrik Svensmark and William

Gray, whose research goes against the climate crisis narrative, have difficulty finding funding for their research. As Upton Sinclair wrote, “It is difficult to get a man to understand something if his salary depends on him not understanding.”

To assume CO_2 is the primary control knob of the climate is counter to climate-related measurements, principles of physics, paleoclimate reconstructions, archaeology findings, and the historical record. The real climate and science deniers are those who discount evidence for global warming from natural causes and deny climate change cycles of the past such as the Little Ice Age 500 years ago and the Medieval Warm Period 1,000 years ago. The following pages cover previous climate cycles and examine each of the drivers of climate to facilitate a science-based rational discussion on climate change.

Chapter 1 – The Scientific Consensus

Respected Scientists Demonstrate there is no Climate Crisis

I began my research into climate change by watching an online physics course on YouTube by Michael Van Biezen titled, Astronomy Chapter 9.1 – Earth's Atmosphere (https://www.youtube.com/watch?v=dw3vQ6hguWg). This is an excellent course of 61 five-minute lectures, which covers the greenhouse effect in detail. After this detailed look at the physics behind climate change, Van Biezen concludes, the data and science reveal global warming is being exaggerated in climate models. I also watched videos from a number of prominent scientists including: renowned physicist Dyson Freeman from Princeton and formerly Cornell University (https://www.youtube.com/watch?v=BQHhDxRuTkI); one of the most respected atmospheric physicists, Richard Lindzen from MIT (https://www.youtube.com/watch?v=IOKElp_jGLQ); respected physicist William Happer from Princeton (https://www.youtube.com/watch?v=PblYr-KjOVY); prominent climatologist Judith Curry from Georgia Tech (https://youtu.be/YBdmppcfixM); physicist and former Provost for Cal Tech, Steven Koonin (https://www.youtube.com/watch?v=l90FpjPGLBE), solar physicists Willie Soon from the Center for Astrophysics Harvard & Smithsonian (https://www.youtube.com/watch?v=1zrejG-WI3U HYPERLINK "https://www.youtube.com/watch?v=1zrejG-WI3U&t=762s"& HYPERLINK "https://www.youtube.com/watch?v=1zrejG-WI3U&t=762s"t=762s), Nir Shaviv from Hebrew University (https://youtu.be/hRFIzVB4Qss?si=NBxs5eu1qxHwl4Li), Hendrik Svensmark from the Danish National Space Institute (https://youtu.be/_hRHgz55-zA?si=6Frd-QKq3kjHFRus), and Valentina Zharkova from Northumbria University (https://www.youtube.com/watch?v=JyyuouPSNEA). I also read the well-researched and meticulously footnoted book The Neglected Sun, Why the Sun Precludes Climate Catastrophe, by respected German scientist and environmentalist, Fritz Vahrenholt. These scientists all present scientific data which confirms modest CO^2 warming, but dispute warming alarmism.

To believe that all scientists believe there is a climate emergency is just not true. The organization Climate Intelligence (CLINTEL) has prepared a statement that there is no climate emergency and have collected the signatures of over 1,600 brave scientists and professionals that support this statement, including physicist and Nobel Laureate Professor Ivar Giaever (see Climate Intelligence (CLINTEL) climate change and climate policy), physicist and Nobel Laureate Dr. John Clauser, and Princeton Physics professor and expert in greenhouse gas radiation, Dr. William Happer. Professor Giaever said, "I would say that basically global warming is a non-problem." Dr. John F. Clauser, the recipient of the 2022 Nobel Prize in Physics has recently made a statement which says, "there is no climate crisis." See https://co2coalition.org/publications/nobel-laureate-john-clauser-elected-to-co2-coalition-board-of-directors/. Dr William Happer has said, "Current alarm over carbon dioxide is mistaken… Fears about man-made global warming are unwarranted and are not based on good science."

Even renowned physicist, Edward Teller, who was once a climate alarmist, changed his mind and signed a statement a few years before his death that stated, "There is no convincing scientific evidence that human release of carbon dioxide, methane, or other greenhouse gases is causing or will, in the foreseeable future, cause catastrophic heating of the Earth's atmosphere…" 31,497 American scientists including Teller and Dyson Freeman signed this petition. See http://www.petitionproject.org/. The mechanism of greenhouse gas warming is from quantum physics. It is therefore telling that many prominent physicists have publicly stated there is no climate crisis.

Professor Steven Koonin has authored a book titled Unsettled, to demonstrate with data that the climate crisis narrative is not settled science as claimed by climate alarmists. Dr. Koonin is an MIT educated physicist who was a professor and the provost at Cal Tech before working in the Obama Administration as the Under Secretary for Science in the Department of Energy. If you look at videos of his talks from his time in the Obama Administration, he was an ardent supporter of global warming alarmism. In 2013 he was asked by the American Physical Society to lead the drafting of an updated statement on climate. As part of that process, he convened a workshop with six leading climate experts and six leading physicists to stress test the state of climate science. Koonin was to write, "I came away from the APS workshop not only surprised, but shaken by the realization that climate science was far less mature than I had supposed." He concluded humans exert a growing, but physically small, warming influence on climate. (see Unsettled, Steven Koonin, BenBella Books, Inc. 2021, pg. 4).

True to his belief that scientists have a special responsibility to bring objective science to a discussion, Koonin authored an article in the Wall Street Journal arguing that the science on climate change is not settled (Koonin, Steven E., "Climate Science Is Not Settled." Wall Street Journal, September 19, 2014). In 2021, he published his book Unsettled where he uses data from accepted reports and sources to show dozens of climate alarmist claims are not supported by data. Since publishing his book, Koonin has been a frequent guest on podcasts and other forums. (https://www.youtube.com/watch?v=6Tz1MiX1p5I HYPERLINK "https://www.youtube.com/watch?v=6Tz1MiX1p5I&t=11s"& HYPERLINK "https://www.youtube.com/watch?v=6Tz1MiX1p5I&t=11s"t=11s).

What 97% of Scientist Agree Upon: Humans Have Contributed to the Warming

President Obama said, "97% of scientist agree, climate change is real, man-made, and dangerous." The 97% argument has persisted to this day. I was aghast to learn that the quoted "97% of scientists agree" is nothing more than propaganda and a misrepresentation of the data. This number comes from a 2013 paper by J. Cook et al, which reviewed abstracts of 11,944 papers on climate. Of these 11,944 abstracts, 7,930, representing 66% of the total, were excluded as they gave no opinion on man-made global warming, leaving only 4,014 papers reviewed, or 34%, which expressed an opinion. Of these remaining 4,014 papers, 97% stated humans have contributed to recent warming, but only 105 of these 4,014, papers said humans caused **most** of the warming and the remaining abstracts stated humans only contributed to the warming. None of the abstracts reviewed said the recent warming was dangerous or catastrophic. So only 105 out of the initial 11,944 papers reviewed, or less than 1%, stated climate change was **mostly** man made and zero out of 11,944 papers, or 0%, said recent warming is dangerous.

Other surveys and studies have been cited to claim a scientific consensus that global warming is mostly caused by humans. Bart Verheggen, et al, published a survey in 2014 where the survey asked if >50% of recent warming could be attributed to anthropogenic greenhouse gases (GHG). The survey was sent to scientists who published papers that included "global warming" and "global climate change" in the titles. The favoritism of journals to publish papers which support human caused climate change and reject papers that focus on natural climate change throws a bias regarding the scientists selected for this survey. About 6,000 surveys were sent out and 1,869 were returned. The results were about 66% agreed that GHG caused more than 50% of the recent warming. 66% is a majority, but the term "consensus" is generally not applied to a majority but is an overwhelming agreement of opinion on a matter. While 66% of those surveyed agreed that recent warming is mostly human caused, this figure is

not close to a 97% consensus, especially when the bias of those surveyed is considered (see Bart Verheggen, et al, "Scientific Views about Attribution of Global Warming," ACS, Environmental Science & Technology, January 27, 2014, pgs. 8963-8971). Furthermore, we do not know if these scientists believe 51% or 100% of warming is from human causes. The paper states that a larger majority of scientists responding on the survey with 10 or more peer-reviewed papers on climate agree that more than 50% of recent warming is human caused. This is not surprising, given the bias of journals and funding sources of research, from which the papers are based. Both publishing and research funding are heavily skewed in conformance with the climate crisis narrative. The survey did not ask if recent warming is dangerous.

A study by Neil Stenhouse, et al, for the American Meteorology Society (AMS) states: "Research conducted to date with meteorologists and other atmospheric scientists has shown that they are not unanimous in their views of climate change." The authors cite a study by Doran and Zimmerman in 2009 that found 64% of meteorologists surveyed "are convinced humans have contributed to global warming." He also states that a survey by Farnsworth and Lichter in 2009 found that "83% of meteorologists surveyed were convinced human induced climate change is occurring." Please note neither of those studies conclude there is a consensus that **most** of the warming is caused by humans. Stenhouse, et al, summarizes results of 7,062 surveys sent to AMS members. 1,854 surveys were returned. This survey specifically asked if recent warming over the last 150 years was primarily caused by humans. 52% of those surveyed agreed that the warming was mostly human induced (see Neil Stenhouse, et al, METEOROLOGISTS' VIEWS ABOUT GLOBAL WARMING," American Meteorological Society, July 2014, pgs. 1029-1041). Like the Veheggen study, this is a majority, but 52% is certainly not a 97% consensus and we do not know if they believe 51% or 100% of warming is caused by humankind. The authors point out that a higher percent of those meteorologists who publish papers on climate change attribute most of the warming to human causes. This is not surprising, since climate journals, and climate research funding, on which the papers rely, are significantly aligned with the climate alarmist narrative. The AMS survey asked if warming would be harmful or beneficial over the next 100 years, but the results to this question were not reported.

A recent study by Lynus, et al reviewed 3,000 peer-reviewed papers on climate and declared that 95.5% of scientists agree with the consensus of anthropogenic global warming. A paper published in the journal Climate on October 30, 2023, reexamined this study and its methodology. See Dentelski, David, et al, "Re-examining the Consensus on the Anthropogenic Contribution to Climate Change," Climate 2023, 11, 215. Dentelski and his co-authors point out that the hypothesis for which these 3,000 papers are classified is, "the existence of human-caused climate change." In other words, 95.5% of scientists agree that humans contribute to recent global warming. Interestingly, the Dentelski paper reviewed several of these 3,000 papers from well-known skeptics of the climate crisis, including Dr. Willie Soon, whose papers were classified in the 95.5% consensus in this study. This is not surprising since most climate crisis skeptics do not deny an influence of anthropogenic warming, but only the amount of the warming and its consequences. This 95.5% consensus study did not address the question of whether climate change is dangerous or a crisis.

There are additional surveys and studies that claim that 97% to 100% of scientists agree. But what do they agree on? All these studies and surveys show scientists agree that humans contribute to the warming and there is no consensus that it is dangerous. Based on these studies and surveys, there is no consensus among scientists that recent global warming is dangerous, or **mostly** caused by humans. For additional information on this topic, see https://climatediscussionnexus.com/videos/the-97-percent-consensus-myth-revisited/.

Chapter 2 – The United Nations IPCC and the Climate Crisis Narrative

IPCC Ignores Facts to Promote a Human-Caused Global Warming Crisis

The United Nations has formed a climate science group known as the International Panel on Climate Change (IPCC). The "climate crisis" narrative echoed by politicians and the media is primarily driven by the IPCC. The bias of the IPCC is evident in its mission as set forth in its procedures, which states its role is "to understand the scientific basis and risk of human-induced climate change." If human-induced climate change were determined to be a minor risk, then the very existence of the IPCC would be moot.

On July 27, 2023, UN Secretary-General António Guterres said, "Climate change is here, it is terrifying. And it is just the beginning. The era of global warming has ended; the era of global boiling has arrived." This theme was echoed at the 2023 World Economic Forum meeting in Davos, where Al Gore said, climate change is "boiling the oceans." This claim is pure scare mongering as the Earth has had CO_2 levels above 7,000 ppm vs. 420 ppm today, and the oceans did not boil. In August 2021 UN Secretary-General Guterres also said, "Extreme weather and climate disasters are increasing in frequency and intensity." As we shall see in this paper, **these statements have no basis in fact or science.** So, what is driving the climate crisis fear mongering of the UN and IPCC? Stephen H. Schneider, co-author of the 2001 IPCC report provides us with an explanation. He said, "To capture the public's imagination, we have to offer up scary scenarios, make dramatic, simplified statements." Perhaps this explains the statement of Al Gore at the 2023 World Economic Forum meeting in Davos, where he said, climate change is "boiling the oceans." This claim is pure scare mongering as the Earth has had CO_2 levels above 7,000 ppm vs. 420 ppm today, and the oceans did not boil.

In 2018, Dr. Ottomar Eddinhofer, Co-Chair, UN IPCC Working Group 3 provided further enlightenment when he said, "One must free oneself from the illusion that international climate policy is environmental policy. [What we are doing] has almost nothing to do with the climate. We must state clearly that we use climate policy de facto to distribute the world's wealth." Doomsday sayers predicting the end of the world have always attracted adherents. It is a seductive message that the Earth is being destroyed by carbon dioxide, and we can become heroes by driving Electric Vehicles (EVs) to prevent this calamity. This narrative is especially attractive to those who have no religious faith and need something larger than themselves to believe in.

Every few years the IPCC publishes a detailed report of approximately 1,000 to 2,400 pages on the scientific, technical, and socio-economic impacts of climate change. Many respected scientists and economists have served in various subgroups of the IPCC and the detailed Assessment Reports are generally of high quality. However, policy makers of the IPCC have an agenda to promote anthropogenic global warming and paint a climate crisis in the "Summary for Policy Makers" document, even though **there is no mention of "climate catastrophes" at all in the IPCC scientific assessment reports**. The scientific section of the most recent IPCC AR6 report states there is no discernable increase or attribution to anthropogenic climate change for flooding, meteorological drought, hydrological drought, tropical cyclones (hurricanes), winter storms, thunderstorms, tornadoes, hail, lighting, or extreme winds. According to AR6, only heat waves, heavy precipitation, ecological drought, agricultural drought, and fire weather are detected and attributable to recent climate change. I am not sure why they would cite heat waves, drought, and fire weather as attributable to climate change since the data shows heat waves, droughts, and fires have declined significantly since the last warm cycle of the 1930s (see Chapter 3).

Despite these facts, in public announcements, the United Nations policy makers take every opportunity to sound the alarm of dangerous weather events caused by increasing levels of CO_2, methane, and nitrous oxide from mankind. Surprisingly, their alarmist claims contradict what scientists have written in the detailed IPCC Assessment Reports. For example, a December 5, 2023, United Nations Press Release titled, "Rate and impact of climate change surges dramatically in 2011-2020" states: "Our weather is becoming more extreme, with a clear and demonstrable impact on socio-economic development." The press release continues to list such extreme weather events including floods and tropical cyclones (hurricanes) even though these claims are not supported in the scientific sections of the most recent IPCC Assessment Report, AR6. Regarding floods, IPCC AR6 states, "there is low confidence in the human influence on the changes in high river flows on the global scale." Regarding hurricanes, IPCC AR6 concludes, "There is low confidence in long-term (multi-decadal to centennial) trends in Tropical Cyclone frequency or intensity." In other words, observational data shows no trends for increased floods or hurricanes.

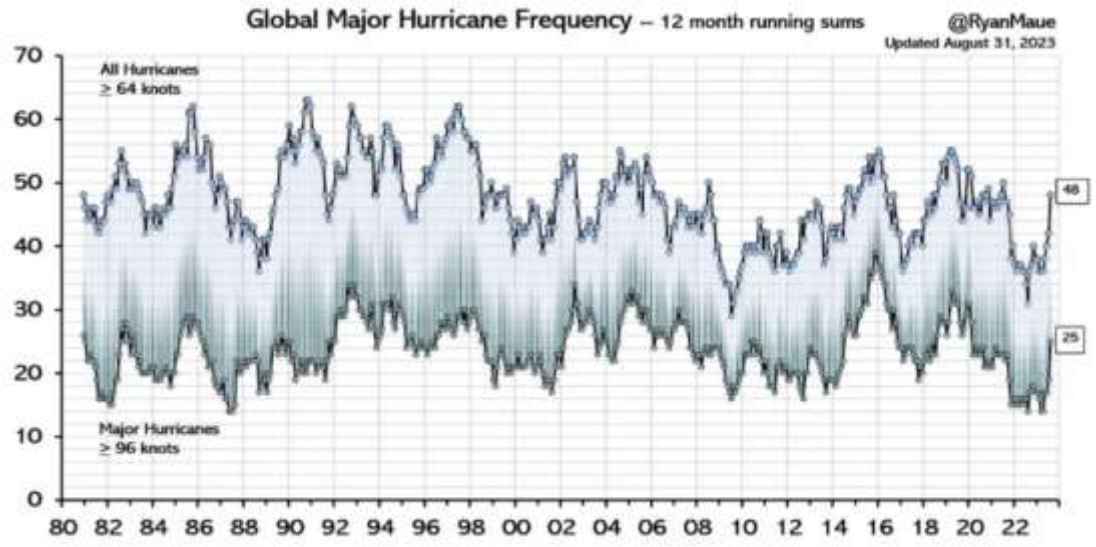

Figure 3 – Number of Global Hurricanes since 1980. *Policy makers of the United Nations publicly announce that hurricanes have become worse in recent years due to climate change. This claim is not supported by data or in the conclusions of the scientific sections of the IPCC Assessment Reports. Globally there have been fewer hurricanes as measured by satellites since 1980, and there is no trend in severe hurricane frequency. Source: Meteorologist Ryan Maue charting data from the hurricane database of Colorado State University, August 2023.*

Chapter 3 – Climate Change and Extreme Weather Events

Data Shows there are no Climate Catastrophes, as Claimed by Alarmists and the Media

The media has brainwashed the population into believing every extreme weather event of our time is caused by climate change. **The data clearly proves this supposition is wrong**. In his book Unsettled, Professor Steven Koonin uses data from the IPCC Assessment Reports, which clearly shows that despite the recent increases in CO_2 concentrations in the atmosphere, catastrophic weather events have not increased. Data from Koonin's book and other credible sources show that hurricanes have not gotten more severe, incidences of strong tornados are actually significantly down, heat waves have moderated, the percentage of the Earth in droughts is declining, fires and acreage burned have dramatically decreased since the 1920s and 1930s, there is no trend in floods, there has been a significant reduction in endangered species as temperatures have risen, polar bear populations have grown by three-fold, snowfall in the Northern Hemisphere has increased, and record amounts of coral cover are now reported across two-thirds of the Great Barrier Reef. None of these disaster claims of climate alarmism can be seen in the data.

A paper published in the European Physical Journal Plus on 13 January 2022 by Gianluca Alimonti, et al reviewed data on extreme weather events globally. The paper shows the lack of trend or decline in hurricanes, tornados, extreme precipitation events, floods, droughts. They also present the increase in global greening and agricultural production. They conclude that observational data does not support a climate emergency. See Alimonti, G., "A critical assessment of extreme events trends in times of global warming," The European Physical Journal Plus, 13 January 2022, 137, Article number 112. Because this publication goes against the climate alarmist narrative the publication was forced to later retract the article, even though all the data is from reputable sources and other peer reviewed papers. This type of censorship is detrimental to true scientific discovery.

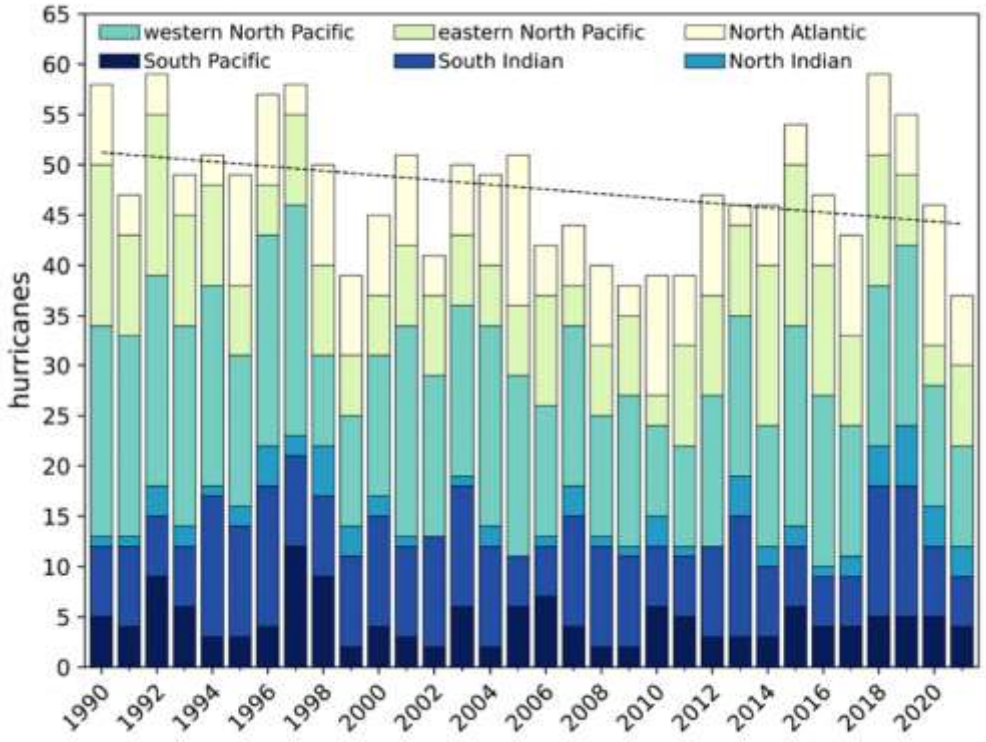

Figure 4 – Number of Global Hurricanes since 1990. *The climate alarmist claim that hurricanes are getting worse because of climate change is not supported by the data. Globally there have been fewer hurricanes as measured by satellites since 1990. Source: P. Klotzbach, et al, "Trends in Tropical Cyclone Activity 1990-2021," Geophysical Research Letters, March 17, 2022, for the full report, see https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2021GL095774*

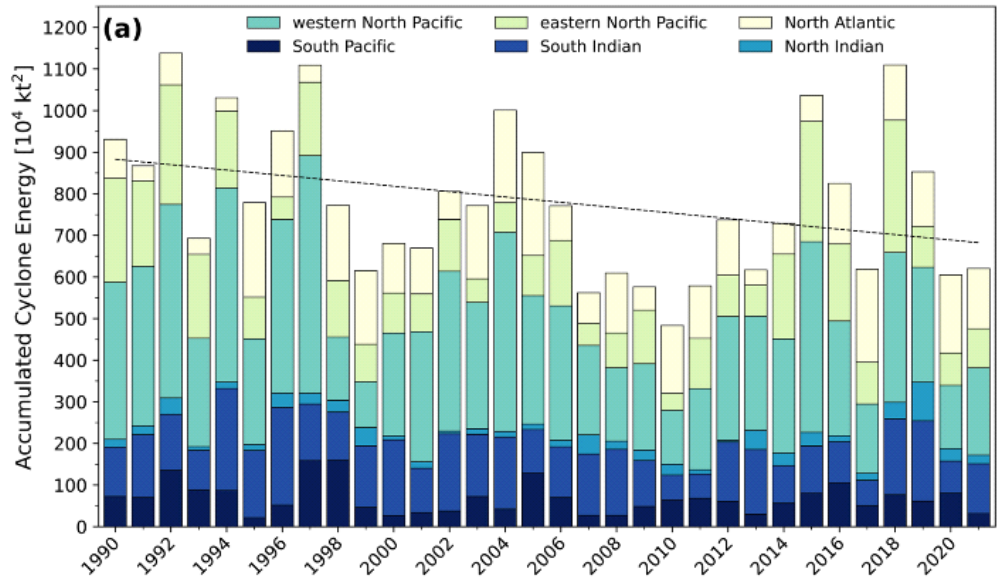

Figure 5 – Accumulated Cyclone Energy Since 1990. *Satellite data since 1990 reveal fewer hurricanes are occurring globally (see Figure 4) and the Tropics are producing less Accumulated Cyclone Energy—*

a metric accounting for hurricane frequency, intensity, and duration. The actual data is counter to climate alarmist claims. Source: P. Klotzbach, et al, "Trends in Tropical Cyclone Activity 1990-2021," Geophysical Research Letters, March 17, 2022, for the full report, see https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2021GL095774. A similar decline in hurricanes has been reported by the National Hurricane Center for the United States, see https://pointofview.net/viewpoints/hurricanes-and-climate/.

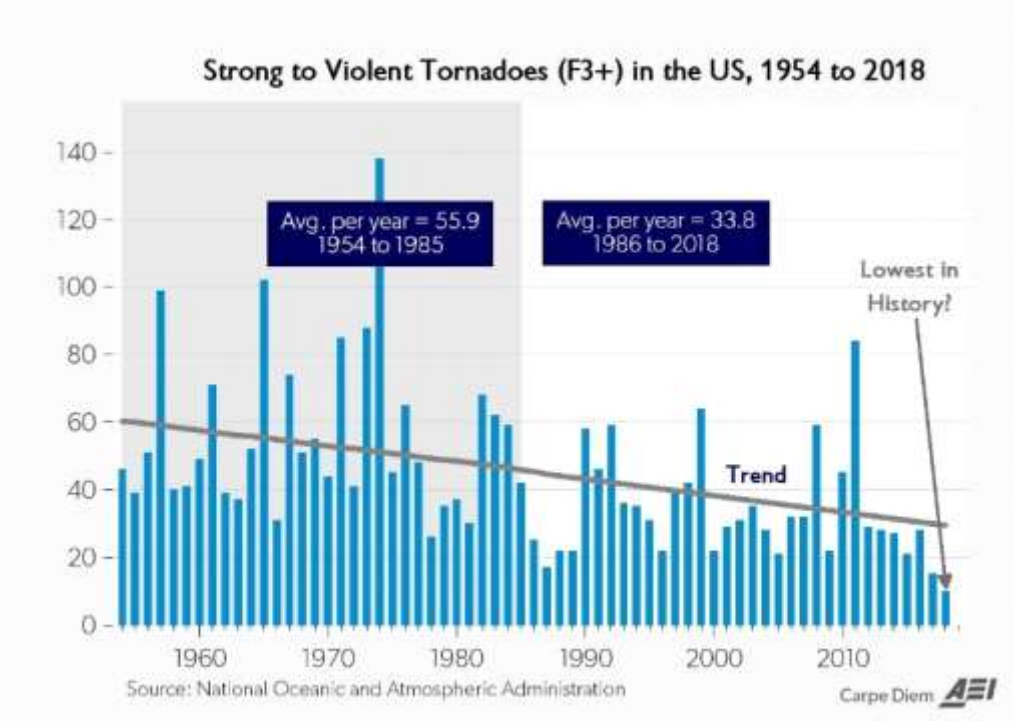

Figure 6 – Strong Tornadoes are Declining. *Data shows tornados are less severe than in previous years, contrary to the repeated claims of climate alarmists. Source: The U.S. National Oceanic and Atmospheric Administration (NOAA). Chart created by Dr. Roy Spencer, University of Alabama, Huntsville.*

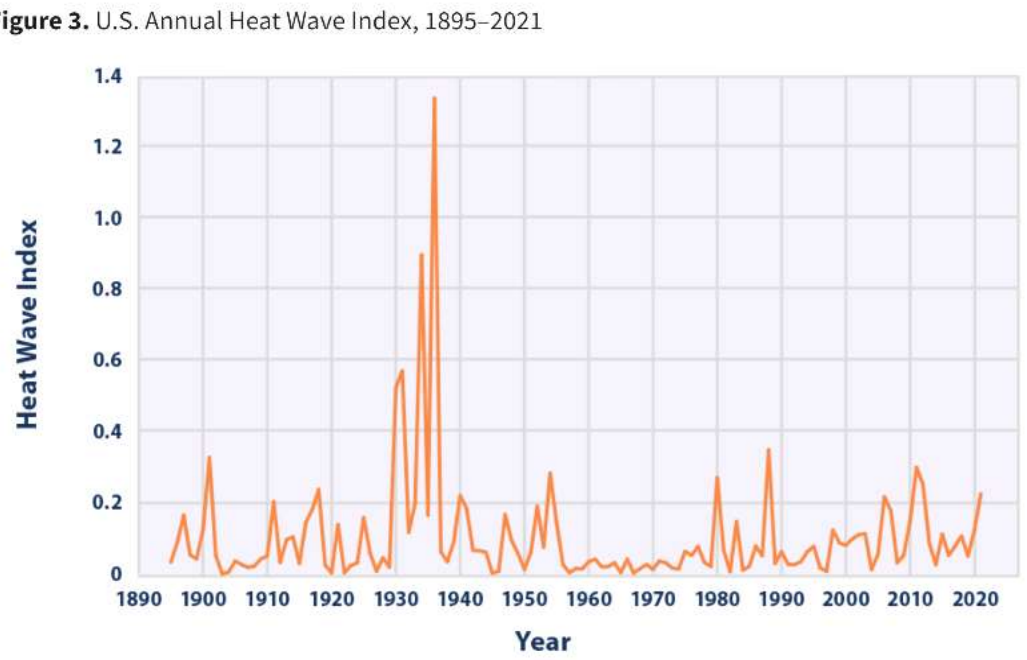

Figure 7 – U.S. Heat Wave Index, 1895 to 2021. *Despite increases in CO_2 emissions, heat waves are dramatically lower than during the "Dustbowl" 1930s. Source: The United States Environmental Protection Agency (EPA) Climate Change Indicators Heat Waves*

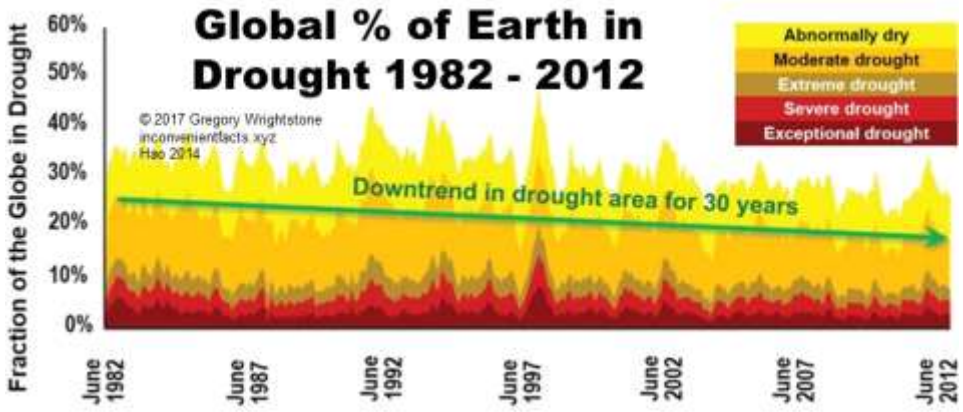

Figure 8 – Global Droughts 1982 to 2012. *Data shows droughts are declining, contrary to the repeated claims of climate alarmists. Source: Gregory Wrightstone using data from Hao, Z, AghaKouchak, A, Nakhiri N et al (2014) Global integrated drought monitoring and prediction system.*

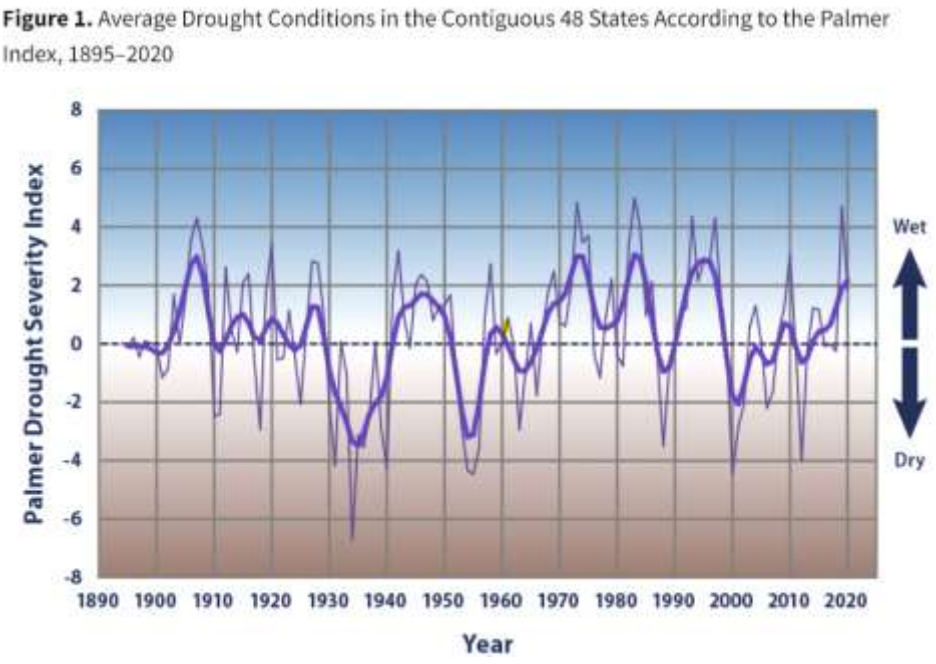

Figure 9 – U.S. Drought Conditions 1895 to 2020. *Droughts have also declined in the United States in recent years. The last 50 years have been wetter than normal, not dryer. Source: EPA Climate Change Indicators Droughts.*

The media would have you believe that the Earth is drying up and turning brown due to global warming. The opposite is true. As the temperature warms, the atmosphere holds more, not less humidity. Anyone who takes care of a swimming pool well knows that more water evaporates on hotter days as they need to replenish this water. When the atmospheric temperature increases more evaporation from the oceans occurs resulting in more moisture in the air. Thus, humidity and rain has increased with global warming and the Earth has become greener. In addition, warming allows plants to grow better at higher latitudes due to the moderated temperatures. The world has greened by more than 20% in the past 35 years, some measurements have placed it over 30%. Scientific papers have attributed 8% of this greening to global warming (see Zhu Zaichun, et, al, "Greening of the Earth and its drivers," Nature Climate Change, 6, 791-755, 25 April 2016 and Piao, Shilong, et al, "Characteristics, drivers and feedbacks of global greening" Nature Reviews, published online at www.nature.com.com/natevEarthenviron, 14 pages, 9 December 2019). A new paper confirms greening has continued. A recent paper has looked at greening from 2001 to 2020. Highlights of the paper include: "The global greening is an indisputable fact." The rate of global greening increased slightly." and "The drought has only slowed the global greening, but not caused global browning." (see Xin Chen, et al, "The global greening continues despite increased drought stress since 2020," Global Ecology and Conservation, Volume 49, January 2024). The world is getting wetter and greener as it warms, not dryer and browner as climate alarmists would falsely have you think. If you want a green Earth, you should welcome the warming.

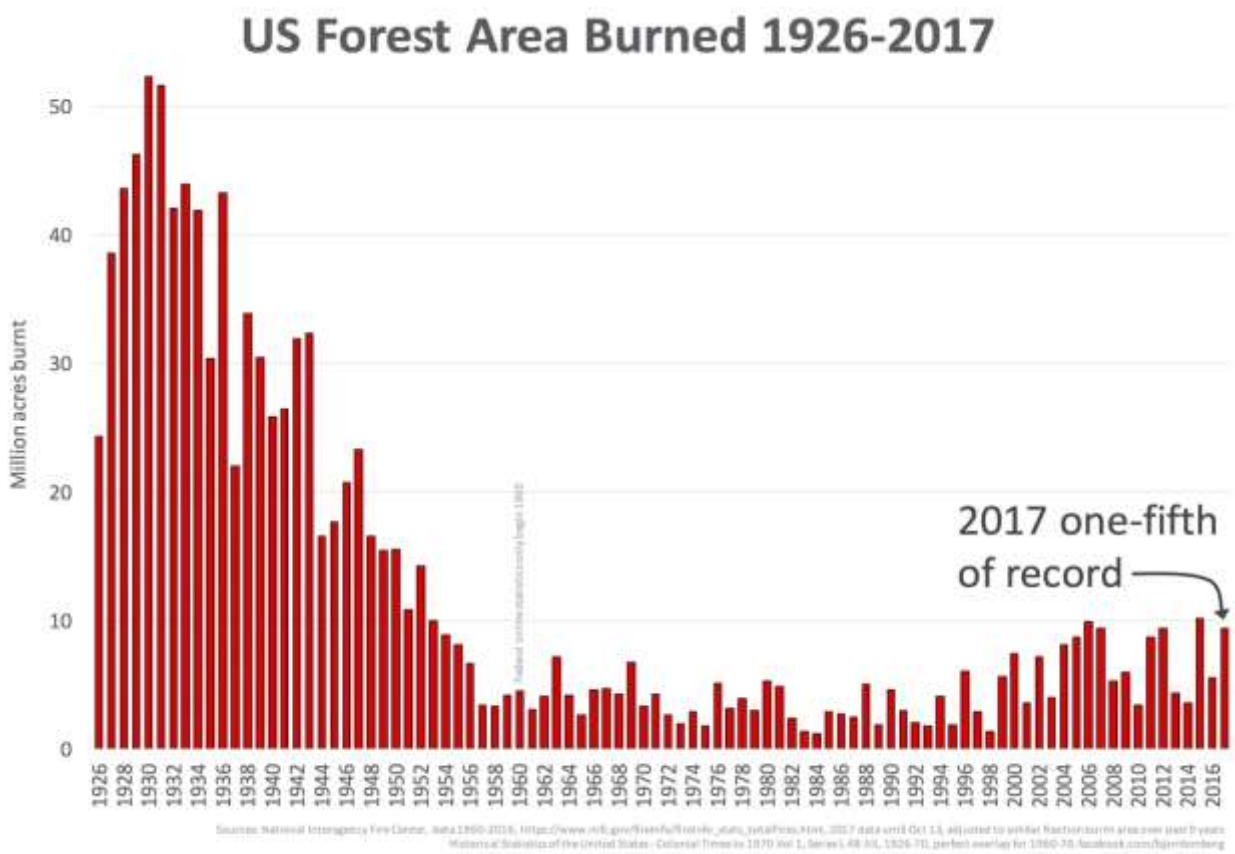

Figure 10 – US Forest Area Burned 1926-2017. *Wildfires are dramatically down from the 1920s and the "Dustbowl" days of the 1930s. Wildfires in the 1920s saw 5 times more acreage burned than currently experienced in the United States. Source: National Interagency Fire Center.*

The media would also have you believe the Earth is burning up and that wildfires have increased in recent years. This also is a false narrative. To provide evidence of the increased burning, they often show data since the late 1970s, which does show an increase. But the 1970s were a period of cooling, known as "The Big Freeze" (See Figure 33) and you need to look back to the last warm climate cycle of the 1930s during the "Dustbowl." When you look at the past 100 years, you can see that wildfires have declined significantly. The chart above shows the 5-fold decline in wildfires in the United States since the 1920s. The decrease in wildfires is not just a local trend in the United States. The website for CO2 Science has posted 23 scientific papers which show declining fire trends in Canada, Australia, Turkey, Europe, Siberia, and the United States (see CO2 Science).

In the year 2000, Avid Viner, Senior Research Scientist said, "Within a few years, winter snowfall in the UK will become a very rare and exciting event. Children just aren't going to know what snow is." This is yet another false claim. Data from the reputable Rutgers University Snow lab reveals an increasing trend in snowfall in the Northern Hemisphere from 1967 to 2023.

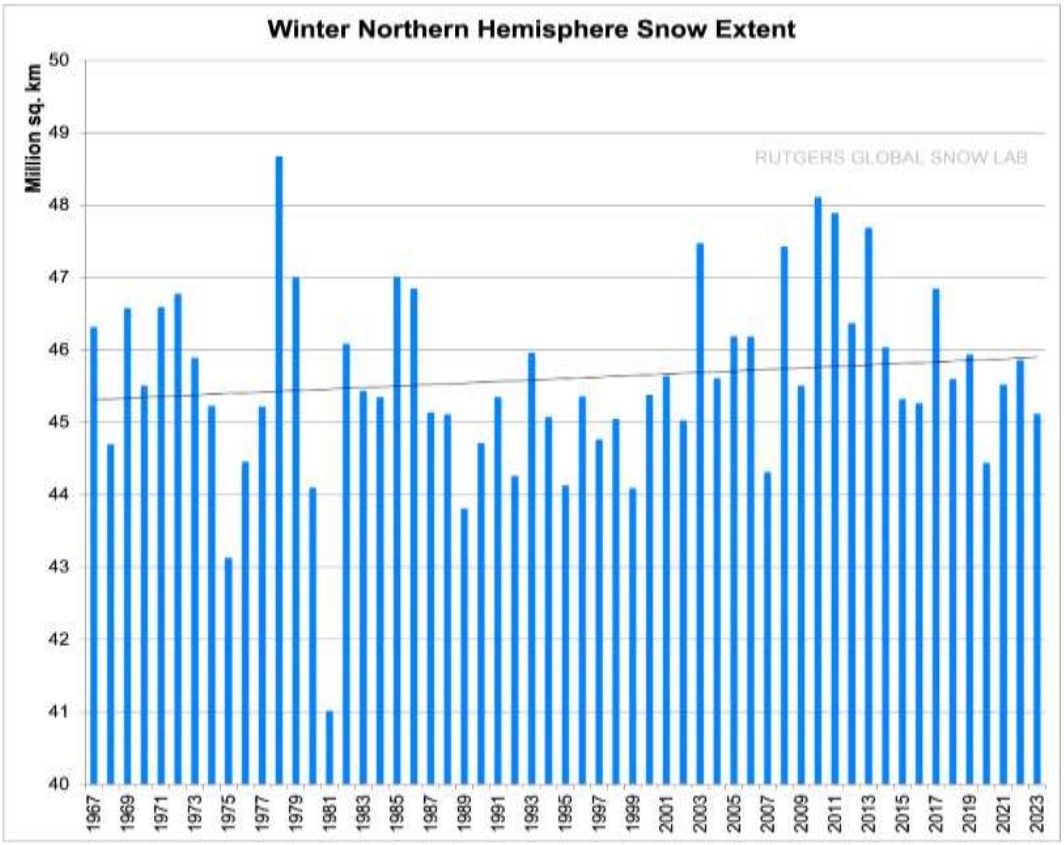

Figure 11 – Winter Northern Hemisphere Snow Extend, 1967 to 2023. *Despite climate alarmists predicting snow would be a thing of the past, total snow fall in the Northern Hemisphere has increased. Source: Rutgers University Global Snow Lab.*

Scientific Reasons for the Decline in Extreme Weather Events

There are in fact scientific reasons why many of these climate disasters are declining. Recent global warming has been most significant in high latitudes. Between 1978 to 2022, temperatures at the North Pole increased by 0.25C per decade, while the temperature increases in the Tropics measured only 0.12C in warming per decade, less than half the warming experienced in high latitudes (see Figure 27). This means less drastic temperature contrasts between high latitudes and the Tropics. As MIT Professor Richard Lindzen points out, severe storms are caused by warm moist air colliding with cold air, so moderating the frigid air should lessen severe storms, which is reflected in the tornado data (see Figure 6).

The decline in fires can be directly attributed to higher levels of CO_2. Plants use pores, or stomata, in their leaves to breathe in CO_2, but these stomata dry out the plant as water evaporates out of the pores. With more CO_2 in the atmosphere, plants partially close their stomata and lose less water. Over time, plants also evolve with fewer stomata to adjust to higher concentrations of CO_2 in the atmosphere. A study on this topic was conducted by Indiana University Bloomington and Utrecht University in the Netherlands, titled, "Rising carbon dioxide is causing plants to have fewer pores, releasing less water to the atmosphere." The study finds, "As carbon dioxide levels have risen during

the last 150 years, the density of pores that allow plants to breathe has dwindled by 34 percent, restricting the amount of water vapor the plants release to the atmosphere." The paper also reports, "…doubling of today's carbon dioxide levels -- from 390 parts per million to 800 ppm -- will halve the amount of water lost to the air." (see Indiana University. "Rising carbon dioxide is causing plants to have fewer pores, releasing less water to the atmosphere." ScienceDaily, 4 March 2011. www.sciencedaily.com/releases/2011/03/110303111624.htm).

Around 90-95% of water in plants is absorbed from the soil through roots (ChatGPT). Therefore, increased levels of CO_2 result in plants taking less water out of the soil and the ground retains moisture, which deters fires. Researchers from NASA's Goddard Space Flight Center used data from the NASA Soil Moisture Active Passive (SMAP) satellite to track the correlation between soil moisture conditions and wildfire susceptibility in the 2020 California wildfire season. "Researchers compared the amount, location, and timing of the MODIS fire detections, with SMAP root-zone soil moisture anomalies (the amount that current soil moisture conditions, at the depth of plant roots, deviate from the historical average), and found a strong correlation between the timing and location of low soil moisture conditions and an increase in fires." (see https://appliedsciences.nasa.gov/our-impact/news/nasa-tracks-link-between-soil-moisture-and-fire-susceptibility-california#:~:text=In%2). In fact, the USGS monitors soil moisture in its TOPOFIRE system to predict fire risk, since low soil moisture is an indicator of greater fire vulnerability.

The fact that droughts are declining is also not surprising. Historically, periods of cold are when the Earth has been more arid. Wolfgang Behringer in his book A Cultural History of Climate conducted a comprehensive study of historical climate cycles and concludes, "Increased aridity may be regarded as the typical feature of the global cooling." (see bibliography, Behringer, pg. 88). When global temperatures increase, the atmosphere will hold more moisture. When temperature declines, humidity also declines as the water condenses out of the air. Historical records, archaeological findings, and paleoclimate reconstructions all confirm the Earth was more arid during the cold periods of the Greek Dark Ages, the Dark Ages, and the Little Ice Age and moister and lusher during the warm periods of the Minoan, Roman, Medieval, and Modern Warm Periods.

One surprise in the data is the fact that floods have not increased in modern times. The elevated moisture content of the atmosphere in the current Modern Warming period has resulted in more rain, but as set forth in the most current IPCC AR6 report, the measured data has not detected any trend in floods. Although the IPCC AR6 report indicates an increase in precipitation, the NOAA "Annual 2022 Global Climate Report" cites precipitation in 2020 at 2.70 mm d^{-1} vs. the past 40-year average of 2.69 mm d^{-1}.

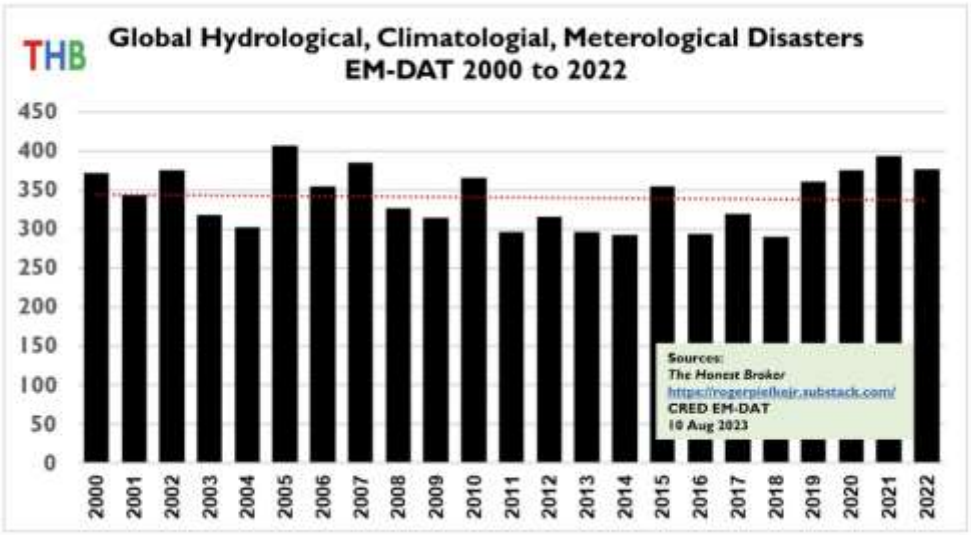

Figure 12 – No Trend in Global Hydrological, Climatological, and Meteorological Disasters 2000 to 2022. *As reported by the IPCC AR6 Report, there is no detectible trend in floods. Roger Pielke using data from the EM-DAT of the International Disaster Database shows a slight decline in hydrological, climatological, and meteorological disasters over the past 22 years (see https://rogerpielkejr.substack.com/p/21st-century-global-disasters?utm_campaign=post&utm_medium=web).*

Other Climate Disasters that Have Not Happened

Protecting endangered species is an important obligation of humanity. Climate alarmists falsely claim the warming climate is causing an ever-increasing number of extinctions. Some media reports claim hundreds of extinctions of species per decade in recent years, but these claims are not supported by documented evidence. The International Union for Conservation of Nature and Natural Resources documents the extinction of 529 animal species over the past 500 years (see https://inconvenientfacts.xyz/blog/f/mass-extinction-lie-exposed-life-is-thriving). Similar data is provided by Endangered Species International (see https://www.endangeredspeciesinternational.org/overview5.html). Data shows that extinctions are declining as temperatures have warmed. It has warmed since the 18th century and the number of extinctions has been in decline. Much of this has been due to restrictions on hunting and other conservation efforts. The decline in extinctions is particularly low and declining since we entered a warm period since 1980. It is difficult to tease out the impact of climate and the impact of intervention as the cause of this decline. However, one fact is clear, the data shows warming temperatures are not hastening the extinction of species, particularly since 1980. It is not a surprise since scientific studies published in GeoScience World, Earth and Planetery Science Letter, Journal of Palaeogeography, Nature Geoscience, and Global and Planeary Change have all shown past extinctions were caused by a cooling Earth, not a warming Earth. (see https://notrickszone.com/2019/05/16/recent-studies-indicate-species-

extinctions-decline-with-warming-mass-extinction-events-due-to-cooling/). Furthermore, in general biodiversity tends to be higher in warmer climates.

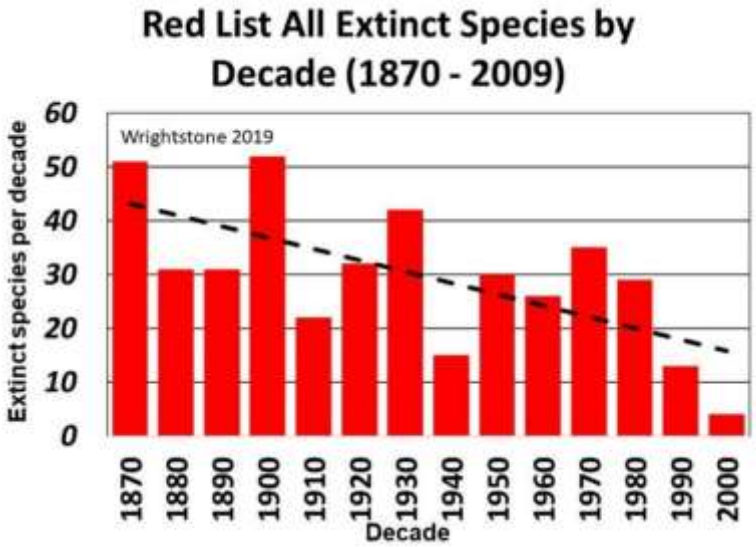

Figure 13 – The Red List of All Extinct Species by Decade, 1870 to 2009. *As temperatures have warmed since 1870 the number of documented extinct species has declined. This is especially true since the warming that began in 1980. Source: Chart by Gregory Wrightstone from the data taken from the International Union for Conservation Nature's Red List of Threatened Species https://iucnredlist.org*

The polar bear is the poster child of climate change, but facts reveal that polar bear populations have increased in recent years, not decreased as dramatically depicted in climate alarmist propaganda. Zoologist Susan Crockford's research on polar bears demonstrates polar bear populations are growing and even thriving despite warming temperatures. Her findings gave a deathblow to the climate change narrative promoting polar bears as victims of anthropogenic global warming, but it may have cost her job. In May 2017, her lectures were shut down and she was subsequently fired from her position as an adjunct professor at the University of Victoria, a position she had held for 15 years. She claimed she was fired because of telling students politically incorrect facts about polar bears. The climate narrative claims polar bear populations are in decline due to climate change with only a few thousand remaining. However, even the International Union for Conservation of Nature's 2015 Red List of Threatened species puts polar bear numbers between 22,000 to 31,000, a number which agrees with Susan Crockford's research.

