Dennis Jaynes

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Dr. Preston

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Global Warming: Myths & Realities

Introduction

"If 95 of the world's best, most experienced experts in child well-being were to tell you that your child was under lethal attack – and with dramatic signs already visible if you only look – would you say, 'I think I'll wait until the other five experts are convinced before I do anything about it?'" Bill Blakemore

The topic of Global Warming has been surrounded with controversy since it was first proposed. From evidence that has come from years of studies, a majority of the world's governments and scientists are in agreement that the Earth's global temperatures are warming. However, there are others who are skeptical of the science; they spread their message by trying to discredit the scientists or have even gone as far as to cover it up. The intent of this paper is to examine the myths and compare them side by side with the latest scientific data to determine what is real and what amounts to simple propaganda.

This paper will begin with an explanation of what global warming is. By explaining what the "Greenhouse Effect" is, the reader should have a good understanding of what this term means. By understanding the "Greenhouse Effect," one can better understand how this effect can have positive and negative effects on not only the human population, but for every species on planet Earth.

After the explanation of what global warming is, the next topic to be addressed will be the causes of global warming. This paper will examine both the natural and man-made causes that contribute to global warming. This will be accomplished by examining data on; natural and man-made CO^2 emissions, volcanic eruptions, sunspots, deforestation, and the burning of fossil

fuels. While examining the natural and man-made causes, this paper will address any of the claims, or myths, that have been presented by the skeptics of global warming.

The final topic that this paper will address in the global warming debate will be what we can expect in the future. Depending on what side one favors, global warming can have a negative or a positive effect on the human race. By applying scientific data to the skeptical claims, or myths, we should be able to definitively know what the future will hold if we continue the status quo. Is it already too late or are we doomed? Can we do something to prevent any further damage? One side of this debate says a warmer planet is good for humanity, while the other side argues just the opposite. This paper will address each of these controversies in terms of whether or not they can be categorized as myth or truth.

What Is Global Warming and Is It Real?

"Individuals base their views on many factors: on their own belief system, their own personal agenda (either financial or political), or whatever is expedient to believe at the time. However, the basis to everyone's views of the global warming hypothesis is determined by how we each perceive the world." Mark Maslin

The Greenhouse Effect

"The temperature of the Earth is controlled by the balance between the input from energy of the sun and the loss of this back into space" (Maslin, 2009. p. 5). This is a natural occurrence where certain atmospheric gases, which are critical to this temperature balance, are known as greenhouse gases (Maslin, 2009. p. 5). Basically, the Earth receives radiation energy from the sun mainly in the form of visible light, which is also called short-wave radiation that helps to warm our planet (Maslin, 2009. p. 4). While the atmosphere absorbs some of the short wave radiation, the Earth's land and ocean areas absorb about sixty-six percent, which in turn helps to heat our planet. The other thirty-three percent of the sun's visible light is reflected back into space by things like white snow, clouds, or shiny metal roofs (Blakemore, 2006. para 5). The short wave radiation that has been absorbed by the land and ocean areas is converted to heat on long wave raqdiation. Then the heat from the Earth's surface areas is radiated back toward space in the form of infrared or heat waves (Maslin, 2009. p. 4). As the infrared radiation is heading toward space not all of it makes its way back into space. Some of the infrared radiation is trapped and re-emitted by natural greenhouse gases which help to warm our atmosphere by 35° C (Maslin, 2009. p. 4). "Naturally occurring greenhouse gases include water vapor, carbon dioxide, ozone, methane, and nitrous oxide", (Maslin, 2009, p. 4). Figure 1 below is a good illustration of

how the Earth's energy balance actually works. "This natural greenhouse effect, discovered two centuries ago, is basically a good thing, as it originally warmed the Earth enough to develop and sustain life," (Blakemore, 2006. para. 10).

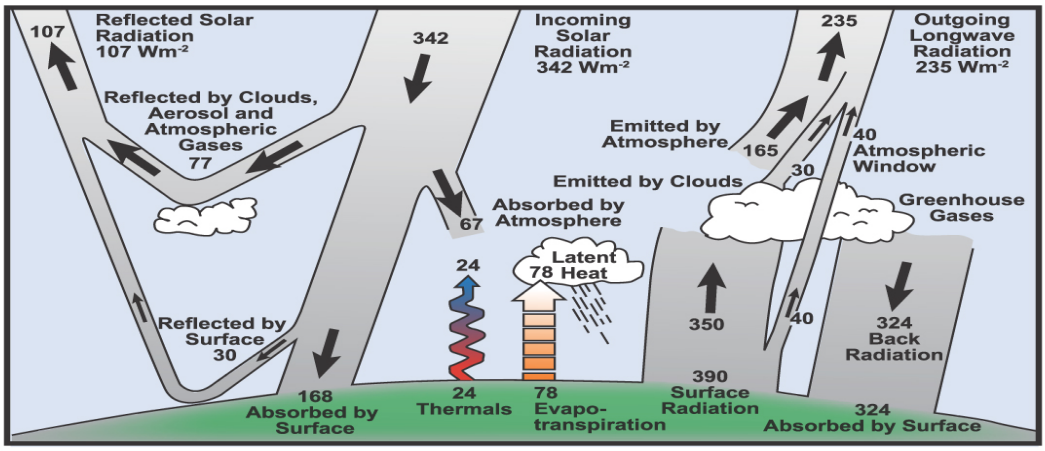

Figure 1- Earth's atmosphere global energy balance

Is Global warming real? Two of the most important greenhouse gases are water vapor and carbon dioxide and without these two gases Earth's average temperature would be a very cold -20°C (-68°F) (Maslin, 2009. p. 6; Dow & Downing, 2006. p. 30). While this natural greenhouse effect is a good thing for life here on Earth, it can also be said that too much of a good thing can be bad. This is exactly what current global warming is about, too much of a good thing. How does science know that greenhouse gases cause global warming? All you need to do is look at two of Earth's nearest neighbors in our solar system to find examples that demonstrate exactly what effects greenhouse gases can have on a planet. Mars is too small to have adequate gravity that would enable it to have a dense atmosphere; it is hundreds of times thinner than Earth's and consists mainly of carbon dioxide (Maslin, 2009. p. 6). With the average surface temperature of Mars being -50°C (-122°F), most of the carbon dioxide that is present is frozen in the ground (Maslin, 2009. p. 6). Venus on the other hand has roughly the same mass of the Earth

with an atmosphere that is much denser, consisting of 96% carbon dioxide (Maslin, 2009. p. 6). The high concentration of carbon dioxide helps to produce intense global warming that contributes to an average surface temperature of over 460°C (860°F). Mars and Venus are great examples that show both extremes of the effects that greenhouse gases can actually have on a planet.

