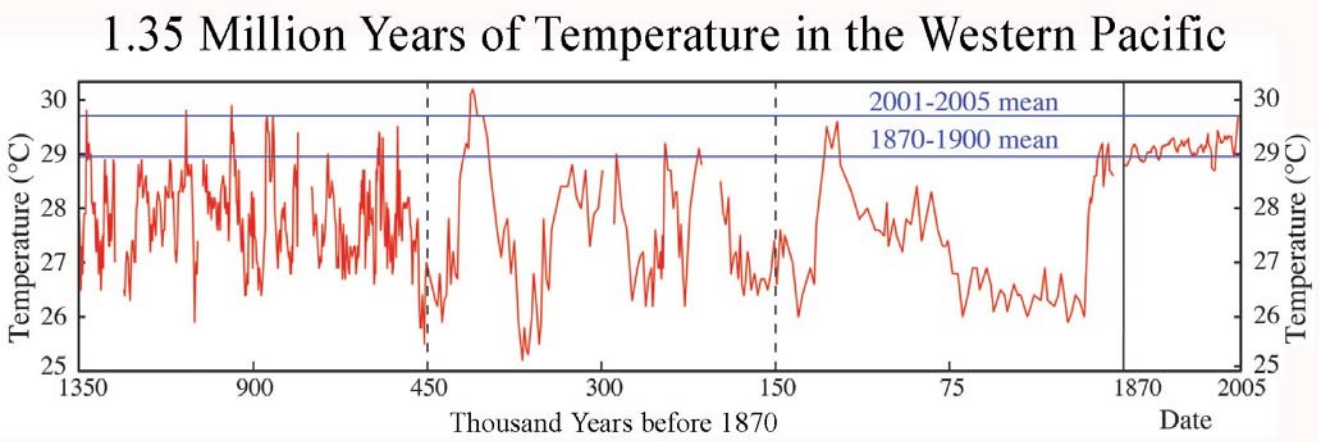
References:

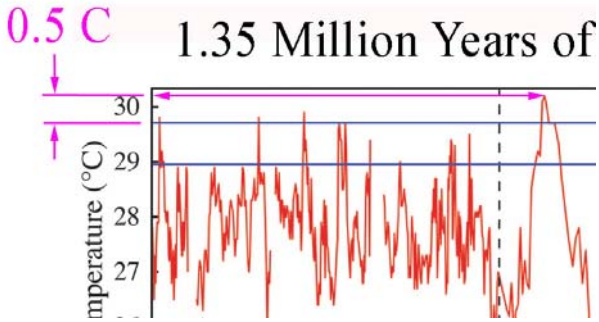
Climate Crisis: Extreme Summer Heat and Irreversible Ecosystem Demise

Temperatures within 1 degree of the last 1.35 million years:

James Hansen's paper looks at the relationship between western equatorial Pacific water temperatures and the importance of the oceans in this area to global climate. His conclusions are that "dangerous climate change" will happen on Earth if manmade forcing of our climate exceeds 1 degree C, not the 2 degrees C assumption that has been the accustomed projection in our past understanding of dangerous climate



change. This is a big deal. The "dangerous" in dangerous climate change is a term that has been agreed upon by climate scientists from the beginning of major climate talks in Rio De Janeiro in 1992, where the Kyoto Protocol was born at the United Nations Framework Convention on Climate Change. Dangerous means that the resulting climate change would put the existence of mankind in jeopardy.



In Hansen's paper, he makes the statistical connection that sea surface temperatures in the western equatorial Pacific, although the amount of variation is less, are very similar to global average temperature records identified from other ocean sediments and polar ice. So we can look at this very clear record from the South Pacific to see what the highest temperature was back to the beginning of the study period. Because western equatorial Pacific temperature reflects only about half of global temperature, the 0.5 degrees C difference between the 2001 – 2005 average and the warmest temperature in the record about 400 thousand years ago, is actually about one degree C of global temperature increase.

Hansen's suggestion is that when our climate changes more than it has changed in the last million plus years, it will be moving out of the climate range where mankind has evolved. This climate range is very narrow compared to the warming that is happening now and the warming that we know is to come because of all of the greenhouse gases that we have put into our atmosphere up until now. Ecosystems on a continental scale will fail as we move out of their evolutionary niches. The resulting environmental devastation will be incalculable.