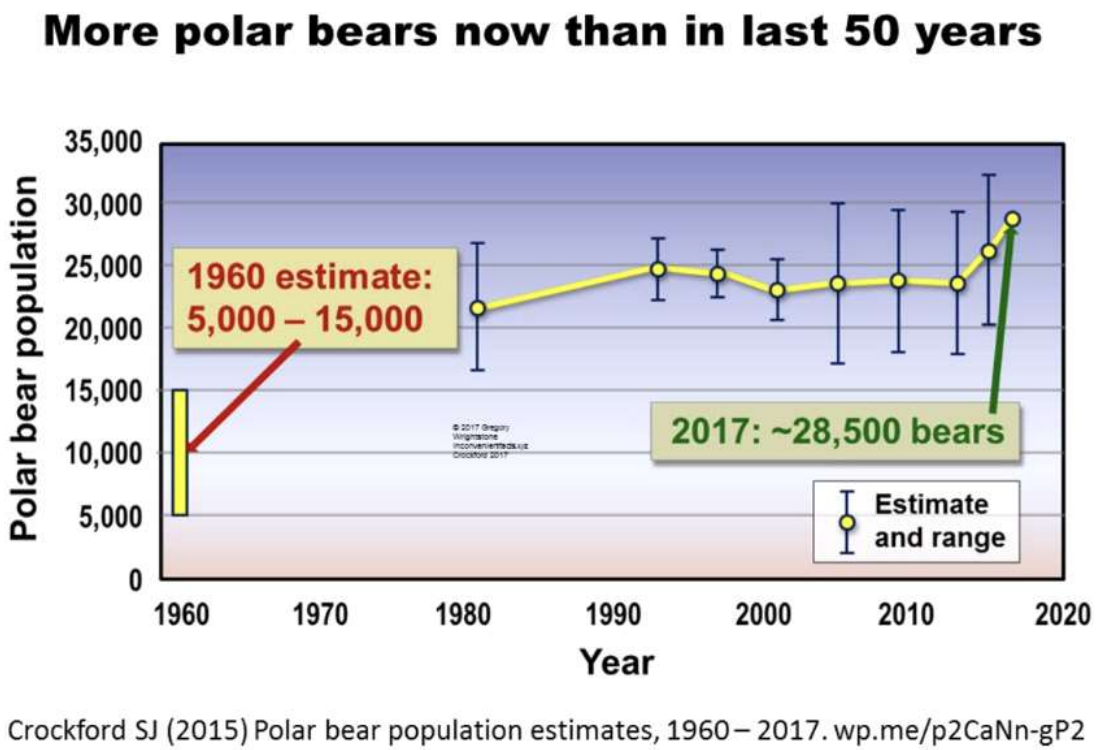

Figure 14 – Growing Polar Bear Populations 1960 to 2020. *Polar bears, the poster mascot for climate change alarmism, have prospered in recent years. Source: Gregory Wrightstone using data from Crockford SJ (2015).*

Another poster child of climate alarmism has been the killing by climate change of the Great Barrier Reef. Bleaching of the reef was experienced in 1998 and 2002 and a decline in coral cover was seen between 2000 to 2012. This decline fits nicely into the climate alarmist narrative. Hurricanes are known to be especially harsh on coral and the cyclone Hamish was no exception with the Great Barrier Reef experiencing more decline. However, it is well-known that coral grows well and even faster in warm water. Some of the most beautiful coral in the world is found in the Red Sea, an area of hot waters. The Australian Institute for Marine Science has been tracking coral growth in the Great Barrier Reef since 1985. Overall, coral has been growing in the Great Barrier Reef for over 10 years. The growth in 2021 was a record and 2022 exceeded this growth figure to set a new record. The growth in 2023 was similar to 2021 and was again near record levels. Coral is known to grow faster in warmer water and the warming of the Pacific may have contributed to the recovery of the reef.

Geophysicist Peter Ridd from the James Cook University wrote about the recovery of the Great Barrier Reef and stated that coral is the "least endangered of any ecosystem to future climate change." He said, "Corals are particularly well adapted to temperature changes… the warmer the better. It seems odd that coral scientists are worrying about global warming because this is one group of organisms that like it hot. Corals are most abundant in the tropics, and you certainly do not find fewer corals close to the equator. Quite the opposite, the further you get away from the heat, the worse the corals. A cooling climate is a far greater threat." For challenging the climate narrative, he was fired from his position at James Cook University.

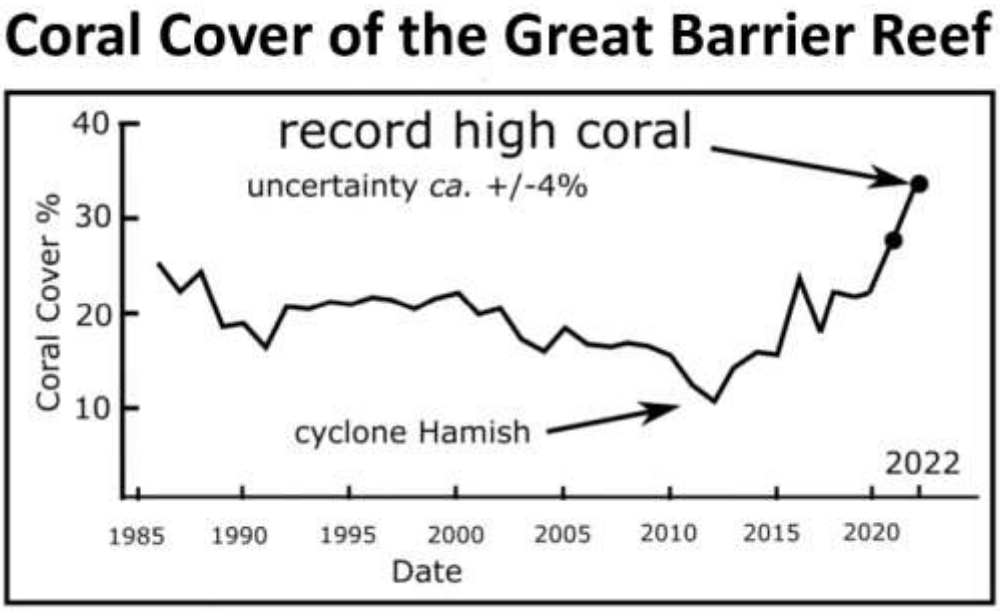

Figure 15 – Coral Cover of the Great Barrier Reef, 1985 to 2022. *Climate alarmists have insisted the Great Barrier Reef is being destroyed by climate change. The claim is contrary to fact. In 2021 and 2022, the Australian Institute of Marine Science reported the highest overall coral cover on record of the Great Barrier Reef. Overall coral cover in 2021 was the highest level since they began to record coral cover in 1985. Overall coral cover in 2022 was even higher than 2021, setting a new record. Hurricanes are known to damage coral and Cyclone Hamish was no exception. Coral is known to grow faster in warmer water and warming seas may have contributed to the fast recovery from Cyclone Hamish. Source: Peter Ridd, using data from the Australian Institute of Marine Science. For more information, see* (559) #9: Peter Ridd on record Great Barrier Reef coral cover and scientific integrity - YouTube.

Sea Level Rise will be Less than One Foot by the End of the 21st Century.

Sea level rise is another climate alarmist claim, with some predicting a greenhouse gas-induced sea level rise of several meters by the end of the century, a claim which is not supported by data. The oceans have been rising since the Earth emerged from the cold Little Ice Age at the end of the 18th Century. There has been almost no acceleration in sea level rise in recent years other than cyclical variations, which have followed temperature swings from ocean temperature oscillations (see Chapter 7). Because of tectonic shifts, land masses on which tide gauges are placed rise and sink (Sweden is rising and Venice, Italy is sinking). Therefore, measurements of sea level in one location cannot be extrapolated globally. An aggregate of tide gauges shows an average sea level rise of 1.7mm to 1.8 mm per year (6.7 to 7.1 inches per century). See https://tidesandcurrents.noaa.gov/sltrends/globalregionalcomparison.html. There are two satellite sea level measures, the GRACE and JASON satellite systems. GRACE satellites measure 1.6mm per year in line with tide gauges (see bibliography, Brady, pg. 58), but JASON satellites measurements since 1994 show an average of 3.4 millimeters per year in sea level rise. JASON satellite measures of sea level rise acceleration in this period is a minuscule 0.084 millimeters per year (https://sealevel.colorado.edu/, see also https://everythingclimate.com/topics/antarctic-ice-melt/). Using the JASON satellite data of the

rate of sea level rise and acceleration, the most extreme of the three datasets, oceans would rise by 10.6 inches by the end of this century. This figure is in line with historical sea level rise of the past 150 years, including decades when CO_2 levels were much lower than today. According to NASA sea level rise was 9.1 cm over the past 30 years, or an average of 3.0mm per year. However, in March 2023, NASA reported sea level rise in 2022 was 2.7mm, lower than the past 30-year average, so in 2022, sea level rise actually decelerated. See [Sea level rise slowed down in 2022. NASA says it's just a blip | Space.] Less than one foot of sea level rise with 80 to 100 years to adapt is hardly a crisis. Island atolls, which climate alarmists falsely claim are disappearing, are generally seeing shores expand as the growth of coral accelerates with warmer temperatures.

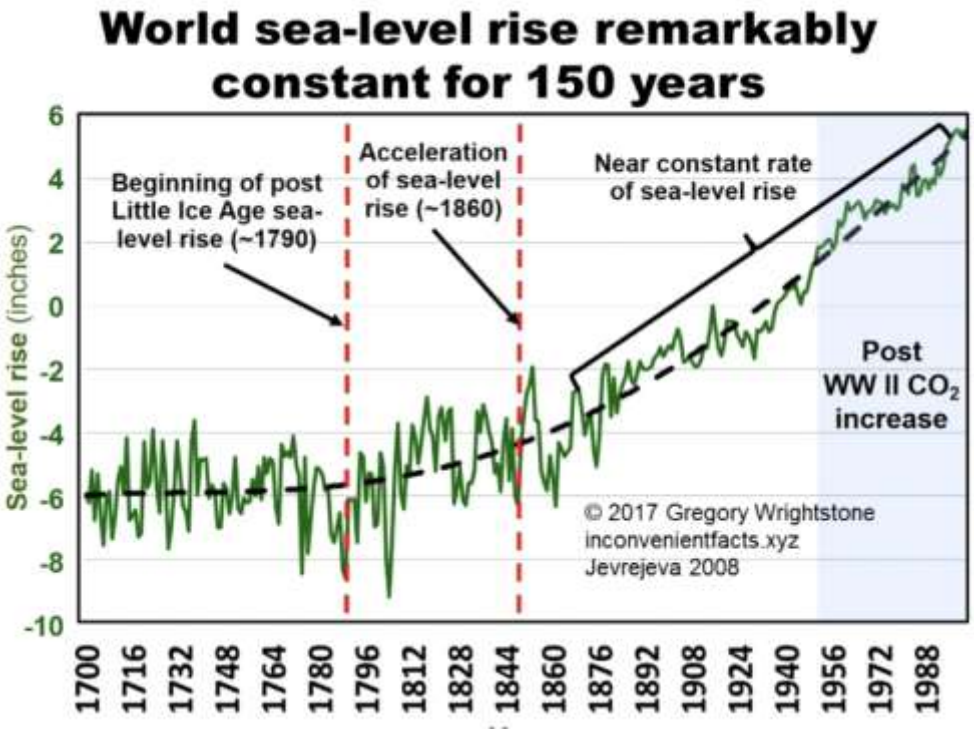

Figure 16 – World Sea Level Rise 1700 to 1998. *Sea rise has seen no appreciable acceleration since 1870. Most of the acceleration occurred before this date as the Earth emerged from the Little Ice Age. Source: Gregory Wrightstone using data from Jevrejeva S, et al (2008) Geophys. Res. Lett.*

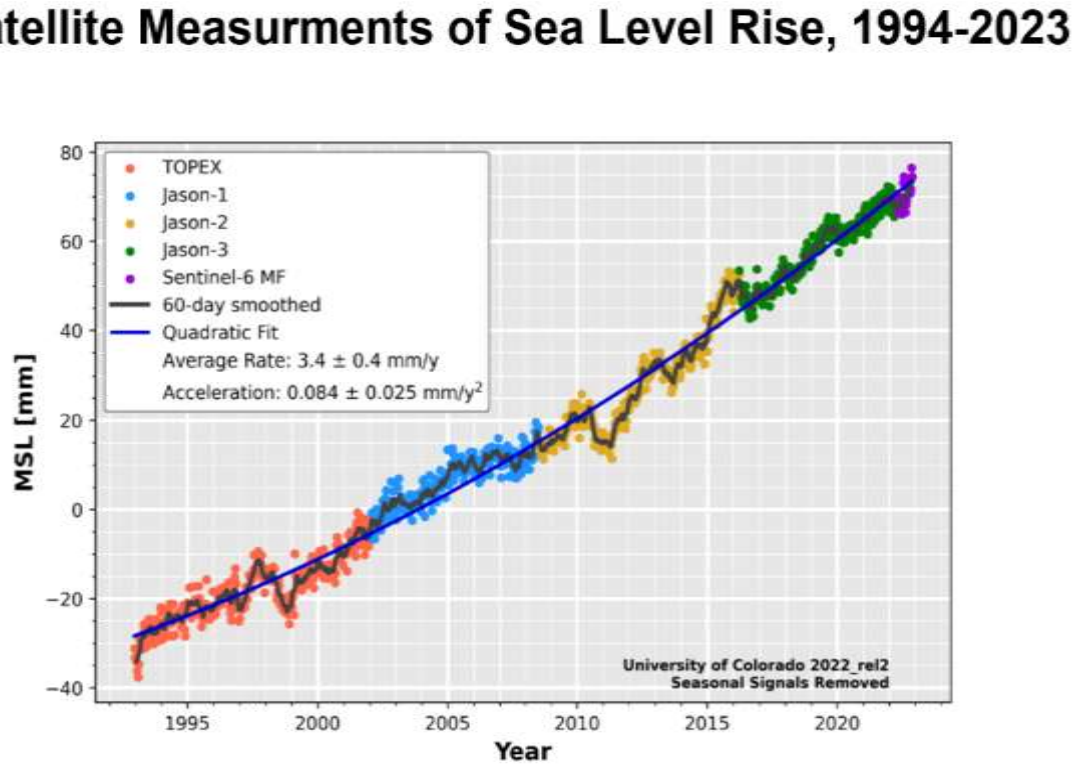

Figure 17 – Satellite Measurements of Sea Level Rise, 1994 to 2023. *JASON satellite measurements of sea level rise since 1994, as analyzed at the University of Colorado, averaged 3.4 mm per year with an acceleration of 0.084 mm per year. At this rate and acceleration, sea rise will be less than one foot by the end of the twenty-first century. Source: University of Colorado (2022), Boulder, CO. Tide gages measurements averaged 1.7 mm pe year in sea level rise and GRACE satellites measurements averaged 1.6mm per year. NASA states the sea level rise has averaged 3.0mm per year over the past 30 years, declining to 2.7mm in 2022.*

Sea level rise has followed ocean temperatures. It has been documented that temperatures of the Atlantic Ocean oscillate between warm and cool every 40 years in an event known as the Atlantic Multidecadal Oscillation (AMO). The correlation between the AMO and sea level rise is insightful. The Atlantic Ocean was cool in the 1910s, warm in the 1940s, cool in the 1970s, and warm in the 2000s. Climate alarmists often cite the 3 mm of sea level rise in recent years as high compared with the sea level rise in the 1970s, thus falsely inferring an acceleration of sea level rise. However, the 1970s was a cold period. No less than three Time magazine articles in the 1970s warned of "The Big Freeze" (see Figure 33). The 1970s was a time of declining temperatures, growing Arctic ice and slower sea level rise. A paper titled "The cause of sea-level rise since 1900" by Thomas Frederike, et al, Nature, 584, 393-397 (2020) provides a detailed assessment of sea level rise from 1900 to 2000. This paper clearly shows the cycles of sea level rise and confirms that the 3 mm per year sea level rise over the last 30 years is not unusual during a warm period of the AMO and is consistent with sea level rise in 1940.

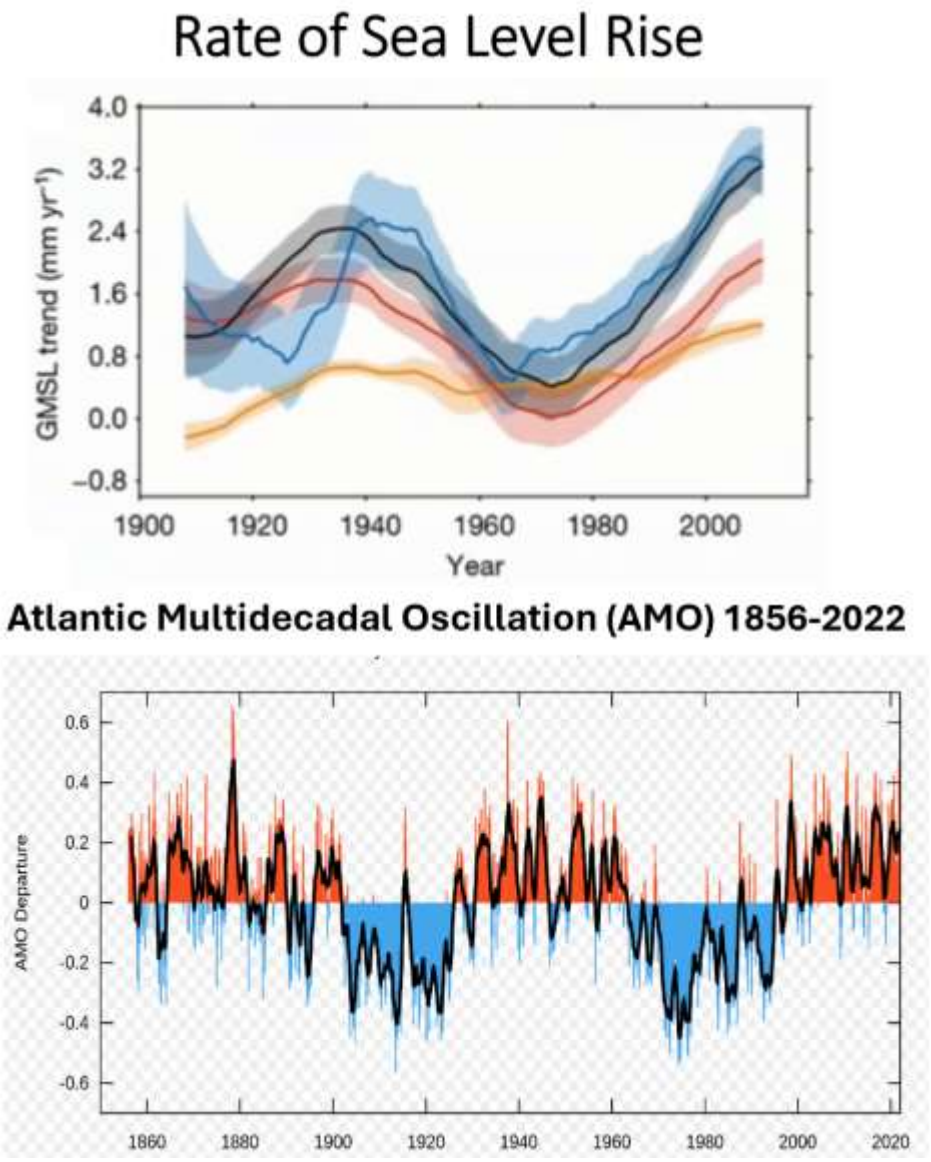

Figure 18 – Rate of Sea Level Rise Compared to the Atlantic Multidecadal Oscillations. *The rate of sea level rise has varied with ocean temperatures. Atlantic Ocean temperatures oscillate between warm and cool every 40 years in an event known as the Atlantic Multidecadal Oscillation (AMO). The figures above show various estimates of sea level rise from 1900 to 2000 and Atlantic Ocean temperature changes. The line in blue on the sea level chart depicts observational measurements, other colors depict elements of sea level rise from models (e.g., glaciers, Greenland ice sheet, etc.), with black being the sum of these pieces. The correlation of sea level rise with the rise and decline in ocean temperatures of the Atlantic Multidecadal Oscillation (AMO) is insightful. The sea level rise of 3 mm per year in 2000 is similar to the sea rise in 1940 and is to be expected in the current warm oscillation of the AMO. Sources: Rate of Sea Level Rise 1900 to 2000, Thomas Frederike, et al, "The cause of sea-level rise since 1900," Nature 584, 393-397 (2020). Atlantic Multidecadal Oscillation (AMO), 1856 to 2022 Wikipedia.*

Sea level rise is caused by several factors. Primarily, sea level rise is influenced by melting of glaciers and ice sheets, and the thermal expansion of seawater due to increased temperature. Other smaller impacts

include pumping and use of water from underground aquifers, storage of water in man-made reservoirs, and changes in humidity which move water from oceans to the atmosphere. There is a clear connection between sea level rise and ocean temperature. Approximately 30% to 40% of sea level rise is due to thermal expansion from warmer oceans (Chat GPT). Figure 18 above shows the close correlation between sea-level rise and 40-year ocean temperature oscillations. About 25% to 30% of sea level rise is from melting glaciers. The melting of glaciers is also associated with ocean temperatures. As we will see in Chapter 5, heat in the oceans is moved to the atmosphere in the Arctic, so ocean warming can explain much of the Greenland and other Northern Hemisphere glacial melt of the last century. Ocean warming plays a much more important role in sea level rise than atmospheric warming from CO_2. Ocean warming is thus the primary driver of sea level rise and, as will be explained in Chapter 5, increased CO_2 emissions have little impact on the heating of oceans. Consequently, increasing CO_2 emissions have only a minimal impact on sea level rise.

A study by one of the world's leading experts in glaciers, Professor Hanspeter Holzhauser, from the University of Bern, Switzerland, reveals that glacier melt has been cyclical and in line with the warm periods of the 1,000-year cycles (see Figure 38), which include the Roman, Medieval, and Modern warm periods. Historical tide gauge records also confirm these 1000-year sea-level cycles (see Figure 37). It just so happens that these 1,000-year cycles are in synch with millennial Eddy Solar Cycles. These solar cycles are times of low cloud cover which results in more solar radiation reaching and heating the oceans. Observational data confirms sea-level rise is primarily from ocean warming due to natural causes. Attributing sea-level rise to increased concentrations of CO_2 is not supported by evidence.

Chapter 4 – The Benefits of Carbon Dioxide and Warming

CO_2 is Beneficial to Mankind and the Earth

Climate alarmists and the media falsely claim the Earth is getting browner due to climate change. Interestingly, climate alarmists warn of browning and weather disasters without comprehensive data to support their narrative, yet scientific data demonstrates the benefits of increased CO_2. Measuring total leaf area of the Earth, NASA satellites have confirmed that the world greened by more than 20% in 35 years (https://www.nasa.gov/feature/goddard/2016/carbon-dioxide-fertilization-greening-Earth). The observation that the world has greened since 1982, as seen through NASA satellites, indicates an overall increase in vegetation cover on Earth. This is a land area equal to twice the size of the United States. Known as CO_2 fertilization, peer-reviewed papers have attributed 70% of this greening to increased CO_2, which is plant food (see Zhu Zaichun, et, al, "Greening of the Earth and its drivers," Nature Climate Change, 6, 791-755, 25 April 2016 and Piao, Shilong, et al, "Characteristics, drivers and feedbacks of global greening" Nature Reviews, published online at www.nature.com.com/natevEarthenviron, 14 pages, 9 December 2019). Most of the greening has occurred in arid lands that were formerly too dry to grow vegetation. Plants become more drought resistant with more CO_2 as they close their stomata and evolve over time with fewer stomata.

Other studies on greening have been conducted and all studies have confirmed the fact of global greening between 1982 to 2000. However, some have questioned whether global greening was a short-lived occurance or long-term trend that is continuing. To address this issue, a new study has been conducted to look at greening and browning of the world between 2001 and 2020. The study used the latest versions of the LAI satellite datasets, which have been updated. The updates reduce uncertainty in the analysis of global vegetation change trends after 2000. All four LAI datasets showed significant global greening between 2001 to 2020. The data showed accelerated greening in 55.1% of the areas, compared with 7.28% of browning. The paper highlights that "global greening is an indisputable fact." (see Xin Chen, et al, "The global greening continues despite increased drought stress since 2000," Global Ecology and Conservation, Volume 49, January 2024, https://www.sciencedirect.com/science/article/pii/S2351989423004262).

The great benefit of more CO_2 is the tremendous increase in agricultural production to feed a growing population. That is why some commercial greenhouses increase CO_2 levels to 1,200 ppm to stimulate crop growth. There is an almost exact correlation of the increase in CO_2 to the increase in agricultural production. It is ironic that we call "green energy" the very energy which will limit CO_2 and result in less greening.

Climate alarmists just cannot seem to accept good news. Instead of welcoming the greening, they point out that plants grown in higher levels of CO_2 is problematic since such plants lack nutrients needed for faster growth such as iron, zinc, and other minerals. However, this fact is well-known and is addressed by fertilizers. It is the practice of CO_2 supplemented greenhouses to increase the amount and mixture of fertilizers to adjust for the increased levels of CO^2. Increasing CO_2 levels require fertilizing with both macronutrients of nitrogen, phosphorus, potassium, calcium, magnesium, and sulfur as well as micronutrients such as iron, zinc, boron, copper, manganese, and molybdenum. Micronutrient fertilizing is especially important (see https://extension.okstate.edu/fact-sheets/greenhouse-carbon-dioxide-supplementation.html).

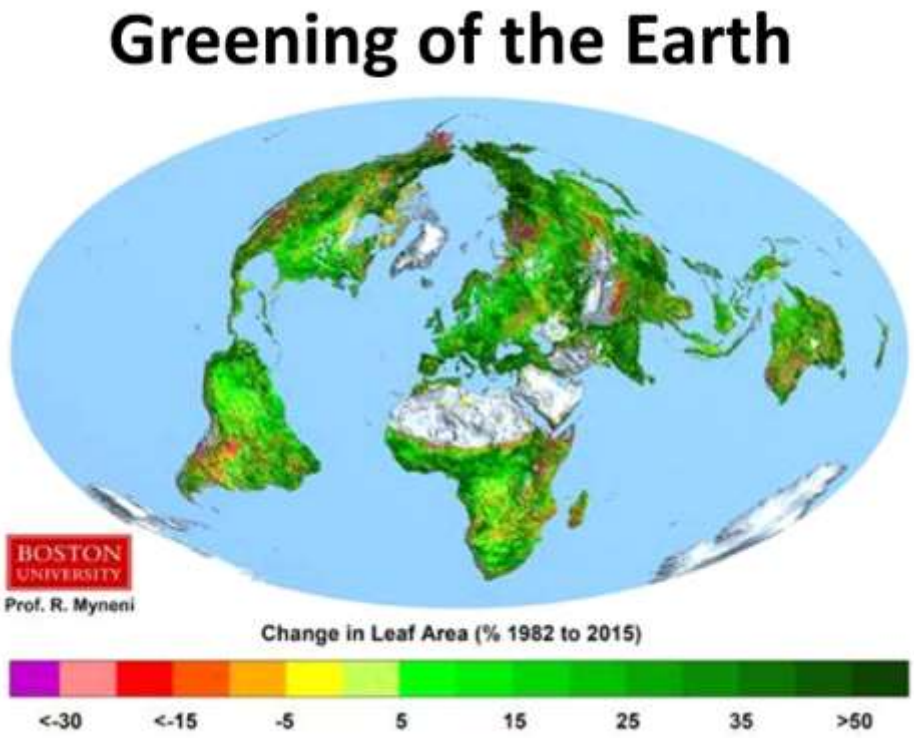

Figure 19 – Greening of the Earth, 1982 to 2015. *CO_2 has greened the Earth by more than 20% in the past 35 years as recorded by NASA satellites. This is an area equal to twice the size of the United States. Source: NASA (2016) Carbon Dioxide Fertilization Greening Earth, R. Myneni, Boston University.*

Figure 20 – Plants Love CO_2. *Experiments by Dr. Craig Idos demonstrate the increased growth of plants that receive higher levels of CO_2. This is really no surprise as CO_2 is food for plants and is essential for life on Earth. Source: CO2 Science. AMB stands for ambient, which is the CO_2 concentration in the atmosphere at the time this experiment was conducted..*

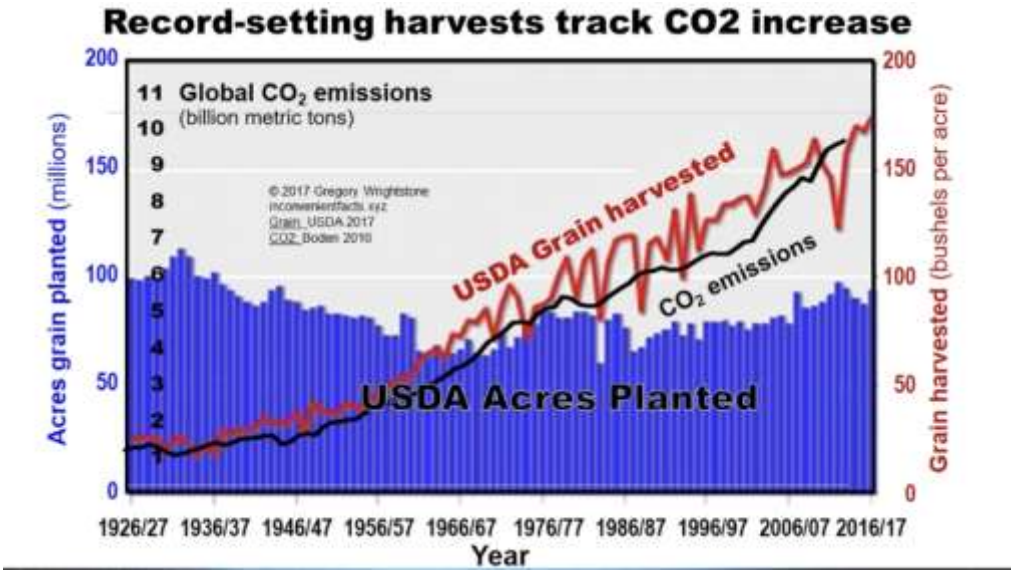

Figure 21 – Record Setting Harvests Track CO_2 Increase. *Despite only modest increases in acres planted, grain crop yields in the USA have increased in synch with rising levels of CO_2. Increasing levels of CO_2 will help us feed an ever-growing population. Source: Gregory Wrightstone using data from the USDA (2017), World Agricultural Outlook Board.*

Global Warming has Saved Many Lives

A recent paper studying climate-related deaths by Qi Zho, et al, titled, "Global, regional, and national burden of mortality associated with non-optimal ambient temperatures from 2000 to 2019, a three-stage modeling study," The Lancet, July 2021, provides data to show that cold kills nine times more people each year than heat. This is especially true of third-world countries in Africa and Asia. A warming planet would save many lives. People living in third-world countries benefit the most from global warming.

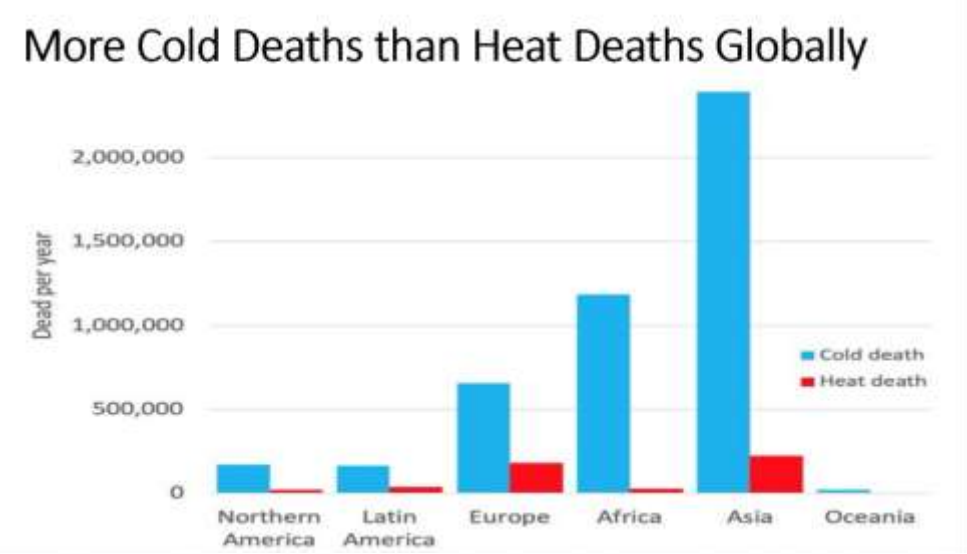

Figure 22 – Cold Kills Far More People than Heat. *Data from around the world confirms that nine times more people die from cold than heat. Global warming saves many lives and should be celebrated. This is particularly true in Third-World countries of Africa and Asia. Source:* https://i0.wp.com/electroverse.co/wp-content/uploads/2022/12/image-25.png?ssl=1. *For the full paper see* Global, regional, and national burden of mortality associated with non-optimal ambient temperatures from 2000 to 2019: a three-stage modelling study - The Lancet Planetary Health.

Climate and weather-related deaths today have plummeted to 1/50 the number experienced in 1920. Although this may suggest warmer temperatures have been good for humankind, the larger implication is the power of adapting to climate. Advancements in forecasting severe weather events and other adaptations, such as flood control measures, improved heating systems in cold weather and air conditioning in heat waves. Ironically, many of these lifesaving adaptations are provided by the burning of fossil fuels. This 100-year history is convincing evidence of the power of humankind to adapt to climate. **Money would be far better spent adapting to climate rather than vainly trying to control it.**

Figure 23 – Climate-Related Death Risk Has Plummeted, 1920 to 2020. *Climate related deaths are significantly down from historical levels. Source: OFDA/CRED International Disaster Database (2021).*

Global warming can sound frightening. Climate alarmists cite rising average global temperatures to paint a picture of gloom. In reality, recent climate change has been one of moderating temperatures. Temperature records reveal that we have not had hotter summers or more heat waves in recent decades, but rather more moderate winters due to the recent warming. Average temperatures have gone up, but in a positive way. Since cold winters lead to more deaths and damaged crops due to late frosts, we should welcome the recent warming, which is moderating the climate.

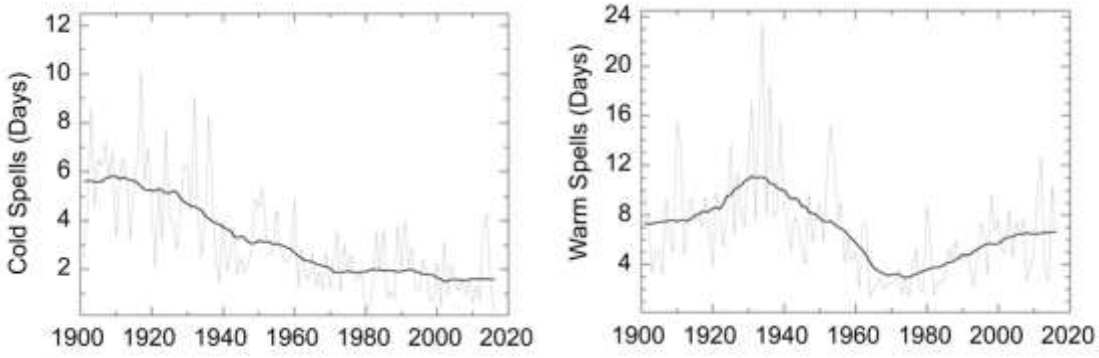

Figure 24 – Cold Spells and Hot Spells, 1900 to 2020. *Climate alarmists use average temperature increases in recent years to suggest a trend of ever-increasing dangerous heat. The data shows average warming has been mostly from milder winters not hotter summers. This is a good trend as cold winters lead to more deaths and crop damage from late frosts. The data above shows the moderating of winters and decline in summer warm spells in the United States. Note the dip in warm spells in the 1970s, which was during the cold cycle of the Atlantic Multidecadal Oscillation. Source: The Fourth National Climate*

Assessment (NCA4), Chapter 6, Temperature Change in the United States, https://science2017.globalchange.gov/chapter/6/

Chapter 5 – Atmospheric Warming from CO_2 Does not Heat the Oceans; the Oceans Heat the Atmosphere and the Oceans are Warmed by the Sun.

Solar Heat in the Oceans Drives Global Atmospheric Warming.

Increasing levels of anthropogenic greenhouse gas emissions have contributed to global atmospheric warming. However, many credible scientists have attributed 40% to 87% of current global atmospheric warming to solar heat stored in the world's oceans. Astrophysicist Nir Shaviv attributes 50% to 66% of global atmospheric warming to solar heating of oceans (see Figure 64). Physicist Max Derakhashani says ENSO ocean temperatures account for 72% or more of atmospheric temperature variation since 1979 (Tom Nelson Podcast #81, March 13, 2023). Fritz Vahrenholt cites 8 peer-reviewed scientific papers estimating 40% to 70% of global atmospheric warming in recent decades is caused by the sun (see The Neglected Sun, pg. 137). A recent paper in Climate by an impressive list of 37 international authors concludes that 70% to 87% of recent global atmospheric warming of the Northern Hemisphere can be explained by natural forcing from the sun and volcanoes (see Willie Soon, et al, "The Detection and Attribution of Northern Hemisphere Land Surface Warming (1850-2018) in Terms of Human and Natural Factors: Challenges of Inadequate Data, Climate, 28-August-2023, 11/(9), 179., also see https://www.scienceunderattack.com/blog/2023/9/18/the-sun-can-explain-70-or-more-of-global-warming-says-new-study-138?format=amp, and https://judithcurry.com/2023/09/10/controversy-surrounding-the-suns-role-in-climate-change/?amp=1).

The oceans are a massive collector of solar heat. Because the seas have a very low albedo (reflectivity) they readily absorb heat from the sun. The reflective albedo of land masses is, on average, higher than the oceans, so in general, the oceans absorb more heat from the sun than land. The oceans represent just over 70% of the area of the globe but absorb about 90% of the world's solar heat, due to their low albedo. For the Earth's Energy Budget to remain in balance (energy in equals energy out), solar heat in the oceans is transferred to the atmosphere in the process of radiating such heat out to space.

Incoming solar radiation is estimated at 173,000 TW, which constitutes over 99.9 % of the energy input to the Earth's climate system (see Javier Vinós & Andy May, "The Sun-Climate Effect: The Winter Gatekeeper Hypothesis (III). Meridional transport, the most fundamental climate variable." August 16, 2022, posted by Andy May, The Sun-Climate Effect: The Winter Gatekeeper Hypothesis (III). Meridional transport, the most fundamental climate variable – Andy May Petrophysicist). The scientific reason solar radiation is the dominant source of ocean heat is because radiation from the sun crosses a broad spectrum of short-wave ultraviolet light, visible light, and long-wave infrared radiation. The shorter wavelength light spectrums carry more energy. Most important, however, is the fact that sunlight can penetrate the water to a depth of about 1,000 meters which is effective at heating the oceans.

According to ChatGPT, "**As a global average, the oceans transfer more heat to the atmosphere than the atmosphere transfers to the oceans.** The vast thermal capacity and heat storage capability of the oceans play a crucial role in regulating Earth's climate. Oceans absorb a considerable amount of solar

radiation, storing heat within their vast volumes of water." The process of transferring heat from the oceans to the atmosphere occurs primarily through evaporation and convection. Evaporation from the ocean surface absorbs heat energy from the water's surface, transferring it into the atmosphere. In addition, convection allows the release of heat from the sea surface of warm ocean currents, which contributes heat to the atmosphere.

CO_2 Does not Heat the Oceans

Climate alarmists falsely claim recent ocean temperatures are rising at an alarming rate due primarily to increased CO_2 emissions in the atmosphere. Not only is this statement false, but they also have the relationship backwards. **Oceans are a major driver of atmospheric warming, while the atmosphere cools the oceans.** The Second Law of Thermodynamics is based on the observation that heat **always** moves from warmer objects to colder objects until they reach thermal equilibrium (the same temperature for both objects). **On average, the surface of the oceans are 2C warmer than the atmosphere at sea level.** According to ChatGPT, as of January 2022, "the average global seas surface temperature is approximately 17 degrees Celsius. This figure represents the mean temperature of the uppermost layer of the world's oceans. The average global atmospheric temperature at sea level is around 15 degrees Celsius. This temperature signifies the average air temperature at the Earth's surface measured at sea level across the entire planet."

Because the atmosphere is colder than the oceans, the atmosphere cannot directly warm the oceans because heat always moves from the warmer object (oceans) to the colder object (atmosphere). Since CO_2 heats the atmosphere and not the oceans, increases in CO_2 do not directly heat the oceans. The hypothesis that CO_2 slows the cooling of the oceans is also not confirmed by observations. Heat is removed from the oceans by latent heat evaporation, radiation, convection, and conduction. Evaporation and radiation represent about 89% of this heat removal. Yet both evaporation and radiation of heat from the oceans are enhanced by warmer atmospheric temperatures. Furthermore, CO_2 can only effectively absorb radiation from the ocean in the 13 to 14 micron wavelength and emit such radiation back to the ocean in this same 13 to 14 micron wavelength. However, radiation in the 13-to-17-micron wavelength can only penetrate water to a depth of a human hair, so this heat is lost to evaporation. Convection and conduction of heat from the oceans represent 11% or less of the cooling of the oceans, and because they only can warm the ocean surface they also result heat loss through evaporation. Because of evaporation on the ocean surface, warming of the atmosphere by CO_2 cools rather than warms the oceans. Let us look at each of these mechanisms of ocean warming and cooling in further detail.

Impact of Atmospheric CO_2 Radiative Forcing on Water Temperature

It is estimated that the oceans radiate 36% of their released heat to space through the atmosphere (see NASA "Surface Energy Budget." January 14, 2009). Known as the Absorbed Solar Radiation or ASR, the average global solar radiation received by the Earth's surface, when clouds are included, is 240W/m^2 See Wikipedia, "Energy Budget." Since 36% of this energy is radiated out to space from the oceans, this represents 240 x 0.36 or 86 W/m^2. Such heat is radiated out of the oceans in the form of a full spectrum of infrared long-wave radiation from wavelengths of 3 to 70 micrometers. The only meaningful radiation absorbed by CO_2 and partially emitted back to the oceans is infrared radiation in the 13-to-17-micron wavelength.

This is a narrow slice of the full infrared spectrum emitted out to space from the oceans (see Figure 45). Some of this radiation will be emitted back to the oceans from CO_2 molecules. However, radiation in the 13-to-17-micron spectrum has relatively high absorption coefficients, which means it is readily absorbed by water molecules. Therefore, the oceans absorb over 90% of the radiative heat in the 13-to-17-micron wavelength in the first 100 microns of the water's surface. To put this into perspective, a human hair is 70 to 100 microns. According to Chat GPT: "It's estimated that a significant majority, possibly over 90% or even higher, of the energy from infrared radiation in the 13 to 17-micron range is absorbed within the top 100 microns of water." Because CO_2 radiative forcing can only warm an extremely thin top layer of the ocean it leads to evaporation and a net cooling effect. Therefore, radiative forcing of CO_2 cools the oceans from evaporation, so it does not slow the release of heat from the oceans. It has the opposite effect; it increases the release of heat from the oceans through evaporation.

In summary, CO_2 emits nearly all of its absorbed radiation at the 13-to-17-micron wavelength range, which transfers most of its heat in the first 100 microns of the water's surface. Such surface warming results in increased evaporation where heat is transferred to the atmosphere by evaporation. Therefore, radiative forcing from CO_2 is not effective at heating or slowing the cooling of the oceans.

Warmer air enhances the radiation of heat out of the oceans. According to ChatGPT: "Warmer air typically does not impede the radiation of heat from the surface of the Earth. In fact, warmer air can facilitate the radiation of heat from the Earth's surface into the atmosphere and eventually into space. Warmer air molecules allow for more energetic collisions, which can enhance convective heat transfer, moving heat upward through the atmosphere. In essence, warmer air does not block or impede the radiation of heat from the surface of the Earth. Instead, it contributes to the overall heat exchange process, facilitating the movement of heat energy away from the Earth's surface and into the atmosphere and space." Consequently, the warming of the atmosphere from CO_2 results in a cooling of the ocean by radiation, not reduced cooling of the ocean.

Evaporation is a Powerful Mechanism of Removing Heat from the Ocean

Evaporation, or latent heat is the largest pathway for heat exchange from the oceans to the atmosphere. Globally, evaporation representants an estimated 52% of heat transfer (NASA, "Surface Energy Budget," January 14, 2009) away from the Earth's surface. This would be even greater over the oceans, since more evaporation occurs over the oceans than on land. Heat captured in evaporation is carried high into the atmosphere in water vapor. The heat is not released until the water vapor condenses high in the troposphere, where the latent heat from the oceans is transferred to the atmosphere. Evaporation is driven by heating the ocean surface, therefore the warming of the atmosphere by CO_2 radiative forcing only enhances the cooling of the oceans from evaporation.

Evaporation is a powerful mechanism of removing heat from the ocean surface and such heat is transferred to the atmosphere. Since the average Absorbed Solar Radiation at the Earth's surface, or ASR, including cloud cover is 240W/m^2 and 53% of this energy is transferred out of the oceans by evaporation, this represents 240 x 0.53 or 127 W/m^2. This can be verified by

calculating evaporation from the oceans. The latent heat of evaporation for water is 2,260 joules per gram, so 2,260 joules of heat are absorbed to convert one gram of liquid water into vapor from the ocean surface. According to ChatGPT, "As a rough estimate, the average global evaporation rate for the world's oceans is generally considered to be in the range of approximately 1 to 8 millimeters per day. Using 4.5 millimeters as an average within this range could serve as a rough approximation." In one square meter of water, the surface depth of 4.5 millimeters includes 4,500 cubic centimeters of water or 4,500 grams. Therefore, as a general average 118 watts of heat is absorbed through evaporation in each square meter of ocean surface every day. This is close to the 127 W/m2 figure representing 53% of the ASR. To put this into perspective, it would require 3 watts per square meter of radiation forcing from CO_2 to increase atmospheric temperature by about 0.8C, and this would take over 150 years of emissions to achieve, at our current level of fossil fuel use (see Chapter 8). By contrast, it would take approximately 36.6 minutes to remove the equivalent energy of 3 watts per square meter from the ocean's surface through evaporation (see Table 1).

Table 1. Power of the Latent Heat of Evaporation of Ocean Water	
Latent Heat of Evaporation	*2,260 joules per gram of water*
Average Global Ocean Evaporation Rate	*4.5 milliliters or 0.45 centimeters per day*
Average Global Evaporation per m^2	*1 m^2 = 10,000 cm^2 x 0.45 cm^2 = 4,500 cm^2 or 4,500 grams*
Joules of Heat Absorbed per day per m^2	*4,500 g x 2,260 joules/g = 10,170,000 joules*
Watts absorbed per day per m^2	*10,170,000 joules/24 hrs./60 min/60 sec. = 118 W/m^2*
Joules in 3 W/m^2	*3 W/m^2 x 24 hrs. x 60 min. x 60 sec. = 259,200 joules*
Time for evaporation to absorb 3 W/m^2	*259,200 joules/118 watts = 2,197 sec./60 = 36.6 minutes*

Atmospheric Conduction and Convection are Weak Mechanisms for Transferring Heat Out of the Oceans

Globally the transfer of heat from convection is estimated to be only 11% (see NASA, "Surface Energy Budget," January 14, 2009). 11% of ASR would only be 26 W/m^2, which pales in comparison to the 213 W/m^2 of heat (127 evaporation + 86 radiation) removed from the oceans from evaporation and radiation. Heat transfer from conduction is insignificant. Conduction is the transfer of heat between two touching objects. The conduction of heat from the atmosphere is extremely poor because the thermal conductivity of air is very low. The thermal conductivity of silver is 420 k(Q/M_0C), water is 0.60, wood is 0.12, glass wool, used as insulative batting in homes and buildings, is 0.040, and air is 0.023 (see https://phys.libretexts.org/Bookshelves/University_Physics/Book%3A_University_Physics_(OpenStax)/Book%3A_University_Physics_II_-_Thermodynamics_Electricity_and_Magnetism_(OpenStax)/01%3A_Temperature_and_Heat/1.07%3A_Mechanisms_of_Heat_Transfer). Any small heat transfer by conduction only warms the ocean surface, so it is lost to evaporation.

Convection is from the movement of air which carries heat. Wind makes convection a potent means of transferring heat in the atmosphere, but winds are generally not effective at transferring heat to the oceans. The problem with heat transfer from the air to the ocean by wind convection is that it impacts only the top surface of the ocean, so it results in increased evaporation, which further cools the oceans. Warm winds over the ocean enhance evaporation

since wind carries away the water vapor molecules that evaporate from the immediate surface, preventing them from saturating the humidity of the air immediately above the water. The constant replacement of dryer air above the surface greatly enhances the evaporation process which can lead to a net cooling effect. This is why a fan will dry a wet object so quickly. Cooling from evaporation is why an evaporative cooler, also known as a swamp cooler, can cool a room as the water on the damp pads evaporates and absorbs heat from the hotter air from outside as it passes over the wet pads. Despite blowing hot air over the wet pads, the net impact is to cool the room as evaporation absorbs more heat than is added from the hot blowing air. Warm winds have the same net cooling impact over the oceans and removes heat from the surface of the ocean by enhancing evaporation.

Measurements Confirm CO_2 Does not Slow the Cooling of the Oceans

The atmosphere can only transfer heat to the oceans by radiation, convection, and conduction. CO_2 radiation, conduction, and wind convection all transfer heat only at the top surface of the ocean and they do not penetrate deep into the seas. **Since ocean heating from the atmosphere is limited to the top surface of the water, such heating results in evaporation. Evaporation absorbs heat from the ocean surface which has a net effect of cooling of the surface of the water. Therefore, CO_2 warming of the atmosphere does not result in slowing the cooling of the ocean, it enhances the cooling by increasing evaporation.**

Radiative forcing from CO_2 can only effectively absorb and emit heat in the 13-to-17 micron infrared spectrum and this limited spectrum is almost entirely absorbed in the top 100 microns of the ocean surface, so such heating is lost to evaporation.