Will The Greenhouse Effect Have Positive and Negative Effects on Mankind

Scientific data is so strong that no one debates that CO^2 levels have been rising and continues to climb. The real controversy is over whether the warming from the Greenhouse Effect will have a positive or negative effect on mankind. The scientific community has warned us that a rise in greenhouse gases could have dire consequences for the human race. However, others want us to believe that global warming is a good thing that could benefit humanity. They believe that rising CO^2 is the "lifeblood of the planet," not a pollutant (Bailey, 2002. p.11).

According to a book by Thomas Gale Moore, who is an economist not a scientist, entitled *Climate of Fear*, global warming is nothing to fear. The consequences that may occur from our climate warming will have positive effects on the human population. Moore contends that a warmer climate will be a wetter climate, which means humans will be able to grow more food. By using the Medieval Warming Epoch (MWE), which existed from about 1000 to 1400 (Wigley , Ingram, & Farmer, 1981. p. 16), Moore makes the argument that the warmer climate equated to food supplies that were more reliable (1998. p. 49). The climate was so favorable that farmers and peasants were able to grow wine grapes, which produced a thriving industry south of Manchester, England (Moore, 1998. p.55). In order to produce good wine, grapes need to be in

an area that is; free of frost, substantial summer warmth, sunshine without too much rainfall, and sunny days in the fall (Moore, 1998. P. 55). Moore also concludes that since the climate was warmer, there was more evaporation, which meant that swamps and bogs dried up (1998. p. 49). If swamps and bogs disappear, this would mean that the habitat for the disease spreading mosquito would also disappear (Moore, 1998. p. 49). On the one hand, Moore claims that warmer weather aids in stopping the spread of diseases by mosquitoes by drying up swamps and bogs, and on the other hand he claims that "most of the causes of premature death have nothing to do with climate" (1998. p. 69). Scientific research and data will show that the claims by this economist would have to fall into the category of myth.

What Does the Scientific Evidence Say?

How can science disprove the claims that warmer weather will make agriculture more productive and decrease the spread of vector born diseases? By studying the effect that CO^2 has on plants, scientists collect data that will help them to predict future possibilities. CO^2 is what you might call food for plants, so some might think more is a good thing. Unfortunately, this is not true. Through scientific studies it has been concluded that plants that grow in higher concentration of CO^2 have lower nutritional values (Watts, 2007. p. 90). Also, lower nutritional values in plants we consume could have consequences on the insect populations. While it is not completely known if those consequences will be positive or negative, scientists are aware of some insects that can increase their populations during warm periods by producing extra generations (Watts, 2007. p. 90).

Scientists are concerned that lower nutritional values in plants will mean insects will have to eat more to survive (Watts, 2007 p. 90), which will mean more damage or loss of agricultural crops. Insects are not the only concern for plants in a warmer climate. “Mild winters have been connected to outbreaks of powdery mildew, brown leaf rust in barley, and strip rust in cereal crops” (Watts, 2007. p. 90). In addition, combining the mild winters with warm summers creates the optimal conditions for “cercosporia leaf spot disease and potato blight” (Watts, 2007. p. 90).

Now let’s discuss the effects that scientists believe a warmer climate will have on our health. The largest threat to human health is the availability and access to fresh drinking water (Maslin, 2009. p. 95). In today’s world there are 1.7 billion people already experiencing some type of water stress. Climate models predict this number could rise to 5 billion by the year 2025 (Maslin, 2009. p. 95). If warming continues to grow, extreme droughts on the Earth’s surface is expected to climb to 40% (Fagan, 2008. p. 233). “Evidence is mounting that drought is the silent and insidious killer associated with global warming” (Fagan, 2008. p. 233). An example of the effects that drought can have on our health comes from what is called the “Dust Bowl” droughts of 1934-1940, which effected over three and a half million people in the Great Plains region of the United States causing many to suffer from typhoid and other diseases (Fagan, 2008. p. 235).

While some people will try to claim that global warming will aid in preventing the spread of vector born diseases, like malaria, the truth is “that higher temperatures accelerate the life cycle of parasites, and this could result in insects developing resistance to control methods more quickly, and diseases becoming resistant to drugs more quickly” (Watts, 2007. p.98). Scientists are completely aware of the fact that the mosquitoes that transmit malaria can survive winter temperatures that are above 18°C (64.4°F) and with only slightly warmer temperatures the incubation phase of the parasite within the mosquito that carries the disease accelerates (Watts,

2007. p.98). Other possible vector born diseases that could increase with rising temperatures are; African Trypanosomiasis (sleeping sickness), American Trypanosomiasis, Onchocerciasis (river blindness), which is also spread by mosquitoes and flies (Watts, 2007. p. 98). Also, there is the pulmonary disease Hantavirus that is transmitted by airborne particles of rodent feces, which causes death in 45% of the people who contract it (Watts, 2007. p.99). An example of this happened in the American southwest in 1997-1998, above average amounts of rainfall created conditions favorable for deer mice who were responsible for an outbreak that broke out in that area (Watts, 2007. p. 99).

The amount of temperature rise is another controversy that one will hear people debating when global warming is discussed. Some skeptics believe that the warming that we are experiencing today is not as warm as it has been in the past. To be more accurate, skeptics will argue that the MWE had a warmer climate than we have today (Lomborg, 2007. p.53). In fact, scientific research has been able to reconstruct past climates where there is no written record and has determined that the warmth of our present climate is setting an unprecedented mark (Mann, 2003. p. 5-4).

