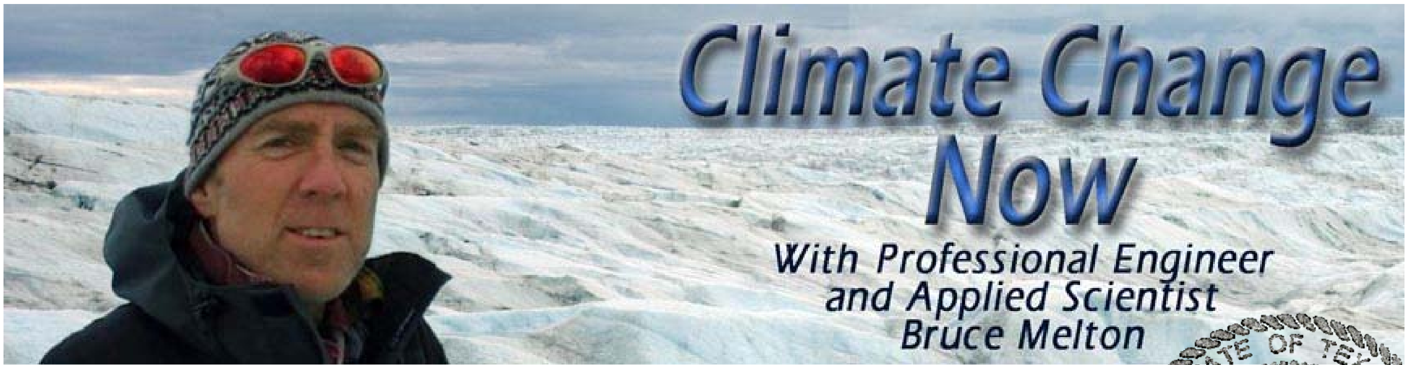


Climate Crisis: Extreme Summer Heat and Irreversible Ecosystem Demise

The U.S. Global Change Research Program (USGCRP) coordinates federal research on environmental changes and their implications for society. The USGCRP began as a presidential initiative in 1989 during the Reagan – Bush era and called for "a comprehensive and integrated United States research program that will assist the nation and the world in the understanding, assessment, prediction and response to human-induced and natural processes of global change." Thirteen departments and agencies participate in the USGCRP, which was known as the U.S. Climate Change Science Program from 2002 through 2008. The program operates under the Committee on Environment and Natural Resources, overseen by the Executive Office of the President.

The USGCRP has published a new report titled *Global Climate Change Impacts in the United States.* It is two hundred pages of the most recent climate change science written primarily for the thirteen U.S. Government departments that are supported by USGCRP. Its primary goal is to help policy makers understand the current impacts and future risks of climate change.