Convection by wind blowing over the ocean greatly increases evaporation, so this heat transfer is also lost to evaporation.

Conduction of heat from the atmosphere to the oceans is insignificant since air is a very poor conductor of heat. The small amount of heat transferred by conduction can only heat the surface of the ocean, so conduction heat is lost to evaporation.

This fact can be tested from observations. If a warming atmosphere slowed cooling of the ocean from CO_2 the net impact of evaporation, radiation, conduction, and wind convection, would be to warm the surface skin of the ocean. In such a case, the surface skin temperature of the ocean would be warmer than the temperature just below the surface. If the temperature of the surface skin of the oceans is cooler than just below the surface, this would indicate the impact of evaporation more than offsets any heat of the ocean surface from CO_2 radiation, convection, and conduction. If atmospheric warming enhanced net cooling of the ocean surface skin from evaporation, the cooling of the surface skin would be even greater during the day when atmospheric temperatures are higher.

Measurements of the thin top layer of the ocean, known as the “Sea Skin” confirm the net cooling of the ocean surface, as expected, from evaporation. Ocean Sea Skin measurements show the water surface is 0.1C to 0.6C colder than the water below the skin. At night, the Sea Skin is colder in the first 20 microns of the ocean. In daytime, the Sea Skin is colder in up to the

first 1 mm layer of the ocean and the temperature cooling is more than twice as large as at night. The Sea Skin is not as cold in areas of high humidity (see P.J. Minnett, et al, "Half a century of satellite remote sensing of sea-surface temperature," Remote Sensing of Environment, Volume 233, November 2019). Evaporation rates are lower in high humidity. Because this layer is colder, and is impacted by humidity, this confirms the colder Sea Skin temperature is most likely the net impact of evaporation. The fact that daytime Sea Skin temperatures are even cooler and deeper than at night confirms the net impact of a warmer atmosphere is evaporation. Thus, the net impact of a warming atmosphere is increased evaporation on the ocean surface, which cools the ocean. Increased temperatures in the atmosphere also allow the atmosphere to hold more moisture, which also aids evaporation of the ocean surface. **Increased emissions of CO_2 warm the atmosphere, but they do not warm the oceans.**

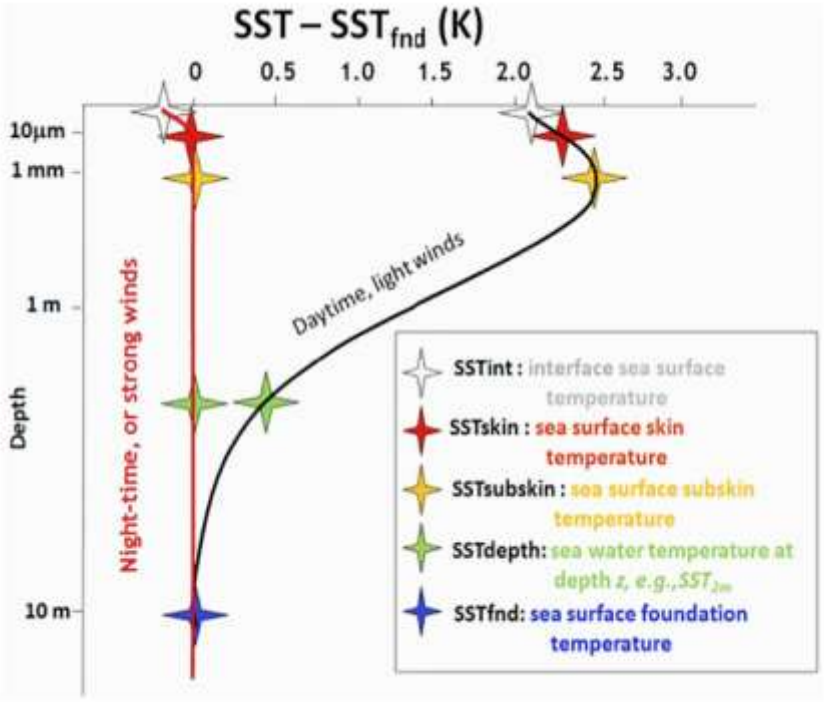

Fig. 2. Near-surface oceanic temperature gradients. From Minnett and Kaiser-Weiss (2012).

Figure 25 – Sea Skin Temperature (SST) *– The top thin layer of the ocean is known as the Sea Skin. Measurements confirm the Sea Skin temperature is generally colder than water just below the surface. As seen in the chart above, at night the Sea Skin layer is colder in the first 10 microns from the surface and the Sea Skin temperature in the day is colder in the first millimeter of surface waters. Measurements also show the Sea Skin is not as cold in areas of high humidity. Since evaporation cools the surface of the ocean and evaporation is reduced as humidity increases, these measurements seem to confirm net impact of global atmospheric warming is enhanced evaporation more cooling of the oceans. Since any influence the atmosphere has on ocean temperatures would be revealed at the surface where the atmosphere touches the oceans, the Sea Skin temperature measurements confirm that the oceans are not warmed by atmospheric CO_2 greenhouse gas radiative forcing as many would have you think. Neither does CO_2 greenhouse gas warming slow the release of heat from the oceans. Source: P.J. Minnett, et al, "Half a century of satellite remote sensing of sea-surface temperature, Remote Sensing of Environment, Volume 233, November 2019.*

Further confirmation of the fact that CO_2 warming of the atmosphere does not slow the cooling of the ocean is found through Sea Skin measurements in the Tropics, where the atmosphere is warmer than the ocean. According to ChatGPT, "Generally, the sea surface skin is most often cooler, than the water below it in the Tropics due to factors like evaporation and heat exchange with the atmosphere." ChatGPT also states, "In General, temperatures in the Tropics are warmer in the atmosphere than the ocean at sea level." Since the Sea Skin temperature is cooler than below the surface of the ocean, the impact of greenhouse gas warming of the atmosphere is to accelerate the release of heat from the oceans rather than slow the escape of heat.

On a Volume Basis, Oceans Store 4,200 Times More Heat than the Atmosphere.

If you fill a bathtub with warm water and close the bathroom door, the air temperature in the bathroom increases rapidly. However, if you fill a bathtub with cool water and heat air in the room, the temperature of the water in the bathtub hardly changes. On a volume basis, the heat capacity of water is about 4,200 times more than the heat capacity of air. If one square meter of air at 40C is next to one square meter of water at 20C the heat transfer to equilibrium results in the air cooling to 20.005C and the water warming to a temperature of 20.005C, which takes several hours to complete. In contrast, the sun will heat one square meter of water by the same amount of 0.005C in 20 seconds. (see "What Warms the Oceans," Markus Ott, tps://youtu.be/m9PCgCGo17w?si=aQi-y6xbfyAb6Mi4)

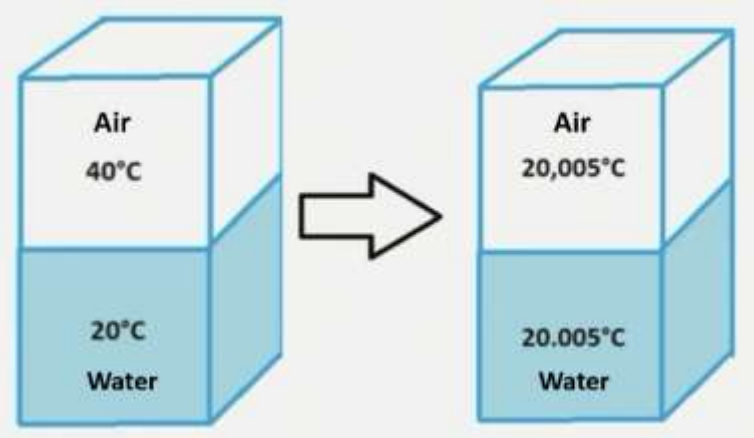

Figure 26 – Air Temperature has Little Impact on Ocean Temperature. *Oceans significantly impact the climate, but the atmosphere has an insignificant influence on ocean temperatures. If you place one square meter of air at 40C next to one square meter of water at 20C, after several hours, the air and water will come to equilibrium, both at a temperature of 20.005C, or a net change in water temperature of only 0.005C. By contrast, the sun will heat one square meter of water by 0.005C in only 20 seconds. Source: Markus Ott, "What Warms the Oceans," Tom Nelson Podcast, March 19, 2023.*
Heating the oceans by conduction and atmospheric convection is inefficient as it only warms the surface of the ocean, whereas sunlight penetrates up to 1,000 meters in the ocean and is effective at heating the water. CO_2 radiative forcing has even less heat transfer than air conduction and convection to water since it primarily radiates heat in the 13-to-17-micron infrared spectrum, which can only penetrate a few microns into water. Consequently, heating the oceans from atmospheric conduction, atmospheric convection, and CO_2 radiative forcing is ineffective since heat in the surface layer of ocean is returned

into the atmosphere through evaporation, which evaporation is accelerated with wind. Solar radiation is by far the primary driver of ocean temperature, this is an undisputed fact.

Today, the global average ocean temperature is 17C and air at sea level is 15C. The amount of heat you need to transfer from one cubic meter of water at 17C to one cubic meter of air at 15C would be 0.00024C to warm the air by 1C to 16C. This would lower the temperature in one cubic meter of water to 16.99976C. If you were to heat a column of air 1 kilometer high at 15C to 16C with the heat in one cubic meter of water at 17C, you would need to transfer only 0.24C of heat from this one cubic meter of water or lower the temperature of the cubic meter of water to 16.76C. The oceans store a tremendous amount of heat and transfer heat to the atmosphere through evaporation and convection. The power of CO_2 to heat the atmosphere pales in comparison to the power of the oceans to impact climate. **Small variations in the transfer of heat from the oceans to the atmosphere can easily overwhelm the small contribution of CO_2 warming of the atmosphere.**

Direct heating of the oceans by the sun's energy is the primary driver of ocean warming. The small amount of heat transferred from the atmosphere to the oceans is greatly surpassed by the vast amount of heat that is conveyed to the oceans by the sun. Therefore, an increase or decrease in the solar heating of the oceans can have a major effect on the climate. **The oceans cover 71% of the Earth's surface and cloud cover, which plays a leading role in the amount of solar radiation that reaches and penetrates the oceans, is a major climate driver**. Low cloud-cover shades the Earth and reflects sunlight back out to space, due to its high albedo of 0.7 to 0.9. Therefore, on a cloudy day only 10% to 30% of total solar radiation reaches the oceans compared to the solar radiation reaching the ocean on a cloudless day. On average, the sun delivers 1361 watts per square meter to the Earth. Without clouds, 277 watts per square meter makes it to the Earth's surface each day. Cloud cover can block 194 to 249 watts per square meter of solar heat from heating the oceans. This is a massive amount as compared to the 3 watts per square meter of radiative forcing required to increase atmospheric temperature by 1C from increased CO_2 emissions. This is why Nobel Laureate John Clausen said the radiative forcing from CO_2 is nearly two orders of magnitude (10^2 or 100-fold) smaller than low cloud cover.

Arctic Amplification and Its Implications

Modern global atmospheric warming is not global, it is primarily warming of the Northern Hemisphere and most specifically, the Arctic. Between 1978 and 2022, UAH satellites measured 1.1C warming at the North Pole, 0.84C warming in the Northern Extra Tropics, 0.53C in the Tropics, 0.44C in the Southern Hemisphere Extra Tropics, and 0.04C at the South Pole (see Figure 27). Since 1978, the TRIOS-N satellite measures an even greater disparity with the Arctic warming by about 1.5C and virtually no warming measured in Antarctica. Most atmospheric global warming has occurred in the Arctic. This fact is well-known and is referred to as Arctic Amplification. This has significant consequences. Climate alarmists continually point to scarry scenarios of sea level rise due to the melting of Antarctica ice sheets. However, the actual data does not support such a claim. Despite periods of decline, "as a whole the Antarctica sea ice continues to have positive overall trends in yearly average ice extent." (see Parkinson, et al, "A 40-y record reveals gradual Antarctica sea ice increases followed by decreases at rates far exceeding the rates seen in the Arctic," PNAS.org., July 1, 2019).

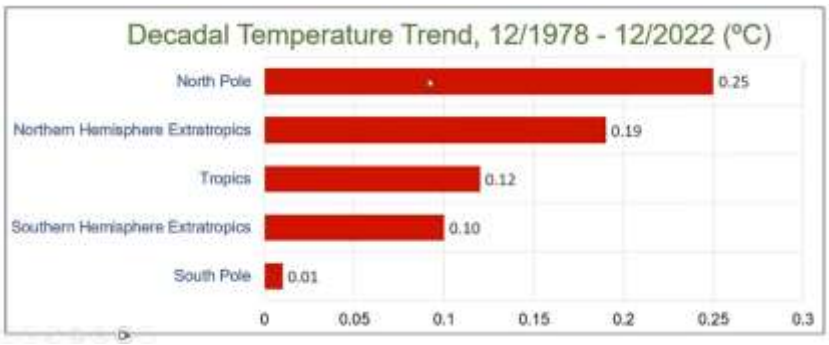

Figure 27 – Warming Is Mostly in the Arctic and Northern Latitudes *– UAH Satellite temperature records from 1978 through 2022 reveal temperatures have increased much faster in northern latitudes, especially in the Arctic. Source: Dr. Roy Spencer, University of Alabama Huntsville as presented by Arthur Viterito, Tom Nelson Podcast, November 28, 2023.*

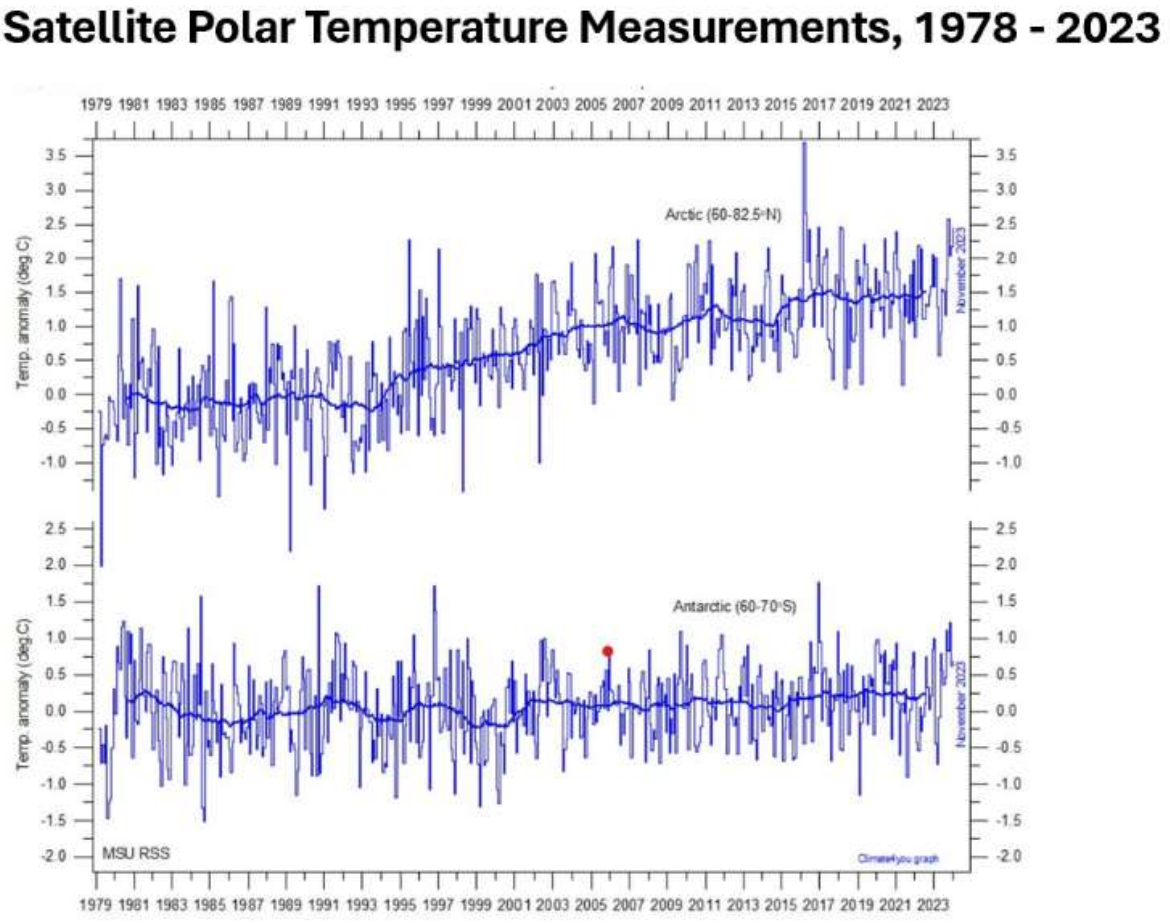

Figure 28 – Polar Warming 1978 to 2023 *– Known as Arctic Amplification, the Arctic is warming faster than Antarctica. NOAA TRIOS-N Satellite temperature measurements mirror UAH Satellite temperature records from 1978 through 2022. During this period, NOAA TRIOS-N Satellites show warming in the Arctic of about 1.5C and virtually no warming in Antarctica. Since CO_2 concentrations are similar in the Arctic and Antarctica, CO_2 warming cannot explain Arctic Amplification. Data interpreted by Dr. Carl Meise of the Remote Sensing System, chart from Climate4you.com.*

CO_2 radiative forcing alone cannot explain why the northern latitudes are warming faster than the southern latitudes since CO_2 readily disperses evenly throughout the atmosphere. The concentration of CO_2 is on average similar between the North Pole and the South Pole, usually in the range of 400 to 420 ppm. Yet the North Pole is warming at a rate that is 25 times faster than the South Pole. This would not be the case if CO_2 were the only driver of global warming. This temperature discrepancy is explained by the transport of heat to northern latitudes in the ocean currents and the release of this heat into the atmosphere.

Other theories of Arctic warming include climate feedbacks, such as: 1) the loss of albedo as ice melts which reflects less radiation back out to space, 2) weakening of the polar vortex, due to warming, which transports warm air masses to the Arctic, and 3) the release of the greenhouse gas methane as permafrost melts. However, observational measurements of these feedbacks do not explain why the Arctic has warmed 25x more than Antarctica:

> **Loss of Albedo as Ice Melts**: A study published in the Journal of Climate by Brian J. Soden and Isaac M. Held examines impact on temperature of the changes to surface albedo as ice caps melt. They determined that the feedback was 0.26 W/m^2-K for a 1C increase in temperature (see Chapter 9). Since the global temperature has only increased by 0.75C since 1978, the feedback from ice melt would be 0.75 x 0.26 or 0.20 watts per square meter, which is a change of temperature of about 0.07C, not even a noticeable fraction of the 1.1C more warming in the Arctic over Antarctica between 1978 to 2022.
>
> **Weakening of the Polar Vortex:** The principles of the polar vortex for the Arctic and Antarctica are similar so a weakened polar vortex would impact temperatures in both the Arctic and Antarctica. The Antarctic Polar Vortex is more stable than the Artic Polar Vortex, but this is a result of Arctic warming, not the cause of Arctic warming. When the temperature gradient between the poles and the lower latitudes moderates, the polar vortex is weakened. Since warming from CO_2 would warm both poles fairly evenly, the polar vortex over the Arctic and Antarctica would be virtually the same, except for some small variations due to geography. The weaker polar vortex in the Arctic is caused by the ocean warming of the Arctic. This weak Arctic polar vortex may amplify warming, but it is certainly not the primary cause of the warming and cannot account for the 25-fold temperature increase in the Arctic over Antarctica.
>
> **Release of Methane from Permafrost:** According to Chat GPT: "At the North Pole, average methane concentrations have been observed to range from around 1860 to 1900 ppb. At the South Pole, methane concentrations typically range from about 1650 to 1750 ppb". Methane contributes about 1/10 of the greenhouse gas warming as compared to CO_2, (see Chapter 8). The difference of methane concentrations between the poles of 110 to 150 parts per billion of methane is only 8% of $1/10^{th}$ or about 0.006C (see Chapter 8 for calculating radiative forcing of methane). A temperature increase of 0.006C does not explain hardly any temperature difference between the North Pole and the South Pole and certainly does not explain even a small fraction of the 1.1C greater warming at the North Pole.

These three feedbacks cannot explain why the Arctic is warming 25 times faster than Antarctica. As will be covered below, an examination of the facts supports the theory that the primary driver of Arctic Amplification is from ocean heat transfer, not CO_2. Oceans are primarily heated by the sun, so the rapid

warming of the Arctic can be explained today and in past climate cycles from solar heating of the oceans, which is significantly impacted by cloud cover.

The Atmosphere and Ocean Currents Move Heat to the Polar Regions

Since 1978, global warming, as measured by UAH satellites has been 0.25C per decade in the Arctic, 0.12 in the Tropics, and 0.1 in Antarctica. Understanding atmospheric and oceanic heat transfer explains why the Arctic has warmed more than twice as fast as the Tropics and much faster than southern latitudes over the past 44 years.

The sun shines nearly directly on the equator and the Tropics region from 30 degrees north to 30 degrees south latitude. Due to the curvature of the Earth, other regions of the world receive less direct sunlight. Therefore, the Tropics are the region of most heating of the Earth. Since nearly 77% of the Tropics is covered by the oceans, most of this solar energy is absorbed into the oceans. In contrast, the polar regions receive significantly less solar energy due to their higher latitudes, oblique angle of sunlight, and high reflective albedo of snow and ice cover. Because of the angle of the sun in the polar regions, light is easily reflected off into space. Yet the Arctic is warming faster than the Tropics. This can only be explained by the transport of heat from the Tropics to the Arctic. Satellite observations confirm that the Tropics absorb more solar heat than they radiate to space at the top of the troposphere. Therefore, the Tropics would continue to heat if they do not move the heat out to other areas of the Earth. The Arctic has warmed twice as fast as the Tropics over the past 40 years. This is explained by the heat transferred from the Tropics to the Polar regions, particularly the Arctic.

There are two primary modes of moving heat from the Tropics to the Polar regions: 1) atmospheric circulations, and 2) ocean currents.

Atmospheric Circulation - The accepted model of meridional atmospheric heat transfer to the Polar regions from the Tropics is the **Hadley, Ferris, and Polar Cells**. Both the Northern and Southern Hemispheres have these alternating (clockwise and counterclockwise) circulation loops. Between the northern and southern Hadley cells is the **Intertropical Convergence Zone (ITCZ)**, a location of intense rain. The movement of the ITCZ can impact monsoon rains. The Northern Hadley Cell is a clockwise circulation pattern, which take heat near the equator and at the ITCZ and lifts it high into the top of the troposphere (12 to 15 kilometers). This creates a strong wind that carries the heat northward high in the troposphere. As the wind cools, it drops back to the Earth at about 30 degrees latitude north. The Southern Hadley Cell is a counterclockwise mirror of the Northern Hadley Cell extending from about the ITCZ to about 30 degrees south. Deserts are often found at the termination of the Hadley Cells, around 30 degrees latitude north and south of the equator. Such deserts include the Saraha Desert in Africa, the Thar Desert in Asia, the Sonoran Desert in North America, the Great Victoria Desert in Australia, the Kalahari Desert in southern Africa, and the Atacama Desert in South America.

At about 30 degrees latitude north, the Northern Ferris Cell begins as a counterclockwise circulation pattern which blows the heat north along the surface until it is taken up into the troposphere at about 60 degrees latitude north. 60 degrees latitude north is the edge of the Arctic Polar region. The Southern Ferris Cell is a clockwise mirror of the Northern Ferris cell spanning from about 30 degrees to 60 degrees latitude south. At the Polar regions, the clockwise Northern Polar Cell and the counterclockwise Southern Polar Cell take heat back up into the Troposphere, where much of the heat is

radiated out to space. The radiation of heat in the Polar regions is how the Earth Radiation Budget is maintained as excess heat from the Tropics is radiated to space from the Polar regions.

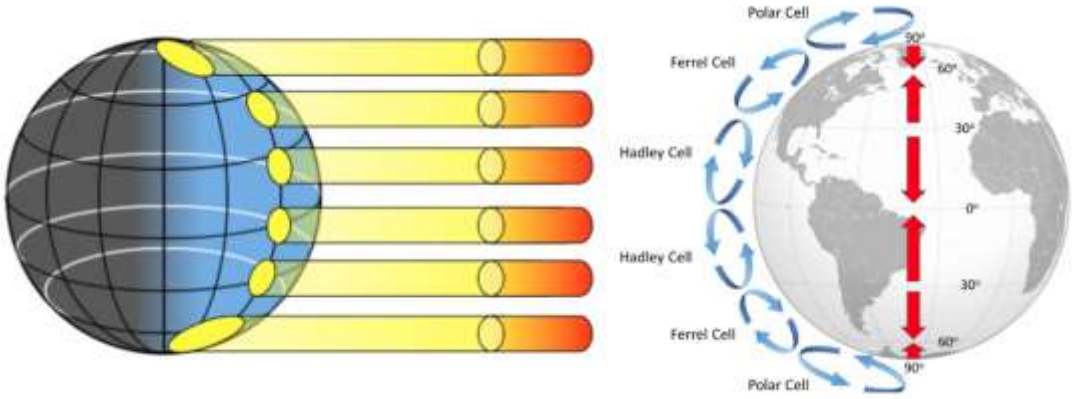

Figure 29 – Heat from the Sun and Movement of Heat in the Atmosphere. *On the left, depicted is the incoming sunlight to the Earth. Because of the curvature of the Earth, the Tropics from 30 degrees north to 30 degrees south receive the greatest amount of solar energy per area. The Tropics send heat to the poles through a series of alternating atmospheric circulation loops (clockwise and counterclockwise). On the right, is depicted the Hadley Cells, Ferrel Cells, and Polar Cells which transport heat from the Tropics to the Poles.*

The Earth's circumference is largest at the equator, therefore the Earth spins faster at the equator than in regions further north or south of the equator. The Earth spins at 1600 kilometers per hour at the equator, 1400 kilometers per hour at 30 degrees latitude and 800 kilometers per hour at 60 degrees latitude. Because of this differential in speed, winds of the Hadley, Ferris, and Polar Cells are not true north and true south. This differential in speed creates the Coriolis Effect which moves the Northern Hadley and North Ferris Cell winds northeast and the South Hadley and South Ferris winds southwest. The region between the Hadley Cells and Ferris Cells is known as the trade winds which blow from west to east in the northern hemisphere and east to west in the southern hemisphere.

The existence of the Hadley Cells, Ferrel Cells, and Polar Cells has been confirmed in observations. However, the atmosphere is a dynamic system and random eddies, seasonal influences, and other impacts constantly move the locations and intensity of these Cells and the ITCZ. Paleoclimate reconstructions of prior eras have shown the movement of deserts and wetland areas, which can be explained by the movement of the ITCZ. Javier Vinos in his book Climate of the Past, Present and Future illustrates the movement of the ITCZ, accounting for different climates in the Holocene Climatic Optimum and Neoglacial times.

Cooling of air in the high troposphere and the movement of the Hadley Cell winds on the surface back to the equator limit the amount of heat transferred to the poles, but observations have confirmed about 10% of the heat in Hadley Cells is transported towards the poles. Latent heat transferred to the troposphere through evaporation and returning the latent heat to the Earth through condensation and rain is a major component of the Hadley Cells. Therefore, storms become an important mechanism in the transfer of heat in the atmosphere. Since Ferris Cells have surface winds that blow north in the

Northern Hemisphere and south in the Southern Hemisphere, they receive additional heat from the oceans, which is transported to the poles.

According to Professor Dennis Hartman of the Department of Atmospheric Science at the University of Washington, the Southern Hadley cell is stronger on average than its northern counterpart because it extends slightly beyond the equator into the Northern Hemisphere (see Dennis Hartman, Global Physical Climatology, Second Edition, 2016, Amsterdam, Elsevier, ISBN 978-0-12-328531-7). According to "Hadley Cell, Energetics and Transport," Wikipedia, "This results in a strong Southern Hemisphere Hadley cell relative to its northern counterpart which leads to a small net energy transport from the northern to the southern hemisphere; as a result, the transport of energy at the equator is directed southward on average, with an annual net transport of around 0.1 PW." The Hadley Cells move more heat south than north. However, more heating is observed in the Northern Hemisphere, which can be explained by additional northward flow of heat in ocean currents.

Ocean Currents - The oceanic meridional heat transfer from the Tropics to the Polar regions is from ocean currents that move heated ocean water. The primary heat moving currents include the so-called **Thermohaline** circulation, the **Gulf Stream** circulation, and the **Kuroshio** circulation. According to Encyclopedia Britannica's description of the Thermohaline circulation, "A significant characteristic of the large-scale North Atlantic circulation is the poleward transport of heat. Heat is transferred in a northward direction through the North Atlantic. This heat is absorbed by the tropical waters of the Pacific and Indian oceans as well as of the Atlantic and is then transferred to the high latitudes, where it is finally given up to the atmosphere." The term "Thermohaline" is a misnomer. It was originally thought that this current was pushed by the sinking of heavier colder water (thermo) and saltier water caused by evaporation (haline). Emeritus Professor of Physical Oceanography at MIT, Carl Wunsch has published a paper which reveal the thermohaline mechanism would not work and proposes wind and tidal forces move the currents (see Carl Wunsch, "What is the Thermohaline Circulation?" Science, Vol 298, 8 November 2002, pgs. 1179-1181).

Thermohaline Circulation is sometimes referred to as **the ocean conveyor belt** as it moves ocean water around the globe. A recent, more popular, and more appropriate name is the **Meridional Overturning Circulation (MOC)** since it does not limit the ocean current to temperature and salinity mechanisms that may not be a part of the current. Heat from the MOC moves northward to northern latitudes of the Atlantic and Pacific. The heat transfer is most pronounced in the oceans off Greenland and Europe, but the MOC current also warms the North Pacific Ocean along the coast of North America. The warming in the North Atlantic is further enhanced by the Gulf Stream Ocean Circulation, which sends warm waters from the Caribbean northeasterly along the North American coast to the seas near Greenland and Europe. The North Pacific warming is enhanced by the Kuroshio Ocean Circulation, which sends warm waters from the Philippines northwest past the coast of Japan and over to Alaska.

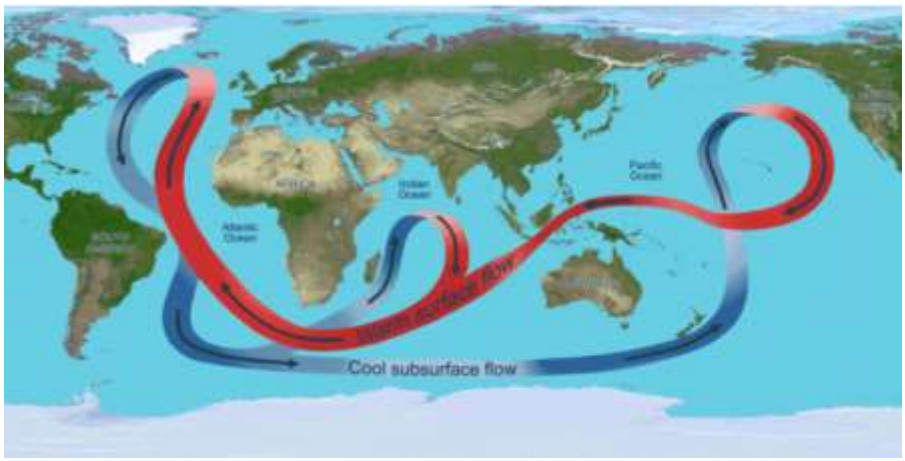

Figure 30 – The Meridional Overturning Circulation or MOC (aka, Thermohaline Ocean Circulation) Moves Heat to Northern Latitudes *– The currents of the Meridional Overturning Circulation transport sea water, heated by the sun, to northern latitudes. The transport of heat to the oceans off Greenland and Europe is most pronounced, but the Northern Pacific Ocean along the west coast is also heated by the MOC. The heating of the North Atlantic is enhanced by the Gulf Stream Circulation and heating in the North Pacific is enhanced by the Kuroshio Circulation. Because of these ocean currents, global warming from solar heating of the oceans would be more extreme in the Northern Hemisphere, which is exactly what is found in temperature records over the past 44 years. If CO_2 were the only driver of temperature, warming would be more uniform around the globe. Source of the Meridional Overturning Circulation Diagram: NASA.*

The potential change in the Earth's Energy Balance from the Meridional heat transport is worth noting. Because more heat is absorbed in the Tropics than is radiated out to space, the energy balance can only be maintained if the Meridional Heat Transport moves enough heat to be radiated out to space in the Polar regions. If this heat transport is disrupted, the Earth's Energy Balance could change, and this would result in a change in temperature. Andy May has pointed out that "since moving energy around does not alter the total energy within the system. This fact has caused many climate scientists to believe that changes in meridional transport cannot cause climate change, probably the most fundamental mistake of modern consensus climatology" (see Andy May, "Meridional Transport, the most fundamental climate variable., October 2022 https://andymaypetrophysicist.com/2022/10/24/meridional-transport-the-most-fundamental-climate-variable/. Also see the Tom Nelson Podcast #34 #34 - Andy May: "CO2-driven climate models of the IPCC are inadequate" (youtube.com)).

Rui Xin Huang from the Woods Hole Oceanographic Institution has conducted a detailed study of the atmospheric and oceanic transfer of heat from the Tropics to the Polar regions by latitude (see Rui Xin Huang, "Ocean, Energy Flows," Encyclopedia of Energy, Volume 4, 2004, Elsevier, Inc., pgs. 497-509). The chart below summarizes Huang's findings which include 1) The largest transport of heat from the Tropics to the Poles is via the atmosphere, and 2) Ocean heat transfer is higher in the Northern Hemisphere than the Southern Hemisphere. Due to the ITCZ being slightly in the Northern Hemisphere, the heat at the equator initially moves more heat south than north, but as heat from the oceans is released into the atmosphere, the greater ocean heat in the Northern Hemisphere allows the atmosphere in the Northern Hemisphere to overtake the heat flux of the Southern Hemisphere. Although the heat flux from the oceans is less than from the atmosphere, ocean heat makes a real

difference. According to MIT Emeritus Professor Carl Wunsch, the oceanic heat transport "would correspond to an atmospheric radiative forcing of about 9 W m^{-2}, larger than what is expected from doubled atmospheric CO_2."

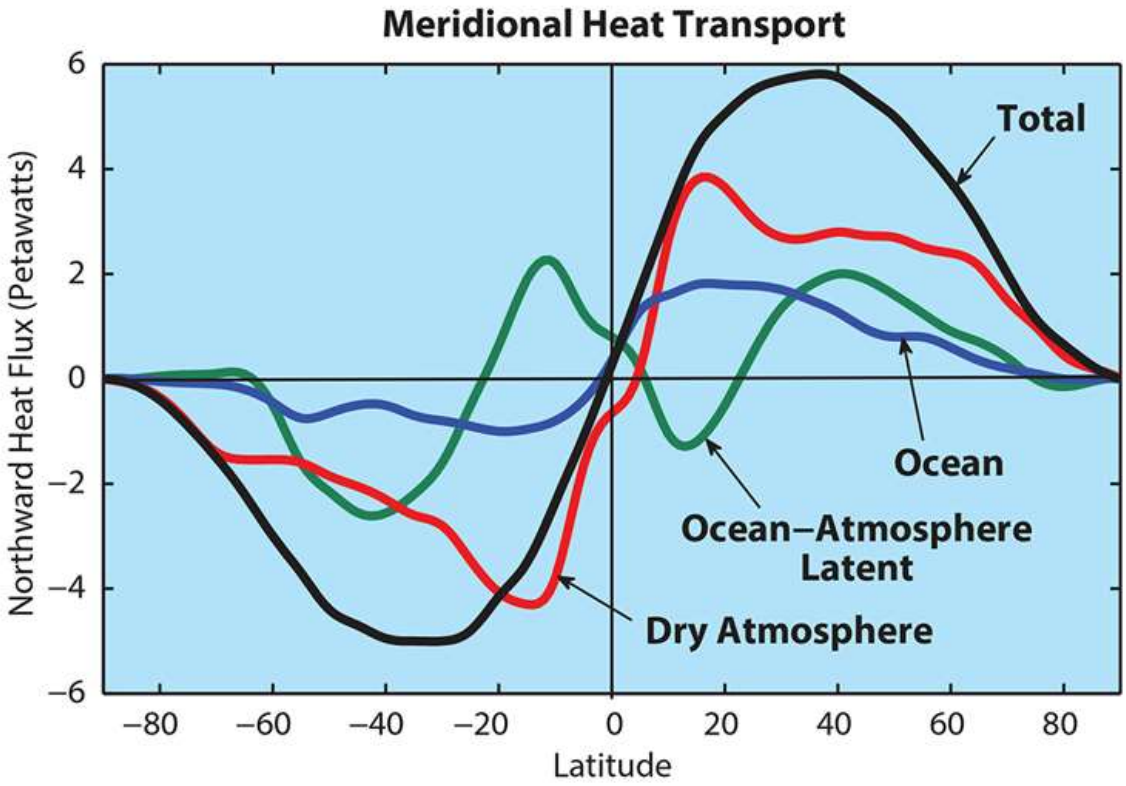

Figure 31 – Meridional Heat Transport from the Tropics to the Polar Regions. *A study of the meridional heat transport from the Tropics to the Polar regions by Rui Xian Huang reveals: 1) most of the warming is from the atmosphere, and 2) the oceanic heat flux is higher in the Northern Hemisphere. As heat is released from the oceans in the Northern Hemisphere the atmosphere becomes warmer, which explains why the Arctic has warmed faster than the rest of the globe. Source: Chart by Andy May from Rui Xin Huang, "Ocean, Energy Flows," Encyclopedia of Energy, Volume 4, 2004.*

Theoretically, atmospheric heat flux, without oceanic flux, would see similar warming of the Northen and Southern Hemispheres because the Hadley and Ferris Cells are similar in both regions. In fact, the Southern Hemisphere might be slightly warmer, since the Southern Hadley Cell is stronger than its northern counterpart. Extra heat flux in the oceans of the Northern Hemisphere explains why the Arctic has warmed faster than the rest of the world.

Some have speculated that the greater land area in the Northern Hemisphere is responsible for Arctic Amplification, since land heats and cools faster than the oceans. This does not, however, seem like a plausible explanation. This may explain some of the warming of the Arctic, but such warming seems to pale in comparison to the influence of the North Atlantic warm currents. London, Moscow, Krasnoyarsk, Siberia, and Winnipeg, Canada are on similar latitudes, yet the climate in London, in the North Atlantic is considerably warmer than land-locked Moscow, Krasnoyarsk or Winnipeg. And although it is true that any location near the water will have more moderate temperatures, the contrast in average

temperatures between London and these land locked cities is extreme. The average annual temperature in London is around 50F (10C), Moscow is 39F (4C), Winnipeg is 28F (-2C), and Krasnoyarsk is 21F (-6C). Only the warm North Atlantic current near London can explain these stark temperature contrasts.

José Peixoto and Abraham Oort propose in their book Physics of Climate that the Southern Ocean surrounds Antarctica which forms a substantial barrier to meridional transport of heat. This could explain why Antarctica is colder, but it does not explain why the Northern Extra Tropics is warming faster than the Southern Extra Tropics (see Figure 27). Once again, the ocean heat transfer to the north explains this discrepancy. Because winds in the Northern Hemisphere from the Ferris Cell blow in a northeast direction, it is not surprising that the greatest glacier melt in recent years has been in Greenland, Europe, and Alaska. These regions are northeast of the North Atlantic and North Pacific Ocean currents.

Cyclical Ocean Temperature Oscillations Impact Atmospheric Temperatures Over Years and Decades

Climate is not linear but cyclical. There are several important ocean cycles that must be considered in assessing climate change. In the short term there are changes in ocean temperatures which drive climate. El Niño and La Niña are the warm and cool phases of a recurring climate pattern across the tropical Pacific, known as the El Niño-Southern Oscillation (ENSO). El Niño and La Niña Ocean patterns occur in short bursts, usually lasting less than one year. Temperatures spike up during an El Niño and down during a La Niña. It is interesting to note that warm El Niños form during periods of low winds and cool La Niñas form during periods of high winds. High winds increase evaporation which cools the ocean surface while low winds result in less evaporative cooling. This may be an area warranting additional research. Several papers have shown that the majority of the atmospheric warming in the last few decades was due to ENSO spikes in ocean temperature, which drove atmospheric temperatures. According to physicist Max Derakhshani, since 1979, warming from ocean "ENSO events" accounts for 72% or more of the global temperature variation (see 269) HYPERLINK "https://www.youtube.com/watch?v=oo8lyL6lYQU"Maaneli HYPERLINK "https://www.youtube.com/watch?v=oo8lyL6lYQU" (Max) Derakhshani: ENSO Warming vs CO2 Warming | Tom Nelson Pod #89 - YouTube). According to Derakhashani, the combination of ENSO warming, along with modest warming from CO_2 radiative forcing, accounts for all the Earth's warming measured since 1979.

Longer and more significant cycles include the Atlantic Multidecadal Oscillation, or AMO, every 60 to 80 years. The AMO alternates between warm for 30 to 40 years, then cool for 30 to 40 years, completing the cycle back to warm, 60 to 80 years after the start of the previous warm period. Atmospheric temperature records follow this pattern. We had the heat waves of the end of the 19th century, then cooling up to 1910, then it was hot again during the 1930s and 1940s "Dustbowl," then cooling during "The Big Freeze" scare of the 1970s, shifting to warm again in the current warm period. The AMO warm cycle peaked in about 2010 and is expected to move into a cold phase in the 2030s (former NOAA meteorologist David Dilley places the start of the AMO cold phase in 2034).

During the warm AMO cycle of ocean temperatures in the 1930s and 1940s atmospheric temperatures throughout North America and Europe were high. In a paper by Joakim Kjellsson, et al they investigated European heat waves in the 20th Century. They found more heat waves in Europe between 1920 to 1950 and conclude this "may be related to the positive phase of the Atlantic Multidecadal Variation" (see the Smithsonian Astrophysical Observatory under NASA, April 2021, https://ui.adsabs.harvard.edu/abs/2021EGUGA..23.2582K/abstract). Many of the hottest temperatures on record in the United States and Canada remain those experienced in 1930s.

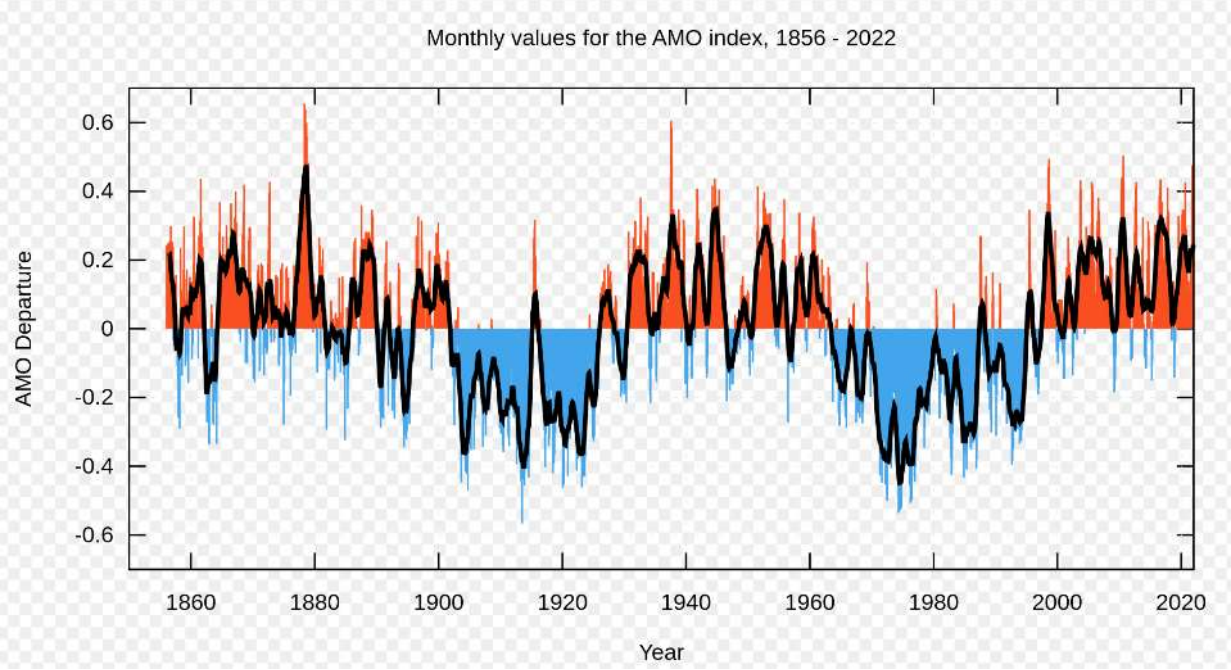

Figure 32 – Atlantic Multidecadal Oscillations (AMO) Match Recent Temperature Cycles. *The repeating observed temperature cycles of the Atlantic Multidecadal Oscillation match the atmospheric temperature swings from the heat waves at the end of the 19th century, the cold weather in 1910, the heat of the "Dustbowl" 1930s and 1940s and warm 1950s, "The Big Freeze" of the 1970s, and the current warm period. The AMO is expected to be in another cool phase starting in about 2030-2035. Source: Wikipedia.*

Often known as the Dustbowl due to the dry and dusty conditions of the Great Plains States in the 1930s and early 1940s. Many cite over-plowing, which led to soil erosion as the primary cause of the massive dust storms. Dry conditions were also experienced, and this seems counter to the historical record where warmer climates are generally more humid and result in more precipitation. However, the Dustbowl dry conditions were an extreme local event. Warm conditions were seen throughout North America, but the dry conditions were only experienced in the Great Plains states. Conditions in the Northeast, Southeast, and West Coast were unusually hot, but not dryer than usual. For example, on July 19, 1934, Cincinnati experienced a temperature of 99F combined with high humidity that made it feel like 110F. On July 20, the temperature increased to 105F. On July 21, the temperature reached 108.5F, the highest temperature ever recorded in Cincinnati. Temperatures of 100F or higher were experienced for 7 consecutive days. The high humidity made the heat more dangerous and as many as 150 people died from heat-related causes in Cincinnati during that week.

1936 was another unusually hot summer in the United States and Canada. Many temperatures soared to all-time highs with 12 states measuring 120F or higher. North Dakoda measured 121F on July 6, 1936, and Wisconsin recorded 114F on July 6, 1936. In New York City, the temperature reached 106F. By the end of the summer of 1936, 5,000 Americans and 1,100 Canadians died from heat-related causes. 23 of the 48 contiguous United States set records in the 1930s that remain records to this day. Many of the highest temperatures in Canada remain those recorded in the 1930s. Such temperatures remain record highs for seven of the thirteen providences of Canada, including 113F in Saskatchewan on July 5, 1937, 110F in Alberta on July 21, 1931, 108F in Ontario on July 11, 12, and 13, 1936, and 103F in New Brunswick on August 18, 1935.

Europe was also warm. A temperature of 119.3F was recorded in Catania, Italy on August 11, 1935, a record that has not been exceeded since in Italy. Seville, Spain recorded 116.6F on August 4, 1931 and 118.4F was recorded in Athens, Greece, records which have held for these two countries. Sweden recorded 101.8F in Ultuna on July 9, 1933, the hottest day ever recorded in Sweden to this day. Conqueyrac, France recorded 114.8 on August 12, 1930, Garmerdorf, Germany recorded 104.5F on July 27, 1935, and Uccles, Belgium recorded 101.8F on August 27, 1930.

There is a similar warming and cooling pattern in the Pacific Ocean known as the Pacific Decadal Oscillation, or PDO, which swings between cool and warm waters every 20 to 30 years. This cycle peaked in a warm period in about 2005 and is expected to move into the cold phase in the 2020s (former NOAA meteorologist David Dilley places the start of the cold phase of the PDO in 2024). If past correlations of the AMO and PDO with atmospheric temperatures continue as expected, we should start to see the beginning of a cooling trend as the cold periods of the AMO and PDO converge in the 2030s.

In a study by Dr. Markus Donat, et al, titled “Warm oceans caused hottest Dust Bowl years in 1934/1936” Dr. Donat and colleagues from the AERC Centre of Excellence for Climate System Science explored the causes of the severe heat in North America in 1934 and 1936. They revealed that unusually warm sea surface temperatures occurring at exactly the same time in two very specific locations were likely responsible for creating the record breaking heat” in 1934 and 1936 (see https://www.sciencedaily.com/releases/2015/05/150504101248.htm). They site warm oceans in both the Atlantic and Pacific oceans. It is worth noting these warm oceans events occurred during the warm phase of the Atlantic Multidecadal Oscillation and warm phase of the Pacific Decadal Oscillation.