Hansen, et. al. Global temperature change, Proceedings of the National Academy of Sciences, September, 2006.

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:
Changes like this will shift virtually all ecosystems around the world in amounts that almost guarantee their demise (see the discussions about desertification below for more). When the dinosaurs were around, tropical forests with alligators were in the Arctic. But today's Earth is a vastly different place. On today's Earth, these changes have been modeled to show that the interior of the World's continents will change to deserts with this amount of warming. The planet that evolved mankind's complicated society will be changed to something that, to the natural environment, is light years distant. Agriculture will become a completely different thing than what it has evolved to be over the last 6,000 years.

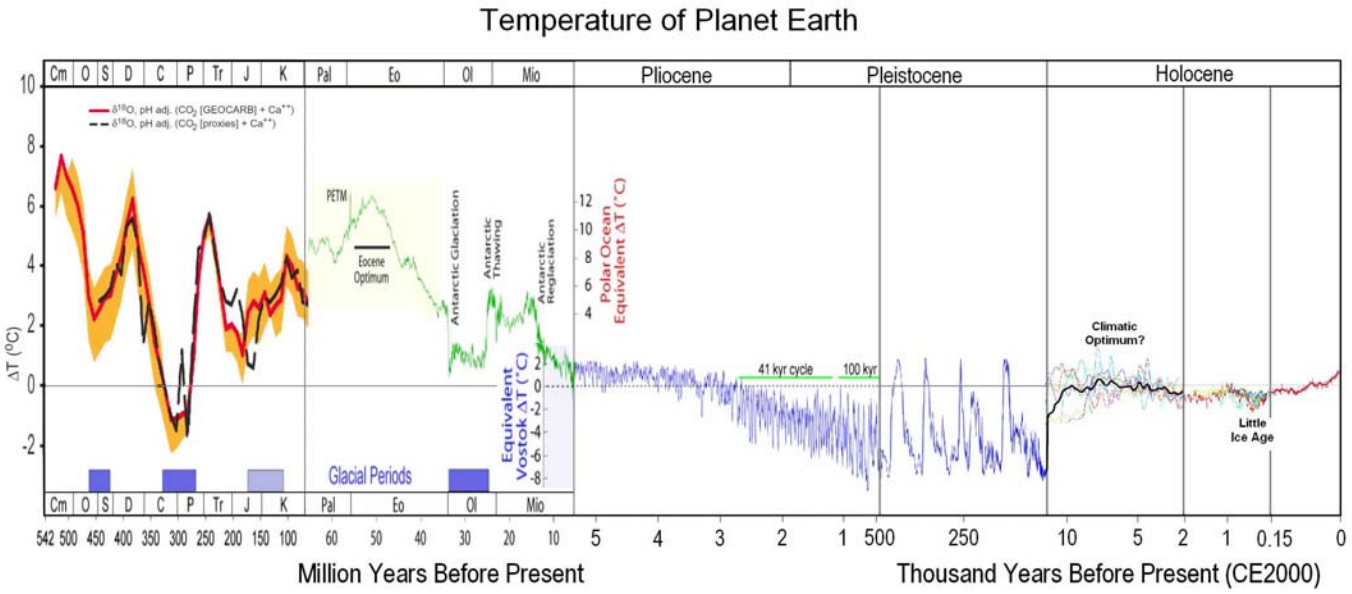
Ice sheet disintegration is now an event that could be completed in as little as a couple of centuries. What conservative science understood for a couple of decades as a millennial timescale event, we have now leaned is a much more aggressive event. Sea level rises of 16 feet per century have been sustained for centuries on end and with peaks of up to ten feet per decade. But the loss of Florida is nothing compared to global environmental changes because of this amount of temperature change.

A common propaganda technique of the radical climate skeptics is, they say it has been much warmer on our planet in the past, so what's the big deal about global warming? As usual they are right about one thing, but vastly wrong about the implications. Nothing like what mankind is doing to Earth today has ever happened before. We cannot compare past climates, on an Earth with today's continental configurations and atmospheric compositions to anything in the past. We *can* gain insight from ancient history, but the comparison is otherwise almost completely meaningless.