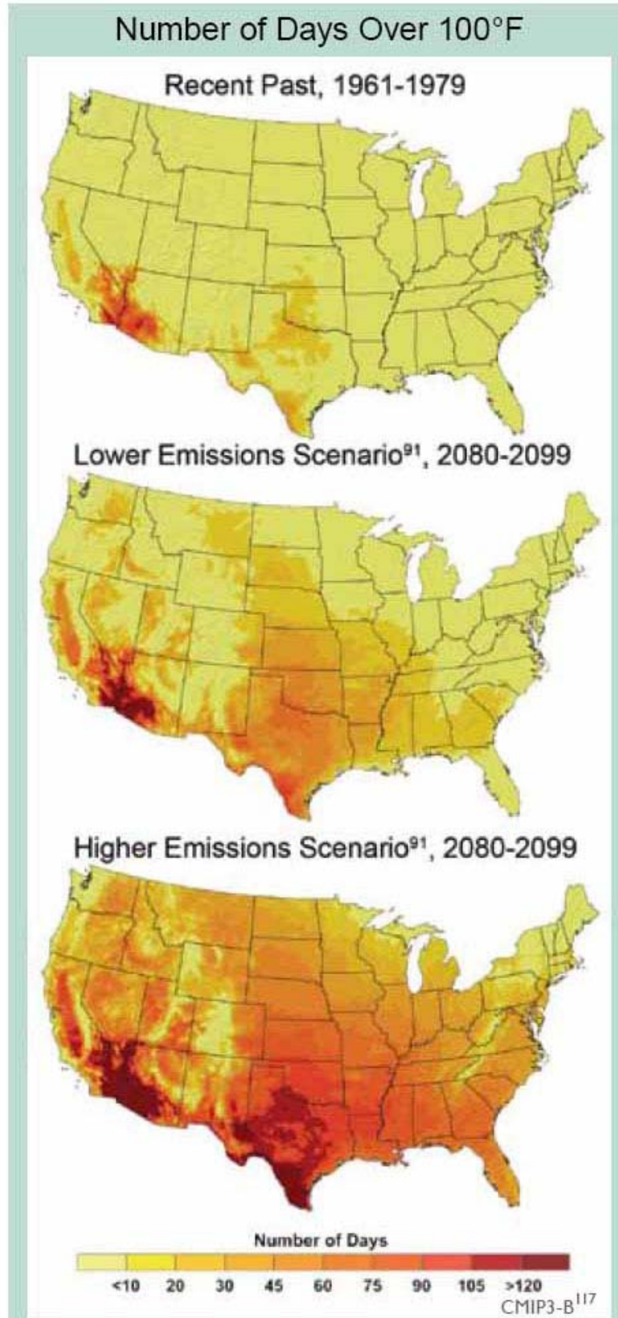
The implications of this new report define the very timeframes that we can expect to experience dangerous climate change. Temperature increases across the globe will be 11.5 degrees warmer if we continue with the worse-case scenario outlined in the 2007 IPCC report, which seems inevitable because CO2 concentrations today are increasing faster than this worst-case scenario. Global temperatures today are within 1.8 degrees F of being as warm as they have been in 1.35 million years. An increase of 11.5 degrees (6.4 degrees C) is as warm or warmer than when the dinosaurs were around and sea level was 250 feet higher. But sea level rise and the impacts to billions of people (One billion people reside within 25 feet of sea level) is only a small part of the story of how most of our planet’s ecosystems would respond to this catastrophic environmental change.

Climate changes rely on how quickly we begin to make substantial cuts in our greenhouse gas emissions. The results of World efforts to curb greenhouse gas emissions have been almost entirely ineffectual. There are a few shining examples of successful efforts, but almost everywhere else, greenhouse gas emissions are increasing. It is also important to understand that our emissions are not only increasing rapidly, they are increasing much more rapidly than just 15 years ago, and China’s responsibility, while real, pales in comparison to that of the United States.

But the single most important thing is that emissions reductions need to happen very soon. Or like my dad used to say, they needed to happen twenty years ago. We have already locked in a large proportion of future warming. Under the worst-case scenario, five degrees F of warming can be expected with even the most aggressive mitigation strategies. The coming change will be determined by how quickly and how aggressively we reduce emissions, and likely to a very significant extent, how we can start removing some of the CO2 already in our atmosphere.

The U.S. is responsible for almost four times more CO2 emissions than China. Half of all CO2 emitted by the U.S. has been emitted since 1973. Three quarters of all CO2 ever emitted by the U.S. has been emitted since World War II. Because of global warming, CO2 now stays in our atmosphere even longer than we understood in the 20th century. Half of CO2 hangs around for 300 years, half of what remains is here for 20,000 years and the last 25% will stay in our atmosphere forever.

Emission reductions in the 2007 IPCC report suggest a worst-case scenario be addressed with reductions of 40% below 1990 levels by 2020 and 95% below 1990 by 2050. The U.S., under President Obama, is proposing zero percent below 1990 emission levels by 2020. (The Kyoto Protocol finalized in 1997 suggested 7% below 1990 levels.)



The number of days in which the temperature exceeds 100°F by late this century, compared to the 1960s and 1970s, is projected to increase strongly across the United States. For example, parts of Texas that recently experienced about 10 to 20 days per year over 100°F are expected to experience more than 100 days per year in which the temperature exceeds 100°F by the end of the century under the higher emissions scenario.[91]

Global Climate Change Impacts in the United States, Global Change Research Act of 1990, Office of the President, 2009.pdf

The first graphic "Number of Days over 100°F" shows the number of days each summer that will be above 100 degrees. The bottom image "higher emission scenario" (A1F1 scenario from IPCC 2007) is the worst-case scenario. These numbers are based on IPCC climate models.