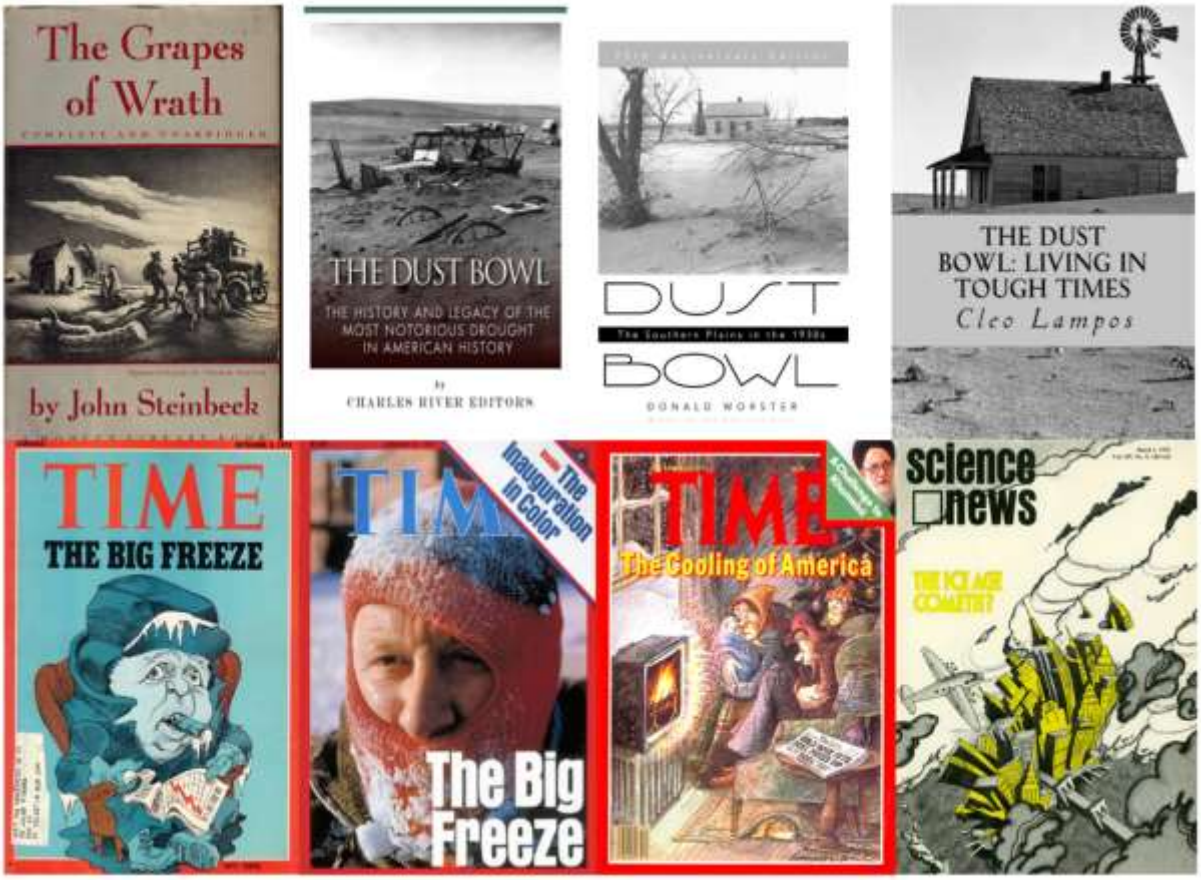

Figure 33 – Climate Cycles – The Dustbowl of the 1930s and The Big Freeze Scare of the 1970s. *The heatwaves and droughts of the 1930 "Dustbowl" are well documented. The book* <u>*The Grapes of Wrath*</u> *by John Steinbeck tells the story of countless numbers of farmers from the Midwest who saw their farms destroyed by heat, drought, and dust, moving to California in the 1930s and early 1940s to find a better life. In the 1970s a number of scientists cited a 30-year cooling trend between the 1940s to 1970s and predicted continued cooling which drove "The Big Freeze" scare. No less than three* <u>*Time*</u> *magazine covers, and one* <u>*Science News*</u> *cover were devoted to this topic in the 1970s. The fingerprint of these hot and cold climate cycles are clearly seen in the US heatwave index (Figure 7), US drought records (see Figure 9), and US wildfire index (Figure 10). The 1930s to1940s is the last period where the AMO and PDO hot periods converged. The 1970s is the last period when the AMO and PDO cold periods converged. We are currently in a period where the hot periods of the AMO and PDO have converged and as expected, we are currently experiencing global warming. Cold periods of the AMO and PDO will converge again after 2030.*

Oceans are not the source of the heat, but the carrier of the heat. Ocean heating is primarily from the sun, so the dominance of the oceans in warming the Earth points to the leading source of global warming as the sun, not anthropogenic greenhouse gases. Understanding the role the oceans and the sun plays in the climate provides clarity as to why we have had historical climate cycles in the past, including the Minoan Warm Period, cold Greek Dark Ages, Roman Warm Period, cold Dark Ages, Medieval Warm Period, Little Ice Age, and the Modern Warming, which match the millennial Eddy Solar Cycles (see Chapters 6 and 7).

Chapter 6 – Past Climate Change Cycles

Climate Change Cycles of the Medieval Warm Period and the Little Ice Age are Firmly Established

Climate alarmists repeatedly tell us current warming is unprecedented. This statement is not true. Hundreds of scientific studies have established that the Medieval Warm Period of 1,000 years ago was as warm or warmer than today, and the Little Ice Age 500 years ago saw temperatures plunge. Both the Medieval Warm Period and the Little Ice Age were included in the IPCC's first Assessment Report.

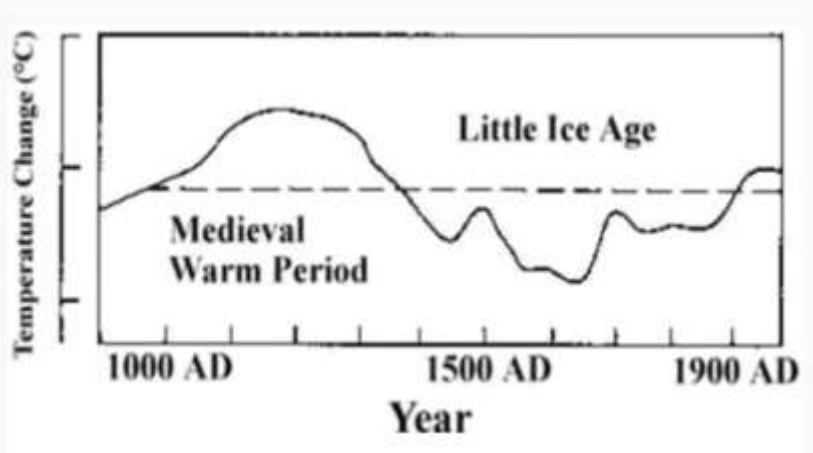

Figure 34 – Warm Medieval Warm Period and Little Ice Age Climate Cycles. *The figure above was included in the IPCC's first Assessment Report, which clearly shows the Medieval Warm Period and the Little Ice Age. These historical climate cycles have been long established with hundreds of scientific papers providing evidence of their occurrence. Source: IPCC Assessment Report 1.*

Temperatures during the Medieval Warm Period and Little Ice Age have been constructed based on the ratio of isotopes Oxygen 16 to Oxygen 18 in Greenland and Antarctica ice cores, sediment cores from North America, Europe, South America, and Asia, and stalactites from the Middle East, Asia, and elsewhere. The ratio of isotopes Oxygen 16 to Oxygen 18 in these samples, as measured by mass spectrometry, can be used as a proxy to estimate past temperatures. Samples from colder periods generally contain more Oxygen 18 than samples from warmer periods. This is because water containing these oxygen isotopes have different evaporation rates which reveals the temperatures of various layers of the sample, at the time they were deposited. Additional semi-millennial climate cycles have been confirmed from such samples, including the Minoan Warm Period(1500 BC – 1100 BC), followed by the cold Greek Dark ages (1100 BC to 800 BC), then the Roman Warm Period m(250 BC to 400 CE), followed by the cold Dark Ages (400 CE to 900 CE), then the Medieval Warm Period (900 CE to 1300 CE), followed by the cold Little Ice Age (1300 CE to 1850 CE) and the finally, Modern Warming (1850 to today).

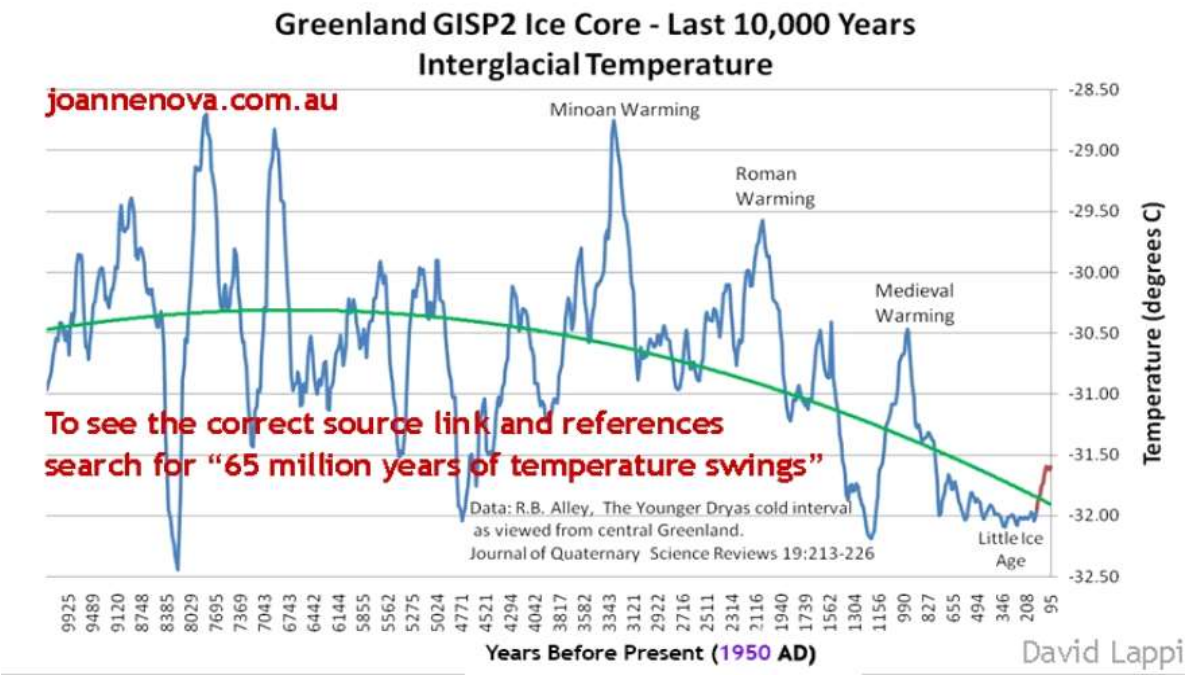

Figure 35 – Historical Climate Cycles. *Ice cores reveal that temperatures in Greenland during the Medieval Warm Period were warmer than the present. The Little Ice Age, where temperatures dropped, is also seen in the ice cores. Hundreds of scientific papers confirm the existence of both the Medieval Warm Period and the Little Ice Age in the North Atlantic, North America, Oceana, South America, and Africa. Source: Historical temperatures in blue, R.B. Alley, 2004, Journal of Quaternary Science Reviews 19:213-226. Current temperatures in red, Yang L. et al, 2007, American Meteorological Society, Journal of Climate Vol. 22, pp 4029-4049..*

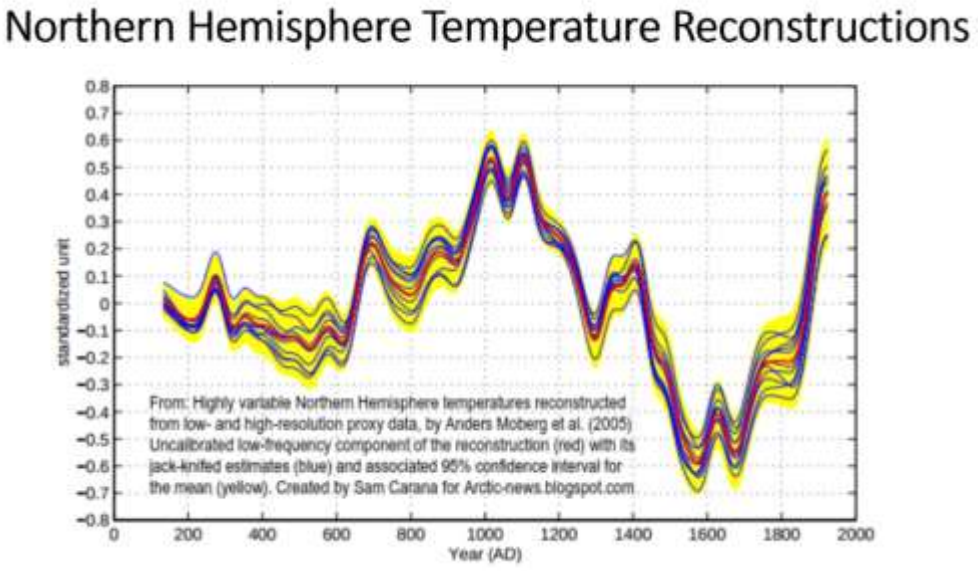

Figure 36 – Northern Hemisphere Temperature Reconstructions. *Anders Moberg, et al used ocean sediment cores and tree ring data to reconstruct temperatures in the Northern Hemisphere over the past*

2,000 years. They conclude: "According to our reconstruction, high temperatures—similar to those observed in the twentieth century before 1990 occurred around 1000 CE to 1100 CE, and minimum temperatures that are about 0.7 K below the average of 1961–90 occurred around 1600 CE." These temperature reconstructions show with clarity the Medieval Climate Optimum and the Little Ice Age, just as these same climate cycles are seen clearly in Greenland Ice Cores. Source: Moberg, A., et al, "Highly variable Northern Hemisphere temperature reconstructions from low-and high-resolution proxy data." Nature, 433 613-617 (2005).

Dr. Craig Lohle published a paper titled, "A 2,000-Year Global Temperature Reconstruction Based on Non-Tree Ring Proxies" in Energy and Environment, 18, pgs. 1049-1058, where he used non-tree proxies to reconstruct the climate over the past 5,000 years from 18 separate locations (see A 2000-Year Global Temperature Reconstruction Based on Non-Treering Proxies - Craig Loehle, 2007 (sagepub.com)). Lohle concludes, "The mean series shows the Medieval Warm Period (MWP) and Little Ice Age (LIA) quite clearly, with the MWP being approximately 0.3°C warmer than 20th century values at these eighteen sites."

We have additional evidence beyond oxygen isotopes to confirm the warm temperature cycles of the Minoan, Roman, and Medieval Warm Periods, and cold periods of the Greek Dark Ages, the Dark Ages, and the Little Ice Age (see Figures 5, 6, 11 and 40). Additional proof of these climate cycles include: 1) historical sea level rise, 2) glacial growth and retreat in Norway, Greenland, New Zealand, China, and the Alps, 3) the settlement of Greenland made possible by the warm climate in the Medieval Warm period, and the abandonment of Greenland forced by the cold climate in the Little Ice Age, 4) the tree line in the Medieval Warm Period in Canada and Europe were further north or at higher altitudes than today, 5) the freezing over of the Thames River in London, the canals in The Netherlands and Venice during the Little Ice Age, and 6) agricultural records in Europe, Greenland, and China confirm these climate cycles.

Historical records confirm these semi-millennial climate cycles over the past 3,000 years. Wolfgang Behringer has written an excellent and meticulously footnoted book which reviews the historical record on these climate cycles (see Behringer, Wolfgang, A Cultural History of Climate, Polity Press, 2010). Behringer writes, "In a number of research projects, Hubert Horris Lamb in England, Christian Pfister in Switzerland, Rüdolf Bradzil in the Czech Republic, Rudiger Glasier in Germany have so clearly demonstrated climatic fluctuations in European History that their evidence is now beyond all doubt." Behringer also provides historical evidence of these climate cycles from Greenland, China, the Americas, and other geographical areas.

During the Roman Warm Period, mining operations were located in the high Alps, in locations where permafrost was still the norm at the end of the twentieth century (see Behringer, pg. 62). Glaciers retreated and passes through the Alps were open all year for the Romans. During the cold Dark Ages, the river Danube froze so solidly in winters that it afforded cart crossings (Behringer pg. 64). In China during the Dark Ages, the Yangzi froze over more than once (see Behringer, pg. 65). The Dark Ages also saw the growth of glaciers and tree lines fell in altitude by two hundred meters in Central Europe (see Behringer, pg. 65). In the Alps, glaciers advanced from the early fifth century to the to the mid-eighth century. The Val de Bagnes glacier in Switzerland grew making an old Roman Road impassible (see Behringer, pg. 66).

According to Behringer, "A warm period in the high Middle Ages can scarcely be disputed." During the Medieval Warm Period between 900 and 1300 glaciers retreated in Europe, North America, and throughout the World, a sure sign of warming (see Behringer, pg. 75). As a result, sea levels rose. The

tree line in the Alps rose to an elevation of over two thousand meters, much higher than today (see Behringer, pg. 77).

Agricultural records confirm the warming. Grapes were grown in Germany in the Medieval Warm Period at elevations 200 meters above where they are now grown (see Behringer, pg. 77). The northern tree line in the Medieval Warm Period in Ontario, Canada was 130 kilometers further north than it is today (Arseneult and Payette, 1997, see https://mail.google.com/mail/u/0/#search/from%3A+me/QgrcJHrtsHBstHvJLhPcjPtRwjjlhjbkJsb). In January 1187, during the Medieval Warm Period, trees blossomed in Strassburg, Germany (see Behringer, pg. 76). In the Baltic grapes were grown 500 kilometers further north during the Medieval Warm period than they are today (see Behringer, pg. 94).

Millet was cultivated in Scandinavia in the Minoan Warm period (see Brady, pg. 35). Pollen analysis has shown that Norway had crops in the Medieval Warm Period that disappeared with the onset of a cold climate (see Behringer, pg. 78). During the Medieval Warm Period, wheat was grown as high north as Trondheim, Norway, and barley in high latitude of Norway (see Behringer, pg. 78). Barley was also grown in Greenland in the Medieval Warm Period. Citrus fruit and grapes were grown in Northern England during the Roman Warm Period. None of these crops or plants can be grown in these regions today, as it is not warm enough.

The warm climate of the Medieval Warm Period also allowed Vikings to settle Iceland and later Greenland under Eric the Red (c 950 – 1005). Not known as a farming area today, recent excavations have uncovered about 450 Viking farms in Greenland (see Behringer, pg. 83). Viking graves on Greenland are in areas of permafrost in the twentieth century, although not evidently at the time of burials (see Behringer, pg. 83). By the fourteenth century, Greenland was abandoned as the world plunged into the Little Ice Age. As the climate cooled, the vegetation period grew dramatically shorter and growing cereal became impossible (see Behringer, pg. 98). Excavations of bone and teeth shows famine and disease ravaged the island during the Little Ice Age (see Behringer, pg. 98).

Subtropical plants spread to Northern China in the Medieval Warm Period. Citrus fruits and Chinese grass (*Boehmeria nivea*) have never grown as far north in China as they were during the thirteenth century. Records show their cultivation in 1264 was several hundred kilometers further north than in the twentieth century (see Behringer, pg. 78). Japanese monks recorded cherry blossoms arrived early during the Medieval Warm period (see Brady, pg. 36).

Entomology also confirms these climate swings. Archeological evidence establishes that the warm loving nettle ground bug (*Heterofaster urticae*) was found as far north as York, England during the Roman Warm Period and Medieval Warm Period, but absence during the cold Dark Ages and Little Ice Age. Despite recent warming, the nettle ground bug is only found today in sunny areas of Southern England (see Behringer, pg. 78). Traces of the heat seeking *Aglenus brunneus* beetle are found in York during the Medieval Warm Period, which also confirms the warm temperatures at that time (see Behringer, pg. 78).

In 1644, during the Little Ice Age, the Bishop of Geneva led a procession near Chamonix to plead with God to halt the advancing Des Bois Glacier. The Des Bois Glacier had already swallowed up two villages and a third was in eminent danger (see Behringer, pg. 90). In London during the Little Ice Age, winter markets were held on the ice of the frozen Thames River. The last winter market on the Thames River was 1814 as the ice has not frozen solid enough since then to hold a fair with stalls, entertainment, and

various activities on the ice. In the winter of 1691/1692, the Delaware River and Boston Harbor froze over. Canals in Venice and Amsterdam froze over. In Egypt in 1660, the temperature plunged enough that people were wearing fur coats for the first time in recorded history. Behringer also writes, "It has been concluded from the total freezing of major lakes in China that the average temperature there between 1470 to 1850 must have been one degree colder than in the late twentieth century (see Behringer, pg. 90).

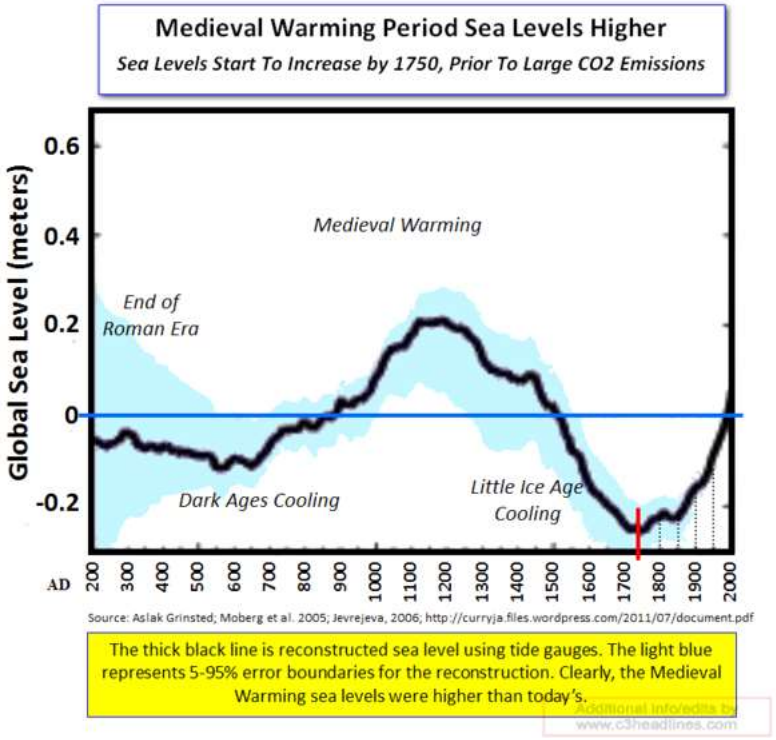

Figure 37 – Medieval Warm Period Sea Level Rise. *Historical tide gauges of sea level rise and fall are another climate proxy, which infer temperature swings that correlate to the warm Medieval Warm Period and the cold Little Ice Age. Source: Moberg, A, et al "Highly variable Northern Hemisphere temperature reconstructions from low-and high-resolution proxy data" Nature, 433 613-617 (2005).*

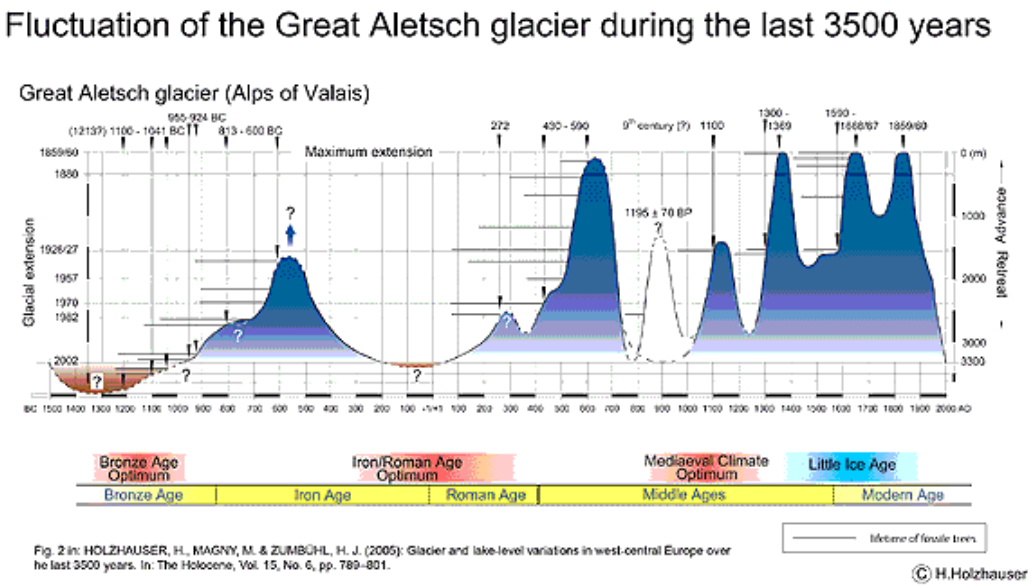

Figure 38 – Growth and Decline of the Great Aletsch Glacier Over the Past 3,500 years. *Growth and decline of the Great Aletsch glacier in the Alps clearly show the climate cycles of the Minoan Warm Period (Bronze Age Optimum), the cool Greek Dark Ages, the Roman Warm Period (Roman Age Optimum), the cool Dark Ages, the Medieval Warm Period (Medieval Climate Optimum), and the Little Ice Age. Source: Professor Hanspeter Holzhauser of the University of Bern, Switzerland. The Holocene, Vol 15, No.6 pgs. 789-801.*

Figure 39 – The London Winter Market on the Thames River. *A winter market was held on the ice of the Thames River in London during the cold Little Ice Age. The image above depicts London and the winter market on the Thames in 1694. The last winter market on the Thames River in London was in 1814 as the ice has not frozen solid enough since then to support such a fair. Source:* The Frost Fairs of River Thames | Amusing Planet.

Historical Impact of Eddy Solar Cycles on Climate

Scientists Nicola Scafetta and Fritz Vahrenholt cite several scientific papers from Nature, Science, and Solar Physics, which present compelling evidence of a quasi-millennial solar cycle, known as the Eddy cycle and how it impacts climate (see Crok and May, pg. 81). The Eddy solar cycle switches from a grand solar maximum to a grand solar minimum about every 500 years. History and paleoclimate proxies all confirm millennial climate cycles which switch from warmth to cooling and back again about every 500 years in synch with millennial Eddy solar cycles. Gerald Bond and colleagues first described these climate cycles in the North Atlantic and explicitly stated that they were synchronous with solar activity (see Crok and May, pg. 81.) Scafetta and Vaherenholt cite 15 scientific papers from Global and Planetary Change, Geophysical Research Letters, Planetary Science Letters, Quaternary Science, Geochem. Geophys. Geosyst., Clim. Past, Science, and Journal of Oceanography that establish a connection with solar activity and past climate cycles in the USA, Brazil, Patagonia, Peru, Antarctica, South Africa, Morocco, Oman, India, China, Australia, Spain, Austria, and Finland (see Crok and May, pg. 81).

Cloud cover which shades the Earth and reflects sunlight back out to space is a significant factor in climate change (see Chapters 10 and 13). Astrophysicists Hendrick Svensmark and Nir Shaviv have provided convincing evidence of how solar cycles modulate cloud cover (see Chapter 13). Variations of cloud cover, in synch with solar cycles, has a major impact on the climate. It is interesting to note that the cold Little Ice Age was a period of the Maunder Minium solar cycle and a time of cloudiness. The Anglican bishop Robert Burton (1577 to 1640) described the times in the British Isles as one of "endless days when dark clouds obscure the sunlight" (see Behringer, pg. 115).

The IPCC Erased the Inconvenient Medieval Warm Period and the Little Ice Age

The Medieval Warm Period and Little Ice Age do not align with the anthropogenic global warming narrative. Since fossil fuels were not in use in those times, these warm and cool cycles must have occurred from natural causes. Despite overwhelming evidence of the Medieval Warm Period, an email was sent by a major IPCC climate science researcher who wrote: "We have to get rid of the Medieval Warm Period"(see https://realclimatescience.com/2018/12/erasing-the-medieval-warm-period/). The IPCC did just that. In the third IPCC Assessment Report 3, "Summary for Policy Makers," they featured as a centerpiece, the famous "hockey stick" graph of Michael Mann, which completely removed the Medieval Warm Period and Little Ice Age. The curve resembles a hockey stick, where the first 850 years show stable temperatures, void of the Medieval Warm Period and Little Ice Age. This part of the graph was the flat handle of the hockey stick, while the last hundred years' temperature increase rapidly, forming the blade.

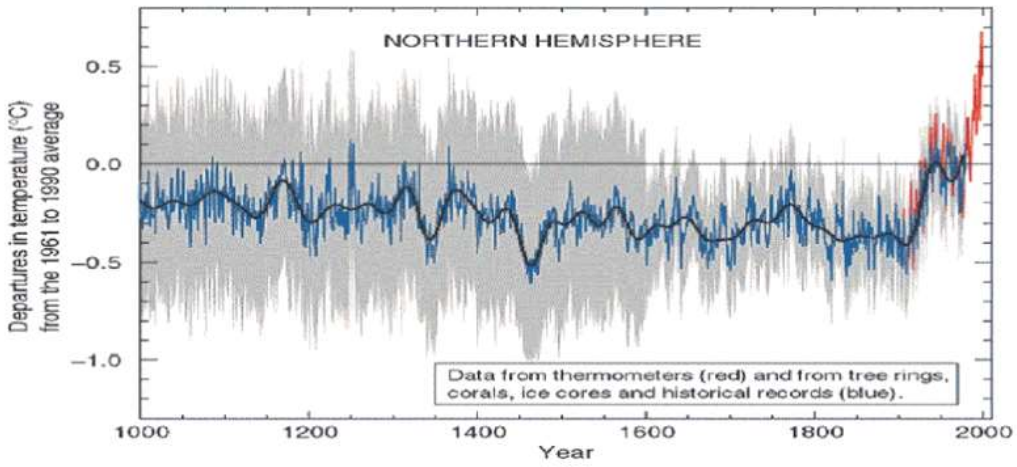

Figure 40 – The Mann Hockey Stick Graph of Climate. *The Mann hockey stick graph above was featured in the IPCC Assessment Report 3. This one graph erased the Medieval Warm Period and the Little Ice Age, despite hundreds of scientific papers that confirm these climate periods from ice core, sediment cores, stalactites and other proxy and historical records. The inclusion of this faulty graph in the IPCC Assessment Report 3 shows the bias of the IPCC. Source: IPCC Assessment Report 3.*

The Mann hockey stick graph has been discredited as Mann used a flawed statistical methodology. Using the R^2 statistical test to validate the chart, the Mann temperature graph fails. (see https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2004GL021750). The Mann Hockey Stick was heavily criticized for major deficiencies in its paleoclimatic proxies and statistical methods. Crok references four such critiques in scientific journals including Soon, et al in Climate Research, 2003, McIntyre and McKintrick in Energy & Environment, 2003, McKintrick, et al in Geophysical Research Letter, 2003, and McShane and Wyner in Geophysical Research Letters, 2011 (See Crok, pg. 5). Mann used primarily tree ring proxy data to predict temperature by year, based on the growth rings of the trees. Where the tree ring data fits the anthropogenic warming narrative, Mann included it in the graph. However, the tree ring data showed cooling in the second half of the 20th century, which did not fit the narrative. So, he discarded tree ring proxy data and switched to thermometer data in the 20th century to create the blade of the hockey stick (see Spencer, Roy W., The Great Global Warming Blunder, pg. 10). This calls into question the reliability of the proxy data he used to predict the temperatures during the Medieval Warm Period and Little Ice Age. Despite the scientific flaws in the hockey stick, Mann was rewarded since his work supports the anthropogenic climate change narrative. He was appointed by the IPCC as lead author on climate variability for the IPCC's third Assessment Report. Professor of Meteorology of the University of Hamburg, Hans Von Storch, was also a lead author in the IPCC Assessment Report 3. He strongly opposed any use of Michael Mann's hockey stick graph in the report. He was overruled and not invited to participate in the subsequent IPCC Assessment Report 4 (see Brady, Howard Thomas, Mirrors and Mazes: A guide through the climate change debate, pg.41.

Despite being discredited, the Mann Hockey Stick was used significantly in the media and internet posts to deceptively substantiate anthropogenic greenhouse warming. The Mann Hockey Stick was not included in subsequent IPCC reports AR4 and AR5. Surprisingly, in the "Summary for Policymakers" of the IPCC Assessment Report 6, a similar hockey stick graph, which erases the Medieval Warm Period and Little Ice Age is presented. The new hockey stick graph is from the PAGES 2k group headquartered at the University of Bern, where Thomas Stocker chairs the climate and environment physics department.

Stocker co-authored the "Summary for Policy Makers" of the IPCC AR3 report, which featured the Mann Hockey Stick. With strong links to the IPCC, Stocker also ran for the IPCC chairmanship in 2015.

It is interesting to note that in 2013, this same PAGES 2k group published a reconstruction of temperatures over the past 2,000 years that shows parts of the first millennium were as warm as present day (see Crok, pg. 33). Referring to the AR6 hockey stick graph, CLINTEL investigators write, "Evidence suggests that a significant part of the original PAGES2K researchers could not technically support the new hockey stick and seem to have left the group in dispute. Meanwhile the dropouts published a competing temperature curve with significant pre-industrial temperature variability. On the basis of the thoroughly verified tree rings the specialist were able to prove that summer temperatures had already reached today' level several times in the pre-industrial past." (see Crok, pg. 35). This new paper includes 22 authors (Büntgen, U., et al, "Prominent role of volcanism in Common Era climate variability and human history," Dendrochronologia, v. 64, p. 125757, 2020). The work of Büntgen, et al was not included in the IPCC report, which shows the bias of the IPCC.

The AR6 Hockey Stick uses poorly documented tree ring data that tree ring specialist Büntgen had previously cautioned are too complex to be used as overall temperature records (see Crok, pg. 37). In contrast the Büntgen 2020 paper validates every tree ring data set individually (see Crok, pg. 37). In some cases, the AR6 Hockey Stick erroneously used proxies that turned out to reflect hydroclimate and not temperature (see Crok, pg. 37). Steve McIntyre studied the AR6 Hockey Stick proxy data and summarized his critique which includes results from questionable data processing (see Crok, pg. 38). McIntyre points out the blade of the AR6 hockey stick disappears when some data sets are analyzed with a dplR statistical package or a single Hugerhoff curve fit (see Crok, pg. 38). The AR6 Hockey Stick makes the same error as the Mann Hockey Stick in combining paleoclimate and temperature records. The precision of the Paleoclimate reconstructions is within 40-years to 100-years. From the mid-1940s to the mid-1970s temperatures declined. The warming since 1980 would be moderated if it were averaged with the mid-1940 to mid-1970 temperature records. This illustrates why temperature records accentuate the warming in the blade of the hockey stick, when temperature records are intermingled with paleoclimate data.

Paleoclimate reconstructions can be debated, but glacier advance and decline, sea level measurements, tree line altitudes and latitudes changes, entomology, and agricultural records do not lie. Such evidence presented in this chapter confirms the Medieval Warm Period and Little Ice beyond doubt. The inclusion of the AR6 Hockey Stick graph and the exclusion of the extensive number of paleoclimate studies and other evidence of the Medieval Warm Period and Little Ice Age discredits the IPCC and shows its bias in perpetuating the Climate Crisis narrative.

Current and Historical Climate Change Has Been Primarily in the Northern Hemisphere

Since the overwhelming evidence of natural climate cycles discredits the anthropogenic climate change theory, the IPCC and Michael Mann have attempted to erase history and falsely eliminate these past temperature swings. Because the evidence of past global warming cycles in Europe and Greenland is so overwhelming, Mann and the IPCC argue that the Medieval Warm Period and Little Ice Age were not global, but regional, primarily in Greenland and Europe. This seems a strange argument against past global warming, since global warming between 1978 to 2022 saw a temperature increase of 0.25C per decade in the Arctic and 0.01C in Antarctica (see Figure 27 and Figure 28).

Current global warming is also localized, predominantly in the northern hemisphere, especially Greenland and Europe. This localized warming is due to the heating of oceans by the sun and the transport of this heat to northern latitudes by the MOC, Gulf Stream, and Kuroshio ocean currents. Heat from these currents is released into the atmosphere in the North Atlantic and North Pacific. The transport of heat by these ocean currents is most pronounced in the oceans off Greenland and Europe (see Figure 30). Claiming global warming is localized is actually an argument against anthropogenic greenhouse gas warming. Greenhouse warming would be more uniform globally since CO_2 emissions disperse rapidly throughout the atmosphere and the concentration of CO_2 in the Arctic and Antarctica are virtually the same. However, solar warming of oceans would concentrate warming in northern latitudes, especially Greenland and Europe. The warming of the Minoan, Roman, Medieval, and Modern warm periods have coincided with the peak of the warm periods of the Eddy Solar Cycle. Since Greenland ice cores also show significant heating in the Minoan, Roman, and Medieval warm periods (see Figure 5), these same ocean currents likely brought warm seawater, heated by the sun, to northern latitudes in these periods, just as is happening today.

Most of the evidence for past global warming has come from the northern hemisphere including Europe, China, Japan, Greenland, and North America. The warming in Greenland and Europe is most pronounced. However, we have evidence from other regions to show these climate cycles were indeed global. As previously covered in this paper, historical records, archeology, and paleoclimate reconstructions from Greenland, Europe, the North Atlantic, North America, China, Japan, Africa, South America, Antarctica, New Zealand, the South and Central Pacific, and the Indian Ocean all confirm these climate cycles were experienced globally. Fritz Vahrenholt in his book The Neglected Sun references 16 papers which document the Medieval Warm Period in Africa, Antarctica, Aisa, Oceana, and South America (see Vahrenholt, pg. 145).

Yair Rosenthal of Rutgers University published a reconstruction of temperatures in the Pacific Ocean in Indonesia with Braddock Linsley and Delia Oppo. They analyzed ocean sediment core samples. Based upon the ratio of Oxygen 16 to Oxygen 18 in these samples, Rosenthal, et al reconstructed temperatures of the Northern and Southern Pacific and Indian Oceans going back 10,000 years. The Little Ice Age, the Medieval Warm Period, the Roman Warm Period, and the Middle Holocene Thermal Maximum are seen clearly in this data. Consistent with glaciation and tree line records (see Crok, pgs. 25-26), they found the Middle Holocene Thermal Maximum to be 2C warmer than today. (see Yair Rosenthal, et al, "Pacific Ocean Heat Content During the Past 10,000 Years" Science 342, 617 (2013) https://www.ldeo.columbia.edu/~blinsley/Dr._B._K_Linsley/Indonesia_&_Pacific_Intermediate_Water_files/Rosenthal.Linsley.Oppo%202013%20Pac.Ocean.Heat.pdf.

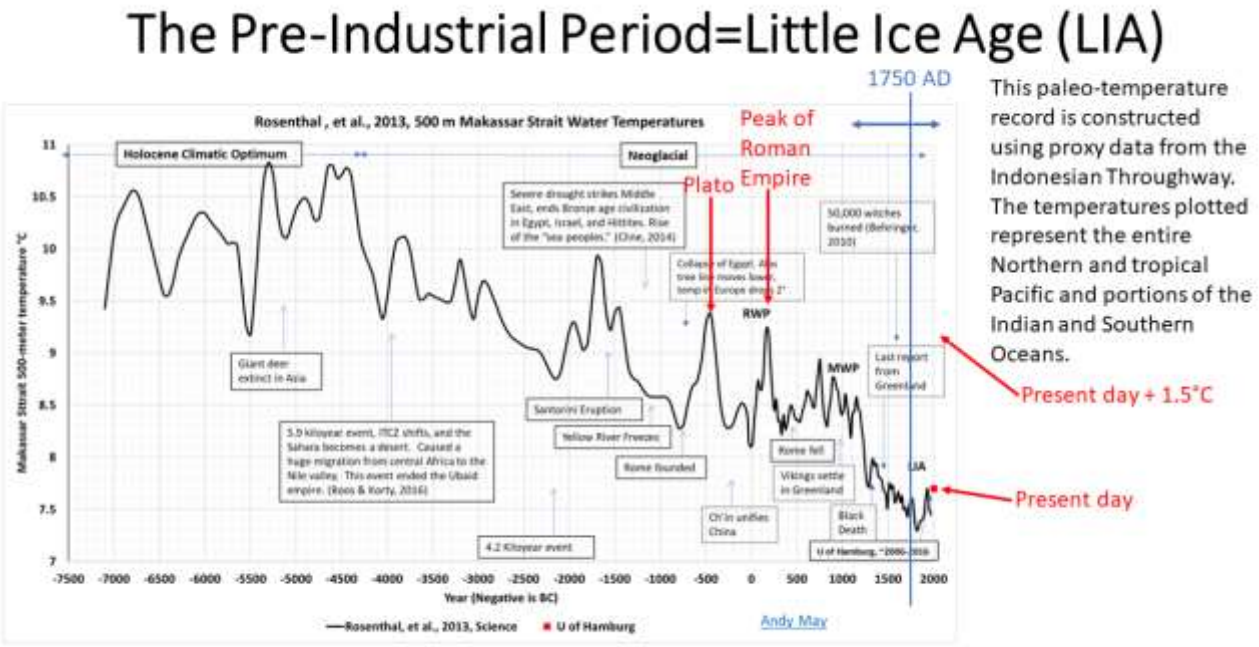

Figure 41 – Temperature Reconstruction of the Northern and Southern Pacific and Indian Oceans. *A temperature reconstruction using ocean sediment samples from Indonesia show the climate swings of the Little Ice Age, the Medieval Warm Period, the Roman Warm Period, and the Middle Holocene Maximum. Clearly these climate periods were not limited to Europe and Greenland as claimed by Michael Mann and other climate alarmists. The temperature reconstructions above include the Northern and Tropical Pacific, and portions of the Indian and Southern Oceans. Presentation by Andy May using data from Yair Rosenthal, et al, "Pacific Ocean Heat Content During the Past 10,000 Years" Science 342, 617 (2013), (see* https://youtu.be/vEeOorISVsI?si=ZpGIuZ1WzswfxNL).

For additional evidence on the global nature of the Medieval Warm Period and the Little Ice Age, see https://est.ufba.br/sites/est.ufba.br/files/kim/medievalwarmperiod.pdf by Don J. Easterbrook from the Department of Geology, Western Washington University and https://wattsupwiththat.com/2018/02/12/more-evidence-that-the-medieval-warming-period-was-global-not-regional/ by Anthony Watt. Watt maps temperature changes during the Medieval Warm Period as cited in over 1,000 studies. The global nature of the Medieval Warm Period is clearly shown.

Chapter 7 – History of Civilizations and Climate Change

History Teaches Warming is Good for Mankind and Cold is Bad, Very Bad

History teaches us that civilizations prosper in warm ages and decline in cold times. This should come as no surprise, as crop yields go up in warmer humid climates and down in colder arid ones. The benefits of warmth and the detriment of cold climates are seen in the prosperity of the Bronze Age Optimum (Minoan), Roman Age Optimum, Medieval Climate Optimum, and Modern warm periods, depopulation, and collapse of the Bronze Age in the cold Greek Dark Ages, the decline of civilization in the cold Dark Ages, and the massive starvation of the Little Ice Age. There is a reason historians call these warm climate cycles "Optimums."

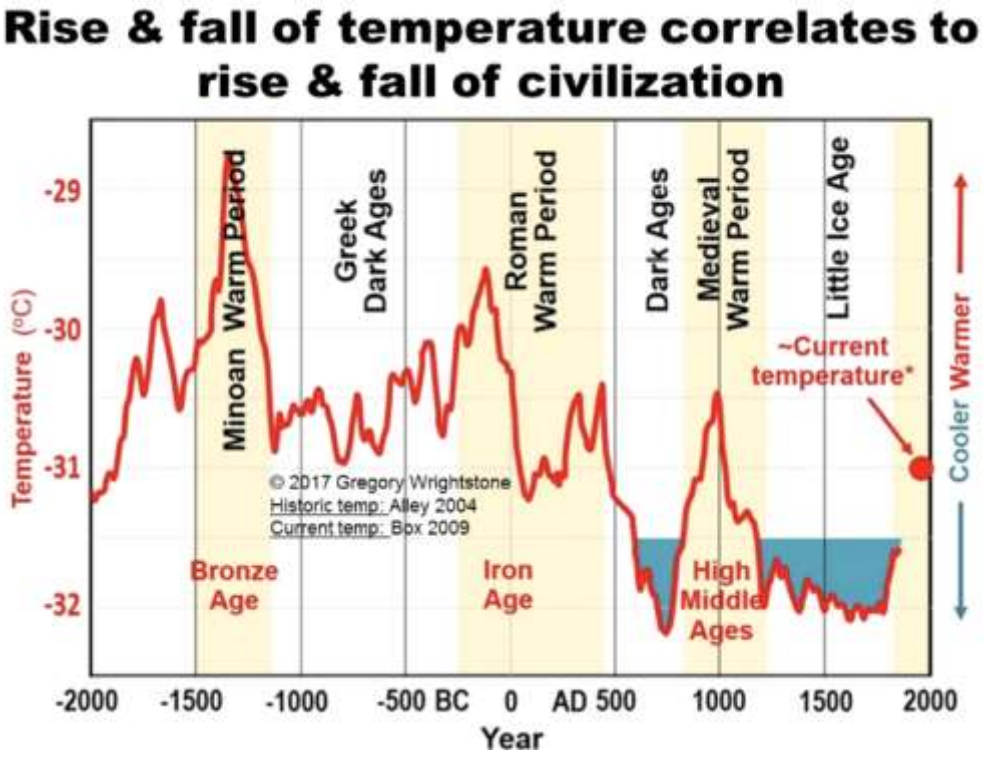

Figure 42 – Rise and Fall of Temperature Correlates to Rise and Fall of Civilizations. *Civilizations have thrived during warm times and declined during cold times. The chart above correlates estimated Greenland temperatures from ice core data to the rise and fall of major civilizations. Source: Gregory Wrightstone using data from Alley, R.B. (2004) Ice Core Temperature and Accumulation Data, Paleoclimatology Program Boulder, CO.*

In his book A Cultural History of Climate, Wolfgang Behringer chronicles civilizations and how the climate impacted their rise and fall. Citing archeological, paleoclimate, and historical records, he documents the rise of advanced civilizations of the Bronze Age, Roman Empire, and Medieval High Period during warm temperatures with lush growing conditions. These are all times of great prosperity and growing populations. He also details the collapse of societies during the cold Greek Dark Ages, the Dark Ages, and the Little Ice Age. A common theme is cold climates lead to harvest failures, which result in famines, increased disease due to malnutrition, migrations of peoples to warmer regions, wars,

rebellions, and declining populations. The real climate crisis has repeatedly been cold periods. Warm periods are now and have always been times of prosperity.

Climate is of course, only one factor impacting the prosperity of nations. The Renaissance and American Constitution occurred during the Little Ice Age. Unleashing the power of fossil fuels and machines and the spread of Capitalism and Liberty during the Industrial Revolution has had a far greater impact on prosperity than climate. As mechanization and science has improve agricultural productivity climate impacts on civilization is less pronounced. Technological advances help us more easily adapt to a changing climate. Nevertheless, a survey of history definitely teaches us that warmer climates have positive benefits and colder climates have severe negative impacts.

Civilizations Emerged and Prospered in Minoan Warm Period

The great civilizations of the Bronze Age appeared and prospered during the Minoan Warm period. Historians point to the warm and stable climate of the Bronze Age as an environment that fostered cultural development and trade. This warm and humid climate boosted agricultural production and allowed the passage from agrarian societies to advanced civilizations. People were freed from basic food production which advanced a division of labor. New administrative, economic, and military positions were created, including royal courts, state officials, priests, craftsmen, merchants, and soldiers. Great ancient urban civilizations began at this time in Mesopotamia, Egypt, and China.

Civilizations Collapsed During the Cold Greek Dark Ages

The sudden fall of the great Bronze Age nations of the Hittites (Turkey), New Kingdom Egypt, Kassites (Babylon), Minoans (Crete), and Mycenaeans (Greece) occurred as the Earth climate cycle became cold. Historical records from the Hittites and New Kingdom Egypt record multi-year droughts and declining agricultural production. Many historians believe these climate calamities led to migrations and wars with the "Sea Peoples" and eventual collapse of these civilizations (see Behringer, pg. 56). During the entire cold period, known as the Greek Dark Ages, hallmarks of civilization such as written records and palace building went dormant. According to Behringer, "The 'climate plunge' around 800 BC was first discovered in archaeological excavations then confirmed by paleobiologists." He describes conditions during this period where snow remained longer in the season and over large areas, glaciers grew, and tree lines moved lower, some 300 to 400 meters lower in the Alps (see Behringer, pg. 58).

A paper by Brandon L Drake in the Journal of Archaeological Science, Volume 39, Issue 6, June 2012, pages 1862 to 1870, titled "The Influence of Climatic Change on the Late Bronze Age Collapse and the Greek Dark Ages" (https://www.sciencedirect.com/science/article/abs/pii/S0305440312000416) studies radiocarbon-dated pollen in the area, which confirms the decline in agriculture. The paper also covers oxygen and carbon isotopes in Mediterranean Sea sediments and concludes, "Mediterranean Sea surface temperatures cooled rapidly during the Late Bronze Age, limiting freshwater flux into the atmosphere and thus reducing precipitation over land. These climatic changes could have affected Palatial centers that were dependent upon high levels of agricultural productivity. Declines in agricultural production would have made higher-density populations in Palatial centers unsustainable. The 'Greek Dark Ages' that followed occurred during prolonged arid conditions that lasted until the

Roman Warm Period." History repeatedly shows how it is more arid during cold times and agricultural productivity declines.

Prosperity Returned in the Roman Warm Period

After the Greek Dark Ages, the climate once again warmed into the Roman Optimum. This warm cycle saw a resurgence of civilization and the establishment of the prosperous Roman Empire in Europe and Hun Dynasty in China. Once again, a warm climate provided prosperity to the region. During the warm Roman Optimum, more people lived on Earth than at any time before. This level of population would only be reached again a thousand years later in the Medieval Warm Period (see Behringer, pg. 61). The early Roman Empire was blessed with a warm and stable climate for several centuries. The warm climate allowed Rome to have bountiful harvests and allowed Rome to begin to expand north. It has been noted that the prosperity of the Roman Empire coincided in time with the great prosperity in China under the Hun Dynasty. In China the Hun Dynasty saw populations grow to approximately 60 million by 2 CE (see Behringer, pg. 62).

Famine and Civilization Collapse Occurred Again During the Cold Dark Ages

Since the publication of Edward Gibbon's History of the Decline and Fall of the Roman Empire, many reasons have been given for the collapse of the Roman Empire. However, since the year 2000, there is an increasing number of papers which use paleoclimate reconstructions using carbon, oxygen, and beryllium isotopes to assess the impact of climate on the fall of Rome. These paleoclimate proxies reveal temperature cooling after 250 CE, leading to droughts and mass migrations. By the fifth century, the climate grew colder and Rome's traditional granary in North Africa dried up (see Behringer, pg. 64). Eugippius (c. 465-533) describes the collapse of the Roman Empire, and he constantly refers to cold, famine, and disease (see Behringer, pg. 64). This is also a period when great cities fell into decline including Ephesus, Antioch, Palmyra, and some six hundred settlements in Arabia were abandoned (see Behringer, pg. 64). By the sixth century the population of the Roman Empire declined and only half of its 15 million inhabitants were left (see Behringer, pg. 66). Most settlements north of the Alps were abandoned and pollen analysis testifies to a general decline in agriculture (see Behringer, pg. 67).

This period of colder temperatures from 250 CE to the seventh century is known as the "Migration Era Pessimum." Some scholars, including Kyle Harper, believe colder temperatures and droughts drove Rome's neighbors to the northeast to move southward. The raids by the Huns and Goths were not mere raids, but migrations. The Huns defeated the Roman army and the Goths conquered Rome itself in 410 CE. See The Fate of Rome: Climate, Disease, and the End of an Empire by Kyle Harper, April 2018, Princeton University Press, https://eh.net/book_reviews/the-fate-of-rome-climate-disease-and-the-end-of-an-empire/. Also see "Climate and the Decline and Fall of the Western Roman Empire" by Werner Marx, Robin Hunschild, and Lutz Bornmann of the Max Planck Institute. In this journal article, they summarize 85 papers dealing with climate and the fall of the Roman Empire (see https://www.mdpi.com/2225-1154/6/4/90).

Behringer mentions colder winters set in by 250 CE and lasted in the main part of Europe until the ninth century. Glaciers grew and tree lines fell by as much as 200 meters in Central Europe (see Behringer pg. 65). Accounts by the Bishop of Gregory of Tours (c. 538-594) tell of late frosts, mountain avalanches,

harvest failures, famine, and epidemics (see Behringer, pg. 68). The population in Europe fell to a low that was not reached again in any subsequent period (see Behringer, pg. 68). In the year 784, a third of the population of Europe was said to have died (see Behringer, pg. 69). The cold climate not only impacted harvests, but the weight of pigs and cattle was lower than during the Roman Optimum (see Behringer, pg. 69). Famines were also common in America and the Classical Maya civilization collapsed by 900 CE. Studies cite wars, harvest failures, famine and epidemics as significant causes for the Maya collapse (see Behringer, pgs. 70-71).