The argument that these propagandists use, that the Earth has been much warmer than today and CO2 levels have been much higher is a particularly backwards justification for allowing dangerous greenhouse gas emissions to continue. And I will get to that in a minute, but first I have to clean up after spilling the bad propaganda toilet water. This argument is completely ludicrous for so many reasons. Sure, the planet was warmer and temperatures were higher. Why? Well, there was no vegetation on Earth at the time maybe? Or the atmosphere was vastly different with only 1% oxygen compared to 21% today? Or there were no ice sheets then? Or maybe this one - that is a little more complicated to explain: The continents were all lumped together in one supercontinent. This created a completely different greenhouse world terrarium experiment that reacts in a vastly different way to the continental configuration we have today. And lastly, when the planet was so much warmer and greenhouse gases so much higher than today, there was no life at all on the planet beyond algae and plankton-like creatures that grew in the sea.

All of these things did not happen at the same time for all time periods of course, we did have much higher temperatures during the Mesozoic period when Dinosaurs roamed the planet, but the continents were situated in a fundamentally different way than they are today. Ocean circulation was different and there was no ice on the planet. Comparison of Earth today with Earth then is just not a productive use of time. What these propaganda actions amount to, with the full understanding of the danger of the climate crisis, are criminal acts. This is endangerment pure and simple.

Just after the Dinosaurs went extinct was a period known as the Peleocene/Eocene Thermal Maximum (PETM). It was one of the warmest periods on Earth in 500 million years. It happened about 55.8 million years ago.



The temperature at the PETM was about what we can expect due to man-caused planetary change by the time our grandchildren are grown, only there is one tremendously large difference between now and then - CO2 concentrations are changing 20,000 times faster today than they were then. That's right, I did not add a few extra zeros: I said twenty thousand times faster.

In the year 55.8 million years ago, the evolution of an oxygen rich atmosphere on Earth, primary productivity as we know it today, volcanism, rapid tectonic movement, and etc., had all caused the evolution of our planet to proceed to a point where CO2 was somewhere around 1000 ppm. Back then, and for all time except the last few hundred to several thousand years when human civilization has existed, the gaseous concentrations of our atmosphere changed on a geologic time scale. The latest research has found that 1000 ppm is likely the highest that the atmospheric CO2 has ever been on Earth, at least when we had plants on land (not 2,000 to 3,000 ppm that has been around in the literature for some time). This latest research also showed that our climate models have likely been using too small of a climate sensitivity to greenhouse gases. Which means that our climate likely changes more per given increase of CO2 than we previously thought. This really was a big study. It was actually two big discoveries in one paper. Both of which have the effect of making our current understanding of the climate crisis more critical. If past maximum CO2 concentrations were two thirds lower than previously assumed, it means that our current concentration of 390 ppm is much higher than we thought. The increased sensitivity means that smaller increases of CO2 will produce a greater warming than previous model projections.

There has been a lot of controversy over Earth's CO2 concentration history. The radical climate skeptics like to jump on the 2,000 to 3,000 ppm wagon and point. But the higher estimates of Earth's atmospheric CO2 concentrations have been gaining less favor as the years go by, because there are fewer papers that support those theories as time goes on.

So the Paleocene/Eocene Thermal Maximum (PETM) happens in the middle of this exceedingly warm period 55.8 million years ago. In just about a thousand years, the planet warmed an *additional* several degrees F. except it appears that CO2 wasn't the culprit. It looks to be that methane was released from undersea reservoirs of frozen methane (clathrates) because of the immense warming of the PETM. This

spike in methane caused an additional spike in temperature. So if we compare the PETM with today, it looks like we have a long way to go to equal the hottest temperatures on the planet. But that's not the case.

There are two vitally important details that make today far beyond comparison with the PETM. The sun today is 2% brighter than it was 55 million years ago. This is huge in climate speak. It doesn't sound like much to you and me, but our climate doesn't care what it sounds like to you and me. The other big thing is that the response to the forcing that greenhouse gases exert on climate is increased by the size of the forcing. In other words, the harder we push our climate, the greater will be the resulting response. And today's CO2 concentration is increasing 20,000 times faster than anything seen in the last 65 million years.