When a discussion about the future of rising temperatures presents itself, one argument always seems to be at the focus, which would be the “hockey stick curve”. Back in the 1990’s a palaeoclimatologist by the name of Michael Mann, who embarked on one of the first serious attempts to reconstruct and compare the past and present temperatures over the last millennia (Pearce, 2006).What Mann did was collect the proxy evidence, from thousands of different researchers and regions from around the world, and combine them all to provide a more reliable and global picture of historical climate change (Pearce, 2006) While the scientific community has accepted the findings of Mann, two skeptics from Canada that had a problem with Mann’s

analysis of the data. Stephen McIntyre, a mathematician and oil industry consultant, and Ross McKitrick, an economist at the University of Guelph Ontario questioned the results of Mann's research (Pearce, 2006). The main argument of McIntyre and McKitrick was that Mann's statistical analysis was flawed and that the computer program used to analyze the proxy data did not accentuate the "hockey stick" shape, but created it (Pearce, 2006). "What counts in science is not a single study, however. It is whether a finding can be replicated by other groups. Here Mann is on a winning streak: upwards of a dozen studies, some using different statistical techniques or different combinations of proxy records, have produced reconstructions more or less similar to the original hockey stick" (Pearce, 2006).

Through direct temperature measurements that only begins in the 1860's, scientists can adequately and accurately determine that temperatures have been rising since the beginning of the industrial revolution (Pearce, 2006: Wigley, Ingram, & Farmer, 1981. p.182). To understand the significance of the warming that has taken place throughout the 20th century it should be compared it to past climates. If there are no written records, how can scientists obtain this information? This is accomplished through the use of "indirect or proxy records of temperature, such as tree rings and isotopic ratios in coral, ice cores and lake sediment" (Pearce, 2006). "Knowledge of chemical, biological, and/or ecological processes is used to guide sampling, analysis, and conversion of natural proxy data into surface temperature reconstruction" (National Research Council, 2006. p. 9). Michael Mann can be considered the pioneer of this meta-analysis, which merges all of the different proxy records to reconstruct past climates that can then be compared with the instrumental record (Pearce, 2006). Understanding each proxy and how they are used by scientists can aid in understanding how scientists are able to come to their conclusions. By understanding how proxies are used and collected false information that finds its

way into the main stream can be identified and refuted. This paper will explain four proxies that scientists use the most in reconstruction.

The first proxy that scientists use to reconstruct past climates are tree rings. The science of studying tree rings to understand past climates is known as dendrochronology, its application of the tree ring science is known as dendroclimatology (NRC, 2006 p.45). The best way to reconstruct past temperatures from tree rings is to sample trees from high latitudes or from high elevations, where tree ring growth is directly related to surface temperatures (NRC, 2006. p. 7). "Tree ring records offer a number of advantages for climate reconstruction, including wide geographic availability, annual to seasonal resolution, ease of replication, and internally consistent dating," (NRC, 2006. p. 7). While tree ring proxies can also be influenced by other factors, biological and environmental, scientists have taken this into account by implementing quality control and choosing sites carefully (NRC, 2006. p. 7). "In the application of these procedures, emphasis is placed on replication of records both within a site and among sites and on numerical calibration against instrumental data" (NRC, 2006. p. 7).

Another proxy that scientists use to reconstruct past climates is by examining coral reefs. Coral proxies originate mainly in tropical and sub-tropical waters, which provide a useful compliment to tree ring data (NRC, 2006. p. 7). Coral forms annual bands that can provide information about environmental conditions that were present when the bands formed (NRC, 2006. p. 7). These coral bands supply scientists with enough information to reconstruct "sea surface temperature and salinity for that region" (NRC, 2006. p.54). Coral bands are composed of aragonite (calcium carbonate), that are directly connected to water temperatures and are correlated with salinity (NRC, 2006. p. 54). As seawater temperatures rise, aragonite in the coral and the salinity of the seawater decreases (NRC, 2006. p. 54). Samples from coral in both

hemispheres have indicated “abrupt shifts toward warmer/fresher water” in the 20th century (NRC, 2006. p. 54).

A third proxy that scientists use to reconstruct past climates comes from ice cores extracted from glaciers. Scientists drill into the ice of glaciers and ice caps and extract an ice core. Ice, which holds little air bubbles from the past, can be used to determine the temperature at the time the snow was originally falling (NRC, 2006. p. 7). Scientists use the ice cores to measure the oxygen and hydrogen isotopic ratios, which are also referred to as ice isotopic ratios (NRC, 2006. p. 65). Examining and analyzing these ice isotopic ratios provides scientists with a high resolution record of climate changes over a long period of time (NRC, 2006. p.65). Results from all available ice cores that have come from Tibet, Greenland, Antarctica and the Andes have shown that the climate of the 20th century was unusual with respect to the preceding 1900 years (NRC, 2006. p.70). According to an article by Chaz Firestone, scientists of the West Antarctica Ice Sheet drilling project are “three-quarters of the way towards pulling up the most temporally precise record of carbon dioxide for the past 100,000. Paleoclimatologists are already aware of the connection between rising temperature and rising CO^2 levels, they hope that this latest ice core sample will provide a better understanding for which rises first (Firestone, 2010. p. 408). They hope to determine if the rising CO^2 acts as an amplifier, which will drive up temperatures further (Firestone, 2010. p. 408). While the ice core experiment mentioned above only examines the climate for the last 100,000 years, there is a clear record of CO^2 levels for the last 650,000 years. “The atmospheric concentration of carbon dioxide has risen from 315 parts per million (ppm) in the 1950’s to over 380 ppm in 2006 (Dow & Downing, 2006. p.34).

The final proxy method that will be discussed in this paper is the use of marine and lake sediments. When samples that are taken from ocean and lake sediments are analyzed they can

provide evidence of past climate changes and the temperature of the water when the sediments were deposited (NRC, 2006. p.8). Past climates and water temperatures are determined by examining oxygen isotopes and the relative abundance of different micro-fossils that either have temperature preferences (like insects), or a strong temperature correlation [like diatoms and some other algae] (NRC, 2006. p. 8). Another way to derive past temperatures from marine sediment cores is the ratio of magnesium to calcium (De Chant, 2008). Within these marine sediment cores scientists can examine what they call as "hard parts" (De Chant, 2008). These hard parts are composed of exoskeletons, shells and the like and the "more magnesium in the hard parts indicates warmer waters," (De Chant, 2008).