Austin (Central Texas) normally has 12 days of 100-degree plus heat per summer based on temperature records that go back to 1854. Because of climate change, this report says Austin will likely average between 90 and 120 days of 100 degree plus heat every year. Summers in Austin will be *ten times* more extreme than they are normally.

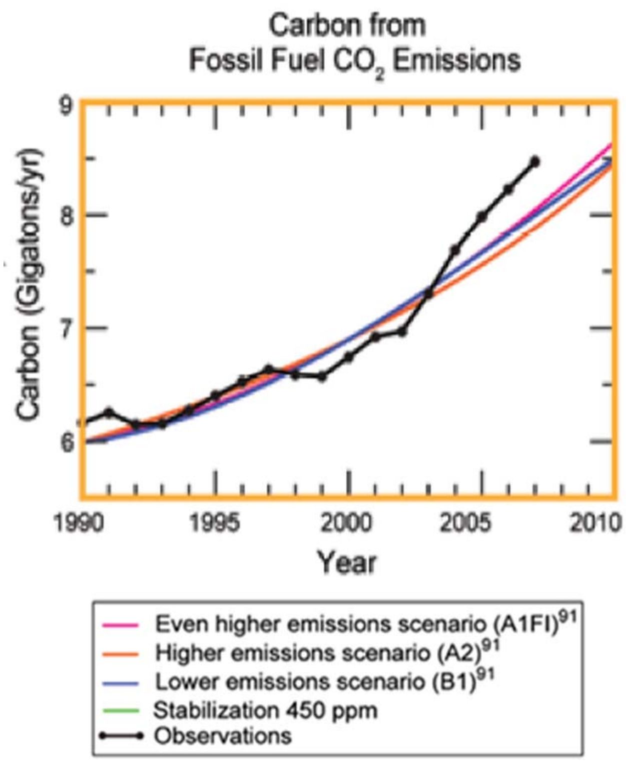
The Arizona-Sonoran Desert Museum, the home of the giant saguaro spine, has an average of 87 days over 100 degrees every year. This is a traditional spine and gravel desert with little to no water, blistering temperatures and, would be totally inhospitable to most life found naturally in Central Texas.

The Sonoran Desert is a wonderful place and, full of life, but it has evolved this way over thousands of years. Austin's summers will be a third more extreme than those of the Sonoran Desert. These changes are beginning now and will be complete in 80 to 90 years. Considering that *normal* Texas heat is stifling and Texas is one of *the* hottest places in the United States, to say the least, ten times more extreme is alarmingly critical.

This is an issue that Americans have never dealt with before. The people of this planet have never dealt with this before. We do not know what it means for our climate to warm by a dozen degrees or so, because nothing like this has ever happened, to any of us, and records of these events in the distant past are completely unknown to the vast majority of us as well. But these events have happened in the past and today, a decade after the turn of the 21st century, our records of the changes are quite good.

What we have learned from these records is that most life, as we know it in the Hill Country, outside of air conditioners, will not be able to adapt. Life will perish. It takes just 5 to 7 degrees F of warming to make this happen. The worst-case scenario results are a lifeless sea of sand. It happened 6,000 years ago in the Saharan Grassland. What? Isn't the Sahara a drifting sand desert? About 6,000 years ago, an environmental threshold was crossed in North Africa and the Saharan Grassland became the Saharan Desert. This has happened in the U.S. too. Twice between 900 A.D. and 1350 A.D., the Great Plains turned to sand in megadroughts that lasted 200 years. These megadroughts were more than 20 times more extreme than the Dust Bowl in the 1930s.

The Central Texas environment, like the Sonoran Dessert, has evolved over thousands of years. Plants and animals depend on a relatively stable environment. The Sonoran Desert is a spine and gravel desert for a reason. The animals and insects of the desert are mostly nocturnal for a reason. This reason is inhospitable heat. The plants and animals of the desert have adapted to the environment for survival. To subject a non-desert ecosystem to desert conditions, in the ecological evolutionary blink-of-an-eye, will result in a vast extinction event in Central Texas.



Global Climate Change Impacts in the United States, Global Change Research Act of 1990, Office of the President, 2009, page 23.