Oh, one last little thing that has another extreme effect on our climate. About 3 million years ago, the Isthmus of Panama closed up. Previously, we had a one-world oceanic circulation where the Pacific and the Atlantic were connected in three places – at both polls *and* the equator. This meant that global climate dynamics were completely different.

Now the crux of all of this discussion is that we could be much nearer the runaway climate syndrome than has been previously been considered. To know which much greater certainty that Earth's CO2 concentrations have never been 2,000 or 3,000 ppm, and have likely maxed at 1000 ppm is tremendously important. Dangerously increasing CO2 concentrations on our planet today is bad enough, but to dangerously increase them when we know that the worst conditions on the planet have ever been is only 30% as bad as was previously believed, well that's suicidal.

Blanchon et. al., Rapid sea-level rise and reef back-stepping at the close of the last interglacial highstand Nature April 2009.
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Hansen et. al., Target Atmospheric CO2: Where should humanity aim, Open Atmospheric Science Journal, August 2008.
Hansen, et. al. Global temperature change, Proceedings of the National Academy of Science, September 2006.

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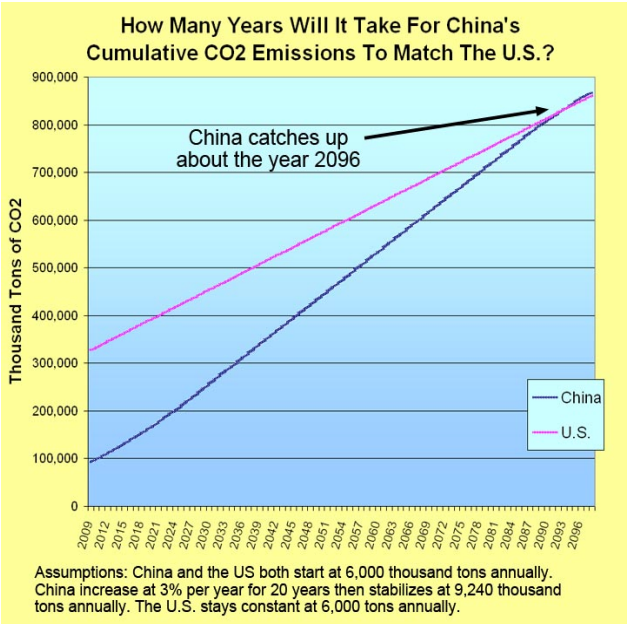
Park, A re-evaluation of the coherence between global-average atmospheric CO2 and temperatures at interannual time scales, Geophysical Research Letters, November 2009.
Knorr, Is the airborne fraction of anthropogenic CO2 emissions increasing?, Geophysical Research Letters, November 2009.
Schmittner, et. al., Global impact of the Panamanian Seaway closure, EOS, 2004.
Bartoli, Final closure of Panama and the onset of northern hemisphere glaciation, Earth and Planetary Science Letters 2005.
Greenhouse gas emissions growing faster since 2000, European Union, Joint Research Centre, European Commission, May 2009.

One billion people reside within 25 feet of sea level:
Christian Aid Agency, Human tide: the real migration crisis, May 2007.
The USGS says 700 million with a rise of 25 feet and 2 billion with a rise of 240 feet.
United states Geologic Survey, Center of Excellence for Geospatial Information Science (CEGIS)
http://cegis.usgs.gov/sea_level_rise.html

…China's responsibility, while real, pales in comparison to that of the United States:
Greenhouse gas emissions increased 15% between 2000 and 2005, representing a sharp jump in the rate of emissions growth, which was 3% for the period 1990-1995 and 6% between 1995 and 2000.
Greenhouse gas emissions growing faster since 2000, European Union, Joint Research Centre, European Commission, May 2009.
The United States emitted 41.5 gigatons of CO2 equivalents between 2000 and 2006, China emitted only 75 percent of this amount at 31.5 gigatons. Climate change is based on warming from greenhouse gases (GHGs). The warming is done by the vast load of GHGs in our atmosphere. We have put an extra 1,400 gigatons of CO2 into our atmosphere over time and about 60 percent, because of the long life of greenhouse gases in our atmosphere, is still there. This means that there are about 840 extra gigatons of greenhouse gases making our climate out of balance, and warming the planet beyond where it has evolved for the last 10,000 years.