By combining all of the proxy methods that are used, scientists are able to reconstruct past climates with the help of computer models. "Computer models can be used to simulate the behavior of the climate system, taking into account both temporal and geographic variability, to understand both the natural variability of the climate system and the response of the climate system to changes in climate forcings" (NRC 2006. p. 105). However, some skeptics believe that computer generated climate models are inaccurate because the numbers are being altered for a desired outcome (Maslin,2004. p. 60).

Skeptics of global warming attack computer generated models as being inaccurate. They believe that the models are based only on theories, not data, on how scientists think the real world functions (Bailey, 2002. p.12). Science is an ever evolving work of knowledge that adjusts itself with new technologies that can better collect and analyze data. As new discoveries and technologies come into existence, scientists are able to adjust their earlier analysis and predictions. These changes in earlier predictions are used by skeptics who want to show the general public that global warming is not about good science, "it is about politics and about

laying the groundwork for taking drastic steps that will almost certainly raise energy costs and put downward pressure on the standard of living in the United States" (Haley, 2002). Others believe that computer models that predict future climates encompass such large regions that all of the variables cannot be accounted for and that many factors must be assumed (Moore, 1998. p.18).

When it comes to the topic of computer generated climate models, scientists openly admit that in some cases there are some uncertainties that science cannot account for, which is then used by skeptics to prove that the science of paleoclimatology is a hoax. When data is being entered into a computer, which will generate a model predicting possible climate conditions, certain unknowns, such as future CO^2 levels have to be assumed (Maslin, 2009. p.70). Scientists can not accurately predict exactly what the future CO^2 emission levels will be. They must run multiple models to show all possible future levels. It should also be noted that simulations using computer generated climate models performed by scientists indicated "that a combination of solar and volcanic forcings can explain periods of relative warmth and cold between A.D. 1000 and 1900, but anthropogenic forcings are needed to reproduce the late 20th century warming" (NRC, 2006. p.109).

So, if there are uncertainties, how do scientists know that their computer models are accurate? There are three methods that science uses to check for consistency in computer generated models. The first method used is to compare computer models with the historical and archaeology records, which has long been recognized as an accurate source of information on past climates including the last 150 years (Wigley, Ingram, & Farmer, 1981. p. 181). Results from this comparative methods have shown that, "climate models do faithfully describe the changes in climate that have occurred in the 20th century" (Watts, 2007. p. 41).

A second method employed by scientists to validate computer models is pseudo-proxy data constructed to have similar attributes of actual proxy records, including the cooling effects from volcanic explosions (Mann, Rutherford, Wahl, & Ammann, 2005. p.4098). In order for the pseudo-proxy data to reflect climate models that are reasonably realistic to our current climate, scientists constructed pseudo-proxies that have attributes similar to actual proxies already recorded (Mann et al., 2005. p.4098). Results from this method have shown that the computer climate models produced from real world proxy records provide a faithful estimate of long-term hemispheric temperature histories (Mann et al., 2005. p.4106).

A third method used to validate computer generated climate models comes from their ability to accurately predict our current climate by entering in data (Watts. 2007. p.41). While this method has its limitations when applied to local climate, it does a remarkably good job in matching the climate of large areas covering several states (Watts, 2007. p.41). Conclusion from this method has yielded results that show a statistically significant warming in the past 100 years (Watts, 2007. p.69).

Conclusion: Global Warming Is Real

Scientific research has provided plenty of evidence to dispute claims by skeptics. Through the use of proxies, such as ice cores, coral reefs, and tree rings, scientists have been able to reconstruct the climate on Earth for the last 650,000 years. These methods have provided a look into the future in a world that continues to warm. While the greenhouse effect is what made it possible for life to develop on this planet, too much of a good thing can also make it difficult for life. Neighboring planets provide us with good examples of the effects of global warming

from greenhouse gases. While many skeptics think that global warming will only have positive benefits for humanity, science has shown that most of the effects that we will encounter will be negative. Carbon dioxide levels are higher today, and continuing to rise, than at any other time in the last 650,000 years. Now that science has a pretty good idea as to what to expect from the continuing rise in greenhouse gases, we should concentrate on what causes the increase so we can start to reduce it.

What Are The Causes of Global Warming?

> "Fluctuations in past temperatures have been shown to be caused by natural forces, such as cycles of solar energy, changes in the Earth's orbit and volcanic eruptions that send gases and dust into the atmosphere. However, the variability and trends in historical global temperatures can only be explained if both natural forces and green house gas emissions from human activity are included in the models". Kirstin Dow & Thomas E. Downing

Even though the scientific evidence proves without any doubt that global warming exists and that it is a real problem, there are those that perpetuate the myth that human activity is not responsible for it. Skeptics believe that any increase in temperatures are due to natural causes; anthropogenic (man-made) causes are too insignificant when compared to natural ones. "The temperature of the earth is determined by a balance of the energy entering the Earth-atmosphere system and the energy leaving the system. An energy imbalance imposed on the climate system either externally or by human activities is termed a *climate forcing"* (NRC. 2006. p.99). The only way to understand what causes global warming is to understand the processes, natural and anthropogenic forcings, that contribute to it. Ice core samples have distinctly shown that there is a direct correlation between rising CO^2 levels and rising temperatures (Dow & Downing, 2006, p. 34). This section will begin with a discussion on nature's mechanism for dealing with carbon dioxide, then transition into both natural and man-made CO^2 forcings that contribute to the carbon cycle, and conclude by determining if the skeptics are right or wrong.

Natural Causes

A myth that usually surfaces in the global warming debate is that the current warming being experienced is a natural cycle of warming and cooling (Mann & Kump, 2009. p. 34). Skeptics will say that man is not responsible for the increase in CO^2 in the atmosphere. Instead, they claim that volcanic eruptions, increases in solar radiation, and natural cycles areresponsible. What does the scientific data say about the impact of natural forcings on global warming?