You may think that this article is following the alarmist "worst-case scenario" line of thought. You would have been right if this were written back then. Unfortunately scientists are sometimes wrong. This time their projections and models have been conservative.

The graphic "Carbon from Fossil Fuel CO2 Emissions" shows the atmospheric load of carbon dioxide (calculated as carbon) from the USGCRP Report. The colored lines are the different computer model's projections. The black line with the circles represents actual atmospheric measurements. The magenta line is the A1F1 scenario, which is the worst-case scenario used by the climate models. What the actual measurements show is that carbon dioxide concentrations, right now, are greater than and increasing faster than the worst-case scenario from the climate models.

Everywhere one turns today in climate science there is evidence that either: the computer models are conservative, or the impacts from climate change have started happening faster since the turn of the century, or both.

There is a simple scientific concept that says that scientists are conservative in their work. This is the “publish or perish” concept. Simply put, a scientist must be absolutely certain about the results of his or her discoveries or they will not be able to publish their papers in the academic journals. If a scientist is found to be wrong after their results are published, the journals will think twice about publishing that scientist’s work in the future. A scientist’s work is therefore made conservative to minimize the risk of being wrong and perishing.

The impacts are getting stronger; we know this. They are also getting stronger at a much faster rate than the scientists expected. There is a quote from the USGCRP Report the states the obvious to climate scientists. "Some of the changes have been faster than previous assessments have projected." As you have seen above, our climate is changing faster than the worst-case scenario used by the super computer climate models. This is very important to understand because knowing what we know about the computer models and the way our climate behaves, we know that there is a huge time lag, of about a generation, between the emission of the greenhouse gases and the warming of our climate.

In essence, we have a safety valve. Our climate will not fully respond to the gigatons of greenhouse gases we have dumped there for a generation. We have time to act. But reductions in emissions will only slightly reduce the rate that we are still putting greenhouse gases into the atmosphere. Because of this long life, the amount of CO_2 in the sky will continue to grow.

This is a big problem. Since we started emitting extra greenhouse gases into our atmosphere, about 840 billion tons (gigatons) are still there warming the planet. The Empire State Building weighs 365,000 million tons. There are 2,300 Empire State Buildings worth of greenhouse gases in our atmosphere. These gases are causing our sky to be out of balance, and they are not going anywhere by themselves, any time soon.

Either the computer models are conservative, or the impacts from climate change are actually happening faster now (or both). The evidence is everywhere: Artic sea ice 70 years ahead of schedule and has not been absent from the Arctic in 14 million years; Greenland’s melt quadrupled; Antarctica melt is one hundred years ahead of projections; Carbon dioxide emissions are beyond the worse case scenario; Ocean temperatures are the warmest ever recorded; CO_2 is higher than any time in the last 15 million years; and carbon dioxide emission rates are 20,000 times higher than anything in the last 65 million years.

This all sounds like so much cow manure, but it is not. The science behind this information was new twenty to thirty years ago. This was when the climate scientists were telling us that it would take twenty years to know for sure. That time has elapsed now and every year there are 1,000 times more new climate science discoveries published in the academic journals than there were in 1990. The gig is this: We have extensively and radically altered the atmosphere of our planet. Because of the long lag times in the reaction of our climate to the pollution that we have dumped in the atmosphere, we could not see the impacts of our actions until now. And the full impacts of these additional greenhouse gases, just the additional gases emitted through today, will not be apparent for thirty years.

The projections in the USGCRP report will not happen at the end of the century, they will be finished by that time. If we have not judged the amount of climate change correctly because of any of the conservative findings described above, the impacts will be even greater. If we have not acted aggressively enough or soon enough to re-balance Earth’s climate, even more warming will occur.

The hottest summer ever recorded in Austin happened in 2009. Trees by the thousands died. The toll in other life is unknown. The second most extreme summer happened in 2008. The heat records broken in Central Texas were more extreme than those of the great drought of the 1950s, which was more extreme even than the Dust Bowl of the 1930s. There were 68 days of 100-degree plus heat in 2009 and in 2008 there were 50.

Remember, the average number of 100-degree days is twelve in Austin. The environment here can withstand 68 days of 100-degree heat only every now and then, and even so there is great disturbance in the environment when this happens. When the average summer in Austin has 90 to 120 days of 100-degree plus heat, only the coolest summers will have 68 days of 100-degree extreme heat.