The paradox however is that annually; our global emissions of 32.5 gigatons in 2006, even if all of the annual emissions went straight to warming the planet (they do not), our annual contribution to greenhouse warming on the planet is less than 4% per year. Now consider that GHG emission reductions by 2020 would be 20%. This means that every year our global greenhouse gas emissions reductions equals less than 1% of the total warming from the total atmospheric load – and this load would still be increasing. The life of greenhouse gases in our atmosphere is so long that truly meaningful reductions in warming can only come from reduction of greenhouse gases already in our atmosphere, in quantities that are significantly greater than the annual global emissions.

Don't get me wrong now. We have to reduce emissions. Removing greenhouse gases from the sky is as unproven as coal plant carbon sequestration. Lord Nicholas Stern, Author of Great Britain's 700 page economic analysis of climate change, says that that we have to be doing everything within our power to solve the climate crisis challenge – all at the same time. We can't just wait till the technology becomes available, what if it availability never happens, is slow or problematic?

Another fact about responsibility and China is that since we started emitting CO2 into the atmosphere the U.S. has emitted 328,000 gigatons and China has emitted only 28 percent of this amount at 92,000 gigatons. If the U.S. were to cap the increase of CO2 at today's level and China was allowed to increase their emissions for twenty years at three percent, it would take 86 years for them to catch up with the amount of GHGs that the U.S. has emitted.

World Resources Climate Analysis Indicator Tool
http://cait.wri.org/cait.php?page=yearly&mode=view&sort=val-desc&pHints=shut&url=form&year=1900&sector=natl&co2=1&update=Update

Under the worst-case scenario, five degrees of warming can be expected with even the most aggressive mitigation strategies:
This study analyzed the IPCC climate mitigation scenarios to see how our climate is impacted in the future with plausible emissions scenarios being developed in the 21st century. The worst-case scenario increase was five degrees F even with the most aggressive mitigation proposals. This type of scenario seems to be occurring now with actual greenhouse gas emissions today greater than the IPCC 2007 worst-case scenario.
Van Vuuren, et. al., Temperature increases of 21st century mitigation scenarios, PNAS, October 2008.

Half of CO2 stays in our atmosphere for 300 years:
As our planet warms, oceans can absorb less CO2. Drying soils on a warmer planet absorb less CO2. Even the CO2 fertilization effect breaks down after just a few degrees of warming in most ecosystems meaning that forests absorb less CO2. These impacts of warming are being seen across the planet now and this is why the "new" life span of CO2 in our atmosphere has increased. What was once called a half-life of 100 to 200 years, where half of CO2 emitted into the atmosphere stays there for 100 to 200 years, is now considered to be 300 years, approximately double what the estimate was in the 20th century.
Archer, Fate of fossil fuel CO2 in geologic time, Journal of Geophysical Research, volume 110, 2005.

50% of CO2 emitted since 1973:
Emissions from the chart on the right are calculated as CO2 equivalents, or the approximate same amount of warming

U.S. GHG Emissions
(million tons or gigatons of CO2 equivalents)

Year	Cumulative total 1850 to 2005	Annual Emssions	Percent of Total (Cummulative)
2006	334033	5770	100.0%
2005	328263	5892	98.3%
2004	322371	5864	96.5%
2003	316507	5783	94.8%
2002	310724	5722	93.0%
2001	305002	5692	91.3%
2000	299310	5769	89.6%
1999	293541	5597	87.9%
1998	287944	5551	86.2%
1997	282393	5512	84.5%
1996	276881	5364	82.9%
1995	271517	5181	81.3%
1994	266336	5180	79.7%
1993	261156	5103	78.2%
1992	256053	4952	76.7%
1991	251101	4881	75.2%
1990	246220	4902	73.7%
1989	241318	5001	72.2%
1988	236317	4942	70.7%
1987	231375	4735	69.3%
1986	226640	4585	67.8%
1985	222055	4604	66.5%
1984	217451	4584	65.1%
1983	212867	4392	63.7%
1982	208475	4416	62.4%
1981	204059	4652	61.1%
1980	199407	4721	59.7%
1979	194686	4914	58.3%
1978	189772	4880	56.8%
1977	184892	4860	55.4%
1976	180032	4668	53.9%
1975	175364	4398	52.5%
1974	170966	4591	51.2%
1973	166375	4743	49.8%