Before addressing the natural causes of carbon dioxide, an understanding of the "carbon cycle," which is responsible for storing and emitting carbon dioxide from the atmosphere, is instructive. According to the United States Environmental Protection Agency (EPA),

> "Natural sources of CO2 occur within the carbon cycle where billions of tons of atmospheric CO2 are removed from the atmosphere by oceans and growing plants, also known as 'sinks,' and are emitted back into the atmosphere annually through natural processes also known as 'sources.' When in balance, the total carbon dioxide emissions and removals from the entire carbon cycle are roughly equal".
> (http://www.epa.gov/climatechange/emissions/co2.html)

"The main reservoirs (sinks) of carbon are the atmosphere, the ocean, and vegetation, soils, and detritus on land," also "various processes transfer carbon between these reservoirs, including photosynthesis and respiration, ocean-atmosphere gas exchange, and ocean mixing" (Mann & Kump, 2009. p. 95). What this means is that the land and the ocean areas act as sinks to absorb carbon that is produced, naturally or anthropogenically.

Another component of the carbon cycle is the emitting of carbon back into the atmosphere. On dry land carbon is stored in plants and animals, which is later released back into the atmosphere when they are consumed for food. Also, plant and animal respiration is another

contributing factor to natural forcings. For example, as a tree grows it consumes and stores carbon dioxide through the process of photosynthesis, when that tree is either harvested or burned there is a release of that stored carbon back into the atmosphere. Oceans emit carbon in similar ways such as organism respiration and decomposition. For example, phytoplankton plays an important role in transferring carbon dioxide from the atmosphere into the oceans (Mann & Kump, 2009. p. 95). An interesting fact about marine life is that it actually represents a very small portion of carbon released (Mann & Kump, 2009. p. 95).

Now that you have a basic idea of how the Earth's carbon cycle works, it is now time to begin our discussion on natural forcings that are taking place in the carbon cycle. There are four natural forcings that contribute to CO^2 in our atmosphere, but only three of these sources also act as sinks. As mentioned above, one natural CO^2 forcing, that also acts as a sink, are the oceans. Skeptics believe that the next three natural forcings actually play a larger role in global warming then scientists are willing to admit.

"Of all the possible causes of climate changes, volcanic eruptions are among the most adequately documented and understood' (Kondratyev & Cracknell,1998. p.449). Depending on the magnitude and location, volcanic eruptions add large amounts of ash and sulfur gases into the atmosphere (NRC, 2006. p.103). While the large ash particles rapidly fall to the ground, the sulfur gases mix with water vapor, which becomes sulfate aerosols, where they affect the Earth's temperature and remain for several years (NRC, 2006. p. 103). While skeptics will adamantly argue that eruptions spew much more greenhouse gases than any man-made source, the irony to this claim is that volcanoes eruptions actually cool the Earth for anywhere from a couple of months, to a couple of years, (see figure below). When the sulfate aerosols are in the atmosphere they act like little reflectors tha diminish the amount of solar radiation that reaches the Earth

(NRC, 2006. p.103). A good example of the cooling effect of volcanoes was the eruption of Mount Pinatubo in the Philippines in 1991. For the next sixteen months after that eruption the Earth cooled by as much as 0.3°C and precipitation over landmasses dropped, on average, by about 0.07 millimeters (Perkins, 2007. para 3). Scientists have even considered purposely injecting sulfate aerosols into the atmosphere to counteract global warming (Perkins, 2007. para. 2). However, "because the current global warming trend results from an increase in the atmospheric concentration of carbon dioxide, not an increase in solar radiation, simply providing Earth some shade doesn't address the problem" (Perkins, 200. para. 4).

An additional natural forcing that contributes to global warming is solar variability. This is a perfect example of how skeptics exploit the uncertainties in the knowledge of the "physical understanding of solar activity and its influence" (NRC, 2006. p.103). The analysis of global means temperature records "suggests a detectable signal of solar influence on decadal, centennial and millennial time-scales" (Haigh, 2003. p. 95). This area of study is important in understanding the extent of how solar variability may affect our climate. When a skeptic claims that global warming is not caused by human actions, but by the solar variability. The awareness that there is no real evidence that backs up their claim will assist in refuting them. Uncertainty is the breeding ground that skeptics use to find life in the myths that are created. The main intention of myths about natural causes is specifically designed to confuse the general public of the nature of man-made causes.

Man-made Causes

As stated earlier, scientific data that has been obtained through the use of historical records and proxies (i.e. ice cores) show that CO^2 levels are higher now than at any other time in the last 650,000 years. Concentrations of CO^2 had stayed at a fairly constant rate of 280 ppm from the end of the last ice age up until the dawn of the Industrial Revolution; levels climbed to 350 ppm in 1998 (Kondratyev & Cracknell, 1998. p. 8) and as of 2008 levels have risen to 386 ppm (Mann & Kump, 2009. p.82). We have also discussed how there are natural forcings that contribute to CO^2 in the atmosphere. But, scientists know that nearly two-thirds of all CO^2 emissions, along with significant amounts of nitrous oxide and methane, are derived from human activities such as; electricity production, transportation, industrial processes, and heating and cooling, which are all derived from the burning of fossil fuels such as oil, natural gas, and coal (Dow & Downing, 2006. p.42). Since there are both natural and anthropogenic (man-made) forcings that contribute to the rise in CO^2, how do scientists compare their propotional impact?

Not all carbon isotopes are created equally, chemically they are all the same but they have different atomic weights (Watts, 2007. p.32). These carbon isotopes exist in three forms; they all have six protons, but each one has a different number of neutrons in its nucleus (Mann & Kump, 2009. p. 34). They are carbon-12, carbon-13, and carbon-14. Nearly 99% of all carbon in the atmosphere is in the form of carbon-12, the remainder consists of carbon-13 and very small amounts of carbon-14, which is a radioactive isotope (Watts, 2007. p.33). All plants selectively take up carbon-12 when they are growing. “Because fossil fuels were originally plany and animal matter, they also contain proportionally less carbon-13 than is present in the atmosphere” (Watts, 2007. p.33; Mann & Kump, 2009. p.35). Because fossil fuels that have been stored in the Earth have been there much longer than it takes carbon-14 to decay; there is no trace of this

isotope (Watts, 2007. p. 33). “Thus when scientists analyze carbon sources that were derived from organic matter, like the fossil fuels coal and oil, they find a lower ratio of carbon-13. Just as the atmosphere has gradually become less radioactive over time, its ratio of carbon-13 to carbon-12 has been decreasing” (Mann & Kump, 2009. p. 35). Through the use of a modern mass spectroscopy scientists have been able to measure this natural carbon ratio, which has shown a definite decrease in the carbon-13 isotope (Watts, 2007. p. 33). While there may be some uncertainties in the knowledge by scientists on global warming, there is one thing that they are 100% certain on; “The combined trends in the atmosphere’s radioactivity and its carbon-13/carbon-12 ratio are satisfactorily explained by only one source: fossil-fuel burning” (Mann & Kump, 2009. p.35).