Prosperity Returned Again in the Medieval Warm Period

Following the cold Dark Ages, the world warmed again into the Medieval Optimum. The increase in food supplies due to the warmer temperatures led to the substantial increase in populations during the High Medieval Ages of 1000 CE to 1300 CE. Populations began to expand in the ninth century and between the years 1050 to 1300, the population of Europe increased from 46 million to 76 million (see Behringer, pg. 81). This was a level never attained in any previous time. This was a period of great town formation. In German speaking areas, towns grew from the few hundred that had survived the cold Dark Ages to over three thousand (see Behringer, pg. 81). Farmland expanded even in mountainous regions such as high Alpine regions and fjords. High mountain pastures were opened as the warming allowed livestock to graze there for longer periods (see Behringer, pg. 82). In China, cultivational limits for some crops were several hundred kilometers further north during the Medieval Warm Period than they were in the twentieth century (see Behringer, pg. 78). The growing population and abundant food supplies led to increased industrial and economic activity. This was another time of great prosperity, as witnessed by the economic expansion and great cathedrals built in Europe and the prosperity and growing population in China.

The warmth allowed grain to be grown in high latitudes and the countries of Scandinavia prospered. The favorable climate fostered the creation of Nordic nations that remain in existence today (see Behringer, pg. 82). With the warmth, Iceland became an attractive land to settle. By the year 930, Iceland had a population of 60,000 and by the eleventh century, Iceland had a population of 80,000 (see Behringer, pg. 82). The warmth was so great that Vikings, led by Eric the Red took settlers to Greenland in the year 985. Grain was grown in Greenland and recent excavations of Osterbygd have uncovered about 450 farms (see Behringer, pg. 83). The warm climate allowed the Vikings to explore further west and evidence from excavations have confirmed migrations to Newfoundland.

The Little Ice Age Brought Famines and Misery to Mankind

By the end of the fourteenth century, the warming ended, and the world was plunged into the Little Ice Age. The drop in temperatures in the Little Ice Age had devastating impacts. Crops failed, food supplies were limited, and agrarian economies collapsed. Living standards plummeted, life expectancy declined, famine and disease increased, war ensued, and societies imploded. The seventeenth century saw more wars globally than any other century. In 1640 wars and rebellions ravaged the globe. According to B. B. Wagner, “As seen with many empires throughout the world, once a limited food supply is established, a series of calamities tend to follow.” (see B. B. Wagner, “The Little Ice Age and Its Giant Impact on Human History,” Ancient Origins, September 25, 2020).

It has been concluded from the freezing of major lakes in China during the Little Ice Age that the average temperature between 1470 and 1850 must have been one degree colder than in the late twentieth century (see Behringer, pg. 90). Periods of spectacular cold were reports everywhere in the Ming Empire. Although people died of cold, it was the aridity associated with cooling that brought Chinese agriculture to the point of collapse (see Behringer, pg. 114). The effects of the Little Ice Age in China were many droughts and famines between the 1300s to the 1700s (see B.B. Wagner). Harvest failures in China led to increased mortality and susceptibility to disease and population levels declined (see Behringer, pg. 113). Poor harvests and food shortages led to a great peasant insurrection in 1643 against the Ming Dynasty in China. This resulted in the suicide of the emperor and the kingdom's demise in 1645. Many scholars believe the Ming Dynasty may have remained in power had the climate not gotten colder (see B.B. Wagner).

During this same period, the Mayan and Aztec civilizations in Mexico experienced rebellion and population decline and entire Native American cultures in North America disappeared. Data from Indonesia and Thailand show famines and epidemics in the early to mid-seventeenth century (see Behringer, pg. 113).

In Europe, the seventeenth century was a time of famine and destruction. The populations of Germany and Bohemia declined by more than half from famine, disease, and the 30 Years War. The population of Finland declined by one half and Scotland's population fell by 15%. The life expectancy of the poor in England plunged to 30 years and the English Civil War erupted and ended with the execution of King Charles I. Russian populations declined by 20% in the seventeenth century due to famines, disease, and wars. In France, the Fronde revolution from 1648 to 1653 was the most widespread rebellion in all of Europe during the mid seventeenth century. Over one million French men and women died in this period. The "Little Ice Age" continued through the eighteenth century and some historians cite continued cold temperatures as the underlying cause of food shortages and the Bread Riots in France in 1789. France experienced a harsh winter in 1788-89 and a renewed drought in 1789 (see Behringer, pg. 162). Grain prices reached their highest level on July 14, 1789, the day of the storming of the Bastille (see Behringer, pg. 163). The Bread Riots and the ensuing French Revolution culminated in the execution of King Louis XVI and Marie Antoinette by guillotine in 1793.

Disease, including the Black Plague also ravaged the world during the Little Ice Age and took many lives. An evaluation of dental and skeletal remains of many victims shows indicators of malnutrition (see Behringer, pg. 113). This weakened condition may have made much of the population vulnerable to dysentery, typhus, tuberculosis, and plagues. Malnutrition on a large scale during the Little Ice Age was a result of the poor agricultural harvests in the cold and stormy weather of the time. Greenland was also abandoned during this period as it was too cold for the inhabitants to survive. Geoffrey Parker estimates that one third of the population of Europe and Asia died during the mid-seventeenth century (see Parker, G., Globa Crisis: War, Climate Change and Catastrophe in the Seventeenth Century, Yale University Press, 2021).

Just as uninformed and misinformed climate alarmists of today blame humankind for climate change, bad weather during the Little Ice Age was deemed to be caused by man. The anthropogenic cause of severe weather events during the Little Ice Age was attributed to witchcraft. Witches were directly blamed for weather and were the scapegoats that people needed to explain the disastrous weather (see Behringer, pgs. 128-129). During this period, 50,000 victims accused as witches were executed to control what was seen as anthropogenic climate change (see Behringer, pg. 130). Such witch hunts were conducted with a religious zeal that characterizes the extreme climate activists' movement of

today. Fanatics of today once again discount natural causes of weather and climate change, blame humankind, spread fear, and push detrimental policies. One such modern detrimental policy example is the eviction of the Ogiek people from their native homes in Kenya. Since November 2, 2023, over 700 Ogiek hunter gather people have been evicted from their ancestral lands and have seen their homes destroyed. Human rights lawyer Dr. Justin Kendrick has stated that the global carbon credit market allows rich nations to purchase carbon credits from poor nations with uninhabited forested areas. Dr. Kendrick says the government of Kenya is evicting these people from the Mau forests of Kenya to maximize the lucrative carbon credits.

Unprecedented Prosperity in the Modern Warming Period

The "Little Ice Age" ended in the nineteenth century and the world has once again moved into a period of warmth and prosperity. The lessons of history teach us warmth is good for humankind as it expands agricultural productivity and reduces the adverse toll on humans from famines. Cold is the enemy of humankind as it has always brought famines, misery, and civilization decline. Famines often lead to political unrest, wars, disease, declining populations, and economic hardship. Recent modern warming has led to a dramatic decline in deaths from famines. Since the 1970s, we have been in a period of warming and declining deaths from famines. In the 1960s, 50 in 100,000 people in the world died of famine. After 2010, this number had fallen by 100-fold to less than 0.5 in 100,000, despite the growing world population. History repeats itself, and once again warmth has proven to be good for humanity and we should welcome warming and not fear it. The contribution of warmth plus increased CO_2 fertilization represents 78% of the enhanced greening of the Earth, which has led to unprecedented agricultural productivity in the Modern Warming Period.

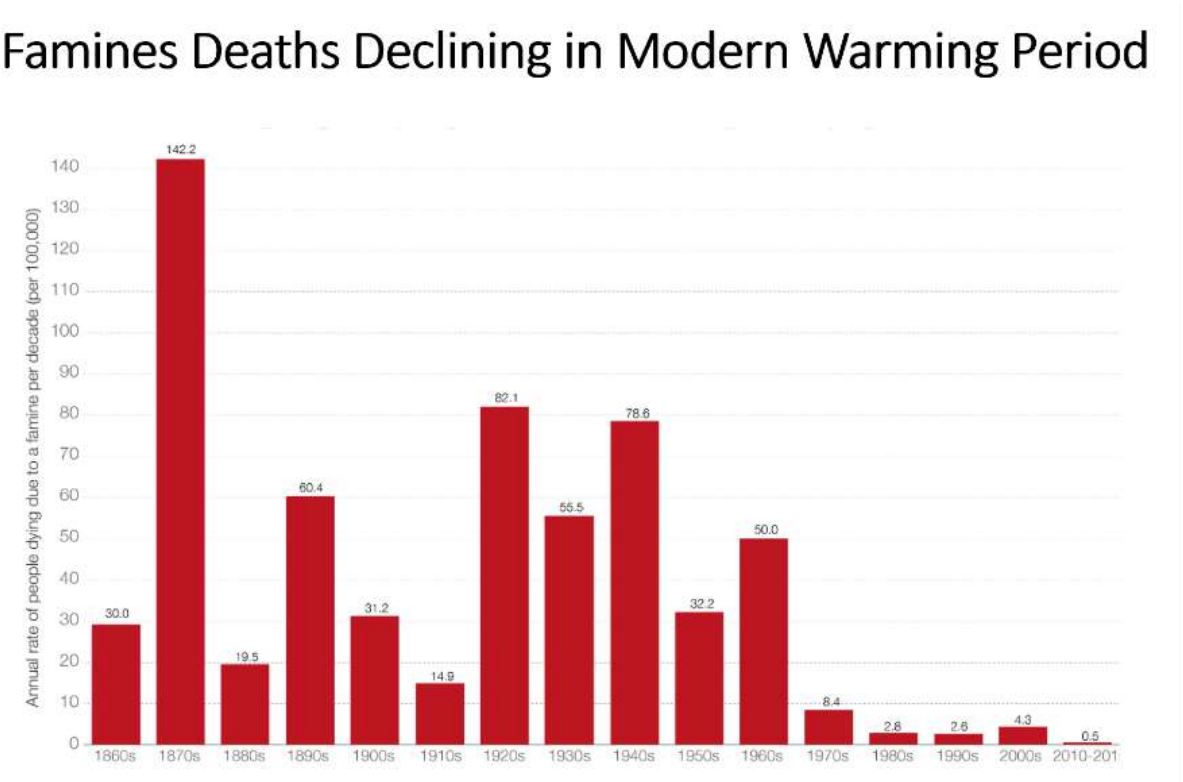

Figure 43 – Famine Deaths are Declining as Temperatures Rise. *Throughout the history of civilization, famines decrease as temperatures rise and famines increase as temperatures fall. Cold periods have more famines which have often resulted in political unrest, increased wars, and disease, declining populations, and economic hardship. Warm periods have less famines resulting in growing populations, prosperity, fewer cases of disease, and less wars. This is also true of modern warming. Since the 1960s, temperatures have increased, and deaths from famines have dropped by 100-fold from 50 per 100,000 to 0.5 per 100,000. Modern warming should be celebrated, not feared. Source: OurWorldinData.org/famines.*

History teaches us to expect climate cycles with alternating warm and cool periods of approximately 500 years each in duration. These warm and cold cycles coincide with the solar maximums and solar minimums of Eddy solar cycles. Warmth has always been good for humanity and the current Modern Warm Period, which is at the height of the warm period of the 1,000-year Eddy solar cycle, has witnessed great prosperity, just as the world experienced in the Minoan, Roman, and Medieval warm periods.

The Economic Benefits of Warming

The historical benefits of a warming Earth are expected to continue. Economist and IPCC contributor Richard Tol analyzed 22 studies on the economic impact of climate change (see Richard S. J. Tol, "The Economic Impacts of Climate Change, Review of Environmental and Economics and Policy, 2018, 12 (1), pgs. 4-25). The mean results of these 22 papers conclude warming from climate change would be net positive for the global economy until the warming exceeded 1.7C from the temperature at the beginning of the industrial era. The temperature has warmed between 0.9C and 1.1C since the beginning of the industrial era. Therefore, the world needs to heat by 0.6C to 0.8C from today's temperature before the warming has negative economic impacts. This is about the same increase in temperature as is expected from the radiative forcing of CO_2 between today and the end of the 21st century (see Chapter 8).

Tol states, "If we take the confidence interval at face value, the impact of climate change does not significantly deviate from zero until 3.5C warming." To achieve 3.5C warming from industrial times means 2.4C to 2.6C in warming from today's temperature. Exceeding a 2.4C temperature increase solely from fossil fuel emissions is very unlikely (see Chapter 8), so CO_2 emissions are not likely to have any negative impact on the economy throughout the twenty-first century and only minimum impact thereafter. And this assumes the unlikely event that there are no natural cooling events in this period. Tol concludes, "Thus climate change would appear to be an important issue primarily for those who are concerned about the distant future, faraway lands, and remote probabilities."

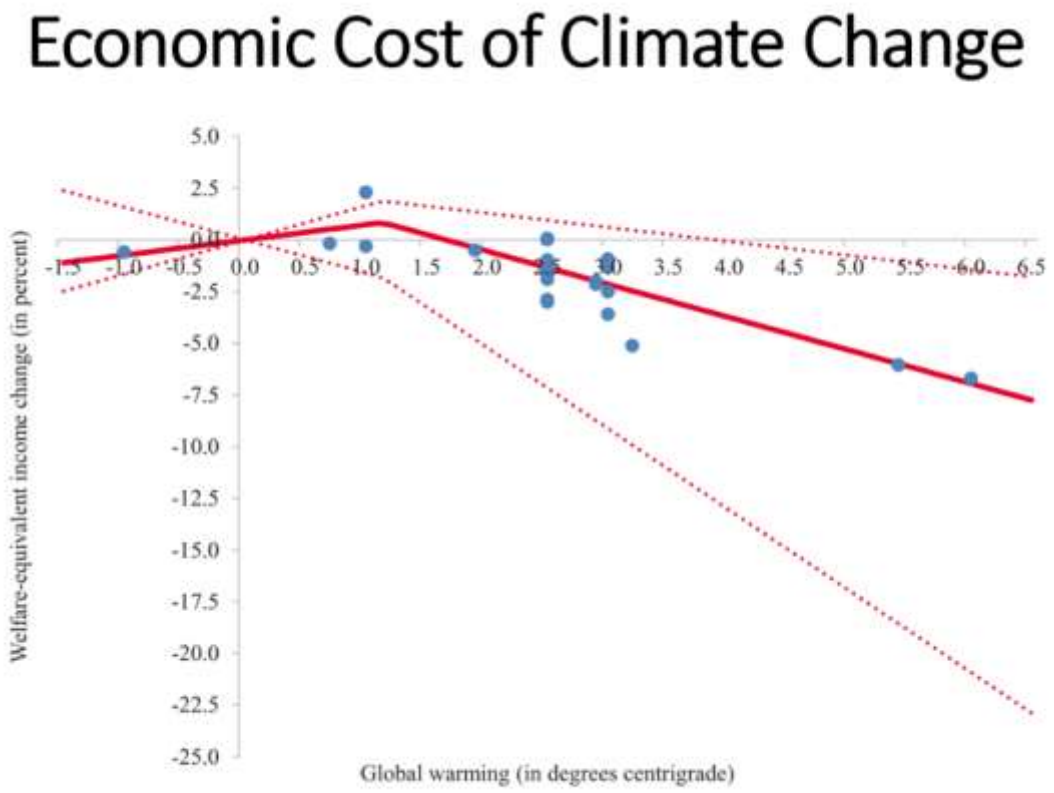

Figure 44 – Global Economic Cost of Climate Change. *Economist Richard Tol compiled the results of 22 economic studies on the impact of climate change. The mean of these studies shows increased temperatures are expected to provide net economic benefits up to a 1.7C increase in warming from preindustrial times, which is 0.6C or 0.8C from today's temperature. This is about the same warming expected from CO_2 warming through the end of the twenty-first century. The center line is the mean. The two dotted are one standard deviation from the mean. Source: Richard S. J. Tol, The Economic Impacts of Climate Change," Review of Environmental Economics and Policy, 2018, 12 (1) pgs. 4-25.*

Chapter 8 – The Science of Greenhouse Gas Warming

Greenhouse Gas Warming by CO_2 is Limited.

The sun warms the Earth, and the Earth radiates this heat back into space in the form of infrared radiation. CO_2 absorbs some of the infrared radiation emitted from the Earth, and CO_2 emits some of this radiation back to Earth, which warms the temperature of the atmosphere. This process is known as the greenhouse effect. CO_2 is limited in its ability to warm as it can only absorb and emit warming from within a very limited spectrum of infrared radiation, based upon quantum mechanics. The full spectrum of infrared radiation is from wavelengths of 0.7 to 100 micrometers, but CO_2 can only absorb radiation in the ranges of 2 to 4 micrometer and 13 to 17 micrometer wavelengths. The Earth radiates very little infrared radiation at the 2 to 4 micrometer wavelengths, so there is little radiation in this spectrum for CO_2 to absorb. As a result, the 13 to 17 micrometer wavelength is the only meaningful absorption spectrum of CO_2.

Water vapor absorbs over half of the infrared radiation at these 13 to 17 micrometer wavelengths and all the low levels of radiation at the 2 to 4 micrometer wavelengths. Therefore, the amount of radiation CO_2 can absorb and emit back to the Earth is limited because most of the energy in its radiative spectrum is already absorbed by water. This is especially true on the Earth's surface where there is ten times more water vapor than CO_2 in the atmosphere. At current levels of CO_2, 99.4% of all radiation in the 13 to 17 micrometer wavelength is absorbed between the ground and the first 10 meters of the atmosphere. Therefore, increased levels of CO_2 cannot absorb any meaningful additional heat near the surface of the Earth. This phenomenon is known as saturation. Because of saturation, most of the CO_2 greenhouse warming takes place at higher altitudes in the troposphere where there is less water vapor and greenhouse gases are less saturated. Such warming in the higher altitudes of the troposphere does raise the surface temperature by limiting the amount of heat radiated out to space, which alters the Earth's Energy Budget.

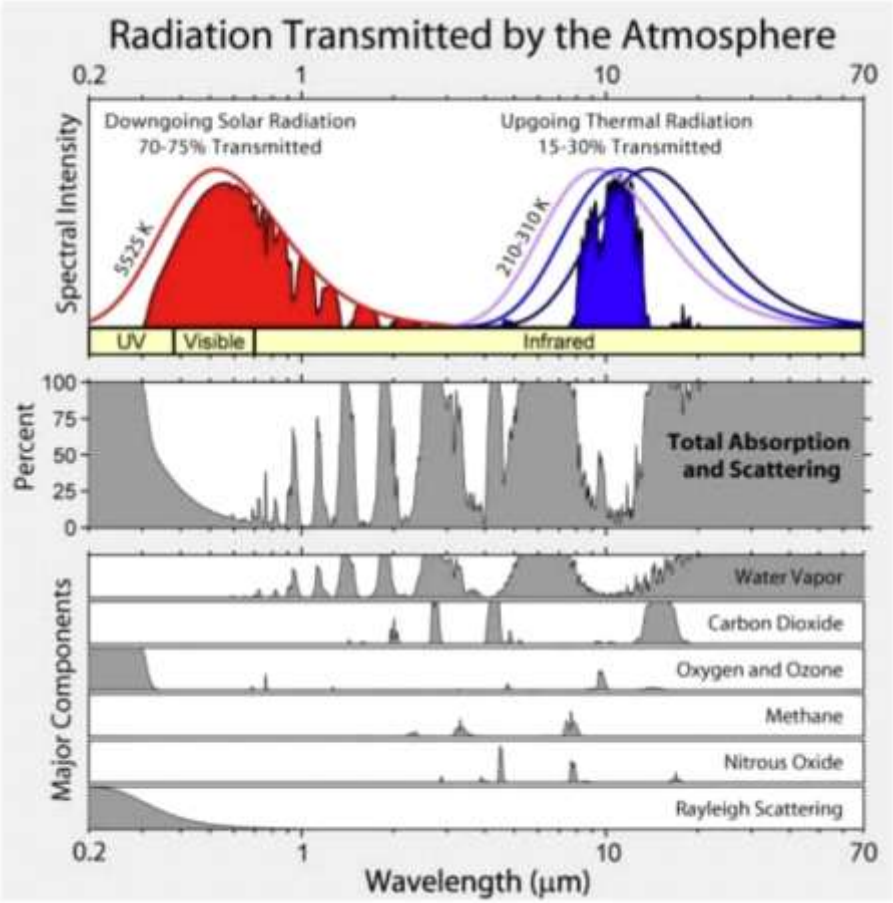

Figure 45 – Radiation Transmitted by the Atmosphere. *The chart above shows incoming solar radiation to the Earth in red and radiation back out to space from the Earth in blue. Greenhouse gases absorb some of the heat radiating from the Earth and warm the Earth. Each greenhouse gas can only absorb radiation from a limited wavelength spectrum unique to the quantum mechanics of the molecule. As seen in the chart, water vapor is the strongest greenhouse gas absorbing radiation from a large spectrum of radiation wavelengths. The only effective radiation band of CO_2 is in the 14 to 17 micrometer wavelengths. However, from the chart above, you can see that water vapor absorbs over half of the radiation in the 14 to 17 micrometer wavelengths, leaving less radiation for CO_2 to absorb. Because there is on average 10x times more water vapor in the atmosphere than CO_2 (0.4% water vapor and 0.04% CO_2), water vapor absorbs most of the warming in the 14-to-17-micron wavelength of infrared radiation at the surface of the Earth. Only at higher altitudes where it is colder and there is less water vapor does CO_2 make a difference. However, such warming at higher altitudes impacts the surface temperature as it limits the amount of heat radiating out to space.*

Exponential Decline of CO_2 Warming as Concentration Increases

Perhaps the most important scientific principle which goes against the climate alarmist narrative is the fact that the power of CO_2 to warm (known as radiative forcing) declines dramatically as concentration is increased. For example, an increase of 400 ppm of CO_2, from today's levels, produces approximately 0.8C increase in temperature. An additional 800 ppm increase is required for another 0.8C increase in

temperature, an additional 1,600 ppm for another 0.8C increase in temperature, and an additional 3,200 ppm is required for yet another 0.8C increase in temperature. The equation for calculating radiative forcing for increasing concentrations of CO_2 is: Radiative Forcing = K x ln(C/Co), where radiative forcing is in watts per square meter, K is a constant, "ln" is the natural log, "C" is the new concentration and "Co" is the original concentration. As set forth in Table 2 below, you need to double concentrations successively to achieve a corresponding one unit of increase of heating. To increase heat by 5-fold, requires a 32-fold increase in CO_2 concentrations.

Table 2. Exponential Decline of the Natural Log	
Natural Log of CO_2 Concentration Increase	*Amount of Heat Produced by CO_2 Increase*
*ln(**2**) = 0.693*	*0.693 = **1** x 0.693*
*ln(**4**) = 1.386*	*1.386 = **2** x 0.693*
*ln(**8**) = 2.079*	*2.079 = **3** x 0.693*
*ln(**16**) = 2.722*	*2.722 = **4** x 0.693*
*ln(**32**) = 3.465*	*3.46 = **5** x 0.693*

Because "ln" is the natural logarithmic function, the greenhouse warming of CO_2 is not linear to CO_2 concentrations, but decreases exponentially, so increasing levels of CO_2 have only a modest and rapidly declining impact on temperature. See the figure below for a visualization of the exponential decline of radiative forcing (warming) from CO_2 as concentrations of CO_2 increase.

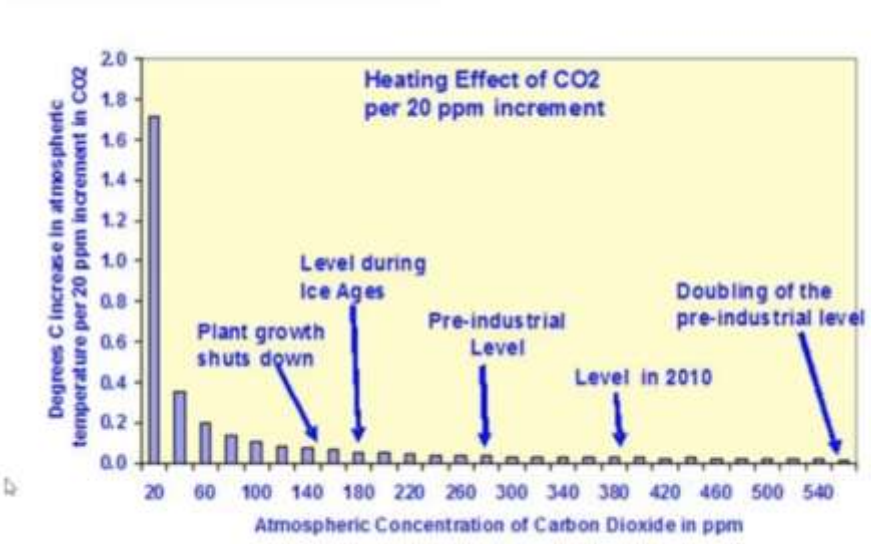

Figure 46 – Exponential Decline of CO_2 Heating Effect with Increasing Concentration. *Successive doubling of CO_2 concentrations is required to achieve one unit in additional heating. For example, an increase of 400 ppm of CO_2 raises temperature by about 1C. It would take another 800 ppm increase for another 1C, so to raise temperature by 2C requires increasing CO_2 by 1200 ppm. Each additional ppm increase in CO_2 concentration has an exponentially declining impact on warming. There is no dispute about this established law of physics. Source: Jeremy Nieboer, Tom Nelson Podcast #151,* https://youtu.be/7cP4o4cNjjA?si=asbz66gZvbuK47WY.

Another factor which reduces the power of greenhouse gases to increase temperature is the Stefan-Boltzmann Law. The Stefan-Boltzmann Law is used to convert heat (in watts per square meter) of a black body, such as from radiative forcing on the Earth, into temperature (in degrees Kelvin or Centigrade). This law states that the total energy radiated per unit surface area of a black body is directly proportional to the fourth power of its absolute temperature. Temperature is thus the fourth root of the energy divided by the Stefan Boltzmann constant. Therefore, it takes exponentially more energy to increase temperature linearly, to the power of 4! This law means that as temperature rises, it takes exponentially more energy to increase temperature by each degree. The hottest temperature recorded on Earth was 134 degrees Fahrenheit (56.7C), measured on July 10, 1913 in Death Valley, California. The reason it has been so difficult to beat this record is the extra energy required to heat over 134 degrees is exponentially higher than the temperature increase. The Stephan Boltzmann law is thus another thermostat of the Earth, which acts to limit extreme temperatures (see Online physics course on YouTube by Michael Van Biezen titled, Astronomy Chapter 9.1 – Earth's Atmosphere (https://www.youtube.com/watch?v=dw3vQ6hguWg).

Anthropogenic Greenhouse Gases Will Increase Temperature by less than 1C by the End of the 21st Century.

The IPCC agrees with other physicists (Happer, Wijngaarden) that doubling CO_2 from present levels of about 400 ppm to 800 ppm would result in an increase in radiative forcing (warming) by 1% or about 3 watts per square meter. The IPCC Assessment Report 5 puts this number at 2.9 watts per square meter. At 400 ppm of CO_2, radiation emitted back to space from the Earth would be 277 W/m^2, if there were no clouds. Doubling CO^2 from 400 ppm to 800 ppm would change this number to 274 W/m^2, which is a net change of 3 W/m^2 (see "The Gas of Life" Will Happer, https://youtu.be/tXJ7UZjFDHU?si=jnY-PTVlTLZZyFF9). You may hear the number of 3.7 watts per square meter for doubling CO_2, but that is the number for doubling CO_2 from the preindustrial level of 280 ppm to 560 ppm. The figure for doubling from 400 ppm to 800 ppm, which tells us the future radiative forcing from CO_2, is about 3 watts per square meter (see Figure 47).

Table 3. Radiative Forcing of CO_2
400 ppm to 800 ppm of CO_2
K x ln(C/Co),
K = 4.3281
C = 800 ppm
Co = 400 ppm
800 ppm/400 ppm = 2
Ln(2) = 0.6931
4.3281 x 0.6931 = 3.0 W/m^2

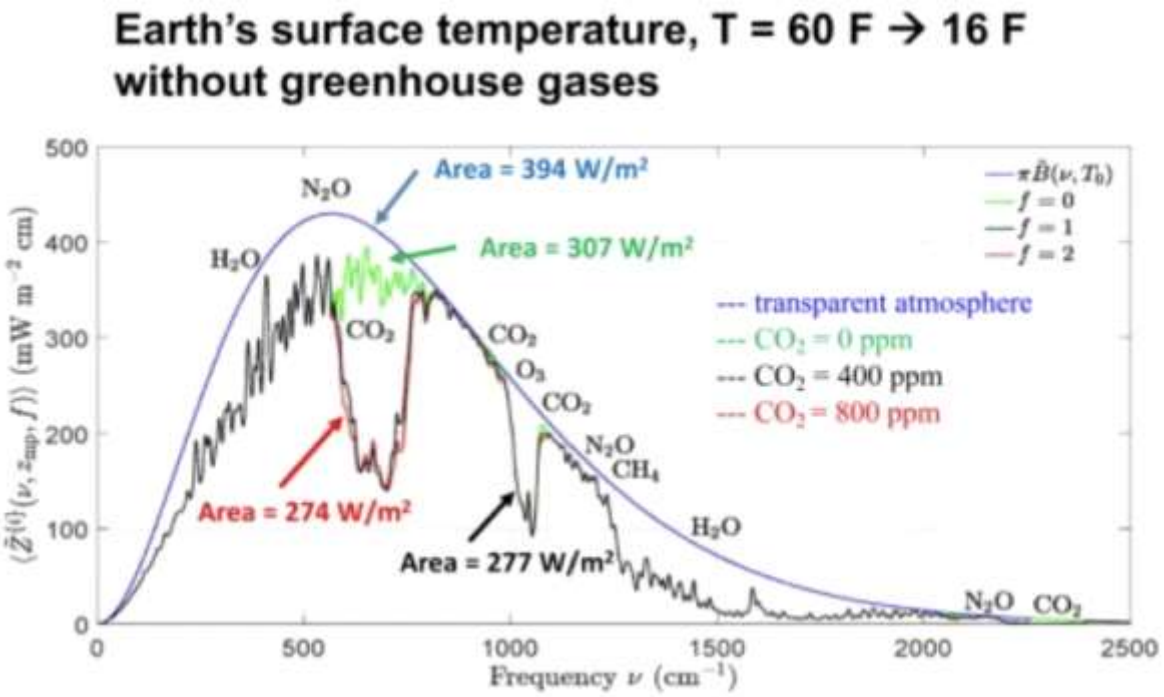

Figure 47 – Black Body Curve of Earth's Surface Temperature. *The Chart above shows the Black Body Curve of the Earth's surface temperature, without clouds. The Black Body curve calculates the amount of the Earth's heat radiated back out to space, if there were no clouds. The line in blue is the theoretical Planck Black Body Curve for a transparent atmosphere without clouds. The green line is the Black Body Curve, without clouds, if no CO_2 were in the atmosphere (307 watts per square meter radiated out to space). The black line is the curve, without clouds, for CO_2 levels of 400 ppm (277 watts per square meter radiated out to space). Moving from 0 ppm to 400 ppm of CO_2 in the atmosphere prevents 30 watts per square meter of heat from radiating out to space (307 – 277 = 30). This quantifies the greenhouse effect of CO_2 in warming the Earth. The red line is the energy radiated out to space, without clouds, at 800 ppm of CO_2 (274 watts per square meter). Because of the exponential decline in the power of to absorb energy as CO_2 concentrations increase, the change from 400 ppm to 800 ppm only absorbs an additional 1% of heat or 3 watts per square meter 277-274 = 3). The temperature increase of doubling CO_2 levels from 400 ppm to 800 ppm only increases heat by 3 watts per square meter or 0.8C. Source:* "The Gas of Life" Will Happer, https://youtu.be/tXJ7UZjFDHU?si=jnY-PTVlTLZZyFF9).

Watts per square meter can be translated into temperature using the Stephan-Boltzmann law. Using the Stephan-Boltzmann law, an increase of 3 watts per square meter translates to an increase of 0.8 degrees Kelvin (K) or Centigrade (C). Using a Stephan-Boltzmann Law calculator, Stefan Boltzmann Law Calculator - Free online Calculator (byjus.com) you can enter the figures in Table 3 below to determine that an increase of 3 W/m^2 produces a temperature increase of 0.79C. At the current rate of fossil fuel use, it will take about 159 years to increase CO_2 from 420 ppm today to 800 ppm. Due to the declining exponential function of CO_2 warming, CO_2 levels would need to increase by another 800 ppm to produce another 3 watts/square meter of heating and by 1600 ppm for yet another 3 watts/square meeting of heating. Therefore, to increase temperature by 2.4C (3 x 0.8C) degrees C requires a CO_2 level of over 3200 ppm, almost 8 times the current level.

Table 4. Stephan-Bolzman Conversion of Heat to Temperature

400 ppm of CO2	***800 ppm of CO2***
m^2 = 1	*m^2 = 1*
Emissivity without clouds = 0.71	*Emissivity without clouds = 0.71*
Radiative Forcing = 277 W/m^2	*Radiative Forcing = 280 W/m^2*
Temperature = 288C	*Temperature = 288.79C*
	Temperature Change = 0.79

At the current rate of increase of CO_2 concentrations (2.4ppm per year), it would take 1,159 years to reach 3,200 ppm and 2.4 C in warming. However, 3,200 ppm of CO_2 could never occur due solely to the burning of fossil fuels. According to the Global Carbon Project, the total amount of carbon contained in the world's remaining fossil fuel reserves is estimated to be around 2,795 gigatons. **If all 2,795 gigatons of these reserves were burned, and none of the resulting CO_2 were absorbed in the oceans, it would produce an increase of 2,470 ppm of CO_2**. Adding that to the current CO_2 level of 420 ppm would lead to a total CO_2 concentration of 2,890 ppm (2,470 + 420). Other estimates have put this total number as low as 1,970 ppm. Both forecasts are higher than would ever be experienced, however, as the ocean would certainly absorb substantial amounts of CO_2 from the atmosphere. At the current level of 2.4 ppm per year increase in CO_2, it would take over 1,000 years to reach 2,890 ppm and even longer if the ocean's absorption of CO_2 is considered. Furthermore, it is not expected that we will burn all fossil fuel reserves, as some will be used for plastics and other petrochemicals (which will see growing demand) and it is expected that alternative forms of energy and transportation, including nuclear energy, hydrogen fuel, and electric vehicles (EV) will be deployed long before the Earth's carbon reserves are exhausted.

Using the radiative forcing equation for this absolute-worst-case scenario, increasing CO_2 levels to 2,890 ppm increases radiative forcing by 8.56 watts/meter squared (R = 4.328 x ln(2890 ppm/400 ppm = 8.56 W/m^2). Using the Stephan-Boltzmann calculator to convert to temperature, we see an increase of temperature of 2.0C in 1,000 years (see Table 4). Given the absorption of CO_2 into the oceans, a temperature increase of 2C or higher from fossil fuel use is very unlikely.

Table 5. Radiative Forcing of CO_2
400 ppm to 2890ppm of CO_2
K x ln(C/Co),
K = 4.3281
C = 2890 ppm
Co = 400 ppm
2890 ppm/400 ppm = 7.225
Ln(7.225) = 1.9775
4.3281 x 1.9775 = 8.56 W/m^2

Table 6. Stephan-Bolzman Conversion of Heat to Temperature	
400 ppm of CO2	***2,890 ppm of CO2***
m^2 = 1	*m^2 = 1*
Emissivity without clouds = 0.71	*Emissivity without clouds = 0.71*
Radiative Forcing = 277 W/m^2	*Radiative Forcing = 285.56 W/m^2*
Temperature = 288C	*Temperature = 290.21C*
	Temperature Change = 2.21C

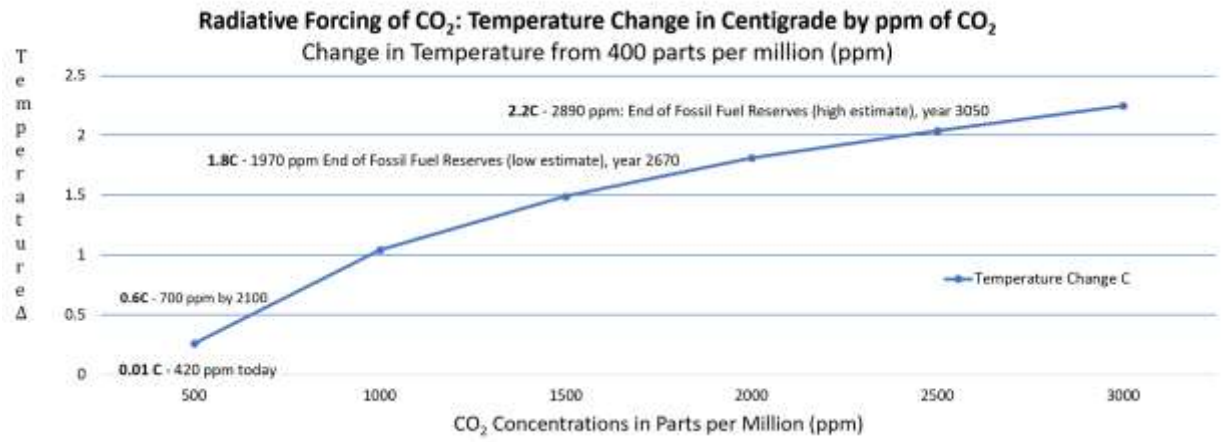

Figure 48 – Radiative Forcing of CO_2 in Degrees Centigrade. *Radiative Forcing (warming) of CO_2 concentrations in ppm. The Radiative forcing of CO_2 would produce warming of about 0.6C by 2100, if we do nothing to curb fossil fuel use. All remaining fossil fuel reserves are estimated to produce from1,970 ppm to 2,890 ppm of CO_2 in the atmosphere, if they were* ***all*** *burned, and* ***no*** *CO_2 was absorbed into the oceans (very unlikely). This unlikely worst-case scenario would result in a temperature increase of 1.8C to 2.2C and would take from 646 to 1,030 years, assuming we continue to add current 2.4ppm of CO_2 per year to the atmosphere. Given there are no significant net negative impacts economically from climate change until temperatures exceed 2.4C in warming (see Figure 44), burning all fossil fuel reserves will likely have only a small net negative impact on the global economy. The exponential decline in radiative forcing of CO_2 as concentrations increase is clearly seen in the downward curvature of the plotted data of the chart above. Assumptions: CO_2 base level 400ppm, Forcing=4.328 x ln(New Concentration/400); Stephan Boltzmann Law Calculator to convert watts/square meter to temperature, average Earth emissivity without clouds of 0.71, current temperature of 288K or 277.00 watts per square meter.*

Increases in greenhouse gases methane and nitrous oxide have even less impact than CO_2. Each molecule of methane and nitrous oxide have a much higher warming capacity than one molecule of CO_2, but because the amount of these gases released into the atmosphere is so tiny (parts per billion) relative to the amount of CO_2 released (parts per million), the contribution of methane and nitrous oxide to warming is only about $1/10^{th}$ of that caused by CO_2. The radiative forcing of methane is about 30 times larger than for CO_2. However, because the rate of increase per year of methane in the atmosphere is about 300 times less than CO_2 the increase in radiative forcing is about 30/300 or 1/10 that of CO_2. The radiative forcing of nitrous oxide as compared to CO_2 is similar. Other anthropogenic greenhouse gas emissions such as refrigerant gases CFCs and HFCs are measured in parts per trillion. Even though CFC's have 1,430 times more radiative forcing power than CO_2 on a per molecule basis, they are increasing at levels of one million times lower concentrations than CO_2. Therefore, their impact on global temperature is negligible at less than 1,430/1,000,000 or about $1/700^{th}$ the warming of CO_2.

As we see a 0.73 C increase in temperature by doubling CO_2 from today (420 ppm to around 800 ppm), during that same period the warming of methane and nitrous oxide will only equate to about .073 C each, or about 0.15 C combined. Together these three greenhouse gases will warm the Earth by less than 0.9 C over the period in which CO_2 doubles (see (223) #56 William van HYPERLINK "https://www.youtube.com/watch?v=WfwnKWIWPzk"Wijngaarden HYPERLINK "https://www.youtube.com/watch?v=WfwnKWIWPzk": Is Global Warming Hot Air? - YouTube).

The IPCC, in its worst-case scenario, forecasts a CO_2 level of 700 ppm by the end of this century if we do nothing to curb greenhouse gas emissions. A change from the current level of CO_2 of 420 ppm to 700 ppm produces an increase of 2.2 watts per square meter in radiative forcing (R = 4.328 x ln(700 ppm/420 ppm) = 2.2 W/m^2), or a rise in temperature of 0.58C. Including CO_2, methane, nitrous oxide, CFC, and HFC emissions to the year 2100, the temperature will increase by 0.7 C, in this worst-case scenario.

The physics behind these calculations is not disputed. Physicists who are climate alarmists, such as Brad Marston of Brown University (see https://youtu.be/LHJjDjEMihg?si=Iz31J0Knq6USrW1v) and climate alarm skeptic William Happer, from Princeton University (see https://youtu.be/PblYr-KjOVY?si=7Pg1S2s3XC3ug3UO), both calculate the number to be approximately 1C or less by doubling CO_2 concentrations. Such mild warming of less than 1C, in this worst-case scenario, is not a crisis, it would have only minimal net negative impacts on the economy (see Figure 44). Furthermore, the increase in CO_2 would certainly boost agricultural productivity. So why do some insist we are having a climate crisis? The entire climate crisis hysteria is based on an unsubstantiated supposition that the warming of 1C will be amplified 3 times by water vapor feedback, which is not offset by negative feedbacks. **The climate alarmist narrative stands or falls on this one conjecture, which we shall see, has been proven wrong with observational data.** MIT Professor Lindzen said the positive feedbacks in the climate models "are assumed - not derived or observed."

Since the start of the Industrial Revolution, Temperature has Increased by 0.9C

The IPCC reported the following in a press release on August 9, 2021: "Emissions of greenhouse gases from human activities are responsible for approximately 1.1C of warming since 1850-1900." Ronan Connoly has stated that the IPPC historical temperature record is contaminated due to the Urban Head Effect. Anyone who has driven into a city from the countryside can observe the temperature increase on the thermometer in their car as they enter the city. I noted once a 10F increase in temperature as I drove from the countryside in New Jersey into New York City. Urban areas have asphalt, concrete and roofs that absorb solar energy and raise the temperature of the surrounding area. They also have more heat from air conditioning, heating, and transportation exhaust. In a recent paper by Genki Katata, Ronan Connolly and Peter O'Neil, Journal of Applied Meteorology and Climatology, "Evidence of Urban Blending in Homogenized Temperature Records in Japan and in the United States. Implications for the Rehabilitation of Global Land Surface Air Temperature Data," 25 Aug 2023, the authors provide convincing data that temperature records report 20% higher temperatures overall, due to urbanization and the number of thermometer readings in urban areas, which were formerly rural. 1.1C minus 20% is about 0.9C. Even a figure of 0.9C is double what can be accounted for by direct greenhouse gas warming over this period.

1850 is considered the start of the industrial revolution for climate studies. CO_2 levels in the atmosphere in 1850 were 285 ppm. (https://www.eea.europa.eu/data-and-maps/daviz/atmospheric-concentration-of-carbon-dioxide-5/download.table). Using the radiative forcing equation for CO_2 yields a temperature increase of 0.50C to increase CO_2 from 285ppm to today's level of 420 ppm (see tables 7 and 8 below). This suggest greenhouse gas radiative forcing from CO_2 represents slightly more than half of the warming since 1850.

Table 7. Radiative Forcing of CO_2
420 ppm to 285 ppm of CO_2
K x ln(C/Co),
K = 4.3281
C = 285 ppm
Co = 420 ppm
285 ppm/420 ppm = 0.6786
Ln(0.6786) = -0.3878
4.3281 x -0.3878 = -1.6783 W/m^2
277 W/m2 – 1.68 = 275.32

Table 8. Stephan-Bolzman Conversion of Heat to Temperature	
285 ppm of CO2	***420 ppm of CO2***
m^2 = 1	*m^2 = 1*
Emissivity without clouds = 0.71	*Emissivity without clouds = 0.71*
Radiative Forcing = 275.32 W/m^2	*Radiative Forcing = 277.21 W/m^2*
Temperature = 287.57C	*Temperature = 288.07C*
	Temperature Change = 0.50C

Chapter 9 - The Water Vapor Climate Amplification Supposition, the Basis of Climate Alarmism, is not Confirmed in Measurements

Only ½x Climate Amplification from Water Vapor and Clouds is Found in Observations and Temperature Reconstructions, far less than 3x Claimed by the IPCC.

As previously stated, Richard Feynman summarized the scientific method as follows: "… we say compare to experiment or experience, compare it directly with observations to see if it works. If it disagrees with experiment, it's wrong." As we shall see, the water vapor amplification theory, which is the basis of climate alarmism, disagrees with observations and is therefore wrong. This is why Dyson Freeman, one of the most brilliant physicists of our time, said there is no climate alarm and that increased levels of CO_2 are probably beneficial.

The alarm about global warming comes, not from CO_2, methane, and nitrous oxide warming, but from an unsubstantiated conjecture of a positive feedback that increased temperature from CO_2 will raise humidity and amplify warming through the greenhouse effect of water vapor and clouds, resulting in temperatures which are magnified by nearly 3x. But this positive feedback supposition is counter to how nature works, which rebalances itself through negative feedbacks, and as a result, the world has never seen oceans boil from positive temperature feedbacks, despite the fact that we have had periods on this Earth with far higher levels of CO_2 (about 420 ppm today vs. over 7,000 ppm in the Cambrian era). For billions of years, the Earth has varied in temperature within a relatively narrow range.

Known as the Earth's thermostat, negative feedbacks rebalance temperatures. Low cloud cover is the major thermostatic feedback as low clouds reflect 70% to 90% of sunlight back to space and prevent this solar energy from ever reaching the Earth. This is a negative feedback of 168 W/m^2 to 216 W/m^2 of solar energy under the low clouds. If it gets too warm, more clouds are formed from the increased water vapor in the atmosphere and the increase in cloud nucleating sulfate aerosols from increased algae growth in the oceans. These clouds cool the temperature. If it gets too cold, less low clouds are formed due to decreased water vapor in the atmosphere and the decline of cloud nucleating sulfate aerosols from decreased algae growth in the oceans. Fewer clouds allow more solar energy to heat the Earth's surface. The Stephan-Boltzmann Law also makes it difficult for the Earth's temperature to increase to extremes, since it requires an exponentially larger amount of energy, to the fourth root, to increase temperature linearly. For specifics on the Stephan-Boltzmann thermostat, see lectures by Michael Van Biezen titled, Astronomy Chapter 9.1 – Earth's Atmosphere (https://www.youtube.com/watch?v=dw3vQ6hguWg).

Scientific evidence demonstrates that net climate feedbacks are not positive, as speculated by climate alarmists, but negative as would be expected by the natural thermostat of the Earth. Changes in cloud albedo and aerosols can have significant impacts on radiative forcing. Despite the presence of well-established negative feedbacks in nature which offset warming, IPCC has ignored the negative feedback of clouds and evaporation and conjured up a theory of a positive feedback from water vapor to exaggerate the temperature impact of CO_2 warming by 3x.

Using 30 paleoclimate proxies, Professor Fredrik Ljungvist from Stockholm University reconstructed temperatures for the past two millennia. This reconstruction places the nineteenth century in context.

It is important to see that the total warming since 1850 is less than 0.9C as reconstructed from proxy data. Professor Ljungqvist shows the temperature change between 1850 to 2000 is 0.5C. There has been an additional 0.35C in warming since 2000. So, the temperature increase from 1850 to 2023 would be less than 0.9C. More significant, the Earth was just coming out of the Little Ice Age in the nineteenth century including the Dalton Solar Minimum in the early 1800s and the temperature increase since 2000 is at a time when the warm periods of the AMO and PDO ocean oscillations converged, which would overstate the warming. In light of the Connely paper on the urban island heat effects on temperature measurements, the 0.9C increase since 1850 from paleoclimate reconstructions is likely more accurate than the 1.1C figure quoted by the IPCC.

In the twentieth century, the Earth moved into the Modern Solar Maximum, the largest solar maximum in 10,000 years (see Crok, pg. 83). As will be explained later in this paper, the increased solar irradiance, reduced cosmic rays, and lower cloud cover of the twentieth century had a major impact on increasing temperatures, just as these forces warmed the Earth in the Roman Optimum and Medieval Optimum. The Earth experiences grand solar cycles about every 500 years, known as the Eddy Solar Cycle. These warm and cold cycles correlate to the temperatures in Figure 42, including Modern Warming. As can be seen in the graph, the Roman Warm Period was 0.6C warmer than the Dark Ages, the Medieval Warm Period was 0.5C warmer than in 1850. History provides a real-world lab experiment that teaches us to expect the Modern Solar Maximum would increase global average temperature by about 0.5C or more since 1850. This warming does not account for greenhouse gases. When you add the 0.4C of greenhouse gas radiative forcing to 0.5C from the Modern Maximum solar cycle, this number totals 0.9C. Since the actual temperature increase since 1850 is between most likely around 0.9C, the negative climate feedbacks offsets or more than offsets all positive temperature feedbacks, just as would be expected from the "Earth's thermostat" which rebalances itself.