potential for all greenhouse gases that equals to carbon dioxide. This is the way that most scientific analyses look at greenhouse warming. There are other numbers out there that differ from these for several reasons. Greenhouse gas emissions are all estimates to start with, some countries do not report their emissions accurately and assumptions are made differently. Reporting is also done in gigatons of carbon dioxide and gigatons of carbon, both of which reveal different numbers, confusing the issue further. A gigaton is one billion tons or two trillion pounds.

For references, one gallon of gasoline produces 19.4 pounds of carbon dioxide. The reason that more weight in carbon dioxide is produced than the gasoline's original 6.3 pounds is that when it burns, it reacts with oxygen in the atmosphere – a lot of oxygen. Carbon dioxide and heat are formed, along with a bunch of other chemical byproducts. A lot of oxygen is required, so a lot of carbon dioxide is the result.
World Resources Institute Climate Analysis Indicator Tool
http://cait.wri.org/cait.php?page=yearly&mode=view&sort=val-desc&pHints=shut&url=form&year=1900&sector=natl&co2=1&update=Update

IPCC 2007 emissions suggestions:
The U.S. is offering only 17% of what the IPCC says is necessary to prevent dangerous climate change. To meet the suggestions of the IPCC, the U.S. would have to increase emissions reductions five times, by 500%. The IPCC estimate is also based on two degrees of warming being the threshold for dangerous climate change. The most up-to-date estimate is one degree C of additional warming will result in dangerous climate change.
Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, 200, B. Metz, O.R. Davidson, P.R. Bosch, R. Dave, L.A. Meyer (eds), Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, Chapter 13, Policies, Instruments and Co-operative Arrangements.

US Emission reductions zero percent below 1990 levels:
Using World Resource Climate Analysis tool, from the chart "U.S. GHG Emissions", shows the Current U.S. Emissions reduction proposal of 17% below 2005 levels (for the year 2020) is approximately equal to 0% below 1990 emission levels. Kyoto required 7% below 1990 levels, so the current climate legislation in the U.S. does not even come up to the level of protection of Kyoto. The Kyoto Protocol was conceived at the Rio de Janeiro Earth Summit under a global treaty titled *United Nations Framework Convention on Climate Control* (UNFCCC) in 1992. It was ratified by the U.S. Congress the same year. The Kyoto protocol set the regulatory requirements to meet the goals set up by the UNFCCC. This (Kyoto Protocol) is the document that was never ratified by Congress. Bill Clinton signed it, but never sent it to the Senate. A summary of a few nations GHG emissions reductions proposals from Copenhagen is given below:

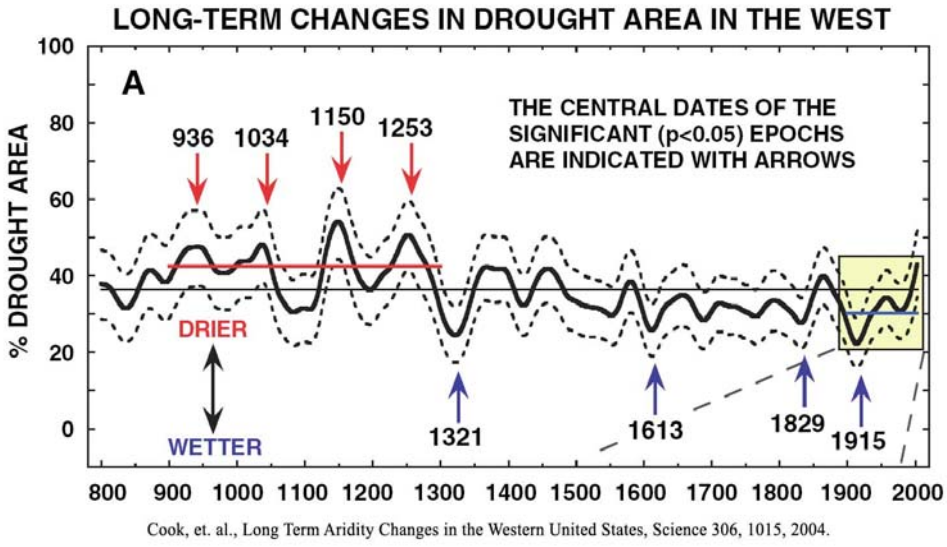
Country	Pledge	1990 terms
United States	17% below 2005	0% below 1990
China	40 to 45% below 2005	39% above 1990
(Cuts based on emissions *intensity*)*		
Japan		25% below 1990
European Union (1)		20% below 1990
European Union (2)		
(if major developed nations commit to significant cuts)		30% below 1990
India	25% below 2005	48% above 1990