There are two other greenhouse gases that are more efficient in warming the atmosphere than CO^2; methane and nitrous oxide. Methane is twenty times more effective at trapping heat than CO^2 and with a shelf life of only twelve years; any reduction in emissions would have a rapid effect (Dow & Downing, 2006. p.44). Skeptics have claimed that an increase in a natural forcing that is caused by animals like cows and termites. While it is true that animals produce methane, any increase in animal methane output can easily be correlated to human activity. An example comes from the fact that many products that we use today come from livestock like cows; things like shoes, furniture, sporting equipment, and all of the related food products that are produced. Also, any increase in termite emissions can be credited to deforestation and the construction of our businesses and homes. According to www.Termites.com, termites have been around for 250 million years and consume dead wood, which is exactly what we see in a lumber yard. Other human contributions of methane are rice cultivation, coal mining, and landfills (Dow & Downing, 2006. p.44).

Another greenhouse gas that contributes to global warming is nitrous oxide, which is 300 times more effective than CO^2 and has a very long lifetime in the atmosphere (Dow & Downing, 2006. p.44). Skeptics have not addressed this gas because of the difficulty in refuting that nitrous oxide emissions are completely connected to human activity. For instance, the production of hydroflurocarbons (HFCs) and chlorofluorocarbons (CFCs), which are used in refrigeration units, also produce nitrous oxide as well (Dow & Downing, 2006. p.44). However, the majority of nitrous oxide emissions comes the agriculture industry; from the use of fertilizers and from livestock waste (Dow & Downing, 2006. p.44).

In addition, another man-made cause contribution to global warming are landuse. Humans have been modifying the land by changing the natural vegetation for thousands of years by clearing forests and planting crops (NRC, 2006. p.103). The amount of carbon that can be absorbed by grass and crops is much less than the forest they replaced (Kondratyev & Cracknell, 1998. p. 9). "The largest regional changes in continental vegetation cover have occurred since the mid-19th century in the Northern Hemisphere (NH) and early 20th century in the Southern Hemisphere (SH)" (NRC, 2006. p.103). It has been estimated that twenty percent of the total land area of the continents have been profoundly changed (Kondratyev & Cracknell, 1998. p. 9). This accounts for about a quarter of the carbon released into the atmosphere over the last 150 years (Dow & Downing, 2006. p.48). Deforestation is not just a problem in the NH and SH, it is a world-wide issue. In fact, in the last forty years alone there has been a ten percent reduction in the forests globally in places like Southeast Asia and in the Amazon (Armesto, 2008. p.786). In Africa deforestation due to human activities has accounted for the loss of half of the tropical forests, Latin America has lost nearly a third (Armesto, 2008. p.786). In some cases, lands used for grazing is so over used that it causes desertification. Some assessments claim that about

seven percent of the Earth's surface is man-made desert, it is continuing to grow as more and more forests are replaced by grazing and agricultural lands (Kondratyev & Cracknell, 1998. p. 9).

Conclusion: Human Activities Cause Global Warming

By examining natural forcings, such as volcanic eruptions and solar variability, scientists have been able to prove that these forcings alone could not be soley responsible for the increase in greenhouse gases. The only way that computer models reflect our current climate is when the anthropogenic forcings are added to the mix (see figure 3). With the increase in human activities such as deforestation for agriculture, livestock grazing, and the burning of fossil fuels, greenhouse gases are reaching unprecedented numbers that have never been encountered by modern human populations (see figure 2 for increases in CO^2). Scientific data is able to measure atmospheric greenhouse gas levels and discern the sources. Global warming and rising greenhouse gases are connected to each other; low CO^2 levels mirror ice ages, while high levels mirror warming trends. Therefore what can mankind expect in the future if we do not make an attempt to reduce our emissions