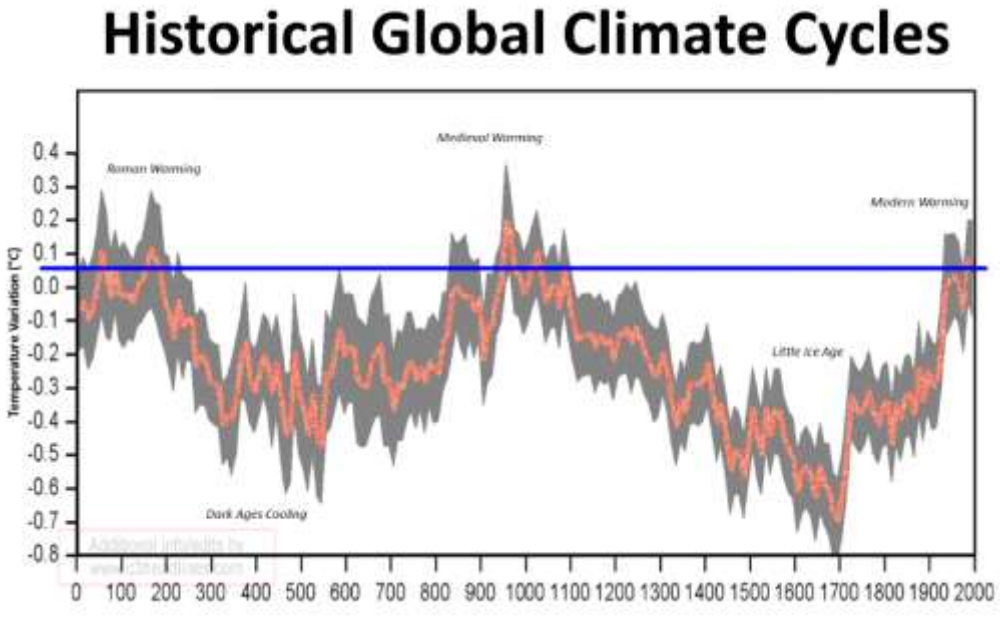

Figure 49 – Historical Global Climate Cycles. *Using 30 paleoclimate proxies, Professor Fredrik Ljungvist reconstructed temperatures for the past two millennia. From this graph, you can see that temperatures increased by about 0.5C between 1850 to 2000. Since 2000, the Earth has warmed an additional 0.35C or a total of 0.9C since 1850 (the IPCC puts this figure at 1.1C, but their number is likely 20% too high due to the urban heat effect, see G. Katata, et all referenced above). CO_2 levels were*

stable during the Roman Warm Period and the Medieval Warm Period, so temperature swings in these periods were not from greenhouse gases. These warm and cold periods do coincide with the Eddy Solar Cycle, so it is likely solar activity and cloud cover (see Chapter 10) impacted these temperatures. The difference in temperature between the Roman Warm Period and Dark Ages was 0.5C and the difference between the Medieval Warm Period and 1850 was 0.5C. The Modern Warming of the twentieth century is accompanied by the Modern Solar Maximum and is the most active grand solar cycle in 10,000 years. The Modern Solar Maximum is the repeated warm phase of the Eddy Solar Cycle and is similar to the solar maximums of the Roman Warm Period and the Medieval Warm Period. The experimental lab of history teaches us to expect the Modern Solar Maximum will increase temperatures by 0.5C between 1850 and today. Using the radiative forcing equation, the warming of CO_2, methane, and nitrous oxide would increase temperatures by 0.4C since 1850. If you add 0.5C from the solar cycle to 0.4C from greenhouse gases you get total warming of 0.9C. Since the actual change in temperature between 1850 to today is likely 0.9C, the data shows any positive water vapor feedback is entirely offset or more than offset by negative feedbacks, as is expected from the Earth's thermostat. Source: Geografiska Annaler: Series A, Physical Geography Volume 92, Issue 3, pages 339–351, September 2010 "A NEW RECONSTRUCTION OF TEMPERATURE VARIABILITY IN THE EXTRA-TROPICAL NORTHERN HEMISPHERE DURING THE LAST TWO MILLENNIA" by Fredrik Charpentier Ljungqvist, Department of History, Stockholm University, SE-106 91 Stockholm, Sweden. Additional edits by www.c3headlines.com*, See also* THE HOCKEY SCHTICK: Paper: Roman HYPERLINK "https://hockeyschtick.blogspot.com/2010/09/paper-roman-medieval-warming-period.html"& HYPERLINK "https://hockeyschtick.blogspot.com/2010/09/paper-roman-medieval-warming-period.html" Medieval Warming Period Temps Reached or Exceeded the 20th Century.

According to the Clausius-Clapeyron principle, in dry air and constant pressure, a 1C increase in temperature would increase humidity by 7% to remain at relative humidity; this is confirmed in laboratories. IPCC models rely on the Clausius-Clapeyron principle to estimate the positive feedback of water vapor. IPCC AR6 it states, "The Clausius–Clapeyron equation determines that low-altitude specific humidity increases by about 7% °C of warming, assuming that relative humidity remains constant, which is approximately true at a global scale but not necessarily valid regionally." (IPCC, 2021, pg. 1065). IPCC climate models base their calculations on the Clausius-Clapeyron principle and generally assume relative humidity will remain constant as temperature increases. These models attribute a 3x increase in temperature, mostly from water vapor, for every 1x increase in temperature from other factors, such as CO_2, methane, and nitrous oxide warming. However, this 3x amplification is much too large. Physicist William van Wijngaarden calculated the water vapor positive feedback effect of less than 1C for each 1C increase in global temperature (1x amplification) if relative humidity remained constant (see (223) #56 William van HYPERLINK "https://www.youtube.com/watch?v=WfwnKWIWPzk"Wijngaarden HYPERLINK "https://www.youtube.com/watch?v=WfwnKWIWPzk": Is Global Warming Hot Air? - YouTube).

The impact of the water vapor amplification is even less than 1x because relative humidity has declined as the temperature has increased. Unlike the laboratory where humidity increases are measured in controlled dry air conditions, the actual increase in the real world is not so simple. Since the Tropics are nearly saturated with water vapor, there would be little increase in humidity with increasing temperatures. It is too cold in the Arctic and Antarctica for the air to hold hardly any moisture, and humidity generally does not increase in deserts as temperature rises. Consequently, the global average humidity increase is less than in laboratory conditions, which is verified in global average humidity measurements. The calculation is extremely complex as it is influenced by local weather conditions, climate patterns, wind speeds, and cloud formation, all of which are in a constant state of flux. Higher rates of condensation will lower humidity, and this is another dynamic having multiple variables. Higher

winds significantly increase evaporation, which you experience when you place a fan in front of a wet towel. With the moderating temperatures in the Arctic, there is a smaller temperature difference between the Arctic and Tropics, which induces lower wind speeds and result in lower evaporation rates (see Milton, Joseph, "Why Winds Are Slowing," Nature, 1668 Access, 17-Oct-2010).

Measured data from weather balloons since 1948 shows relative humidity has declined. This is a period of rapid increases in CO_2 concentrations in the atmosphere. The decline has been most prevalent in the upper troposphere (see Figure 50). This is significant, since global warming from greenhouse gases occurs in the upper troposphere, because greenhouse gases are saturated at lower altitudes, which means they have almost no capacity to absorb additional heat near the surface." Since the calculation of the water vapor temperature amplification is so complex with many dynamic variables, actual humidity measurements, which show a decline in relative humidity, rather than climate models, provide the best clarity to what is actually happening.

Andy May has written an excellent article titled, "Atmospheric water vapor (TPW) and climate change" March 23, 2023, https://andymaypetrophysicist.com/2023/03/21/atmospheric-water-vapor-tpw-and-climate-change/ were he examines specific humidity, or Total Atmospheric Water Vapor (TPW), from weather balloon measurements going back to 1948. May cites studies by Benestad (2016), Miskolczi (2014), and the NOAA R1 datasets, which all show declines in TPW from 1979 to 2011, a period of rapid global warming. From 1985 to 2008, TPW declines sharply as temperature increases. May cites from Paltridge, Arking and Pook (2009), "Negative trends in q [TPW] as found in the NCEP data would imply that long-term water vapor feedback is negative—that it would reduce rather than amplify the response of the climate system to external forcing such as that from increasing atmospheric CO_2." May concludes, "It seems likely that the Clausius-Clapeyron relation is not the only factor affecting TPW. This casts considerable doubt on the CMIP6 model results, which rely only on Clausius-Clapeyron, human activities, and sporadic volcanism."

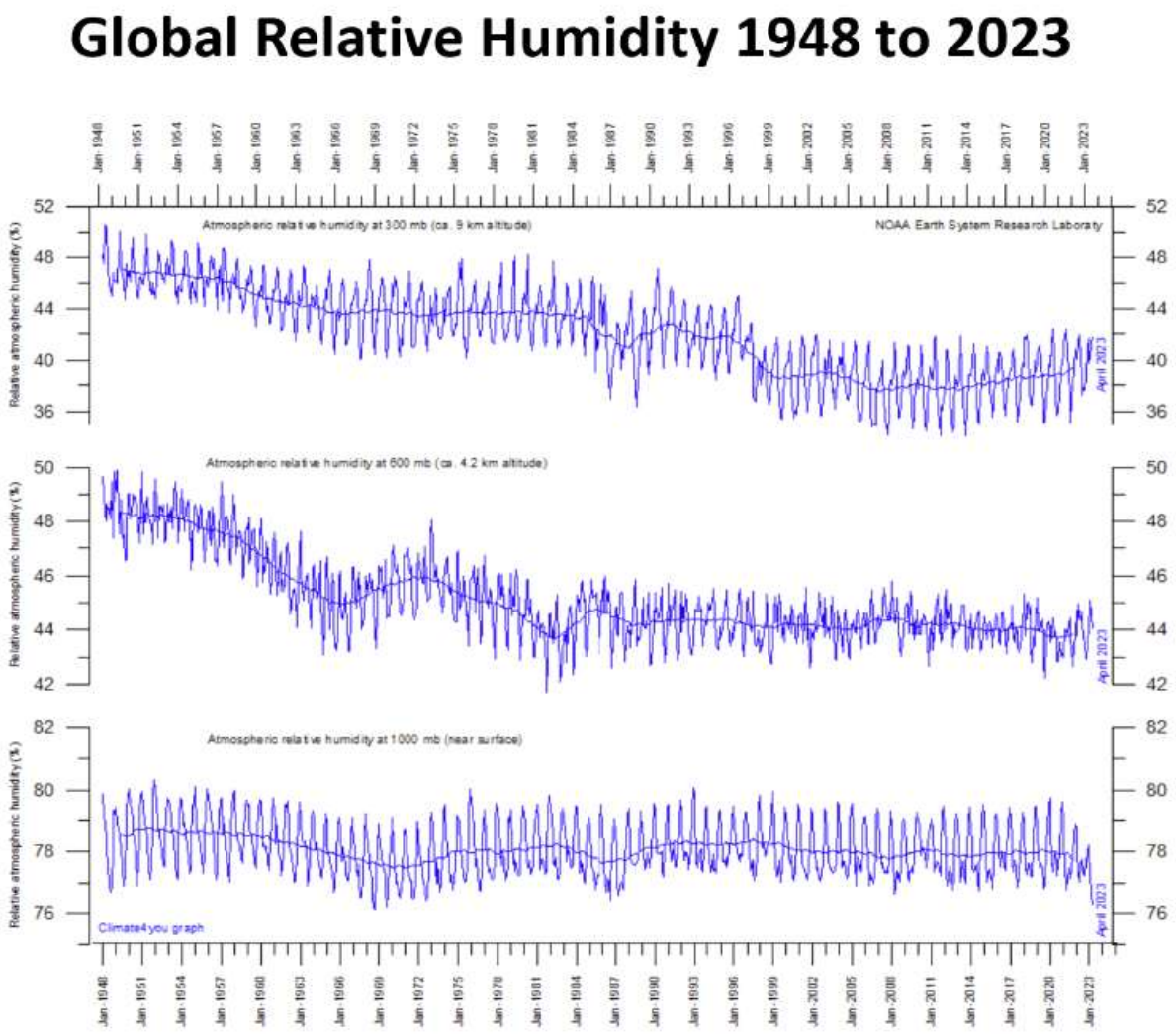

Figure 50 – Global Relative Humidity 1948 to 2023. *Measurements by the National Oceanic and Atmospheric Administration (NOAA) shows relative humidity has declined since 1948, particularly in the upper troposphere. Because greenhouse gases' capacity to absorb heat at the surface of the Earth is saturated, most greenhouse gas warming occurs at higher altitudes. Climate models assume relative humidity remains constant as temperatures increase, so they overestimate the radiative forcing power of the water vapor feedback. Source: NOAA Earth System Research Library, data graphed by Climate4you.*

As mentioned above, calculations of the greenhouse effect of increasing CO_2 to 700 ppm by the year 2100 results an increase of 2.2 watts per square meter in radiative forcing or a temperature increase of 0.6C. You may increase the number to 0.7C, if you also include increases in methane and nitrous oxide. However, the IPCC and climate alarmists use the amplifier of water vapor theory to forecast an increase of 2.1C (3.2 C from the preindustrial age: 1850 to 1900) by the end of this century, a **three-fold amplification**. Clearly these climate models over amplify the impact of water vapor by relying exclusively on the Clausius-Clapeyron principle, which actual observations have clearly shown is too simplistic to portray the complexities of water vapor in the atmosphere of the real world.

A study published in the Journal of Climate by Brian J. Soden and Isaac M. Held examines water vapor feedback and other positive climate feedbacks. The authors look at various climate feedback

mechanisms to determine their impact. Soden, et al conclude water vapor is the largest positive feedback in the climate. They look at the feedback of water vapor and other factors based on a doubling of CO_2 from levels found in the year 2000. The results they report is an amplification from water vapor of 1.8 W/m^2-K, followed by clouds at 0.68 W/m^2-K, followed by changes to surface albedo as ice caps melt of 0.26 W/m^2-K. (see Brian J. Soden and Isaac M. Held, Journal of Climate, "An Assessment of Climate Feedbacks in Coupled Ocean-Atmosphere Models.", 15 July 2006, 3354-3360). W/m^2-K is a measure of the transfer of heat in watts per square meter for each 1K of heating. We have already shown that doubling of CO_2 will result in radiative forcing of 3.0 watts per square meter and a temperature increase of 0.8C. Including all other anthropogenic greenhouse gases, including methane, nitric oxide, and HFCs results in a radiative forcing of about 3.6 watts per square meter and a temperature increase of less than 1.0C. 1.8 W/m^2-K (water vapor feedback) x 1.0K (greenhouse gas warming for doubling CO_2) = 1.8 watts per square meter of heat transfer for water vapor. Since 1.8 watts per square meter is 0.50 of greenhouse radiative forcing of 3.6 watts per square meter, **this paper suggests the anthropogenic greenhouse gases temperature amplification of water vapor is ½x, not 3x**. An amplification of 0.50x is less than the calculations of William van Wijngaarden, who calculates a 1x multiplier of water vapor feedback if relative humidity remains constant. Since relative humidity has declined as temperature has increased, the water vapor feedback multiplier is certainly less than 1x and may be as low as 0.50x as predicted in this Nature Climate paper.

Observations of clouds by the International Satellite Cloud Climatology Project have shown that an increase in cloud cover of 7% lowers temperature by 0.5C (see Chart 54). Using the same assumption that water vapor increases by 7% for each 1C in warming, it is safe to assume that cloud cover also increases by 7% for each 1C in warming. The cooling impact of clouds is thus -0.5C or -1.7W/m2 for each 1C in warming, which is a negative feedback of about 1/2x. Thus, the net cloud negative feedback of cooling offsets the water vapor positive feedback of warming.

Table 9. Stephan-Bolzman Conversion of Heat to Temperature
-0.5C for each 1C in warming
m^2 = 1
Emissivity without clouds = 0.71
Temperature = 287.5 (288 - 0.5)
Radiative Forcing = 275.3 W/m^2
Radiative Forcing Change = -1.7 W/m^2 (275.3 -277)

Other positive feedbacks included in IPCC climate models include clouds and melting ice caps. The IPCC has concluded that clouds have both positive and negative feedbacks to temperature and the net impact of clouds is to lower temperature. Observations confirm the net negative impact of cloud cover is one of cooling (see Chart 54), so we can ignore the positive feedback of clouds (see Chapter 10). If we add the change in the Earth's albedo from melting ice caps of 0.26 W/m^2-K to water vapor heat transfer of 1.8 W/m^2-K, we get 2.1 W/m^2-K, which is 0.6 of 3.6 watts per square meter. So according to this paper **anthropogenic greenhouse gases temperature amplification of combining water vapor, clouds, and albedo loss from melting ice caps is less than 0.6x, not 3x** as claimed by climate alarmists. Temperature amplification of 0.6x is easily counteracted by negative feedbacks including increased cloud albedo and aerosols. The cooling impact of sulfate aerosols also increases with rising temperatures due to algae blooms (see Chapter 11).

Temperature measurements do not support water vapor feedback as the primary driver of climate as claimed by climate alarmists. The IPCC claims temperatures will increase by 3.2C by the end of the twenty-first century from pre-industrial times (1850 to 1900). They claim we have already seen 1.1C in temperature increase leaving 2.1C left from now to 2100. We have seen that only 0.8C can be attributed to radiative forcing from anthropogenic greenhouse gases in that period. This means 1.3C is due to positive feedbacks, which represents most of the warming. The paper by Soden, et al, demonstrates that water vapor feedback is the dominant positive feedback mechanism, but it would only account for 0.53 x 0.8C or about 0.4C in warming by the end of the century, not 1.3C. Furthermore, the water vapor feedback of 0.4C would be offset by the negative feedback of increased cloud cover due to increased water vapor in the atmosphere.

Climate Models Which Incorporate Water Vapor and Cloud Positive Feedbacks to Increase Temperature Run Much Too Warm.

Climate models predict that evidence of the water vapor amplification of the atmosphere should be seen by a hot spot 10 km up in the Tropics. After water vapor evaporates at the surface, it rises in the atmosphere and then condenses at about 10 km from the surface in the Tropics. When the water condenses, it releases stored latent heat, which produces a hot spot. It should be primarily seen in the Tropics as this is the area of greatest water evaporation and humidity. The IPCC's 4th Assessment report included charts to depict this theoretical tropical hot spot. However, observational data from weather balloons and satellites has not been able to confirm a consistent presence of this hot spot as predicted in models. Dr. Steven Japar participated in the 1995 and 2001 IPCC assessment reports, and he resigned over the absence of this hot spot anomaly (see Brady, pg. 105). Dr. Jasper commented, "Temperature measurements show that the hot zone, that is predicted by the models in the mid-troposphere, is non-existent. This is more than sufficient to invalidate global climate models and projections made by them." (see Brady, pg. 105)

The IPCC has removed the hot spot from more recent assessment reports, since observational data does not confirm its existence. There is likely some amplification of temperature from water vapor, but the absence of a consistent tropical hot spot confirms the fact that water vapor temperature amplification of 3x has been highly exaggerated in IPCC climate models.

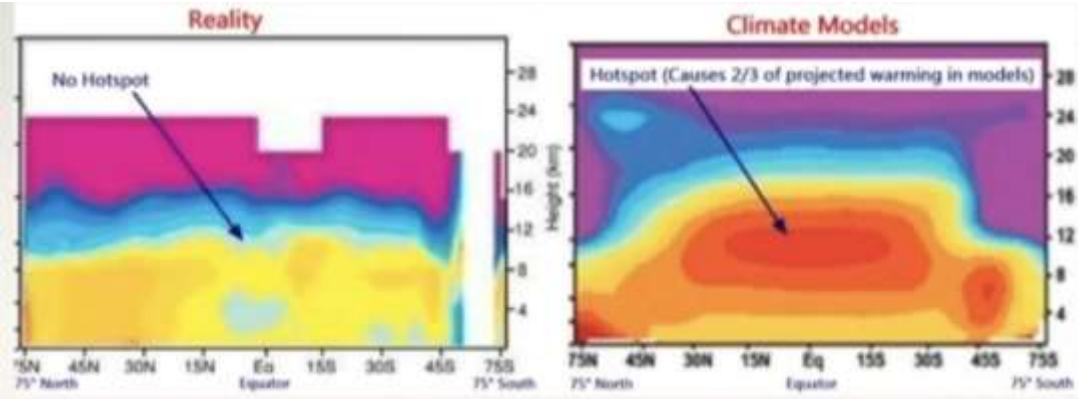

Figure 51 – Tropical Hot Spot from Climate Models is Not Seen in Observations. *Climate models predict global warming will increase water vapor and this water vapor will amplify warming. When water vapor condenses high in the atmosphere, it releases latent energy and these climate models predict a hotspot at an altitude of about 10 kilometers in the Tropics, where water vapor is most prevalent. This water vapor feedback is projected to cause two thirds to three fourths of warming in these climate models. If present, this hotspot in the upper troposphere of the tropics would be evidence of climate water vapor temperature amplification. However, this predicted tropical hotspot has not consistently been found in observations by weather balloons or satellites, which means the water vapor amplification theory of nearly 3x temperature amplification is wrong. The figure on the left shows actual observations, while the figure on the right shows the predictions of the tropical hot spot in typical climate models (this example is from the Canadian IPCC climate model). Source: Presentation by Astrophysicist Nir Shaviv.*

Actual temperature measurements from satellites and highly calibrated weather balloons show that there has been no amplification of warming as is predicted in the climate models (see https://www.scienceunderattack.com/blog/2021/2/22/latest-computer-climate-models-run-almost-as-hot-as-before-71?format=amp).

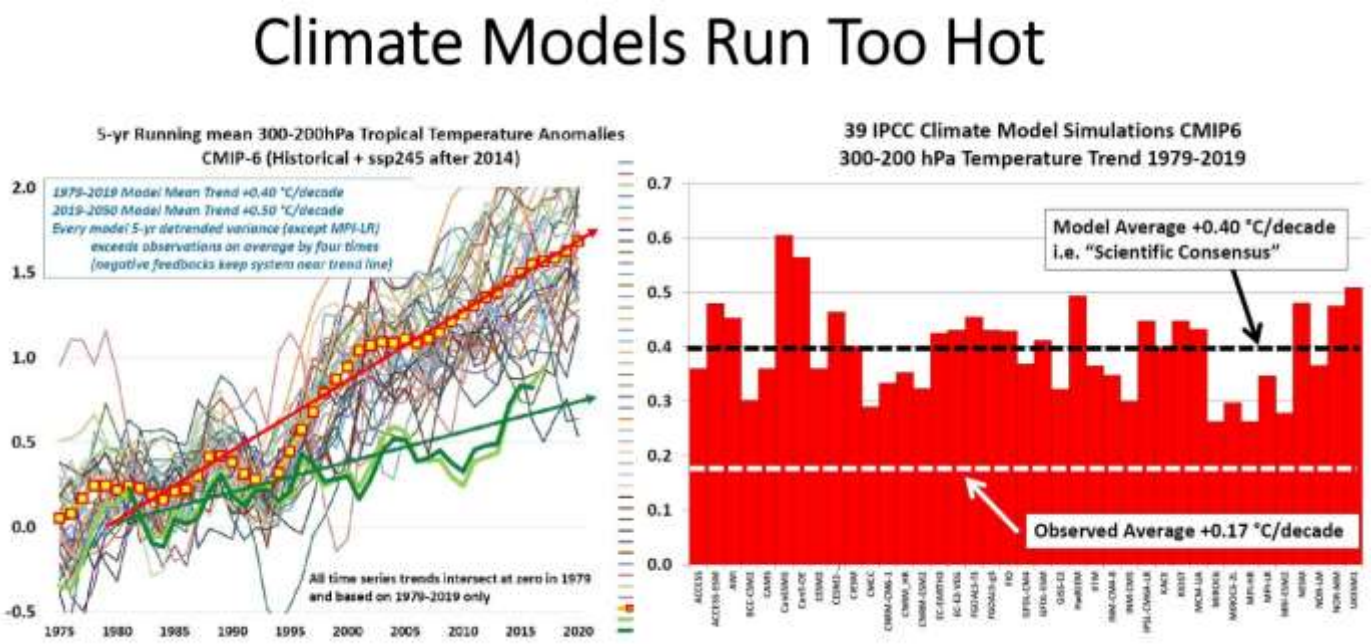

Figure 52 – Tropical Mid-Tropospheric Temperature Variations, Models vs. Observations, 1975 to 2020. *The IPCC climate models run significantly warmer than measured observations of temperature because they include positive climate feedbacks and minimize negative climate feedbacks. The chart above is from Professor John Christy at the University of Alabama, Huntsville. Christy appropriately looks at mid-tropospheric temperatures, as this is the altitude where the climate models predict most CO_2 induced greenhouse gas warming occurs. Because almost all CO_2 radiative forcing is saturated at the surface of the Earth (99.4% in the first 10 meters from the ground), most CO_2 induced warming occurs in the mid to high troposphere. He compares results from 39 IPCC climate models vs. actual satellite and weather ballon observations. In the chart on the left, the yellow boxes are the average predictions of temperature from these 39 IPCC climate models. The green lines are the weather balloon (light green) and satellite (dark green) temperature measurements. In the chart on the right, the actual temperature predictions of the 39 models are displayed, which average 0.40C per decade. The average actual temperature increases from weather balloons and satellite have measured 0.17C per decade on average*

between 1979 to 2020. Source: R. McKitrick and J. Christy, "Pervasive Warming Bias in CMIP6 Tropospheric Layers," Earth and Space Science, September 2020, Volume 7, Issue 9, Christy J (2020).

Since 1979, climate models have predicted a 0.40 C increase in temperature per decade. However, satellite and balloon observations have measured only a 0.17 C increase per decade. Warming in the future is likely to be less than 0.17C per decade since several warm events have occurred since 1979 including warm ocean oscillations of the AMO, PDO, and ENSO and unusually low levels of cosmic rays (see Chapter 13). Furthermore, the rapid exponential-declining power of CO_2 to warm as concentrations increase, will lessen greenhouse gas warming. However, even in the unlikely event that temperatures continue to increase at the current rate of 0.17C per decade, the temperature by the year 2100 would add up to only 1.3C warmer than today, which is far less than the average prediction of climate models of 2.1C. Climate alarmists base their fears on climate model predictions, yet it is clear from observational measurements that these climate models predict far too much warming.

Professor John Christy has pointed out that climate models which include the water vapor feedback, ignore negative feedbacks, and predict 1.4 watts per meter of heat radiating from the Earth out to space for each 1C of warming. Actual satellite measurements record 2.6 watts per square meter of energy radiates out into space for each 1C of warming, which significantly reduces warming. **When compared with actual measurements, we must conclude the water vapor amplification hypothesis is exaggerated and offset by negative feedbacks, which radiate heat out into space.** The supposition that water vaper will amplify greenhouse gas warming by nearly 3x is the entire basis of climate alarm. The true feedback from water vapor is likely around ½ x and this is more than offset by the negative feedback of low cloud cover. Water vapor feedback is by far the primary reason that climate models run too hot and are not able to predict the future. Such poor models should not be used for policy decisions. The water vapor feedback of 3x is not supported by experiment, the historical record, or data and is the reason physicist and Nobel Laureate John Clausen said, "The popular narrative about climate change reflects a dangerous corruption of science."

Chapter 10 – The Impact of Clouds

Low Cloud Cover – the Earth's Natural Thermostat

IPCC climate models assume increased water vapor leads to increased cloud cover. Water vapor content is known to drive low cloud formation, while there is little correlation between high cloud formation and water vapor. Clouds drive both positive and negative climate feedbacks. High cirrus clouds, which are mostly composed of ice, are known to act as a banket, keeping radiation from escaping out to space. Low clouds have a high albedo (reflectivity) to incoming sunlight and reflect much of the sun's radiation back out into space. Both high cirrus clouds and low clouds have a greenhouse effect of radiating heat back to Earth, as can be felt on a cold winter night, which is warmer when overcast and cooler during clear skies.

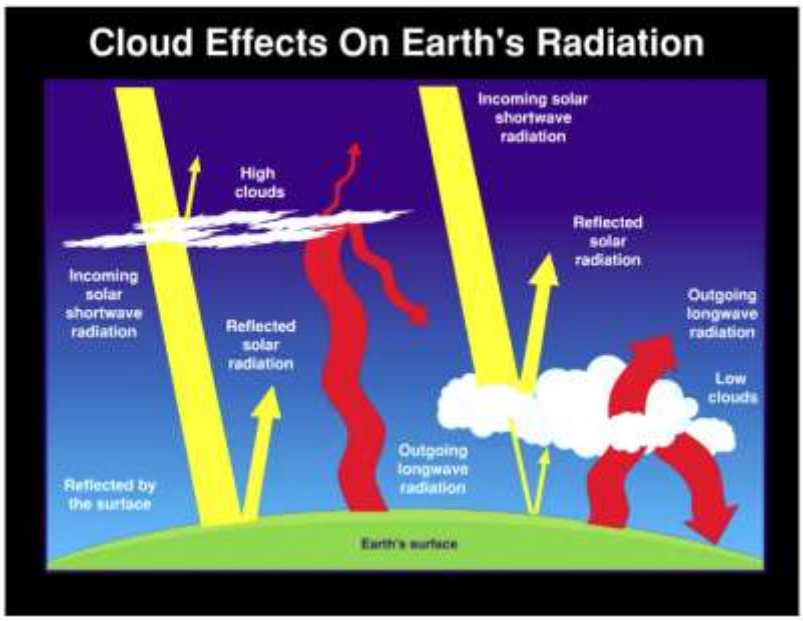

Figure 53 – Cloud Effects on Earth's Radiation. *Clouds have a major impact on the Earth's temperature. Low clouds are white with a high albedo and cool the Earth by radiating more heat out into space than they emit to the Earth. They are known to reflect 70% to 90% of sunlight back to space. High clouds are somewhat transparent to incoming solar radiation and emit more heat back to the Earth than is reflected out to space. Since they are at high altitudes and thin, their impact is far less than low clouds on temperature. Both high and low clouds emit infrared or long wave radiation back to the Earth. However, measurements and IPCC statements agree that the net impact of total cloud cover is one of cooling.*

According to section 1.1.2 of the IPCC climate assessment, *Natural Forcing of the Climate System*," The net average effect of the Earth's cloud cover in the present climate is a slight cooling: the reflection of radiation more than compensates for the greenhouse effect of clouds." Despite this conclusion, many IPCC climate models assume the net impact of clouds will be positive, some by as much as 0.7 watts per square meter. There is observational evidence to confirm clouds provide a negative cooling feedback to climate. As previously stated, these climate models assume only 1.4 watts per square meter of heat is radiated out into space for each 1C increase in temperature, but actual satellite measurements show

2.4C of heat radiated out to space for each 1C increase in temperature. The high albedo of low clouds is a major source of reflecting heat out into space. Using measured data from satellites of total cloud cover and temperature confirms temperatures decline by 0.5C for every 7% increase in total cloud cover (see https://www.climate4you.com/ClimateAndClouds.htm). Using the same assumption that water vapor increases by 7% for each 1C in warming, it is safe to assume cloud cover will also increase by 7%. The 0.5C in cooling for a 7% increase in cloud cover thus means that clouds cool 1.7W/m^2 (see Table 9) for each 1C in warming. The cooling of clouds thus almost entirely offsets the estimated warming of 1.8 W/m^2 from the water vapor feedback, which is the entire basis of the climate crisis.

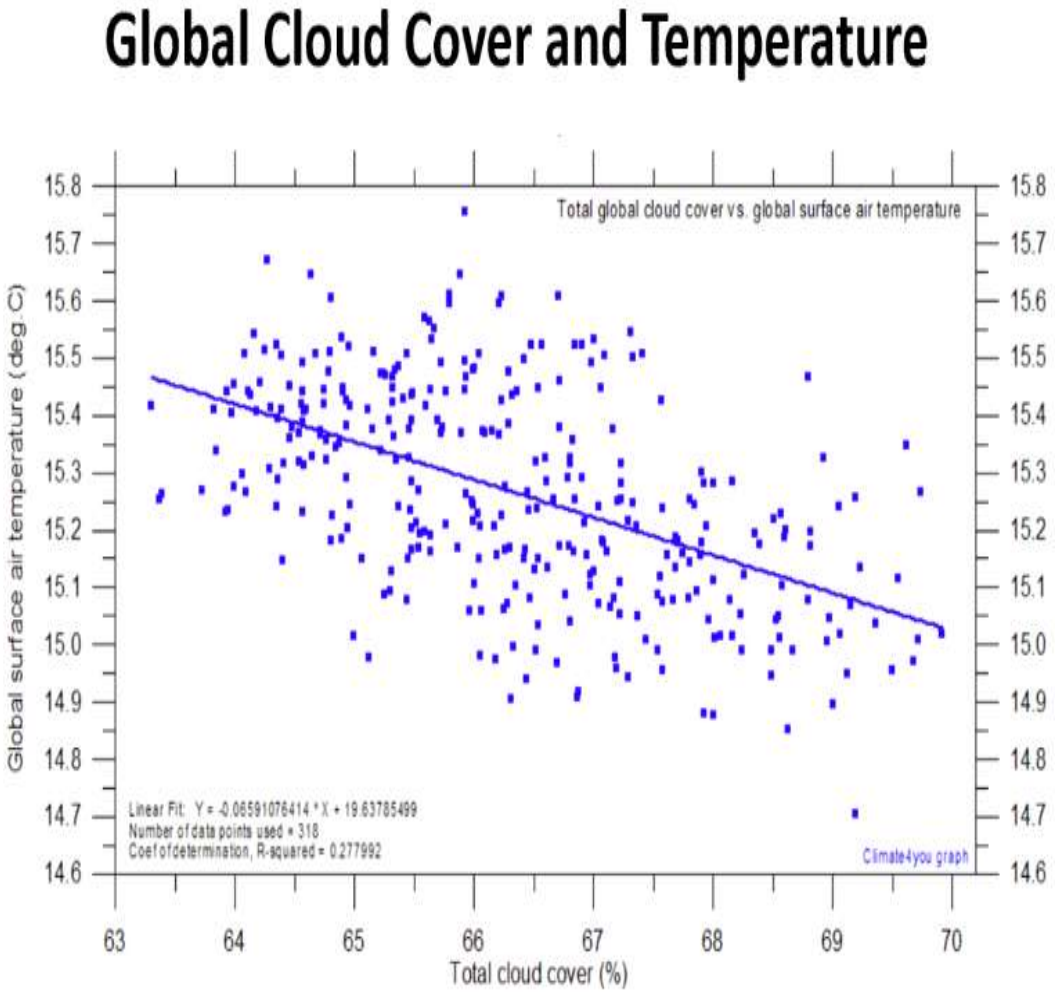

Figure 54 – Global Cloud Cover and Temperature. *The scatter diagram above charts monthly total cloud cover vs. global surface temperatures since 1983. The decline in temperature as cloud cover increases demonstrates the net cooling effect of clouds. A linear fit model reveals a 0.5 drop in temperature for every 7% increase in global cloud cover. This means cloud cover offset nearly all estimated warming from the water vapor feedback, which is the basis of the climate crisis. Source: hardCRUT3 and The International Satellite Cloud Climatology Project.*

Cloud feedback is dynamic and changes with the amount and type of cloud cover, since low clouds reduce temperature by reflecting more energy out to space than they absorb and remit and high clouds act as a blanket to increase temperature and are not effective at reflecting radiation. Clouds are not

evenly distributed around the globe. Measurements report 10% to 15% more cloud coverage over oceans than over land. About 72% of the oceans are covered by clouds and therefore changes in cloud cover have a significant impact on the heating of the oceans. Average net global cloud feedback is currently negative and lowers temperature by 0.07C for each 1% increase in cloud cover.

We will cover cosmic rays in Chapter 13, but cosmic rays both increase low cloud cover and transform high clouds into low clouds. Recent global warming has occurred during a time of low cosmic rays. NASA and others are predicting we are just now moving into a period of higher levels of cosmic rays. "During the next solar cycle, we could see cosmic ray dose rates increase by as much as 75 percent," said lead author Fatemeh Rahmanifard of the University of New Hampshire's Space Science Center (see Cosmic rays increase remarkably as solar activity shows persistent decline, resembles Dalton minimum of 1790 - 1830 - The Watchers). The increased cosmic rays should seed the formation of more low clouds and further increase the net cooling effect of clouds. This expected higher low cloud coverage from increased cosmic rays will have a disproportional cooling impact on ocean temperatures.

Respected MIT atmospheric physicist Richard Lindzen and his research group have published papers which describe how changes in cloud cover produce negative feedbacks, which lower the temperature. The first of these processes deals with high cirrus clouds and is known as the "iris effect." The iris effect proposes that every 1C of sea surface warming reduces high cirrus cloud cover by about 20%, which allows longwave infrared radiation from the Earth to more easily pass out into space. According to Lindzen, this induces a negative feedback which lowers temperature enough to offset warming due to water vapor positive feedback (see Time for an eye exam - Climate Discussion Nexus). Lindzen's iris effect has been challenged by Gavin Schmidt (a well-known climate alarmist) of the NASA Goddard Institute for Space Studies. Nevertheless, observations validate the iris effect, as satellite data from the Earth Radiation Budget Experiment (ERDE) shows energy passing out into space increases noticeably in the Tropics whenever sea temperature increases, as expected from the iris effect. In a blatant censorship of views which are counter to the climate alarmist narrative, the editors who allowed the Iris Effect paper to be published were fired. Such suppression of ideas is reminiscent of Goebbels banning the publication of Vice-Chancellor Papen's speech, which provided the German people with an alternative to Hitler's NAZI narrative.

The second cloud feedback is how increased water vaper in the atmosphere leads to greater low cloud formation. The high albedo of low clouds reflect sunlight radiation back out into space, producing a negative feedback of up to 216 watts/square meter of irradiative energy away from the Earth, which lowers temperature. This is a significant amount. Dr. John F. Clauser, recipient of the 2022 Nobel Prize in Physics, has stated that existing climate models greatly underestimate this negative cloud feedback, which provides "a very powerful dominant thermostatic control of the Earth's temperature." These white low clouds reflect 70% to 90% of the sunlight which shines on them back out into space. As seawater is heated and evaporates, it produces low clouds. According to Dr. Clauser, the radiative forcing from CO_2 is nearly two orders of magnitude (10^2 or 100-fold) smaller than the effective stabilization of the input-power provided by the low cloud-based thermostat. See Nobel Laureate John Clauser Elected to CO2 Coalition Board of Directors - CO2 Coalition. Because of this negative cloud feedback, Dr. Clauser says, "there is no real climate crisis."

Lindzen and Clausen believe these two negative cloud feedbacks are stronger than the positive water vapor feedback, which results in a net-negative feedback from water vapor and clouds. The IPCC admits the greatest uncertainty in climate models is clouds, yet they include positive water vapor and positive cloud feedbacks in their climate models and ignore or minimize negative cloud feedbacks, which

could explain why their predictions of warming temperatures have been significantly higher than actual observational measurements (see Figure 52). Professor Lindzen was the lead author of Chapter 7, "Physical Climate Processes and Feedback" in the IPCC Assessment Report 3. He later resigned from the IPCC, in part because the IPCC refused to consider the negative feedback of clouds in its climate models (see Brady, pg. 108). William Gray, Professor of Atmospheric Science at Colorado State University, known as one of the greatest minds in hurricane research, agreed with Professor Lindzen that the net feedback from increasing CO_2 was negative, not positive. Amongst Dr. Gray's many accomplishments, he established the accumulated cyclone energy index, the accepted measure of hurricane intensity. Despite Dr. Gray's renown, his research funding and career were "cancelled" for expressing these views.

Water Vapor, Aerosols, and Protons – The Three Essential Factors in Cloud Formation

Scientific discoveries have revealed that there are **three factors which drive low cloud cover: 1) water vapor, 2) aerosols, and 3) protons**. As water vapor increases in the atmosphere, increased cloud cover is expected. It has also long been known that clouds are formed as water vapor condenses on dust particles and other aerosols in the atmosphere, particularly sulfate aerosols. Therefore, increases in aerosols also increases cloud cover. Dust particles and sulfate aerosols are generally negatively charged.

Dr. Gerald Pollack of the University of Washington has run experiments which demonstrate that the evaporation of water produces negative ions in the form of H_3O_2 molecules (see Gerald Pollack, The Fourth Phase of Water, 2013, pgs. 255-270). These H_30_2 molecules become integral to water vapor and water vesicles (water vapor and small water droplets) in the atmosphere which become the building blocks of clouds. These vesicles are either water vapor bubbles surrounded by a skin of H_30_2 or water droplets surrounded by a skin of H_30_2 ions. These H_30_2 molecules give these evaporated water vapor a negative electric charge. **Because dust particles, sulfate aerosols, and water vesicles in the atmosphere are negatively charged, they repel each other. As a result, the third factor required to form clouds are positively charged protons**.

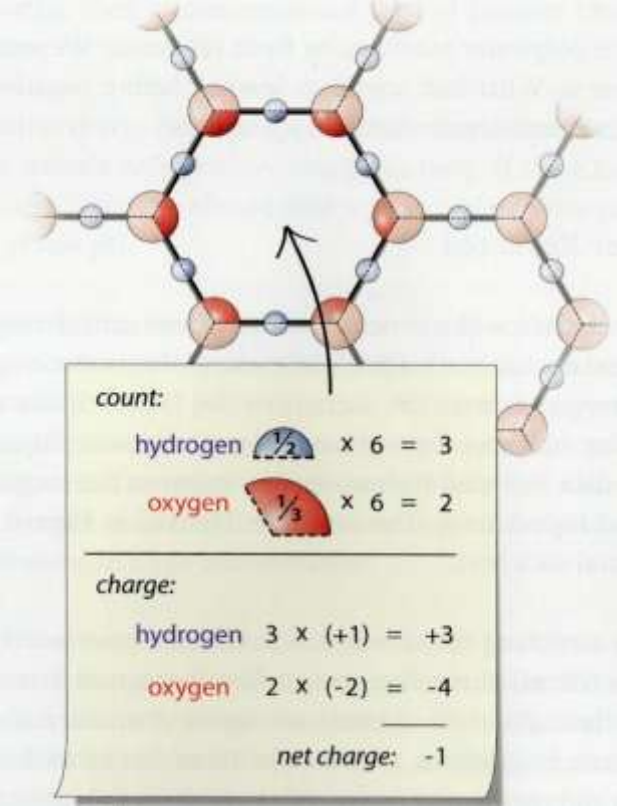

Figure 55 – The Negative Electrical Charge of Water Vapor *– Dr. Gerald Pollack of the University of Washington has demonstrated experimentally that the evaporation of water forms negatively charged H_30_2 ions. These negative H_30_2 ions form a skin around water vapor bubbles and water droplets in the atmosphere. This skin of H_30_2 gives a negative charge to evaporated water. Source: Gerald Pollack, The Fourth Phase of Water, 2013, pgs. 255-270.*

According to Pollack, clouds are formed when positively charged protons attract the negatively charged water vesicles into clusters, which form low clouds. This concept comes from physicist Richard Feynman's principle of "like-likes-like" where positively charged protons act like glue to stick negative particles together. This principle of "like-likes-like" was proven experimentally by Norio Ise of Kyoto University (see Pollack, pgs. 126-127). Gerald Pollack and his research group conducted additional experiments confirming this "like likes like" principle (see Pollack, pgs. 128-132). Because dust and sulfate aerosols are also negatively charged, protons would also allow the aerosols and water vesicles to stick together and thereby seed clouds. Pollack also said that protons cause high cirrus clouds to gain mass and sink so as to become low clouds. (see (430) #58 Gerald Pollack: "Electrical charge is absolutely central to all of weather" - YouTube). Therefore, **increases in protons in the atmosphere usually increase low cloud cover. Cosmic rays are primarily positively charged protons and are therefore a key element in cloud formation**.

Gerald Pollack points to additional evidence of the negative charge of water vapor vesicles and clouds. Clouds are made of condensed water. At the average global temperature of 8.5C at 1,000 meters altitude, water weighs 997 kilograms per cubic meter and air weighs 1.122 kilograms per cubic meter. Therefore, water is 886 times heavier than air, yet clouds float in the sky. Pollack says a large cumulonimbus cloud can weigh the same as fifteen million elephants, yet they stay afloat. Pollack describes the force keeping clouds in the sky as electrostatic. He explains, "Those like-likes-like

attractors amount to spot welds, contributing only modest amounts of positive charge." Therefore, the clouds retain a net negative charge. The Earth bears a negative charge, and the negative charge repels the negatively charged clouds keeping them afloat (see Pollack, pgs. 267-268). I have searched for other theories of why clouds float and cannot find any other satisfactory explanation.

Chapter 11 – Other Climate Forcings

The Impact of Aerosols on Clouds is Not Fully Accounted for in IPCC Climate Models

The IPCC climate models do include the cooling effect of aerosols. Such models show anthropogenic aerosols are projected to cool the Earth by 0.7C over the period in which atmospheric CO_2 concentrations will double, mostly from blocking incoming solar radiation. The impact on climate from cloud formation as impacted by aerosols may be more significant. Pyridinated cluster ions in the atmosphere are positive ions, but these aerosols are only found in low concentrations over the oceans. The dominant aerosols in the lower atmosphere and over the oceans are nitrate and sulfate aerosols including NO_3 (nitrate), HSO_4 (hydrogen sulfate), HNO_3 (nitric acid) and H_2SO_3. sulfuric acid). All of these aerosols are negatively charged, except for nitric acid. However, when nitric acid comes in contact with water it produces negatively charged nitrate aerosols. Volcanoes and algae in the oceans emit SO_2 (sulfur dioxide), which is converted into H_2SO_3 (sulfuric acid) aerosols. H_2SO_3 aerosols are negatively charged and are significant natural nuclei for the formation of low clouds. Observations over large algae blooms in the South China Sea contributed a substantial amount of sulfuric acid aerosols into the atmosphere resulting in observed increased cloud formation (see https://en.m.wikipedia.org/wiki/Cloud_condensation_nuclei). The familiar smell of the ocean is the SO_2 produced from algae, which is one of the major sources of aerosols for cloud formation over the oceans.

Because of their negative charge, protons are required to form aerosol clusters of sufficient size to become cloud nuclei. Using the Feynman "like likes like" principle, positively charged protons act like glue to stick the negatively charged aerosol particles together. Since water vesicles are also negatively charged, protons are also required to attract the water vesicles to the sulfuric acid aerosols. The burning of coal and other processes of the industrial world introduce substantial amounts of dust aerosols in the atmosphere. Such dust particles are also negatively charged, and protons are needed for such particles to form cloud nuclei with negatively charged water vesicles. Protons are supplied by cosmic rays, since over 85% of comic rays are composed of positively charged protons.

The cooling influence of increasing levels of dust particle aerosols was in fact the concern that drove "The Big Freeze" scare of the 1970s (see Figure 33). Industrial aerosols not only provide small particles which nucleate the formation of clouds and reflect radiation out to space, but they also block incoming solar radiation. In recent years, measurements have shown industrial aerosols in the atmosphere have been declining. A December 2022 paper in the Journal of Climate by Jenkins, et al, concludes that the majority of warming since 2000 is not from greenhouse gases, but rather from the decline in aerosols in recent years (see https://journals.ametsoc.org/view/journals/clim/35/24/JCLI-D-22-0081.1.xml). This decline in aerosols would result in fewer low cloud formation with a net heating influence. IPCC climate models do not fully account for the impact of aerosols on the impact on low cloud formation.

Cooling and Heating from Volcanoes has a Large Short-Term Impact on Climate

Dust particles and aerosols from volcanoes also have a major impact on low clouds and climate. One of the significant gases from volcanoes is sulfur dioxide. These sulfur dioxide aerosols are quickly transformed into sulfuric acid aerosols, which, along with dust particles are significant nuclei for low cloud formation. In the year 1815, the eruption of Mount Tambora spewed volcanic ash high into the

atmosphere, which blocked incoming solar radiation and seeded the formation of increased low cloud cover. The dust and sulfate aerosols from this volcano, coupled with the increased protons from cosmic ray flux induced from the Dalton Solar Minimum, resulted in increased low cloud cover, cold temperatures, crop failures, and forced migrations. Crop failures led many Vermont farmers to head west, many to upstate New York. The year 1816 is known as "The Year Without a Summer" in both Europe and North America. Volcanic eruptions are known to be a major force in global cooling. The impact on low cloud formation needs to be an important consideration of the cooling impact of volcanos.

Volcanoes also contribute to warming. When underwater volcanoes explode, they can eject massive amounts of water vapor into the upper atmosphere. Since water vapor is a greenhouse gas, such an increase in water vapor can boost world temperatures. The eruption of the submerged Hunga Tonga-Hunga Ha'apai volcano on January 15, 2022, injected vast amounts of water vapor into the stratosphere. One paper in Nature Climate Change estimates an increase in water vapor in the stratosphere by 10% to 15%, which will raise global surface temperatures by 0.035C over the coming decades (Stuart Jenkins, et al, Nature Climate Change, "Tonga eruption increases chance of temporary surface temperature anomaly above 1.5C," 12 January 2023, 13, 127-129).

Respected geologist Ian Pilmer sarcastically said, "We have only 3.4 million recognized submarine volcanoes." Dr. Pilmer believes these volcanoes heat the oceans. Geologist Arthur Viterito has demonstrated an excellent correlation of ocean temperatures with mid-ocean seismic activity from 1979 to 2022 after a two-year lag. Dr. Viterito claims mid-ocean seismic activity warms the oceans and the thermohaline circulation (aka, Meridional Overturning Circulation or MOC) of the oceans carries this heat to northern latitudes. Submarine volcanoes undoubtedly contribute to warming of the oceans, but the primary driver of ocean temperatures is from the sun, which is estimated to account for 99.9% of the heating of the oceans. Whereas, the sun is estimated to account for 173,000 TW of the Earth's heat, geothermal heat flow from radiogenic decay and primordial heat is estimated at 47 TW (see The Sun-Climate Effect: The Winter Gatekeeper Hypothesis (III). Meridional transport, the most fundamental climate variable – Andy May Petrophysicist).

Submarine volcanoes may also disrupt ocean circulation, which could have a major impact on the climate. More research in this area is needed, but James Edward Kamis has suggested that ENSO ocean circulations may be influenced by seismic activity (Tom Nelson Podcast, Viterito/Kamis/Yim/Catt: "Impacts of Geothermal Energy on Climate," December 23, 2023). Dr. Pilmer also believes volcanoes contribute substantial amounts of CO_2 to the atmosphere. Even though volcanoes are known to be a major source of CO_2, the IPCC has excluded volcanoes from its carbon cycle analysis.

Chapter 12 – Carbon Dioxide is Not the Primary Driver of Climate

Temperature Data and Reconstructions Show CO_2 is Not the Primary Driver of Climate

We have already covered warming during the Roman Warm Period and the Medieval Warm Period. Historical, archeological, and paleoclimate evidence of global warming in these periods is beyond doubt. Historical CO_2 levels can be determined by measuring air bubbles trapped in ice cores. An examination of such ice cores clearly shows that elevated CO_2 levels have only been experienced since the industrial revolution, beginning in the nineteenth century. Since CO_2 levels cannot explain the Roman Optimum, Medieval Warm Period, or the Little Ice Age, such warming and cooling must have come from natural causes, such as the 1,000-year Eddy Solar Cycle, which matches these climate periods and the current Modern Warming exactly. There is no doubt that increased levels of CO_2 warm the atmosphere. However, there is also no doubt that a sizeable portion of the Modern Warming is from natural climate cycles. Yet climate alarmists attribute nearly all modern warming to increases in greenhouse gases, primarily CO_2. This assumption is clearly false.