It is amazingly hard to describe what will happen to our forests and rivers across this country and across the world as this type of extreme heat replaces the environment that has evolved over thousands of years. It is even more unbelievable that something like this could actually happen but, it is happening now, it has already begun. This great ecosystem regime change across the U.S. will not just be limited to Texas. As far away as Pennsylvania and Minnesota, environments will be shattered resulting in an inhospitable landscape for time frames that matter. Places like Minnesota and Pennsylvania only see temperatures above 100 a few times a year at the most (often not for years in a row) but both of these places will see their climate shift in the extreme. The USGCRP report says that they will see 100-degree plus temperatures twenty or even thirty times per year. Their climates will disastrously change to something that is ten or more times extreme than has evolved in these areas over thousands of years. It will as hot as Texas is now, or they will see even more extreme heat; a dozen, or even 20 or 30 days of 100-degree heat per year.

In the last few decades, the temperature in the Rockies has increased at twice the rate that it has across the rest of the planet (2.5 degrees F). This has caused unprecedented forest death from multiple causes including bark beetles, rusts, cankers, fungus, borers, budworms and leaf miners. The largest outbreak totals date is 52 million acres of dead pine trees. They have been killed by the largest pine beetle infestation ever known. This pandemic is twenty times larger than the last record-breaking infestation that ended just after the turn of the century. That infestation was only three million acres and it took a decade to kill those three million acres. In just 2008 alone, 18 million acres of new kill were recorded in this outbreak. This pandemic has been caused by stress from warming. Continued drought and warmth have so weakened the forest of the Rockies that they are succumbing, not only to this massive pine beetle pandemic, but to dozens of other separate forest maladies as well.

The forest professionals say that only extreme cold can stop the beetle and as our planet continues to warm we are quite unlikely to see cold that is extreme enough to kill the beetle. In 2009 for the first time, the great fear among the forest professionals is that this pandemic will spread to the great boreal forests of the north and down the eastern seaboard to the pine forests of eastern North America. They are concerned that the pandemic will become a continent wide event in just the next few decades or less.

The carbon feedback that will occur will rival total global greenhouse gas emissions from mankind. The 52 million acres of dead trees in 2008 have emissions is equal to three quarters of the carbon emissions from Canada's entire transportation fleet. The scientists are concerned that the outbreak will now infest the great forests of the North – The Boreal Forests. These 4.3 billion acres of forests contain about 600 gigatons of carbon. We put about 9 gigatons of carbon into our skies every year. The scale of this problem is beyond beyond.

At the end of the 21st century (2090 to 2100), my grandkids (if I ever get any) will still be alive. But the plants and animals and beautiful Hill Country creeks will have died by mid-century. A transition to a spine and gravel desert does not happen in an instant. The decay of the dead forests will be ongoing. Considering that the scientists' projections are conservative and that the climate crisis is progressing on a path that is worse than the worst-case scenario, it is likely that climate change will be even more extreme than 90 to 120 days of 100-degree heat. Regardless, the warming will continue. It will take centuries for the Earth's energy imbalance to be restored once carbon dioxide emissions cease. Desert plants and animals will not have had time to colonize the area in just a single century.

What will remain, at least far into our great-grandchildren's lives, will be bleak and lifeless. If we don't gain control of greenhouse gases the changes will be permanent and irreversible in time frames that matter (thousands of years). For the next several centuries, the rapid rate of change will not allow enough environmental stabilization for an ecological community to form. Life will be in limbo. The skeleton forests will be the most prominent landform. They will persist for generations. Temperatures in Texas will be significantly greater than those found in the Sonoran Desert. An even more extreme desert environment will be what eventually evolves.

In as little time as ten years, by 2020, great continental regions of forest could be dead. Dry preservation will create a tomb-like landscape, stark, bleached and sun-scorched. A scant few species will continue to live, virtually none will flourish. This may seem far-fetched, but little more than a few degrees of change, like is being revealed in the forests of the Rocky Mountains, can completely devastate an ecosystem.