* Emission intensity compares emissions to economic output. It is **not** an equal comparison to straight emissions cuts. For example, emission cuts can be though of as a savings account. Energy intensity emissions cuts can be though of as saving money making purchases at a retail establishment "on-sale". Much more money is spent than would have been spent if there were no purchases, it's just reduced by a the "on-sale" amount or the "emissions intensity" cuts.

World Resources Climate Analysis Indicator Tool
http://cait.wri.org/cait.php?page=yearly&mode=view&sort=val-desc&pHints=shut&url=form&year=1900&sector=natl&co2=1&update=Update

Sonoran Desert 87 days of 100-degree plus heat per year:
The Arizona - Sonoran Desert Museum enjoys 87 days per year of 100-degree plus heat. I chose the Arizona - Sonoran Desert Museum as my baseline for discussions of the relative climate of the Sonoran Desert, because it has a website where you can go to see the Sonoran desert up close, and because of the likelihood that it is not affected by the urban heat island effect like the municipal weather station at Tucson or Phoenix. The desert museum is located just west of Tucson, Arizona and is surrounded by more than 50,000 acres of parkland containing Tucson Mountain Park and Saguaro National Park. The Tucson Mountains lay between the park and the City of Tucson, so even though the possibility of the heat island affect exists, it is not very likely to be significant. For reference, the 100-degree days statistics for Phoenix from the National Weather Service are listed below:
Average annual number of days with maximum temperatures of 100 of higher 1896-2006: 92
Average annual number of days with maximum temperatures of 100 of higher 1971-2000: 106
Sonoran Desert Museum: http://www.desertmuseum.org/
Phoenix climate statistics: http://www.wrh.noaa.gov/psr/general/history/index.php?page=100deg

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:
The Sahara desert in North Africa was a green and very non-desert like place for nearly 10,000 years since the last ice age. But natural warming caused by the earth/sun cycles, at the thermal maximum 6,000 years ago, caused a dramatic climate shift across this vast region of North Africa. North Africa passed through an environmental threshold. In less than a century, a temperature increase of three to four degrees C (five to seven degrees F) created the massive sea of sand that we know today as the Sahara Desert. This sort of thing has happened in North America too. Between 900 A.D. and 1350 A.D. North America saw two megadroughts that one of the scientists (Cook) described in *Earth Science Reviews* as "scary". These mega droughts lasted for up to two hundred years with precipitation less than 25 percent of what we think of as normal today - only they lasted for centuries… Portions of the Great Plains were changed into a sea of sand that dwarfed the "Dust Bowl" of the 1930s. Mankind is causing similar changes