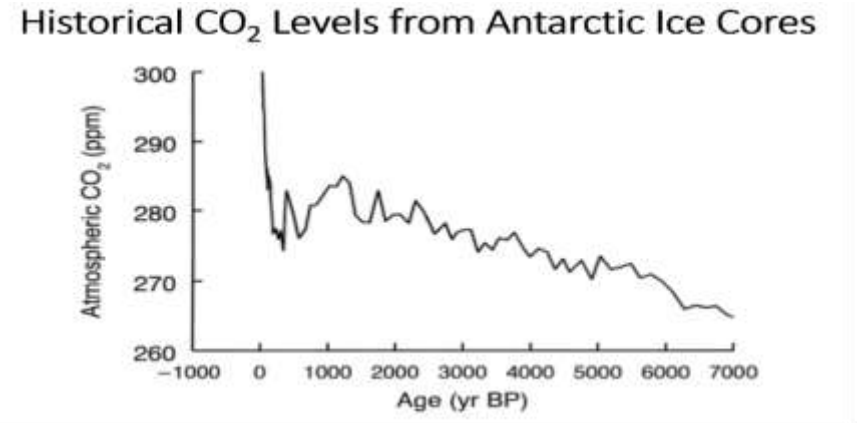

Figure 56 – CO_2 Concentrations Over Seven Millenia Do Not Correlate with Climate Cycles. *The chart above is a reconstruction of CO_2 concentrations in the atmosphere over the past 7,000 years. The Middle Holocene Optimum 7,000 years ago was about 2C warmer than today in the Pacific Ocean and in Greenland, yet CO_2 levels were low. Other than minor blips in concentration levels, CO_2 shows no major correlation with the Minoan Warm Period, Roman Warm Period, or Medieval Warm Period in which temperatures were as warm or warmer than today. Since these climate cycles have been established beyond any doubt, this data is convincing evidence that natural variation is the major driver of climate. Yet despite this evidence, the IPCC attributes nearly all warming in recent years to increases in CO_2 levels. Source: CO_2 record derived from the Taylor Dome Antarctic ice core study (Indermühle et al., 1999).*

A paper published by Statistisk sentralbyra, Statistics Norway in September 2023 titled, "To What extent are temperature levels changing due to greenhouse gas emissions?" by John K. Dagsvik and Sigmond H. Moen finds a weak correlation between CO_2 emissions and global warming. The paper states, "Using theoretical arguments and statistical tests we find, as in Dagsvik et al. (2020), that the effect of human-caused CO_2 emissions does not appear to be strong enough to cause systematic changes in the temperature fluctuations during the last 200 years." See https://www.ssb.no/en/natur-og-miljo/forurensning-og-klima/artikler/to-what-extent-are-temperature-levels-changing-due-to-

greenhouse-gas-emissions/_/attachment/inline/5a3f4a9b-3bc3-4988-9579-9fea82944264:f63064594b9225f9d7dc458b0b70a646baec3339/DP1007.pdf.

Between 1944 and 1976 the burning of fossil fuels exploded, resulting in the annual emissions of CO_2 growing from around 1 gigaton in 1944 to nearly 5 gigatons by 1977. Yet the temperature declined during this 30-year period, despite increased levels of CO_2. Many scientists thought the temperature decline would continue and they sounded alarm of "The Big Freeze" (see Figure 33). The five-fold increase in CO_2 emissions, would have driven higher radiative forcing from CO_2, but such CO_2-induced warming was more than offset by natural cooling, including the convergence of the cold ocean oscillations of the AMO and PDO.

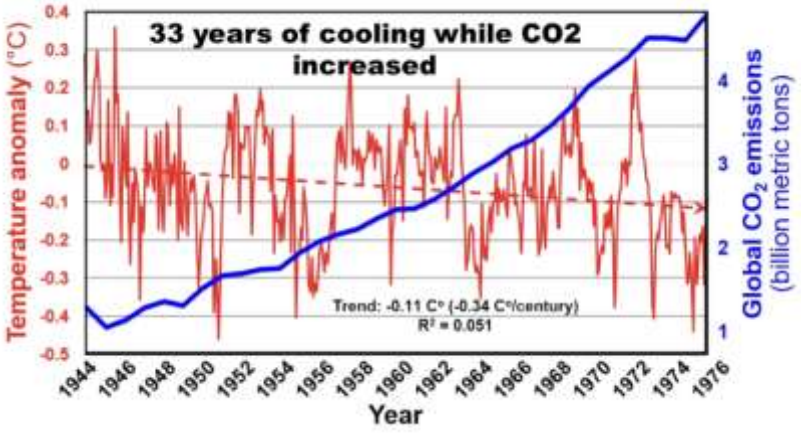

Figure 57 – Cooling During the 1940s through the 1970s Does not Correlate with Increases in CO_2 Concentrations. *Between 1944 and 1976 the temperature dropped despite an increase in CO_2 emissions from about 1 gigaton in 1944 to nearly 5 gigatons by 1976. Clearly, there were negative climate drivers that were greater than the warming from anthropogenic increases in CO_2. Sources: Temperatures from HardCRUT4 (1977) and CO_2 emissions from Boden, et al, "Global CO_2 emissions from Fossil-Fuel Burning and Cement Manufacture and Gas Flaring 1751 – 2013" (2016), CDIC, Oak Ridge National Laboratory, U.S. Department of Energy. Chart by Gregory Wrightstone.*

There has been extensive climate research on the Holocene. There are hundreds of proxy records analyzed by Marcott in 2013 and Kaufman in 2020 to establish regional and global temperature trends. We are currently in the Holocene, which started about 11,000 years ago. The Holocene Climatic Optimum (HCO) around 7000 years ago was a time when temperatures were warmer than today. This warming impacted most of the globe, with the exception of Antarctica. In a post by Renee Hannon, levels of CO_2 and temperature reconstructions of the Holocene are discussed. Antarctica temperatures seem to follow CO_2 levels, but the rest of the globe does not (see Guest Post by Renee Hannon, "The Holocene CO_2 Dilemma," Andy May, May 26, 2023, see https://andymaypetrophysicist.com/2023/05/26/the-holocene-co2-dilemma/). During the HCO, temperatures were warmer globally than today, yet CO_2 levels were 275 ppm. Today, CO_2 concentrations are about 420 ppm. The lack of correlation between CO_2 levels and the global temperatures during the HCO suggests there are natural causes that are far more important than CO_2 levels in forcing climate change. Since climate models rely on CO_2 as the primary driver of temperature, they cannot reproduce the well-documented Holocene Climate Optimum.

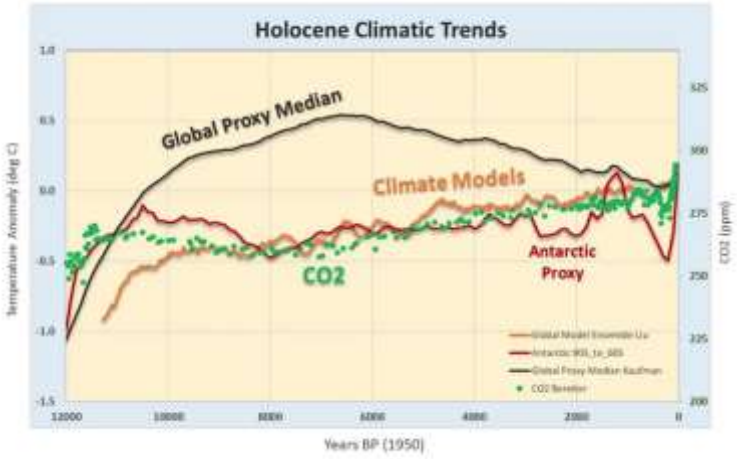

Figure 58 – Holocene Temperature and CO_2 Reconstruction. *Hundreds of proxy records of the Holocene allow for a credible reconstruction of global and regional temperature and CO_2 levels. Antarctica temperatures seem to follow CO_2 levels, but the remainder of the globe does not. This is especially true in the well-documented Holocene Climatic Optimum (HCO)around 7,000 years ago. Global temperatures were higher than today, but CO_2 levels were lower than at present. This lack of correlation suggests there are natural causes of global warming far mor powerful than CO_2 levels. Since climate models use CO_2 as the primary climate driver, they cannot reproduce the Holocene Climate Optimum. Source: Guest Post by Renee Hannon, "The Holocene CO_2 Dilemma," Andy May, May 26, 2023.*

Absorption and Emission of CO_2 from the Oceans Causes CO_2 Levels in the Atmosphere to Follow Rather than Lead Temperature Changes

In studying paleo reconstructions of the Earth's past temperatures, one fact is clear - CO_2 has never been the primary driver of climate as declared by climate alarmists. Temperature reconstructions from Antarctica ice cores have provided a history of climate for over 400,000 years (see Figure 59). The ice cores reveal a correlation between increased temperature and CO_2 levels, but in this case, correlation is not causation. Al Gore in his movie "An Inconvenient Truth" uses Antarctica Ice core temperature reconstructions to make the claim that CO_2 is the driver of temperature. Citing CO_2 as the primary driver of temperature is ridiculous, which any climate scientist should know. Yet you can still find countless lectures online that perpetuate this false claim. The reason this claim has no merit is as follows:

> First, it has been well-know that these 100,000-year interglacial periods are caused not by CO_2, but are attributed to the Milankovitch Cycles of eccentricity, of the Earth's orbit around the sun.
>
> Second, you will notice the temperature varies by over 11C, but CO_2 concentrations vary by only 120 ppm from a low of 180 ppm to 300 ppm. Using the radiative forcing equation for CO_2, increasing from 180 ppm of CO_2 to 300 ppm of CO_2 increases radiative forcing by 2.2 watts per square meter, which is only 0.6C. There is no physical way for 120 ppm increase in CO_2 to increase temperature by 11C. This is pseudoscience.

Third, CO_2 rises in hotter times and falls in colder times, but it follows, not proceeds the heating and cooling, usually by 200 to 1,000 years. This can be clearly seen in Antarctica ice cores (see http://hyperphysics.phy-astr.gsu.edu/hbase/thermo/icecore.html). In fact, the temperature begins to fall, just before CO_2 levels peak in each cycle (see N. V. Vakulenko, et al, "Evidence for the Leading Role of Temperature Variations Relative to Greenhouse Gas Concentration Variations in the Vostok Ice Core Record." Doklady Earth Sciences, June 2004, 396 (5), pgs. 663-667), https://www.researchgate.net/publication/295305841_Evidence_for_the_leading_role_of_temperature_variations_in_comparison_with_the_greenhouse_gases_concentration_variations_in_the_Vostok_ice_core_record). According to Vakulenko, et al, "On the whole, the temperature variations turned out to be 800 ± 200 yrs. ahead of the Greenhouse Gas Concentration (GGC) variations." The authors also state, "Thus, one can conclude that temperature variations always preceded GGC variations during the four main glacial cycles recorded in the Vostok ice core. Of particular importance is the fact that the temperature began to decrease after reaching a very high value, although the GGC values continued to increase." If CO_2 were the control knob of temperature, the temperature would not decline as CO_2 levels continued to rise.

The change in CO_2 is explained by the oceans' absorption and release of CO_2. The oceans contain fifty times more CO_2 than the atmosphere. Just as a Coca-Cola or beer remains carbonated in the refrigerator, but goes flat when it is warmed, so the oceans absorb and releases CO_2 subsequent to temperature changes, pursuant to Henry's Law. According to ChatGPT, "Typically, scientific estimates suggest that for each degree Celsius of warming, CO_2 concentrations in the atmosphere may increase by approximately 10 to 30 parts per million (ppm) over long timescales." Therefore, it is reasonable to assume that 11C of warming could increase CO_2 in the atmosphere by 120 ppm as seen in the Antarctic Ice core data.

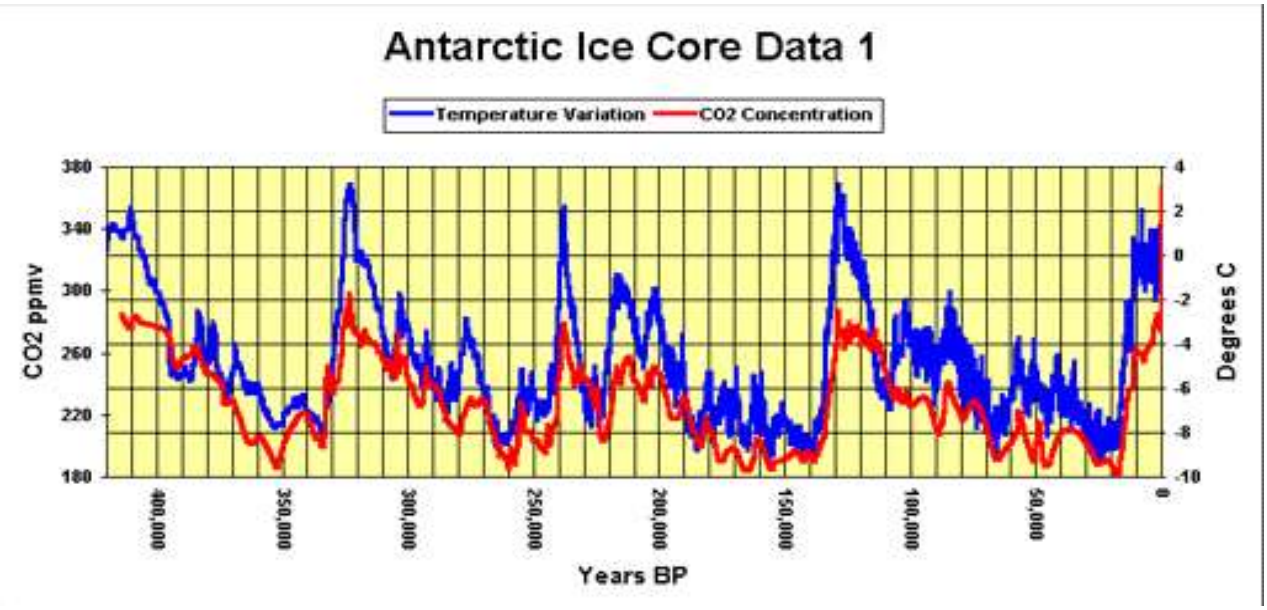

Figure 59 – Temperature Leads CO_2 Concentrations. *Antarctic ice cores show that temperature precedes CO_2 levels by 200 to 1,000 years. CO_2 is not the primary driver of temperature. CO_2 increases as the oceans outgas CO_2 at higher temperatures. The oceans absorb CO_2 at lower temperatures. Source: Pettit et al, (1999) Antarctica ice core data from Vostok, Nature 3 June 1999.*

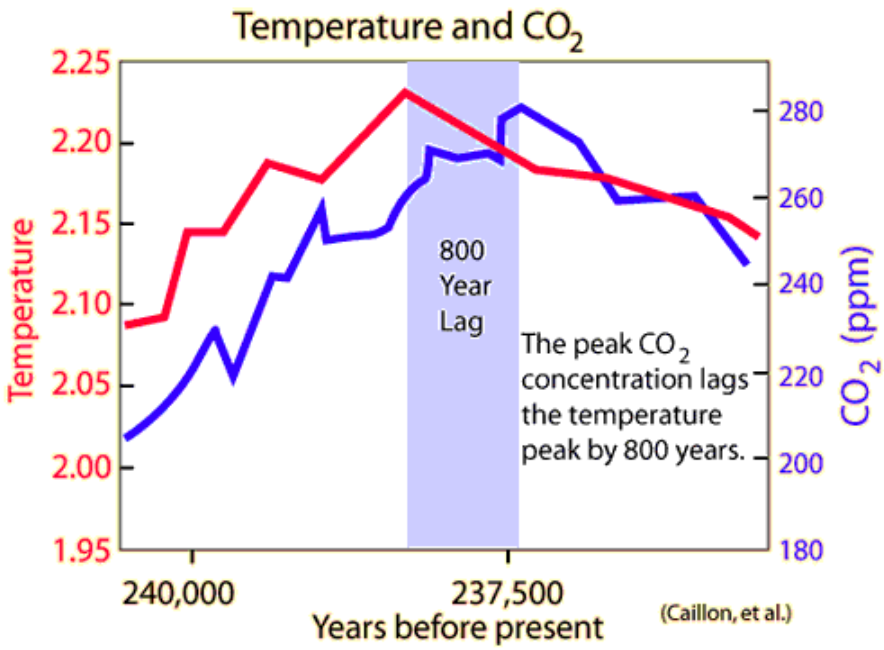

Figure 60 – CO_2 Lags Temperature by About 800 Years. *A closeup of temperature and CO_2 records from an Antarctica ice core clearly shows the delay of 800 years between temperature levels and subsequent CO_2 levels. The chart also shows how CO_2 levels continue to rise while temperatures are falling. Source: Ian Clark, University of Ottawa, Antarctica ice core data from Vostok.*

The conclusion that temperature drives CO_2 is also found in observations over the past 60 years. A paper published in Science in 2023 by Demetris Koutsoyiannis, et al, confirms Temperature as the driver of CO_2 through stochastic evaluation of UAH satellite temperature data and CO_2 measurements at Mauna Loa, Hawaii. The authors of this paper found that all evidence resulting from the analysis establishes a causal link with Temperature as the cause and CO_2 as the effect. Their conclusion is that CO_2 concentrations do not drive temperature, but Temperature drives CO_2 concentrations. This direction of causality holds for the entire 60-year period covered by the of the observations and the causal link applies to all timescales of the available data from monthly to decadal. See Koutsoyiannis, D., et al, "On Hens, Eggs, Temperatures and CO_2: Causal Links in Earth's Atmosphere," *Science* 13 Sep 2023, 5(3).

Chapter 13 – The Significance of Solar Cycles and Cosmic Rays on Climate

The Impact of Solar Cycles and Cosmic Rays is Significant, but Almost Ignored in Climate Models

Perhaps the largest of the cycles impacting climate is the solar cycle. Each solar cycle is about 11 years, and each varies in intensity. When a number of consecutive strong solar cycles are experienced, we have a grand solar maximum. When consecutive weak solar cycles occur, that is referred to as a grand solar minimum (see Figure 61). Solar cycles impact both low cloud cover and changes in solar irradiance. Both factors impact climate. We have just come off the peak of the largest grand solar maximum in 10,000 years (see Crok, pg. 83), known as the "Modern Solar Maximum." Periods of strong solar activity are accompanied by strong solar magnetic fields, increased sunspots, higher solar irradiance, and fewer cosmic rays. Cosmic rays are high energy particles that originate outside of our solar system, usually from the explosion of dying stars, known as supernova. When the solar magnetic field is strong, the Earth is protected from cosmic rays and fewer reach the Earth. Cosmic rays aid the formation of low clouds, so periods of low solar activity and high cosmic ray flux are times of more low cloud cover and colder temperatures. Cosmic ray intensity can be estimated in ice core, sediment, shell fossils, and stalactite samples based upon the mass spectrometry quantitation of Carbon 14 and Beryllium 10 isotopes in these samples. When cosmic rays collide with atoms in the Earth's atmosphere, they induce nuclear reactions which produce Carbon 14 and Beryllium 10 isotopes. These isotopes are more abundant during periods of increased cosmic rays.

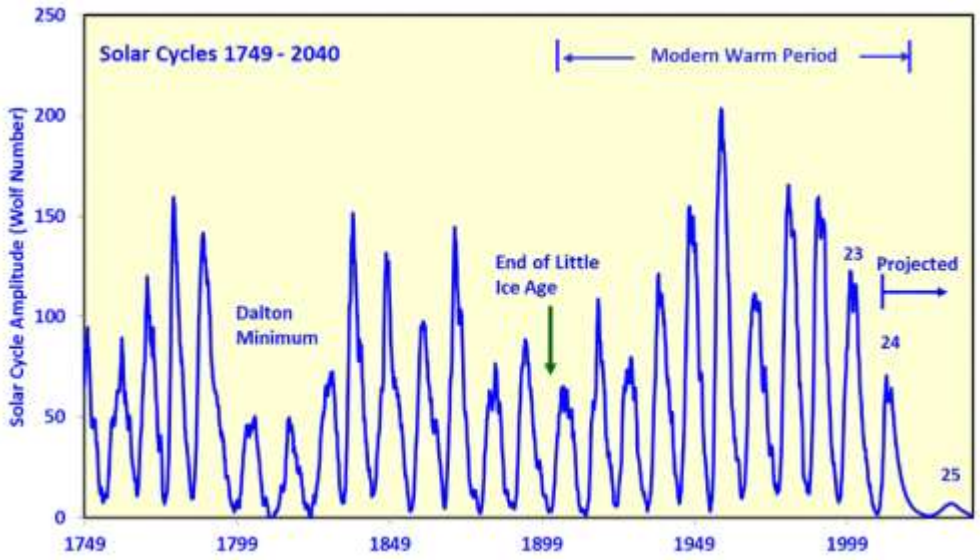

Figure 61 – Solar Cycles 1749 to 2040. *Solar cycles occur about every 11 years. When consecutive strong solar cycles are experienced, this is a grand solar maximum. We are just coming out of the Modern Solar Maximum, the strongest grand solar maximum in 10,000 years. The last grand solar maximum was 1,000 years ago, during the Medieval Warm Period. When consecutive weak solar cycles occur, that is referred to as a grand solar minimum. The Dalton Minimum was a time of low*

temperatures and the infamous year without a summer. Source: Al Fin: Global Cooling: A Return to the Age of a Frozen Thames? (alfin2100.blogspot.com).

Temperature changes have a clear correlation to cosmic rays and solar cycles. Over the past few thousand years we have seen the Minoan Warm Period, followed by the cold Greek Dark Ages, the Roman Warm Period, followed by the cold Dark Ages, followed by the Medieval Warm Period, followed by the Little Ice Age, followed by the current warm period. One factor remains constant, warm periods occur during grand solar maximums and associated low cosmic ray flux and cold periods occur during grand solar minimums and associated high cosmic ray flux.

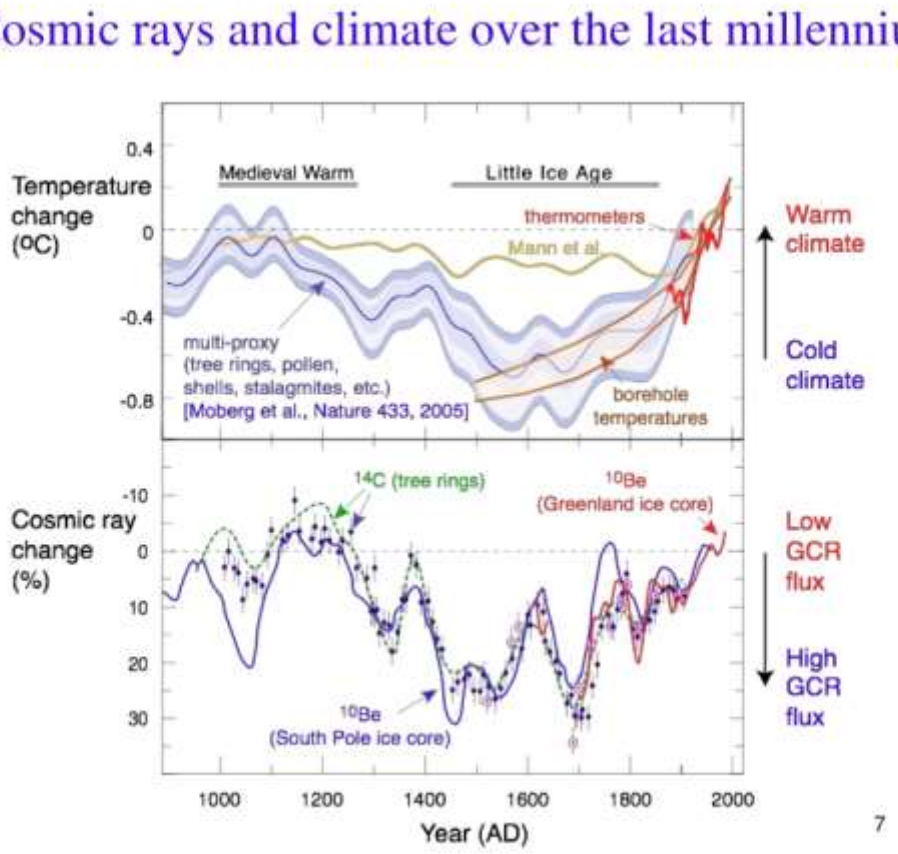

Figure 62 –Cosmic Ray Flux Matches Temperature Cycles of the Past 1,000 Years. *Warm and cool periods have followed solar maxima and minima cycles and the associated low levels of cosmic rays during a solar maximum, and elevated levels of cosmic rays during a solar minimum. The chart shows a reconstruction of temperature and cosmic rays (a proxy for solar cycles). During a strong solar cycle, the sun's stronger magnetic field shields the Earth from cosmic rays and fewer reach the Earth. During a weak solar cycle, more cosmic rays descend to the Earth, producing increased levels of Beryllium 10 and Carbon 14. The cosmic ray change (%) above is inverted to show the close anti-correlation of cosmic ray flux to temperature changes. Source: Henrik Svensmark (2007), Danish National Space Center.*

The Roman Warm Period, Medieval Warm Period, and current Modern Maximum are in synch with the solar maximums of the 1,000-year Eddy Solar Cycle and correlate directly to increases in temperature and decreases in cosmic rays. **No such correlation can be seen in CO_2 levels with these 1,000-year historical temperature cycles.**

Solar Maximums Increase UV Radiation, which Warms the Stratosphere and the Oceans.

Because the variation in total solar irradiance is not significant between the peak and valley of each solar cycle, the IPCC accounts for a meager 0.12 watts per square meter as the total impact of solar cycles in its climate models. However, there is more to look at than just total solar irradiance. Although the full spectrum of radiation flux does not vary much in the peak-to-trough of a solar cycle, UV radiation in the extreme spectrum can increase by up to 15% during the full cycle from a solar minimum to a solar maximum. Most of this UV radiation is absorbed in the upper atmosphere, which warms the stratosphere. Some UV-A radiation does reach the surface of the Earth. UV-A radiation in the 315 to 400 nanometer wavelength range accounts for about 20 watts per square meter of warming at the surface. Most importantly, UV-A radiation at this spectrum penetrates several meters into the oceans, causing the water to heat up.

On average, the amount of UV-A radiation that reaches the Earth's surface during a solar maximum increases by up to 3%. This equates to up to 0.8 watts per square meter, which is much more warming than the 0.12 watts per square meter that the IPCC climate models include for all solar impacts. Oceans cover 71% of the Earth's surface and absorb 90% of the global heat of the Earth from the sun (see Brady, pg. 106). The top two meters of the ocean can hold as much heat as the entire atmosphere. Ocean temperatures are a major driver of climate through the transfer of the heat from the oceans to the atmosphere. This is clearly seen in the temperature record of atmospheric swings in temperature during El Niño and La Niña events (see https://www.drroyspencer.com/2019/05/half-of-21st-century-warming-due-to-el-nino/). In summary, although not fully accounted for by the IPCC, changes in solar radiation over solar cycles are a relatively small contributor to climate change. The significant impact of solar cycles is its impact on low cloud cover.

The Significant Climate Driver: Cosmic Rays Impact on Low Clouds

Solar cycles have another and potentially much larger impact on climate than a 0.8 watts per square meeting from changes in UV-A irradiance. During solar maxima, the strong magnetic field of the sun limits the number of cosmic rays that reach the Earth. Conversely, during a solar minimum, the weak magnetic field allows for up to 20% more cosmic rays to hit the Earth's surface. Astrophysicist Hendrik Svensmark from Denmark postulated that cosmic rays produce low clouds and thus lead to cooling from energy being reflected out to space from the clouds. The theory makes sense as the impact of low clouds on temperature is known to be significant, reducing solar radiation by 168 to 216 watts per square meter under the cloud cover. You can feel this difference on a hot sunny day, when the sun is covered by a low passing cloud, the temperature drops significantly.

It turns out that cosmic rays are mostly positively charged protons (about 85%). Such protons are the third factor in cloud formation along with water vapor and aerosols in the atmosphere. As previously covered in Chapter 10, Dr. Gerald Pollack confirmed the negative charge of water vapor and water particles in the air. The negative charge of dust particles and sulfate aerosols has been well known for years. Dr. Pollack explains how positively charged protons in the atmosphere act as glue to stick the negatively charged water vesicles together to form low clouds. These same positively charged protons

help negatively charged aerosols to become cloud nuclei, which seeds condensation of the water vesicles into clouds.

Svensmark built a cloud chamber and proved that cosmic rays and the ionization created by cosmic rays produce small aerosols from gas molecules, such as sulfur dioxide. These results were independently confirmed in a cloud chamber operated by the European Organization for Nuclear Research CERN group in Meyrin, Switzerland. It has long been known that clouds are formed when water vapor condenses on aerosol particles in the air. These aerosol particles are considered essential to the formation of clouds. Critics of Svensmark used mathematical models, but not real-world data, to suppose cosmic rays do not impact cloud formation on the basis that aerosols created by cosmic rays are too small to become the nucleus of clouds. The model showed that these particles were lost as they were absorbed into larger particles. The climate alarmist media and had a field day stating the comic ray climate theory was dead. This was reinforced by scientists who echoed the media message that cosmic rays do not impact the climate. However, as Mark Twain said, "The reports of my death have been greatly exaggerated." Despite the criticism, Professor Svensmark and his research team persevered. Svensmark and his team did additional work in their cloud chamber and showed that the small aerosols are lost in normal conditions, as predicted by the mathematical models, but when exposed to ionization, as created by cosmic rays, they cluster to become larger aerosols **in about 5 days**, large enough to nucleate clouds. With ionization, these small particles are not lost to the larger particles. The Svensmark team even conducted their experiment in a mine over a mile deep in the Earth to ensure no contamination of their results from cosmic rays at the Earth's surface. Svensmark's discovery may be the greatest breakthrough in climate science in our generation, yet after he and his research group completed a paper on their discoveries, it took one-and-one-half years to have these results published. Svensmark said one scientific journal after another refused to publish his findings, yet they provided no scientific reason not to accept his publication. Finally, the paper was published in 2017.

Svensmark also realized that nature had provided the perfect experiment to confirm his theory that cosmic rays influence cloud formation. Solar flares generate large magnetic waves for a period of about 10 days. It has been observed that this spike in the magnetic field of the sun reduces the cosmic ray flux reaching the Earth. Such events are known as Forbush Decreases. Svensmark and his team used four separate satellite data sets to evaluate the impact of these 10-day solar flares since 1982 on cosmic rays, aerosols, and cloud formation. The correlation was perfect. The data showed a significant decrease in cosmic rays. As verified in Svensmark cloud chamber experiment, **about five days later**, there was a significant drop in aerosols as measured by the AREONET satellite. The SSM/1, MODIS, and ISCCP satellites all showed lower cloud formation and lower water content in clouds with measurements of liquid water, liquid cloud fraction. **The declines were all in step with the change in cosmic ray flux after a 5-day delay**. Interestingly the MODIS satellite did not show this same correlation for ice cloud fractions, which are the higher cirrus clouds. The data reveals that cosmic rays contribute primarily to the formation of low clouds, and not high clouds. It is the low clouds which have a cooling effect on the climate by reflecting more net radiation back out into space, while high clouds have a warming effect by reflecting more net radiation back to Earth.

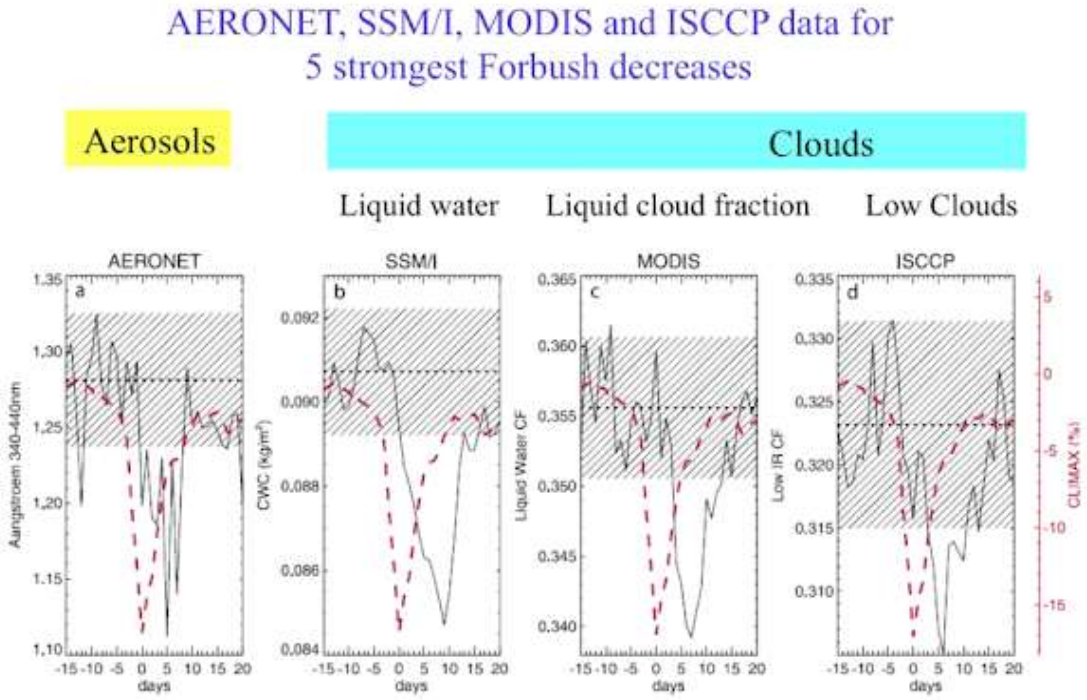

Figure 63 – Cloud Formation Matches Solar Flares and Cosmic Ray Flux. *Solar flares from the sun result in a substantial increase in magnetic waves, which reduce the number of cosmic rays reaching the Earth and lower cosmic ray induced ionization in the atmosphere. These events, known as Forbush Decreases provide a perfect experiment to test the Svensmark cosmic ray cloud formation theory. From experimental data in Svensmark's cloud chamber, it was demonstrated that cosmic rays form aerosols from gases in the atmosphere. In* ***about five days****, additional cosmic rays allow these small aerosols to grow to become of sufficient size to nucleate clouds. Data in the figures above reviews the largest Forbush events since 1982. The red dotted line depicts the decline in cosmic rays and atmospheric ionization during each solar flare induced Forbush event. Using four separate satellite measurements the results show that* ***five days after*** *the beginning of each Forbush event, aerosols decrease (AERONET satellite data), liquid water in clouds declines (SSM/1 and MODIS satellites) and cloud formation declined (ISCCP satellite). Source: Svensmark, et al, "Cosmic Ray Decreases Effect Atmosphere Aerosols and Clouds," Geophysical Research Letters, 2009.*

In 2021, Svensmark and other scientific collaborators published another paper on the 5 strongest week-long Forbush events since the year 2000 and the accompanying declines in atmospheric ionization from reduced cosmic rays. These Forbush events showed natural decreases in ionization of 10% to 20% for each Forbush. Using data from the CERUS satellite, they showed the change in shortwave ultraviolet radiation leaving the Earth from before and during these Forbush Decreases. The results were significant. The data shows that UV radiation changed by an average of 1.7 watts pers square meter over a large part of the Earth during these Forbush events, which average 9-day in duration. The other major finding was that the changes for each Forbush were almost entirely over the oceans. This observational data proves that changes in the solar magnetic field and the associated changes in cosmic rays and atmospheric ionization alter low cloud cover, which primarily impacts heat in the oceans. To put 1.7 watts per square meter in 9 days in context, to achieve radiative forcing of about 1.7 W/m^2 from CO_2 radiative forcing would require increasing CO_2 concentrations from today's 420 ppm to about 600 ppm. Such an increase in CO_2 levels would take decades to reach. Astrophysicist Nir Shaviv and his research group have used this data to calculate the total warming in the 20th Century was **50% to 66%**

driven by the low cosmic ray flux and lower cloud cover during the Modern Solar Maximum. See https://www.youtube.com/watch?v=PHiVlf5PXRA.

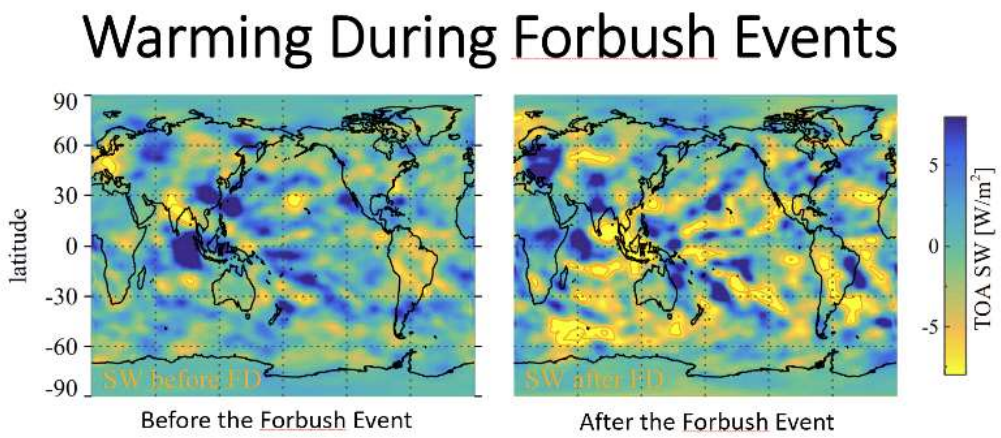

***Figure 64 – Ocean Warming and Cosmic Ray Flux Correlation Confirmed in Measurements**. Using data from the CERUS satellite to measure UV light radiating out to space during the five largest Forbush Decreases since 2000 reveals a meaningful change in UV heating of the oceans when cosmic ray flux changes. The chart above shows the significant decrease in UV light radiated out to space, when cosmic ray flux declines as depicted in yellow. This results in a 1.7 watts per square meeting increase in ocean temperatures over the nine-day period of each Forbush Decrease. Most of this impact is over the oceans. Using these figures, Nir Shaviv and his research group have calculated that cosmic ray flux and associated cloud cover accounts for 50% to 66% of all global warming during the 20th century. Source: Svensmark, et al, "Atmospheric Ionization and Cloud Radiative Forcing," Nature Scientific Reports (2021) 11:19668.*

Observational data over every time scale confirm the warming and cooling of ocean temperatures with cosmic ray flux. Confirming Svensmark's theory, I. G Usoskin, et al, published a study in Geophysical Research Letters on the latitudinal dependence of low cloud amount on cosmic ray-induced ionization, which demonstrates a close correlation to low cloud cover in the Tropics and low cosmic ray concentrations in satellite data from 1985 to 2000. This phenomenon coincides precisely with the main warming phase of the late twentieth century and a period with a strong solar magnetic field (Latitudinal dependence of low cloud amount on cosmic ray induced ionization - HYPERLINK "https://agupubs.onlinelibrary.wiley.com/doi/10.1029/2004GL019507"Usoskin HYPERLINK "https://agupubs.onlinelibrary.wiley.com/doi/10.1029/2004GL019507" - 2004 - Geophysical Research Letters - Wiley Online Library). E. Pelle, et al published a paper in Science on the changes in Earth's reflection during the timeline between 1984 and 2000. The paper shows a decline in albedo (reflectivity of a surface), which would result from less cloud cover, equal to an increase of 2 to 6 watts per square meter, just as Svensmark's theory predicts.

The Impact of Cosmic Rays on Climate is Observed Over Decades, Hundreds of Years, Thousands of Years and Millions of Years

Every 11 years there is a solar cycle where solar activity, the solar magnetic field, and cosmic rays increase and decrease. Modern sea temperature records reflect these 11-year solar cycles. The 11-year solar cycles are also reflected in sea level rise and fall as measured from both satellite measurements since 1980 and tide gages since 1920. (See *Nir Shaviv, "Using the oceans as a calorimeter to quantify the solar radiative forcing," Journal of Geophysical Research, 2008.* https://agupubs.onlinelibrary.wiley.com/doi/10.1029/2007JA012989). As the solar cycle peaks the strong solar magnetic field shields the Earth from cosmic rays and the oceans heat as more UV radiation penetrates the water. When solar cycles decline to the valley of the curve, the solar magnetic field declines allowing more cosmic rays into the atmosphere, which results in increased cloud formation and more radiation reflected out to space leaving less radiation to warm the oceans. When the oceans warm, the water expands, and sea levels rise. When oceans cool, the water becomes denser and sea levels decline.

Ulrich Neff from the Heidelberg Academy of Sciences analyzed O_{18} isotopes from layers of stalactite from caves in Oman. He was able to construct temperatures for Indian Ocean during the Holocene. When compared with C_{14} isotopes a correlation can be found between cosmic rays, solar cycles, and temperature. These results show a strong correlation between cosmic rays as measured by C_{14} isotopes and temperature as measured by O_{18} isotopes in the stalactites at various layers.

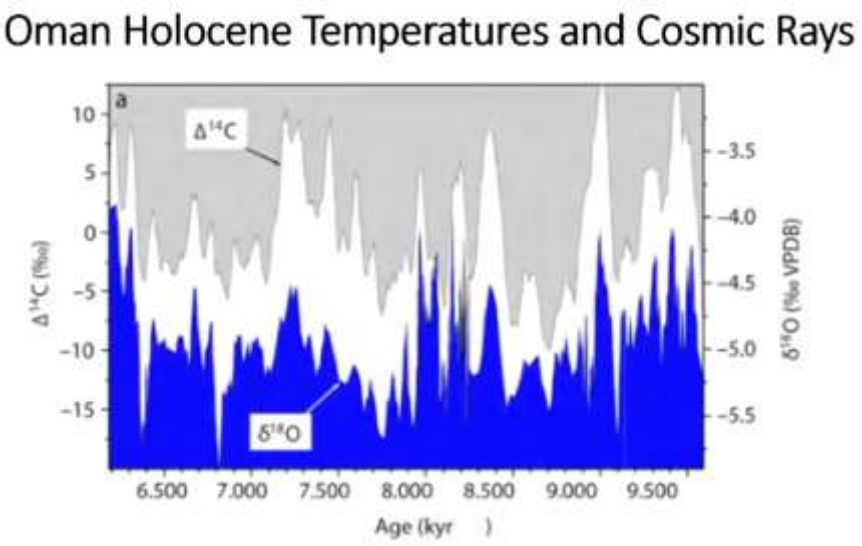

Figure 65 - Holocene Temperatures Match Cosmic Ray Flux. *A reconstruction of Holocene temperature from O_{18} isotopes from stalactites layers taken from caves in Oman (in blue). Comparing these temperatures with cosmic ray reconstructions from C_{14} isotopes (in white) reveals a strong correlation between cosmic ray flux and temperature. Source: U. Neff, et al, Nature 41, 290-293 (2001).*

Working independently from Svensmark, isotope chemist Jan Veizer analyzed isotopes in 24,000 calcium carbonate fossil shells from various sediment levels to reconstruct temperatures of the Earth over the past 500-million years, using O_{18} to O_{16} isotope rations. He was surprised to see a strong cycle of temperature swings of up to 10C every 140 million years. For years he searched for the reason for these

temperature swings but could find no answers. There was no correlation between temperature and CO_2 on these times scales. During the coldest period Veizer discovered, 450 million years ago, CO_2 was over 5,000 ppm and in the period 180 million years ago temperatures were colder than now, yet CO_2 levels were nearly 1,500 ppm as compared to 420 ppm today. Separately, astrophysicist Nir Shaviv studied meteorites to reconstruct historical cosmic ray flux and found cosmic rays increased every 140 million years as our solar system passed through the spiral arm of the Milky Way that had many Super Novas and the resulting elevated levels of cosmic rays. Nir Shaviv was aware of Svensmark's work on cosmic rays and climate and he approached Jan Veizer with a solution to his quandary. The chart below shows how the temperature increases every 140 million years, each time our solar system passes through spiral arms of the Milky Way. Each of these Milky Way spiral arms, including the Perseus, Norma, Scutum-Crux and Sag-Car spiral arms are areas of numerous Super Novas and the resulting abundance of cosmic rays. This data is independent of solar cycles and is yet another confirmation of the impact of cosmic rays on climate. For more information see Hedrick Svensmark's presentation (https://youtu.be/PhdsZHHNy8k)

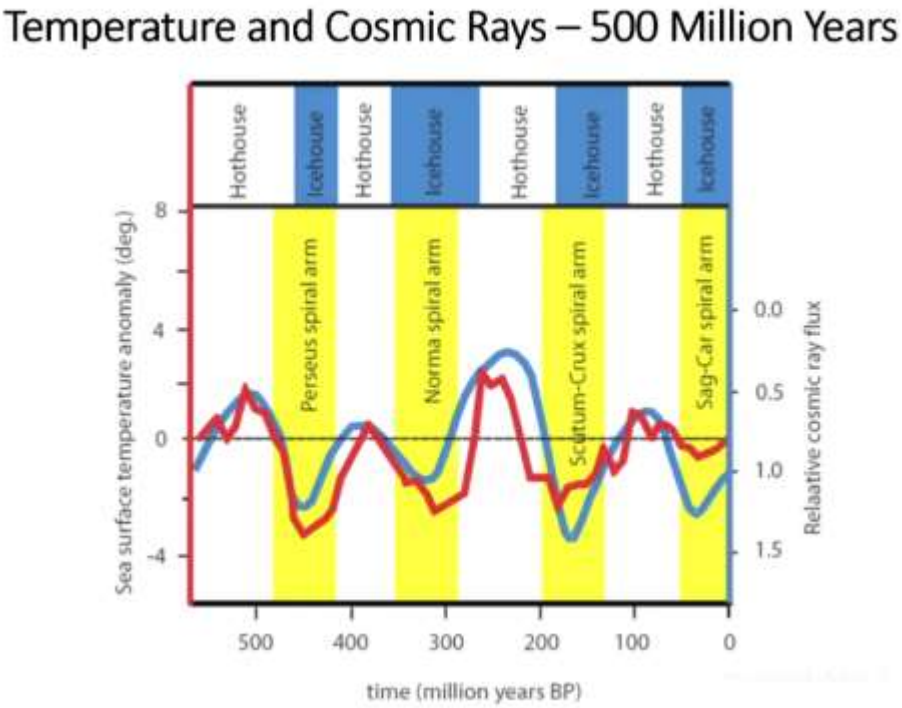

Figure 66 - Temperature Correlates to Cosmic Ray Flux Over 500 Million Years. *The chart above shows the work of Jan Veizer in reconstructing the temperature by analyzing the oxygen isotopes in 24,000 shell fossils from various sediment layers (blue line) and the work of Nir Shaviv in the reconstruction of cosmic rays reaching the Earth from analyzing the isotopes in meteorite samples (red line). Both correlate well and show how temperatures decrease as cosmic rays increase every 140 million years as the Earth passes through the spiral arms of the Milky Way, which has higher levels of Super Nova. These observations are consistent with Svensmark's theory that cosmic rays nucleate low cloud formation, which lowers the amount of solar radiation reaching the Earth. See, https://www.atmos.washington.edu/academics/classes/2003Q4/211/articles_optional/CelestialDriver.pdf*

The correlation between global temperature and cosmic ray flux has been confirmed over millions of years, thousands of years, hundreds of years, and even over recent decades. Yet despite all the scientific evidence, the IPCC does not account for cosmic rays in its climate models and assigns a measly 0.12

watts per square to account for all solar cycle drivers of climate. Since the IPCC considers CO_2 the control knob of climate, they cannot explain the warm and cold periods in the past such as the Holocene Climate Optimum, Minoan, Roman, and Medieval warm periods and the cold Greek Dark Ages, Dark Ages, and Little Ice Age since these were all before significant increases in CO_2 levels. The theory that nearly all warming is caused by CO_2 levels does not explain the temperature drop from the 1940s to the 1970s, a time of rapidly increasing CO_2 emissions. The scientific method demands confirmation from experimental and observational data. Assigning nearly all warming to CO_2 concentrations, fails this test, but the influence of solar cycles and cosmic rays on climate meet this test with overwhelming evidence.

The link between cosmic rays and climate is one of the most important new areas of modern climate research. Sadly, as Dr. Svensmark has commented, "Funding for this research is nearly impossible to obtain." Editors of scientific publications blocked publication of his breakthrough paper for a year and one half, without explanation. For more information on Svensmark's work and the roadblocks he has faced, see (431) HYPERLINK "https://www.youtube.com/results?search_query=hendrik+svensmark+tom+nelson+podcast"hendrik HYPERLINK "https://www.youtube.com/results?search_query=hendrik+svensmark+tom+nelson+podcast" svensmark tom nelson podcast - YouTube.

Climate Alarmists Try to Discount the Overwhelming Evidence of the Impact of Cosmic Rays on Climate, but Their Arguments Come up Short.

Despite impeccable science and overwhelming evidence, climate alarmist apologists continue to block and disregard Svensmark's and Shaviv's cosmic ray work as it undermines their climate catastrophe narrative. Climate alarmists have pointed to rare instances where the correlation of climate and cosmic ray flux does not appear high to dismiss Svensmark's work. In each of these examples, they fail to grasp the essence of Svensmark's conclusions that increased low cloud cover leads to cooler oceans. As we covered previously, low clouds are formed from 1) increased water vapor, 2) increased aerosols, and 3) increased protons or cosmic rays. All three factors need to be considered in assessing the impact of cosmic rays on the climate. Criticism of Svensmark and Shaviv fail to consider how these three factors work together in cloud formation.

Climate alarmist Richard Alley cites an instance of extremely high cosmic ray flux 40,000 years ago, which resulted in only a modest decline in temperature, thus putting a shadow on the impact of cosmic rays on climate. The most recent Ice Age glaciation of North America and Europe occurred between 70,000 to 20,000 years ago. This ice age has been attributed to the Milankovitch Cycles of eccentricity, of the Earth's orbit around the sun and obliquity and precession of the tilt and wobble of the Earth's axis. 40,000 years ago, was during the middle of this glaciation period where glaciers covered Northern Europe, Canada, and several northern states in America. The great Laurentide Ice Sheet covered nearly all of Canada and reached as far south as Chicago and St. Lous. This glacier was up to two miles thick in Nuavik, Quebec. Temperatures were 3C colder than today and they plunged 4C more after the increase in cosmic rays around 40,000 years ago to be 7C colder than today. Temperatures after this high cosmic ray flux 40,000 years ago dropped to one of the coldest temperatures of the 120,000-year interglacial period (see https://nbi.ku.dk/english/news/news13/greenland-ice-cores-reveal-warm-climate-of-the-past).

As the temperature cools, water vapor in the atmosphere dramatically declines. In addition, colder waters result in less algae growth, which is a major contributor to sulfate aerosols. Since cloud formation requires water vapor, aerosols, and protons (cosmic rays), the decline in water vapor and sulfate aerosols in extreme cold limits the formation of low clouds, despite the presence of increased cosmic rays. This is another example of nature's thermostat, which keeps the Earth's temperature within a narrow range. As temperatures plunge, water vapor and sulfate aerosols decline, low-cloud formation is lowered, and more sunlight heats the oceans. This is another feedback of nature to keep the Earth from getting too cold. This example given by Richard Alley does not disprove the impact of cosmic ray flux on cloud formation at today's warmer temperatures. It only shows that the impact on climate of cosmic rays declines in very cold temperatures, due to the low water vapor content of the atmosphere and reduced sulfate aerosols when temperatures decline. It also demonstrates that you cannot isolate one variable in a complex climate system, which has multiple interdependent variables.