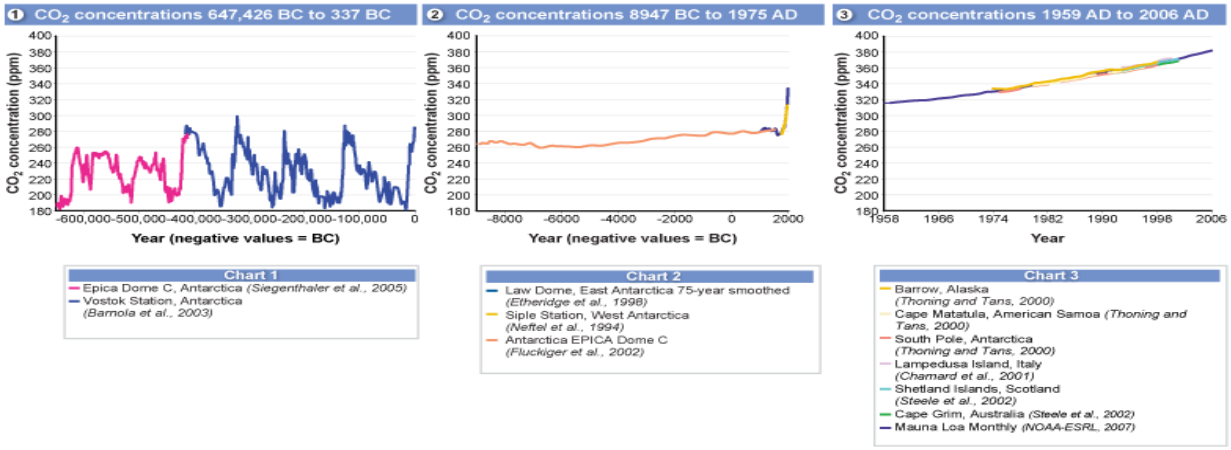

Figure 2: Carbon dioxide levels over time

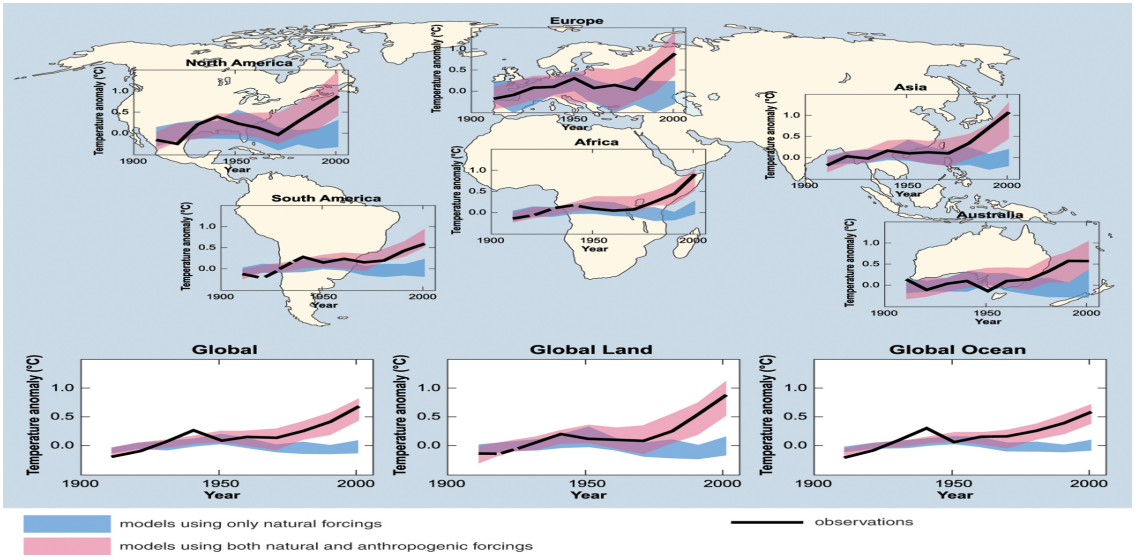

Figure 3: Comparison of natural (blue), natural and anthropogenic (pink), and observational climate models for the last 100 years.

What Can We Expect in the Future?

> "Psychologists tell us that denial is an inevitable and natural first reaction to such news. We don't want to think we can actually have had such effect on the entire planet any more than a young child wants to believe it can hurt its protective and nurturing parent. Nor do we like to think about drastic change. Nor feel moved to fix the leaks in the roof when it isn't raining, especially when we have never experienced a rain storm" Bill Blakemore

Are We Doomed?

What can we expect in the future if global warming continues is probably the biggest question that faces science today. The predictions that have been made by scientists have been attacked by skeptics who believe that there are way too many variables, natural and anthropogenic, involved for accurate predictions to be made (Bailey, 2002. p.20). As we discussed earlier scientists use historical and proxy evidence to reconstruct past, present, and the future climatic conditions that we may encounter. Skeptics believe that "the factors that influence climate are too numerous to even document, much less understand from our present level of ignorance" (Bailey, eds., 2002. p. 20). However, while the skeptics claim ignorance, science keeps expanding their knowledge which in turn lends to better and more credible predictions. Many believe that the scientific communtiy is trying to stir up fear by saying that a major catastrophe will be imminent unless there are major steps taken to head-off this danger (Moore, 1998. p.22). Scientists have a simple explaination why changes in our climate will have negative consequences. "The reason is that civilization, along with plants and animals, has adapted to the current climate" (Watts, 2007. p.83). Now, lets turn our discussion to what could be in store for humanity if we do not take some type of action to reduce greenhouse gases.

Skeptics believe health risks will decrease with warmer weather, which goes against the scientific evidence. Science does not need to use computer models to determine how vector born diseases are spread. “It is well known that the transmission of many infectious diseases is affected by climatic factors such as temperature, humidity, surface water availability, and vegetation” (Watts, 2007. p. 98).

The effects that global warming can have on agriculture have already been discussed. I summary, while higher CO^2 levels may help plants grow faster, it will decrease in nutritional value, increase the spread of pests and plant diseases. Some believe that new technologies will increase future food production, however if it takes more plants plants to get the same nutitional value, technology will only be trying to keep up. Another threat to agriculture are rising sea levels.

There are two factors that are involved in causing sea levels to rise. The first cause is that, as water warms it expands. Therefore, as the ocean warms the sea level will inevitably rise too. The other factor that can cause sea levels to rise are melting of glaciers, which includes the ice sheets of Greenland and Anartica, and mountain glaciers. For example, in the western United States research suggests that snowfalls and water supplies are declining for rivers where demand already is exceeding supply (Bach, 2002. p. 192). The water that flows down mountains supply much more than drinking water, shrinking water supplies will also affect hydroelectic power, recreation, fisheries habitat and irrigation (Bach, 2002. p. 210). While mountain glaciers can be one factor involved in the rising od sea levels, the main contribution will come if the ice sheets in Greenland and Antartica melt. It has been estimated that if the Greenland ice sheet were to melt entirely, sea level would rise by about 23feet (Watts, 2007. p. 96; Dow & Downing, 2006. p. 62). As for the contribution of the ice sheet in Antartica; with the melting of just the western portion,

17ft would be aqdded to sea levels. If all of it melted sea levels are expected to rise by 253feet (Watts, 2007. p. 96). While there is only a small probabilitlity that these ice sheets will waste completely away over the next few centuries, scientists have predicted that this scenario could become reality if global temperatures were to rise 3°C [37.4°F] (Dow & Downing, 2006. p. 62).

The last factor that this paper will consider for what can be expected in the future if global warming continues is severe weather events. These include, droughts, extreme rainfall events that will cause flooding, and an increase in tropical storms and hurricanes. All of the weather events mentioned are connected to an increase in evaporation, which are caused by warmer weather. Droughts occur when there is rapid evaporation of moisture from plants, soils, and reservoirs, and there is strong evidence showing an increase their frequnecy (Watts, 2007. p. 91). Also, there is data that reveals that there has been an increase in extreme rainfall events in the United States, Canada, the former Soviet Union, and Australia (Watts, 2007. p. 91). Some might be wondering how an increase in extreme rainfall events can have any kind of a negative effect. The answer to this is a simple one, extreme rainfall causes flooding, which in turn can contaminate fresh drinking water supplies. When heavy rains fall they increase the runoff from cattle lots, farm areas, industrial sites, and storage ponds that can pollute both surface and ground water sources, which can cause problems from pathogens and harmful bacteria (“Floods May Contaminate Drinking Water”, 1997).