In Austin this year our average three-month summer temperature was the hottest ever recorded (154 year record) by 1.7 degrees at 88.4 F (83.6 is average). The three highest average summer temperatures have now been recorded at Austin since 1998. This heat was accountable for nearly six times more 100-degree days than we usually see. It is hard to imagine that 11.5 degrees of warming will only produce about 100 days of 100-degree plus heat per year. If one year of 60 plus days of 100-degree heat kills trees in Austin, how bad will it be by mid century or so when every year has 60 days of 100-degree plus heat, and an extreme year will have 120 or 150 or more days of 100-degree heat?

The world's ecosystems have evolved over thousands of years. They can take periodic extremes, but when the average is shifted the extremes shift with the averages. Summer heat is a killer. Dead is irreversible.

In the Rockies 52 million acres of forest death has been caused by an increase in average temperature of only 2.5 degrees. Texas has passed the 2.5 degree mark. Last summer was 4.8 degrees above average. But some years, at least in the next decade, may seem somewhat normal. The natural climate chaos is huge compared to climate change that matters to ecosystems. We regularly see temperature changes of 30 to 40 degrees per day and over 100 degrees of temperature change from summer to winter. But it is just a few degrees of average temperature change that can dismantle an ecosystem.

We cannot hope that the relatively cool temperatures in North America over the last several years mean that climate change is not real. It is very real and it is very dangerous. While it has been a little cooler the last several years, carbon greenhouse gases are accumulating at record rates in the atmosphere. A few quick fact checks will show the story. The “cold” winters of 2007, 2008 and 2009 in North America are difficult to see when we look at the global average. Globally, 2007 was the fifth hottest year recorded to date. In 2008 we had the eighth hottest year recorded and in 2009 globally, we had the fifth hottest year ever recorded.

Global Top 10 Warm Years (Jan-Dec)	Anomaly °F
2005	1.10
1998	1.08
2003	1.04
2002	1.03
2009	1.01
2006	1.01
2007	0.99
2004	0.97
2001	0.94
2008	0.86

The cold winters of the last three years are somewhat difficult to see when we look at the individual U.S. numbers too. In 2007, the U.S. had its 10th warmest year ever recorded. In 2008 we were 0.2 degrees above the 20th century average and 2009 was 0.1 degree above average. Cold winters? No. Average winters, yes. What has happened is that it has been so long since we have seen normally cold temperatures in the U.S., when they do happen, it “seems” like it is crazy cold. So do not get comfortable.

Because of civilization’s short memory, the radical climate skeptics say that scientists cannot figure out why we have not continued to set global heat records, that climate change is not real, that it is not caused by man, or it does not matter, etc. One can only respond to this unfortunate display of shortsightedness with continued perseverance. To start with, setting consecutive heat records is not a normal thing to do given the naturally chaotic nature of the weather. The last all-time hottest year was set in 2005, four years ago. The record before that was 1998, six years before 2005. AND unfortunately, there is the planetary cooling influence of three great natural cycles coming together in the last several years to help us understand why we are actually seeing average temperatures again instead of the much above average that we have become accustomed to.

The three natural cycles are the solar cycle, ENSO (or El Nino Southern Oscillation) and the PDO (or Pacific Decadal Oscillation). All three of these massive natural climate manipulators are experiencing, or have just come out of, their “cool” stages. There is a lag in time before the natural cooling influence stops. It is larger than the seasonal lag, but likely no more than a few years. (For example: The shortest day of the year is usually December 21, but the coldest weather of the year does not happen until early or even mid-February). The climate scientists are telling us that we will move back into a period of rapid warming very soon. The time lag from the natural climate cooling trends will have passed. We may see periods in the future where the rate that our climate warming slows a bit for several years, but long term, the warming will not stop because we are still increasing the greenhouse gas contents of our atmosphere and the long life of CO_2 guarantees that the warming will continue for centuries to thousands of years.

The brutal reality is, massive regional extinction will not arrive at the end of the century. It will arrive any year now. It will progress in a worsening spiral until the streams and animals are gone and the forests have been reduced to sticks in the blazing sun.

The death and devastation will come unless we start reducing, not just our emissions, but also the invisible greenhouse gas load that has been building in our atmosphere for centuries. If we can build the bomb or send a man to the moon, we *can* do this. All we have to do is start spending money on our environment like we are spending it on our institutions that are too big to fail because; the Earth is too big to fail.

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