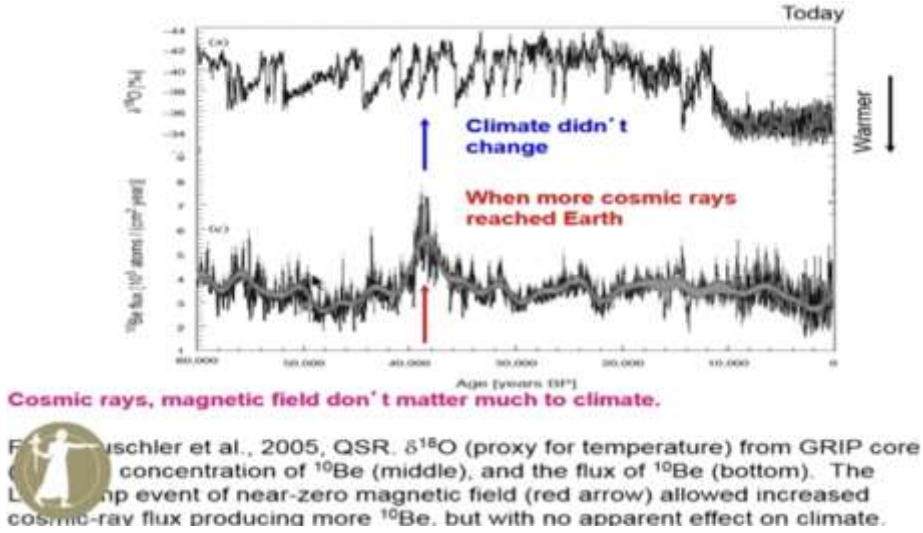

Figure 67 – Argument Disputing Cosmic Ray and Temperature Correlation Fails. *Climate Alarmist Richard Alley provides the chart above to suggest that cosmic rays "don't matter much to climate." He shows that a high cosmic ray flux 40,000 years ago resulted in reducing temperatures by only 4C, which was not colder than other times during the last Ice Age glaciation of 70,000 to 20,000 years ago. 40,000 years ago, was in the middle of the last glaciation which saw glaciers covering most on Northern Europe, Canada, and many Northern States. Temperatures were 3C colder than today and after this high cosmic ray flux 40,000 years ago the temperature plunged to 7C colder than today. As temperatures decline, water vapor and sulfate aerosols from algae declines significantly. Since low cloud formation requires water vapor, aerosols, and protons (cosmic rays), the decline in water vapor in the atmosphere and sulfate aerosols during the Ice Age glaciation would limit low cloud formation despite increased levels of cosmic rays. This example only shows cosmic rays have negligible impact on climate at very cold temperatures, due to lower water vapor and reduced sulfate aerosols. It does not demonstrate cosmic rays have no impact on climate at higher temperatures that we are experiencing today.*

Krivona and Solanki published a paper in 2003 claiming cosmic rays did not impact climate as atmospheric temperature lags cosmic rays and cannot be the cause of the rise since 1970. However, the theory of cosmic rays is that it influences low clouds over the oceans, changing the heating of the oceans not the atmosphere directly. This is confirmed by satellite ocean heat measurements and sea level change observations from satellites and tide gages (see Figure 68). Ocean oscillations such as ENSO, AMO, and PDO may introduce delays over the short term in their influence on atmospheric temperatures. However, in the longer-term the correlation is high between atmospheric temperature

and cosmic ray flux. Ultimately, the heat stored in the oceans drives the climate, but the impact on the atmosphere may not be immediate.

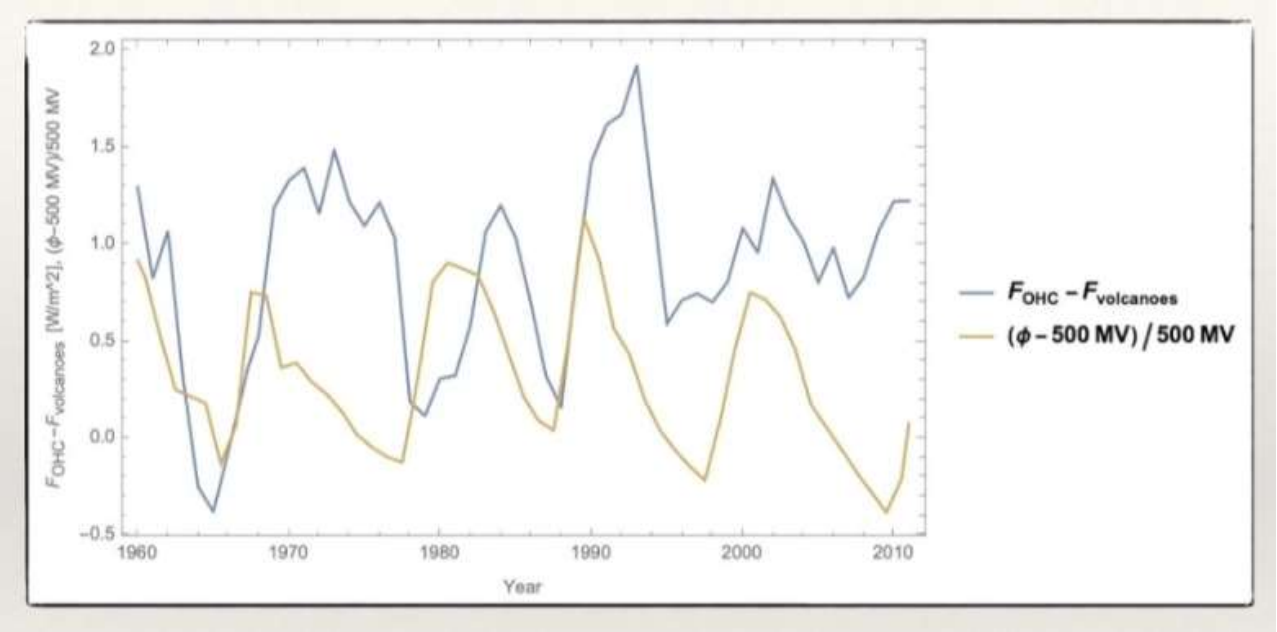

Figure 68 – Ocean Temperatures Follow Cosmic Ray Flux. *The chart above tracks ocean temperatures in blue and solar cycle magnetic flux in gold. 11-year solar cycles produce a fluctuation in the strength of magnetic flux which can clearly be seen gold line in the chart above. When solar magnetic flux is high, there are fewer cosmic rays, less clouds, and the oceans heat up. The chart above clearly shows how the heat in the oceans follows the decline in cosmic rays due to high solar flux from each solar cycle. Ocean temperatures will eventually drive the climate, but atmospheric temperature changes may not be immediate. Source: Astrophysicist Nir Shaviv charting ocean temperatures from NOAA, adjusted for volcanic forcing from NASA GISS and solar modulation from Matthes et al, 2017.*

Agee, et al published a paper in 2012 stating that the high cosmic ray flux in 2008 to 2010 did not result in an increase in cloud cover. The correlation between low cloud cover and cosmic rays was remarkable between 1982 to 2005 but breaks down after 2005. This is, however, likely due to the decline in aerosols since about 2000. Cosmic rays enable aerosols in the atmosphere, particularly sulfate aerosols, to grow to sufficient size to nucleate clouds. Jenkins, et al published a paper in the Journal of Climate and concludes most of the warming since 2000 is from the decline in aerosols in recent years. Lower aerosols in the atmosphere would lead to less cloud formation, despite increased cosmic rays.

Climate alarmists ignore the poor correlation between climate and CO_2 concentrations but cannot seem to accept the overwhelming evidence in all ages of the remarkable correlation between cosmic ray flux, ocean temperatures, and climate. For additional information on cosmic rays' impact on climate, see climatologist Robert Ian Holme's presentation https://www.youtube.com/watch?v=qkcYgEmC8fU HYPERLINK "https://www.youtube.com/watch?v=qkcYgEmC8fU&t=1066s"& HYPERLINK "https://www.youtube.com/watch?v=qkcYgEmC8fU&t=1066s"t=1066s.

The World will Be Getting Colder - Solar Magnetic Waves Predict Past and Future Solar Cycles

Solar physicist and mathematician, Valentina Zharkova, has published several scientific papers on the sun's magnetic field. She has demonstrated that the total magnetic field of the sun is modulated by two dynamo magnetic fields known as the poloidal and toroidal fields. When the magnetic waves of the poloidal and toroidal fields are in resonance, they create a strong magnetic field. When the waves are in anti-phase, they cancel each other out (using the same principle as sound cancelling headphones), resulting in a weak magnetic field. Using principal component analysis of the waves from the poloidal and toroidal fields, Dr. Zharkova has been able to predict past solar maximums and solar minimums with great accuracy. Her models of solar cycles, using this magnetic field proxy, correlate remarkably with observed sunspots, cosmic rays and temperatures as reconstructed from Carbon 14, Beryllium 10, and Oxygen 18 isotopes in ice cores, sediment samples, and stalactites. She has been able to retroactively predict the Maunder Minimum (1645-1715), Wolf Grand Minimum (1200), Oort Grand Minimum (110-1050), and the Homer Grand Minimum (800-900BC) as well as the Medieval Warm Period (900-1200) and the Roman Warm Period (400-10 BC).

Solar cycles occur every 11 years and we are currently in the initial stages of solar cycle 25 (2020 to 2031). Dr. Zharkova accurately forecasted the decline of solar activity in cycle 24 (2009 to 2020) and the dual dynamo of magnetic waves reveals cycle 25 will be similar to cycle 24. This analysis of magnetic waves also foresees cycle 26 (2031 to 2042) as being exceptionally low due to the predicted anti-phase of the two solar dynamo waves. Dr. Zharkova warns cycle 26 should be similar to the Maunder Minimum of the Little Ice Age and temperatures will begin to decline after 2030 (see (242) #42 - Valentina Zharkova: "in next 30 HYPERLINK "https://www.youtube.com/watch?v=LYOMKLDbeYE&t=3558s"yrs. HYPERLINK "https://www.youtube.com/watch?v=LYOMKLDbeYE&t=3558s", global warming prob. will be last thing in our mind" - YouTube). If Zharkova and Svensmark are correct, we will soon have the convergence of lower solar irradiance, higher cosmic rays, increased low clouds, with the beginning of cold phases of the oceans from both the Atlantic AMO and Pacific PDO. The future looks cold after 2030.

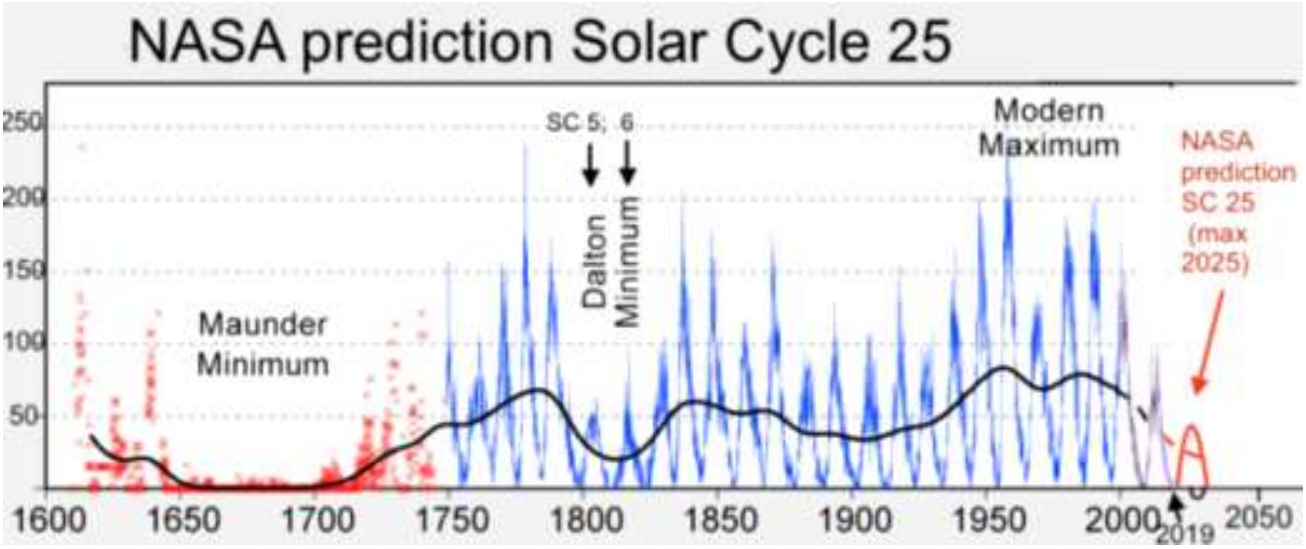

Figure 69 – Future Solar Cycles Will be Getting Weaker. *NASA has predicted solar cycle 25, will be the weakest solar cycle since the Dalton Minimum, a period of cold, including 1816, "the year without a summer." Dr. Zharkova, analysis of solar magnetic waves suggests cycle 25 will be similar to cycle 24, but solar cycle 26 will be as weak as the Maunder Minimum during the Little Ice Age. Source:* Solar-Cycle-25-NASA-full | weatherworkshops.com (briankarstens.com).

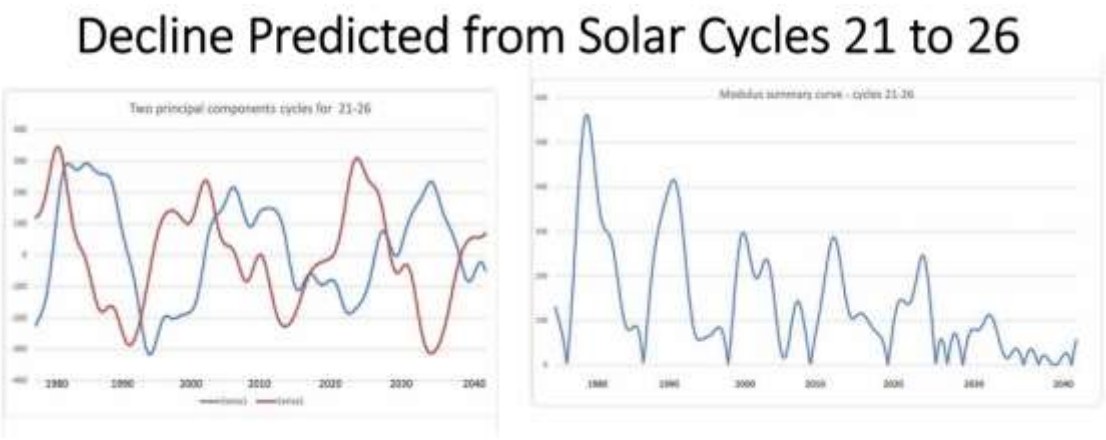

Figure 70 – Decline Predicted from Solar Cycle 21 to 26. *Principle component analysis of the poloidal and toroidal magnetic fields of the sun reveal above on the left that when the two fields are in resonance the solar cycles are strong as seen on the left (solar cycle 21 in 1980 and solar cycle 22 in 1990 (the end of the Modern Solar Maximum). When they are in antiphase, they cancel each other out and we have weak solar cycles as we have had since 2010 with solar cycle 24. We entered solar cycle 25 in about 2020, and the growing anti-phase between the poloidal and toroidal magnetic solar fields should result in very weak solar cycles after 2030. Dr. Zharkova predicts solar cycle 25 will be similar to solar cycle 24 but will drop off sharply and solar cycle 26 will be very weak, like the Maunder Minimum that was experienced during the Little Ice Age. This analysis suggests temperatures should drop after 2030. Source: Zharkova, Valentina, Modern Grand Solar Minimum will lead to terrestrial cooling," Temperature, 7(3): 217-222, 4 August 2020, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7575229/*

Chapter 14 – Summary and Implications

Observational Data Shows there is no Climate Crisis

John Adams said, “Facts are stubborn things; and whatever may be our wishes, our inclinations, or the dictates of our passions, they cannot alter the state of facts and evidence.” Many believe in the climate crisis narrative and will not listen to facts. They want to believe this because they wish to save the Earth and this provides a roadmap, however misled, to accomplish their goal. However, the scientific and historical facts are clear, there is no climate crisis, and this reality will at some time become clear. Applying the definition of the scientific method provided by the great physicist Richard Feynman, it doesn’t matter who tells you there is a climate crisis, it disagrees with experiment and is therefore wrong. A summary of the evidence and implications are outlined below.

The Scientific Consensus of a Climate Crisis is Propaganda

MIT Professor Richard Lindzen, one of the world’s greatest experts on climate said, “What historians will definitely wonder about in future centuries is how deeply flawed logic, obscured by shrewd and unrelenting propaganda, actually enabled a coalition of powerful special interests to convince nearly everyone in the world that CO_2 from human industry was a dangerous planet-destroying toxin. It will be remembered as the greatest mass delusion in the history of the world – that CO_2, the life of plants, was considered for a time to be deadly poison.” After closely examining climate change evidence using the scientific method of verifying theories with observational data and observing the treatment of skeptical scientists, I must agree with Professor Lindzen.

Many respected scientists, including Nobel Laureates, have stated there is no climate crisis. The often-cited paper by Cooke that “97% of scientists agree” only tells us that most scientists accept that anthropogenic greenhouse gas emissions have contributed to the warming in recent years. The data in Cook’s paper shows there is no consensus that current warming is dangerous or that it is mostly caused by anthropogenic greenhouse gases. Even the United Nations, which is a major cheerleader for the climate crisis, does not mention a climate crisis or emergency in any of its scientific assessment reports. The promotion of climate alarmism by United Nation policy makers, the media, universities, scientific institutions, and scientific journals and the firing, defunding, and demonization of climate alarm skeptics as “climate deniers” has created an atmosphere where scientists are afraid to speak out and go against the climate alarmist narrative for fear of destroying their careers. Climatologist Judith Curry, whose career was destroyed by speaking out, said this appalling atmosphere has created a manufactured consensus.

When it comes to climate change, many universities are no longer committed to the pursuit of knowledge and truth. These institutions rely heavily on research grants. An estimated $44.6 billion has been granted to climate research between 1990 to 2018. Public fear fostered by the climate crisis narrative drives politicians to fund research that confirms the narrative. As a result, research that fosters the climate alarm narrative is easily funded, while funding for alternative research, such as research by respected scientists Hendrik Svensmark and Wiliam Gray, has been nearly impossible to obtain. As Upton Sinclair wrote, “It is difficult to get a man to understand something if his salary depends on him not understanding.”

Atmospheric Warming from CO_2 Does not Heat the Oceans; the Oceans Heat the Atmosphere and the Oceans are Warmed by the Sun.

Climate alarmists constantly claim the oceans are warming at an alarming speed due to increasing emissions of CO_2. Not only is this claim false, but it is backwards. It is established that more heat is transferred from the oceans to the atmosphere than is transferred from the atmosphere to the oceans. Most people are not aware of the fact that the oceans are on average 2C warmer than the atmosphere. Because the second law of thermodynamics is based on the observation that heat always transfers from the warmer object (oceans) to the cooler object (atmosphere), on average, heat cannot directly be transferred from the atmosphere to the oceans.

CO_2 warming of the atmosphere does not slow the cooling of the oceans because the heating of the ocean from the atmosphere and CO_2 radiative forcing can only heat the ocean surface and this heat is lost to evaporation. The only means for the atmosphere to warm the oceans is by radiation, conduction, and convection. All three warm only the surface of the ocean.

> **Radiative forcing from CO_2** can only effectively absorb and emit heat in the 13-to-17 micron infrared spectrum and this limited spectrum is almost entirely absorbed in the top 100 microns of the ocean surface, so such heating is lost to evaporation.
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> **Convection** by wind blowing over the ocean greatly increases evaporation, so this heat transfer is also lost to evaporation
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> **Conduction** of heat from the atmosphere to the oceans is insignificant since air is a very poor conductor of heat. The small amount of heat transferred by conduction can only heat the surface of the ocean, so conduction heat is lost to evaporation.

Heating of the oceans by radiative forcing of CO_2, convection, and conduction can only heat the top surface skin of the ocean. Measurements of the Sea Skin layer of the oceans confirms that the net impact of evaporation, radiation, convection, and conduction is to cool, not warm the oceans as the Sea Observations show the Skin layer is colder than the ocean just below the skin. This is true in the Tropics where the atmosphere is warmer than the ocean. This proves that the net impact of a warming atmosphere is enhanced cooling of the oceans by evaporation. If the atmosphere warmed the oceans, the net impact of evaporation, radiative forcing of CO_2, convection, and conduction would result in Sea Skin that would be warmer than the ocean just below the skin layer, but observations show the Sea Skin is colder than the lower layers of the ocean.

The fact that the atmosphere does not warm the oceans has major implications:

1) **Solar Heating:** Over 99.9% of the heating of the oceans is from the sun. As a result, the sun is the primary driver of ocean temperatures, not anthropogenic greenhouse gases.

2) **Oceans Warm the Atmosphere:** It has been established that the oceans warm the atmosphere more than the atmosphere heats the oceans. Since the oceans are 2C warmer than the atmosphere, on average, winds blowing across the ocean surface are heated by the warmer oceans. More importantly, these winds enhance evaporation, which is a powerful mechanism of transferring heat from the oceans to the atmosphere. To evaporate one gram of water absorbs 2,260 joules, which transfers heat in water vapor high into the troposphere until the heat is released when the water vapor condenses to form clouds. Satellite measurements of spikes in atmospheric temperatures during ENSO ocean warming events demonstrate how heat from the oceans represents over 70% of global atmospheric temperature variation since 1979.

3) **Accelerated Warming in Northern Latitudes:** Known as Arctic Amplification, the northern latitudes are warming much faster than the rest of the world. The North Pole is warming 25 times faster than Antarctica. This is because the MOC, Gulf Stream, and Kuroshio currents carry water heated by the sun to northern latitudes including near Greenland and Europe and the Northern Pacific. This heat is released into the atmosphere increasing the heat flux of the atmosphere in these northern regions. Because global warming is found in the very places where the oceans give up heat, this is convincing evidence that solar energy in the oceans is a significant factor in climate change. Concentrations of CO_2 in the Arctic and Antarctica are virtually identical. If CO_2 were the driver of climate, warming in the Arctic and Antarctica would be similar.

4) **Solar Heating of the Oceans is a Viable Theory of the Cause of the Roman Warm Period, Medieval Warm Period and Modern Warming:** Solar heating of the oceans, which heat is transferred to the atmosphere explains the Holocene Climate Optimum, the Roman Warm Period, Medieval Warm Period and Modern Warming since these all took place during grand solar maximums. Greenland ice cores verify these temperature cycles and document there were no spikes in CO_2 during the Holocene Climate Optimum, Roman Warm Period or Medieval Warm Period. The decrease in cosmic rays during solar maximums and its impact on lowering cloud cover explains the increased solar heating of the oceans during the Holocene Climate Optimum, Roman Warm Period, Medieval Warm Period, and Modern Warming.

5) **Melting Arctic Ice is not Primarily Caused by CO_2**. Much of the melting of Arctic Ice is from the warmer temperatures in the Arctic, known as Arctic Amplification. Arctic Amplification heat is mostly from ocean currents and since the ocean is not heated by CO_2 warming of the atmosphere, most Arctic warming is not from CO_2. Therefore, the melting of the Arctic and the associated sea level rise cannot be primarily attributed to CO_2 emissions.

6) **Sea Level Rise is Primarily from Solar Heating of the Oceans**. Between 30% to 40% of sea level rise is estimated to be caused by the thermal expansion of the ocean as it heats. Since this heat is from solar energy and is not caused by CO_2, this portion of sea level rise cannot be attributed to increased CO_2 emissions. Furthermore, since glacier melt in the Northern Hemisphere is primarily caused by ocean currents warming the Northern Hemisphere, only a small amount of sea level rise can be attributed to increasing levels of CO_2 in the atmosphere.

There is no Crisis - Anthropogenic Greenhouse Gas Warming will be Less than 1C by the End of the 21st Century.

We can conclude from scientific evidence that anthropogenic increases in greenhouse gases produce modest warming that is not dangerous heating by any measure. Doubling CO_2 to 800 ppm from today's level of about 400 ppm will result in an increase in radiative forcing of only 3 watts per square meter. At today's level of about 400 ppm of CO_2, 277 watts per square meter of heat would radiate out to space from the Earth, if there were no clouds. Increasing CO_2 to 800 ppm will lower this amount to 274 ppm, which is a reduction of 3 watts per square meter and less than 1%. Watts per square meter can be converted to temperature using the Stephan-Boltzmann equation. In this case, 3 watts per square meter of radiation that is trapped by CO_2 from radiating out to space warms the Earth by 0.8C. In its worst-case scenario, the IPCC says CO_2 concentrations will be at 700 ppm by the end of the 21st century if we do nothing to slow emissions. Therefore, in this worst-case scenario, anthropogenic greenhouse gas emissions from CO^2 will increase temperature by 0.6C by the end of the 21st Century, hardly a crisis. This calculation is made directly from the radiative forcing equations and is not in dispute. Add in other anthropogenic greenhouse gases such as methane and nitrous oxide and the figure is 0.7C. There is no climate catastrophe with a temperature increase of 0.7 by the end of the century.

Perhaps the most colossal inconvenient fact for climate alarmists is that the power of CO_2 to warm declines exponentially as CO_2 concentrations increase. It is well-known that CO_2 levels need to double successively to yield successive one unit increases in temperature. Doubling CO_2 from today's level of about 400 ppm to 800 ppm warms the Earth by 0.8C. To achieve 2.4C in warming would require CO_2 to double 3 times or increase from 400 ppm to (400 + 400 + 800 +1,600) = 3,200 ppm. It is estimated that if we burned the entire known reserves of fossil fuels, it would result in a CO_2 level of 2,890 ppm, which would take hundreds of years to consume, and CO_2 concentrations would be below 3,200 ppm. Therefore, we could never warm the Earth above about 2.4C solely from the burning of fossil fuels.

Climate alarmists and climate models that predict warming substantially above 1C by doubling CO_2 concentrations from present levels are based on an invalidated assumption that the increase in temperature from CO_2 and other human-caused greenhouse gases will result in nearly a three-fold amplification of temperature due to an added greenhouse effect from increases in water vapor and clouds. Climate alarmists use this invalidated theory to increase the warming of 0.7C by the end of the century to an average prediction of 2.1C (3.2C since pre-industrialization). As shown in this paper, observational data and radiative forcing calculations do not support this supposition. If relative humidity remains constant as the Earth warms, the added contribution to heating from water vapor, using the radiative forcing equation, is about 1C, which is 1x, not 3x as alarmists claim. However, observations by weather balloons and satellites have confirmed that relative humidity has declined as the Earth has warmed, so the amplification is less than 1x. Perhaps the most comprehensive study on the water vapor feedback was published by Brian J. Soden and Issac M. Held in the Journal of Climate. They conclude water feedback is the largest positive feedback in the climate, but they could only find evidence for a 0.5x feedback, which calls in question the 3x feedback used in IPCC climate models.

The Arctic has experienced the greatest rate of warming. Because of the excessive cold in the Arctic, the atmosphere is too cold to hold hardly any moisture and the air is very dry. An increase of less than 1C in temperature in the Arctic will result in only a very slight increase in humidity. If temperatures were primarily driven by the water vapor feedback, as is claimed by the IPCC, then warming would higher in the Tropics and mid-latitudes. Humidity would increase much more rapidly in the Tropics and mid-

latitudes as temperatures increase, due to more moderate temperatures. However, temperature measurements show the Arctic has warmed faster than the Tropics and mid-latitudes, so the theory of water vapor feedback as the dominant temperature driver is to be questioned. Between 1978 to 2022, the Arctic warmed by 0.25 per decade, while the Tropics warmed by 0.12C, the Northern Hemisphere mid-latitudes warmed by only 0.19C and the Southern mid-latitudes warmed by only 0.10C.

Soden and Held identify the second largest climate feedback from clouds, but even the IPCC admits that the net impact of clouds is to lower temperature. Over the past 30 years observations have verified an average 0.017C increase in temperature per year from all causes. We have been in a warm period and this warming is likely to decline over the next few decades. However, even if it continued to warm at the rate of 0.017C per year, with 77 years left to the end of the century, this worst-case scenario of taking no action to curb greenhouse gases would yield a temperature increase of 1.3C not 2.1C. Climate alarmists base their fears on climate model predictions, yet it is clear from observational measurements that these climate models predict far too much warming (see Figure 52).

Evidence presented in this paper makes it clear that the water vapor and cloud temperature amplification thesis is either greatly exaggerated, or there are climate drivers which cool the Earth and more than offset any warming from water vapor and clouds. The 2022 Nobel Laureate in Physics, Dr. John Clausen identified low clouds as the primary thermostatic control of the climate. Low clouds reflect 70% to 90% of the sun's radiation back to space and result in lowering temperature. You can feel this temperature decline on a sunny day when the sun goes behind a low cumulus cloud. The impact of low clouds is to reduce radiative forcing by 168 to 216 watts per square meter under the cloud, which is nearly two orders of magnitude greater than the 3 watts per square meter (about 1C) of radiative forcing over the next century by doubling concentrations of CO_2 from current levels. As temperature increases, there is more water vapor in the air from which more low clouds are formed, and these clouds cool the Earth. That is why Dr. Clausen has said, "There is no climate crisis."

The Climate Has Always been Cyclical and We are at the Peak of a Warm Cycle

The climate is driven by many other factors, with oceans temperatures having the greatest impact. Water holds 4,200 times more heat than air on a volume basis. The oceans store heat and transfer this heat to the atmosphere and thus oceans are the primary driver of climate. You can witness this phenomenon when you fill a bathtub with hot water and shut the bathroom door. The air in the room quickly warms. But if you fill a bathtub with cold water and heat the air, the temperature of the water hardly changes. The MOC, Gulf Stream, and Kuroshio ocean currents move seawater heated by the sun to northern regions, particularly near Greenland and Europe, but also in the northern Pacific. As a result, global warming since 1978 has been mostly in the Arctic. Between 1978 to 2022, the Arctic warmed by 1.10, yet Antarctica warmed by only 0.04C, which is 25 times less than Arctic warming. Greenland ice cores show how past warm cycles including the Holocene Climate Optimum and the Minoan, Roman, and Medieval warm periods saw higher temperature increases in the Arctic, just as is observed today.

Climate is cyclical because the oceans have their own temperature cycles including ENSO, AMO, and PDO temperature oscillations that can influence climate over years to decades. Warm and cool waters continuously cycle in the ocean resulting in cyclical temperature oscillations. The oceans are heated almost exclusively by solar radiation, which heating varies by low cloud cover, which low cloud cover is

driven by changes in water vapor, aerosols, and cosmic rays. Cosmic rays increase or decrease based on the strength of the sun's magnetic field, which varies with natural solar cycles. In the short-term solar cycles and comic ray effects can be masked by changes in aerosols and ocean temperature oscillations. However, grand solar minimums and grand solar maximums, with their control of cosmic ray flux, are a major driver of centennial climate cycles. The Holocene Climate Optimum, the Minoan Warm Period, cold Greek Dark Ages, warm Roman Optimum, cold Dark Ages, warm Medieval Optimum, cold Little Ice Age and the Modern Warming align perfectly with grand solar maximums and minimums and the corresponding, sunspots, cosmic ray flux, as well as temperature and cosmic ray paleoclimate proxies of O_{18}, C_{14} and Be_{10} levels found in ice core, sediment, stalactite and shell fossil samples over the ages. Such data confirms the thesis that these centennial climate cycles are primarily driven by solar cycles.

Modern Warming has occurred during the largest solar maximum in 10,000 years. The current warming is compounded by the fact that we have recently been in warm periods of the AMO and PDO ocean oscillations. On a decadal scale, you can see these 30 to 40-year temperature swings of the AMO and PDO in the cold climate of 1910, followed by the hot "Dustbowl" period of the 1930s and early 1940s, then the cold temperatures of "The Big Freeze" scare of the mid-1940s to 1970s, and the warm period since the 1980s. Over yearly time horizons, you can see the temperature swings in synch with the warm and cold periods of the ENSO ocean oscillations.

As expected with Eddy Solar Cycles it was warm 1,000 years ago, cold 500 years ago, and warm today. There is an excellent correlation between solar cycles and climate, but there is poor correlation between CO_2 levels and the warm and cold climate cycles over thousands of years. Furthermore, the strong correlation between climate and cosmic rays can be found in weeks, decades, centuries, millennia, and millions of years. Ocean temperatures have decreased as cosmic rays and low cloud cover increased over the history of the Earth. This correlation can even be seen as cosmic ray flux emanating from regions of the Milky Way match ocean temperature over 500 million years. Temperature and cosmic ray flux have been determined by measuring isotopes in fossil, sediment, and meteor fragments and through astronomy reconstructions. Unlike the excellent correlation between temperature and climate with solar cycles and cosmic ray flux, the correlation of temperature and CO_2 concentrations is poor. This is because the radiative forcing of increases in CO_2 levels is significantly lower than that of low cloud cover. Low cloud cover is induced by the combination of increases in water vapor, aerosols, and positively charged protons, which glue together the negatively charged aerosols and water vapor vesicles into clusters to form clouds. Cosmic rays are primarily protons, which explains their influence on clouds.

CO_2 is Not the Primary Driver of Climate

Analysis of data over the past 60 years and over thousands of years show that CO_2 has never been the primary driver of temperature as historical temperature increases have preceded elevations in CO_2 levels. Temperature drives CO_2 levels because warm oceans emit CO_2 and cold oceans absorb CO_2 pursuant to Henry's Law. This is why a beer or Coca Cola keeps its carbonation when kept cool but loses carbonation when warmed. The ice core records from Antarctica show CO_2 increases lag temperature by about 800 years and temperature begins to drop, before CO_2 concentrations peak. Ice cores show consistently that temperature declines before CO_2 levels peak during each climate cycle. If CO_2 were the primary control knob of temperature, as climate alarmist insist, temperatures would not drop as CO_2 concentrations are increasing. The temperature would continue to rise, but it does not. Climate science

accepts the temperature spikes in the Antarctica ice core record are the result of the Milankovitch cycles that impact the amount of solar radiation reaching the Earth. These temperature spikes are not CO_2 induced as the temperature swings are 11C and the CO_2 change is only by 120 ppm, which the radiative forcing models shows only produces 2.2 W/m2 of heating, or temperature increase of 0.6C, not 11C. Al Gore's use of these ice core record to suggest CO_2 is the control knob of climate is pseudoscience.

We have presented paleoclimate, archaeological, and historical evidence in this paper which establish beyond question the semi-millennial global climate cycles of the past 3,000 years. And although the accuracy of paleoclimate proxies can be debated, the change in glaciation, tree lines, sea level and temperature-related agricultural records from around the globe do not lie. CO_2 cannot explain the historical climate cycles of the last 500 million years or 400,000 years as CO_2 levels did not change enough to account for the warming and cooling periods. Furthermore, many eras in these periods have a negative correlation between temperature and CO_2 levels. CO_2 levels cannot explain the Holocene Climate Optimum or the Minoan, Roman, and Medieval Warm Periods. Nor can it explain the cold periods of the Greek Dark Ages, the Dark Ages, and the Little Ice Age. CO_2 cannot explain "The Big Freeze" which saw temperatures drop from the mid-1940s through 1970s, since CO_2 emissions grew by nearly five-fold during this 40-year period. Clearly, CO_2 is not the control knob of the climate. Between 1978 to 2022 the Arctic warmed by 0.25C per decade, yet Antarctica warmed by only 0.01C per decade, which shows the Arctic has warmed 25 times more than Antarctica. CO_2 cannot be the cause since the concentration of CO_2 is generally the same at the North Pole and the South Pole. Reasons given for faster Arctic warming has been, 1) loss of albedo as ice melts which reflects less radiation back out to space, 2) weakening of the polar vortex, due to warming, which transports warm air masses to the Arctic, and 3) the release of the greenhouse gas methane as permafrost melts. These reasons do not explain the difference between Arctic and Antarctic warming since such feedbacks would impact both Antarctica and the Arctic. Warming discrepancies between the Arctic and Antarctica can be explained by the MOC, Gulf Stream, and Kuroshio ocean currents. Sea water is heated by the sun and this heat is distributed by ocean currents, which transports this heat to northern latitudes, primarily near Greenland and Europe, but also to the northern Pacific. Such heat is released from the oceans, increasing the heat flux of the atmosphere in northern latitudes. Actual temperature measurements thus support the theory that the climate is more sensitive to cloud cover than to CO_2 radiative forcing.

The climate has always been cyclical, gyrating between warm and cool periods. Looking at the past few thousand years, the temperature ups and downs correlate to solar maximums and solar minimums. Looking over the past 150 years, it is evident that decadal cycles exist which follow the ocean oscillations including the multidecadal swings in ocean temperature from the AMO and PDO. When these two ocean cycles are in synch, the impact is greater. This is the current situation.

So, have we seen global warming in recent years? Yes, as expected, we are in a current warm period. We are at the convergence of the hot periods of the AMO, PDO, and the solar Modern Maximum with associated low abundance of cosmic rays and low cloud cover. We also have additional modest warming from increases in greenhouse gases. Is global warming likely to continue? No, the climate has always been cyclical. The Modern Solar Maximum has peaked and is in decline, and we will enter the cold phases of the AMO and PDO after 2030. We are currently at the top of the warming curve. The fatal error in forecasting is to extrapolate from the top of a curve, especially in a known cyclical system. This error was made by those who forecast "The Big Freeze" in the 1970s by extrapolating off the bottom of the curve. A similar error is being made today by climate alarmists. The modest warming from CO_2 will be a fraction of a degree by 2040 and science suggests we should expect the world will get colder after 2030. In the past, a person calling for the end of the world was described as a religious

fanatic, today you call that person a climate alarmist. I expect climate alarmism will fade away within a decade, as it is more likely than not that we will return to a colder world in the 2030s and modest greenhouse gas warming will not be strong enough to offset the cooling.

Snapshot Summary of Climate Change

An overall snapshot summary of the underlying causes of climate change are as follows:

1. The climate is complex and driven by many factors, CO_2 only being one factor.
2. Natural causes drives 50% to 70% of climate change, so CO_2 represents 50% or less of total forcing.
3. The power of CO_2 to heat declines exponentially with increases in concentration. Therefore, CO_2 becomes less of a driver of climate change in the future.
4. 99.9% of the energy input to the Earth is from the sun.
5. Ocean temperatures are a dominant driver of climate since oceans represent 70% of the Earth's area and absorb 90% of the Earth's solar energy due to the low albedo of sea water.
6. Oceans store heat and transfer this heat to the atmosphere.
7. Ocean oscillations such as the AMO and PDO produce climate cycles of between 30 to 40 years.
8. We are currently in the convergence of the warm periods of the AMO and PDO and are experiencing a warm climate.
9. Other than long-term Milankovitch Cycles, cloud cover is the largest modulator of solar heating of the oceans.
10. Clouds are formed from water vapor, aerosols, and protons.
11. Increased protons from cosmic rays seed more clouds by providing positive charge to glue together negatively charged water vapor and aerosols.
12. The magnetic field of the sun modulates cosmic ray flux.
13. Solar cycles vary the magnetic field strength of the sun, which impacts cosmic ray flux and cloud cover.
14. The Eddy Solar Cycle is experienced on a millennial time scale. Every 1,000 years we have grand solar maximum which strengths the sun's magnetic field, reduces incoming cosmic rays, reduces cloud cover and warms the oceans.
15. We are currently in a solar maximum as we were 1,000 years ago, and 2,000 years ago.
16. Clouds are the most powerful thermostat of the Earth. As the Earth warms more water vapor and sulfate aerosols from algae are produced, which form more clouds to cool the Earth; as the Earth cools, there is less water vapor and less algae sulfate aerosols, producing fewer clouds, which warms the Earth.
17. Ocean oscillation and solar cycles driving cosmic ray flux are cyclical. We are at the peak heating of the grand solar maximum and the AMO and PDO ocean oscillations. There should be cooling after 2030 since all three of these cycles should be in cold or declining phases after 2034.

Recent Warming and Increases in CO^2 Concentrations Provides More Benefits than Harm.

The media is constantly warning of a coming catastrophe due to climate change. To discern the truth, it is wise to follow the advice attributed to the famous statistician Edwards Deming, "In God we Trust, all

others bring data." Observational data shows clearly that current warming is not dangerous. Far from dangerous, the data shows the benefits of modern warming. United Nations policy makers, politicians, and news media continue to paint terrifying scenarios of the future and repeatedly falsely claim extreme weather events are getting worse due to climate change. As we set forth in this paper, an examination of the data shows such statements are blatantly false. Despite recent warming, there is no trend in hurricanes, tornados are down significantly, snow fall is not disappearing, floods have not gotten worse, heat waves have declined to a fraction of what they were in the 1930s, droughts are less severe than the past, acres burned in wildfires today is five times less than the 1920s and 1930s, coral growth in the Great Barrier Reef are at record levels, extinction of endangered species has dramatically declined, polar bear populations are increasing, and sea level is changing at a rate to of less than 11 inches of rise by the end of this century. Even the IPCC, in its scientific reports, states that many of these extreme weather events show no positive trend and are therefore not caused by anthropogenic greenhouse gas emissions, which contradict statements by United Nations' policy makers.

Temperature measurements over the past 40 years reveal the Arctic has warmed more than twice as fast as the Tropics. This means global warming has moderated temperature differences between the Arctic and the Tropics and has resulted in a decline in severe weather. This is because severe weather is caused by warm moist air colliding with cold air. Since global warming is moderating the temperature contrast, severe storms are lessened, which can be seen in the data. And although the average temperature has gone up, a close examination of the data shows heat waves are declining, and winters are warming. This means the climate is moderating which is good for agriculture and humanity.

The benefits of CO_2 and a warming climate are clearly seen in the data, yet you never hear the press reporting on this good news. A saying attributed to newspaper owner William Randolph Hearst says, "Bad news is good news and good news is no news." Nine times more people die from cold weather than hot weather, so climate change has saved many lives. Weather related deaths is dramatically down from prior years. In the 1920s, almost 250 people per million died of climate-related causes. By 2020, that number was about 5 deaths per million.

Increased CO_2 allows plants to grow better and faster. Plants use stomata or pores in their leaves to absorb CO_2. Plants partially close their stomata in the presence of higher levels of CO_2. Over longer periods, plants produce leaves with fewer stomata as CO_2 levels increase. This leads to less water evaporating out of these pores and the plants become more drought resistant and draw less water out of the ground, which deters fires. Satellite measurements of total leaf area of the Earth have shown the Earth has greened by more than 20% since 1982. A global figure of 20% is about twice the size of the United States. Scientific papers report that 70% of this greening is from CO_2, followed by 9% due to nitrogen deposition, and 8% to global warming. CO_2 and global warming are greening the Earth which is counter to the climate crisis narrative. Greening has been documented since 1982, and accelerated between 2001 to 2020. The greening has been most pronounced in arid areas bordering deserts as plants become more drought resistant as CO_2 levels rise. It is a preposterous irony that we call "Green Energy" the very energy that will limit CO_2 and cause less greening.

Enhanced vegetation growth from increases in CO_2 is no surprise as growers often increase CO_2 levels in greenhouses by 3-fold to 1,200 ppm to accelerate the growth of tomatoes and other crops. The result of anthropogenic increases in CO_2 emissions has been a tremendous increase in agricultural productivity over the past 50 years. Rising agricultural yields correlate directly to the levels of CO_2 in the atmosphere. Increases in CO_2 thus help us feed a growing population. Even such good news is reported

negatively in the press as articles on the greening of the Earth say it is a problem as plants lack nutrients to properly grow in higher levels of CO_2. This argument is ridiculous, since these nutrient deficiencies are solved by fertilizers which has been worked out for years in CO_2 enhanced greenhouses.

History also teaches us that warm weather is good and cold weather is bad, very bad. Warm weather is moister and generally results in greater harvests, growing populations, prosperity, and the flourishing of civilizations. Warm periods are referred to by historians as "Optimums" since they are times of prosperity, economic advancement, and high points in cultural development. Cold weather is more arid and results in poor harvests, famines, diseases, wars, and the decline of civilizations. Cold periods are referred to as "Pessimums" due to the extreme adversity, hardship, and decline in these periods. These climate and societal cycles have been repeated many times.

The Bronze Age was warm, and civilizations emerged and prospered in the Middle East and China with the abundance of agricultural productivity. The Greek Dark Ages was a cold period which saw the decline of civilizations of the Bronze Age. Hallmarks of civilization such as written records and palace building went dormant. The Roman Optimum was a warm period which saw the return of abundant harvests, growing populations, architectural achievements, and cultural advancements in Europe, the Middle East, China, and Central America. The Dark Ages was cold and once again crops failed, famine and disease led to the decline of the Roman Empire, Han Dynasty in China, and the Classic Mayan civilization in Central America. Historians refer to this cold period as the "Pessimum." Following the Dark Ages, the Earth once again warmed. The Medieval Optimum was a warm period which saw agriculture rebound, unprecedented population increases and prosperity in Europe, China, and Central America.

The prosperity of the Medieval Warm Period was followed by the Little Ice Age where temperatures plunged. During the Little Ice Age crops failed, famine and malnutrition was common, diseases raged, and wars were seen throughout the world. Humankind was blamed for the calamities that followed the cold climate and scapegoats including witches and monarchs were blamed for the bad weather and famines. Over 50,000 witches were executed in an attempt to bring forth better weather. Monarchs of England and France were executed, The Ming Dynasty in China was overthrown, and the Aztecs in Central America suffered rebellions. Following the Little Ice Age, the Earth once again warmed and we are now living in the Modern Warming Period, a time of unprecedented prosperity. Why anyone would think it advisable to reduce temperatures and return to the misery of the Little Ice Age is beyond belief. Winston Churchill said, "Those who do not learn history are doomed to repeat it." Climate alarmists need to study climate history over the past few millennia to fully understand the blessings of warmth and the good times we live in today.

We Have Time to Implement a Rational Energy Transition

CO^2 is not a pollutant, it is odorless, transparent, non-toxic, and the staff of life for plants. A crowded auditorium generally has about 2,000 ppm of CO_2. Astronauts breathe 5,000 ppm of CO_2 for months without side effects. CO_2 concentrations are as high as 8,000 ppm on submarines. An ideal level for plants, agriculture, and thus humanity, is likely about 1,200 parts per million, which is less than the level typically found in a crowded auditorium. The radiative forcing of CO_2 at 1200 ppm is (R = 4.328 x ln(1200ppm/400 ppm) = 4.76 watts per square meter = 1.2C in warming. This remains well under 2.4C and is therefore expected to have only a slight negative economic impact on the world's economy. (see

Figure 44). At the current rate of fossil fuel use, it would take over 300 years to increase the current 420 ppm of CO_2 by 780 ppm to 1200 ppm, thereby giving us ample time to transition away from fossil fuels. Solar and wind energy should be included in our energy power mix, but large-scale solar and wind energy deployments as urgent fixes to a non-existent climate crisis are not needed, damage the environment, destabilize our electrical grid, and hurt the poor with rising energy costs. The harm and blight on the landscape and seascape from wind and solar should be avoided and the massive amounts of money spent on such technology should be diverted to safe nuclear energy and anti-pollution measures. Yes, we should transition to alternative forms of energy, including EVs, hydrogen, synthetic fuels, and nuclear. But the reason is not to reduce CO_2, but to reduce real pollutants and because we will run out of fossil fuels someday.

Although natural gas is exceptionally clean, the burning of oil and coal produces particulates, which are pollutants. The role of wind and solar power as fossil fuel replacements are limited due to their poor energy densities and intermittent outages. Furthermore, wind turbines and solar panels use massive amounts of mined materials, including copper and rare Earth metals, which mining is detrimental to the environment (see https://www.youtube.com/watch?v=sgOEGKDVvsg). Copper and rare Earth metals are in limited supply and are also needed for the more important deployment of EVs and the expansion of the electrical grid. Ore grades are in decline for these metals so as demand grows, an ever-larger amount of rock needs to be excavated, crushed, and processed to produce each ton of refined metal. Nuclear energy, natural gas, the discovery of new energy and anti-pollution technologies, and EVs should be our current focus. In the end nuclear fusion and small-scale and affordable fission nuclear reactors could be the solution to our long-term energy needs.

We should move forward with an energy transition, but we have time to do it properly and not rush into poor and unrealistic solutions, which threaten our energy security, waste money, disproportionally hurt the poor and third world countries, and cause additional threats to the environment, humanity, and the natural beauty of this Earth. We should focus our investments on new energy sources that are affordable, reliable, and reduce real pollution (not CO_2). Focusing spending on adapting to climate is far more prudent than wasting money in a futile attempt to control the climate. Money spent on reducing CO_2 would be better spent on adaptation to climate, reducing pollution, saving endangered species, lifting the poor of the world out of poverty, and protecting the beauty of our natural world. We need to invest in innovation and avoid wasting money on boondoggles such as carbon dioxide capture technologies. All these solutions will be created by people. Accordingly, we need to encourage, not discourage, our children to have children of their own, as it is these future generations who will innovate new technologies and adapt our world to the changing climate, regardless of whether it is warmer or colder.

I leave you with the words of Winston Churchill, “Truth is incontrovertible. Malice may attack it, ignorance may deride it, but in the end, there it is.” The evidence and truth are clear, there it is, there is no climate crisis. Let us act accordingly and focus our attention on solving legitimate environmental and social problems, while protecting the beauty of our precious Earth.

Addendum

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Additional Sources

- Online physics course on YouTube by Michael Van Biezen titled, Astronomy Chapter 9.1 – Earth's Atmosphere (https://www.youtube.com/watch?v=dw3vQ6hguWg). This is an excellent course of 61 five-minute lectures, which covers the greenhouse effect in detail.

- Tom Nelson Podcasts (https://www.youtube.com/@tomnelson2080) are podcasts of climate-related interviews of various experts. Tom has as his guests dozens of credible scientists who provide real world evidence, which refutes the climate alarmist narrative.

- Andy May Petrophysicist (https://andymaypetrophysicist.com/). Andy May is a climate journalist who writes serious articles on important climate change topics. His articles are well researched, using references to credible scientific sources.

- The CO_2 Coalition (https://co2coalition.org/) is a great source of data and lectures on the science of global warming.

- CO2 Science climate change information and references to applicable scientific presentations

- Watts Up HYPERLINK "https://wattsupwiththat.com/"With HYPERLINK "https://wattsupwiththat.com/" That? – The world's most viewed site on global warming and climate change, highlights papers and news on climate change and references to applicable scientific publications.

- The Global Warming Policy Foundation https://www.thegwpf.org/category/climate-research/ is a foundation which provides access to a climate-related publications. They also sponsor an annual lecture series, which can be viewed on YouTube.

- Compilation and articles on important areas of climate change see: https://www.climate4you.com/

- For an excellent list of climate change-related charts see https://www.c3headlines.com/temperature-charts-historical-proxies.html

- Interesting articles can be found at The Hockey Schtick https://hockeyschtick.blogspot.com/

- Additional climate information can be found on Climate Intelligence (CLINTEL) Climate Intelligence (CLINTEL) climate change and climate policy. CLINTEL has prepared a statement that there is no climate emergency and collected the signatures of 1,574 scientists and professionals who agree.

- For climate science and policy discussions see https://heartland.org/topics/. The Heartland Institute holds an annual climate conference that can be viewed on YouTube.

- For information on sea level change see https://sealevel.info/

- For climate and policy discussions see https://judithcurry.com/

- For an environmentalist's view on climate see http://landscapesandcycles.net/
- For discussions on energy policy see https://energytalkingpoints.com/
- For climate information and policy see https://www.netzerowatch.com/global-climate-data/
- For historical information of temperature and other climate topics see Tony Heller's https://realclimatescience.com/