Global Warming is it Good For Us?

Considering all of the evidence that has been presented by scientific research, mankind is headed for a disaster unless changes are made. Any benefits that skeptics believe will happen as a result from global warming are dwarfed when compared to the negative outcomes that the scientific community has predicted. Through the use of computer models, which were discussed earlier, scientists can confidently predict expected outcomes if greenhouse gases contiue to climb unabaited. Increased global temperatures have the potential to cause crop loss, famines, diseases, and even the possiblity of wars between nations who will fight over the dwindling resources. Even with all of the doom that has been predicted by continuing the status quo, there are some who think that we have not passed the point of no return and that we could start to reverse this process if we would just make some changes. If mankind does not reduce the carbon footprint that we have created, mankind could find itself on the endangered species list. If mankind is headed down the road to extinction, how can we get turn back in the right direction?

Conclusion: Can We Stop the Damage or Is It Too Late?

This is a question that does not have a consensus in the scientific community. There are some who have the opinion that mankind has already passed the point of no return. Many climate models have been run to see how much temperatures will rise due to the increase in greenhouse gases; evidence from these models suggests that even if we had stopped emitting CO^2 back in the year 2000, temperatures would still rise by about 0.6°C (33°F), and predictions only become worse with a continuing increase in CO^2 (Watts, 2007 p. 108).

There are others that feel that we can stem the tide by either reducing or eliminating the burning of fossil fuel which creates carbon dioxide (Mann & Kump, 2009. p. 156). The way this can be accomplished is to reduce our dependancy on fossil fuels. The largest producers of CO^2 is the production of energy, that accounts for 25.9% of emissions (Mann & Kump, 2009. p. 159). Renewable energies is one way that we can reduce our dependency on fossil fuels. Examples of these new sources of energy are solar. wind power, and geothermal (Mann & Kump, 2009. p. 159). However, none of this will be possible wi-thout widespread government action as emission rates are projected to rise an additional 50%by e nd of th 21st century.

However, even with the lack of government action there are ways that individuals can reduce their carbon footprint. One way you can make a difference is by just making some home improvements, which include better insulation, passive solar heating, substitution of fans and open windows for air conditioning when practical (Mann & Kump, 2009. p. 180).. Other ways individuals can make a difference is by incorporating things like; better recycling practices, ride a bike instead of driving your car, and just a more efficient use of energy by replacing incandescent light bulbs with compact fluorescent ones or by using a clothesline instead of a dryer (Mann & Kump, 2009. p. 180).

Unless we change our habits, we may be headed down the same road as the dinasours. While there is some debate as to what caused the final extinction of the dinosaurs, one thing that is not debatable is that they are gone. Humans have been able to adapt to every climate on this planet, but many plants and animals have not. Skeptics accuse climate scientists as being alarmists who are crying wolf just to get some attention and funding for their research projects. However, what science does, and is doing, is to inform society of what they have found in their research. Then other scientists will take the results from an experiment and try to reproduce

them. If the re-tests have the same conclusions as the original data, then science accepts that research. Skeptics have no such procedure, they just take admitted uncertainties that science encounters and spin them to place doubt in the minds of the general public. If we continue with the status quo, our grandchildren will be the ones paying the price for our ignorance and narsacistic way of thinking. There is a quote that I have seen outside the office door of my professor. It reads, “we do not inherit the earth from our parents, we borrow it from our children”. If we fail to act on this issue of global warming by reducing or eliminating greenhouse gases there may be nothing for our children to pass on to their children.

Conclusion

> “The situation is analogous to that facedby the engineer who spots a flaw in the Space Shuttle, but finds his complaint ignored by management. He has the right, and responsibility, to make his concern known to the highest authority. In our case the spacecraft carries billions of humans and other life forms, and the highest authority, the only authority with the power to throttle the engine, is the public” Dr. James Hansen

This paper has been a discussion on the myths that surround the issue of global warming, to add to your knowledge about the scientific processes that make it possible for science to measure and to document the rising of greenhouse gases. We began by explaining how the Greenhouse Effect works, by demonstrating how this effect works on other planets as well. If there are too much greenhouse gases in the atmosphere it can damage the inhabitants, while not enough green house gases can also damage life. Paleoclimatologists have combined massive amounts of proxy data with historical and observational records that allows them to get a clear picture of past, present, and future climatic conditions.

Following the explanation of the Greenhouse Effect, an explanation as to the causes were discussed. After examining the contributions of both natural and anthropogenic sources of the gases it should now be clear how much each forcing is responsible for. While natural forcings can and do inject CO^2 into our atmosphere, their contribution alone cannot explain the large increases in greenhouse gases. Only when natural and anthropogenic forcings are combined do the computer models accurately reflect recorded measurements.

In the final section we looked at what we could expect in the future if we continue emitting greenhouse gases at an increasing rate. This is the only aspect of global warming where scientists are not in a consensus. Some scientists believe we have already passed the point of no return, while others believe that with education and new technologies there will be a reduction to of greenhouse gases can be accomplished. Even if we were to bring all emmisions to zero starting today, the effects of what has already been injected into the atmoshpere will still be felt for decades to come.

The main intentions of this paper was to face the myths that always seem to surface when a discussion about global warming arises. By addressing some of the more main stream myths by comparing them to the scientific research that is available, the myths crumble from a lack of evidence. All that can be hoped for is that the majority of the global society aknowledges the warnings of the potential consequences that mankind will face before it is too late. We need everyone to get into the game and do their part.

For anyone who has competed in an individual or team sport there is one type of player all coaches love. All good atheletes are taught to never give up, you play hard and give it your all until the game ends or the officials declare it over. Global warming is a game where we need the

whole team to do their part or we can never expect to win. We know what has to be done to start making the changes neccesary, we just need to stop denying that we are the cause. If I was a betting man, I would bet that mankind will not begin to make any changes until one of the negative scenarios that has been forecasted by scientists comes to a horrible reality.

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Figures

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