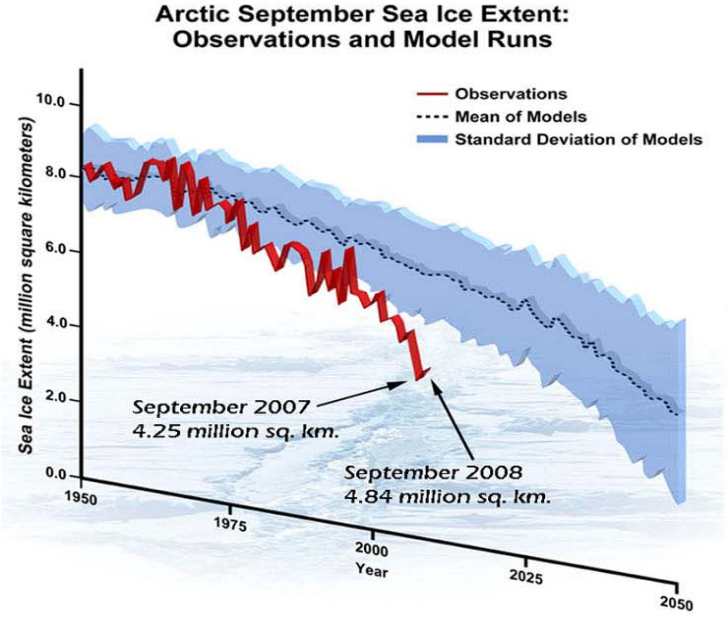
Cook, et. al., Long Term Aridity Changes in the Western United States, Science 306, 1015, 2004.

today, changes that will continue for centuries unless we reduce the amount of greenhouse gases in our atmosphere.

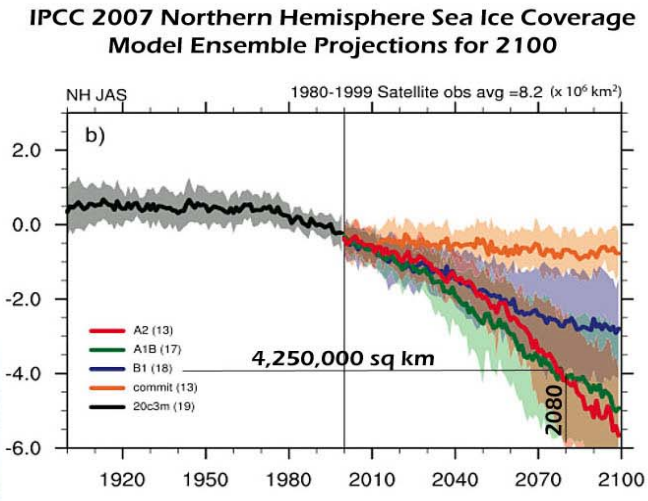
deMenocal, et. al., Coherent high and low latitude variability during the Holocene warm period, Science, June 2000.
Cook, et. al., Long Term Aridity Changes in the Western United States, Science 306, 1015, 2004.
Miao, et. al., High resolution proxy record of Holocene climate from a loess section in Southwest Nebraska, Paleoclimatology, September 2006.
Cook, et. al., North American Drought: Reconstructions, Causes, and Consequences, Earth Science Reviews, March 200.
Broecker and Kunzig, Fixing Climate, Three Books Publishing, 2008.

Computer climate models are conservative. The evidence is everywhere:
Arctic sea ice is extending its rapid trend of melt. This year was the third lowest on record and set a new minimum ice volume record. Only 19% of Arctic sea ice this year was two-year-old ice or older and average ice thickness has decreased 2.2 feet from 2004 to 2007. The next several pages describe briefly what is happening today that shows the conservative nature of the climate models.
National Snow and Ice Data Center: http://nsidc.org/news/press/20091005_minimumpr.html

Arctic Sea Ice decline 70 years ahead of schedule:
The left image shows Stroeve's analysis of Arctic sea ice coverage through 2008. (2009 was a bit greater than 2008, but still 20% below average. (The last five years have seen the five lowest average ice extent years on record.) The image on the right is the IPCC 2007 model summary of Arctic sea ice coverage for the different emissions scenarios through the year 2100. The A2 and the B1B (red and green lines) are the IPCC model scenarios with lower mitigation and higher greenhouse gas emissions. What this image shows is that sea ice extent today, or in 2007 was at 4.25 million square kilometers. The green and red lines depicting the IPCC climate models low mitigation/high emission scenarios predict sea ice to be at 4.25 million square kilometers in 2080 - 70 years from now.



Stroeve, et. al., Arctic Sea Ice Extenet: Decline Faster than Forecast, American Geophysical Letters, February 2006, Updated with 2007 data by Bruce Melton, October 2007, 2008, National Snow and Ice Data Center.



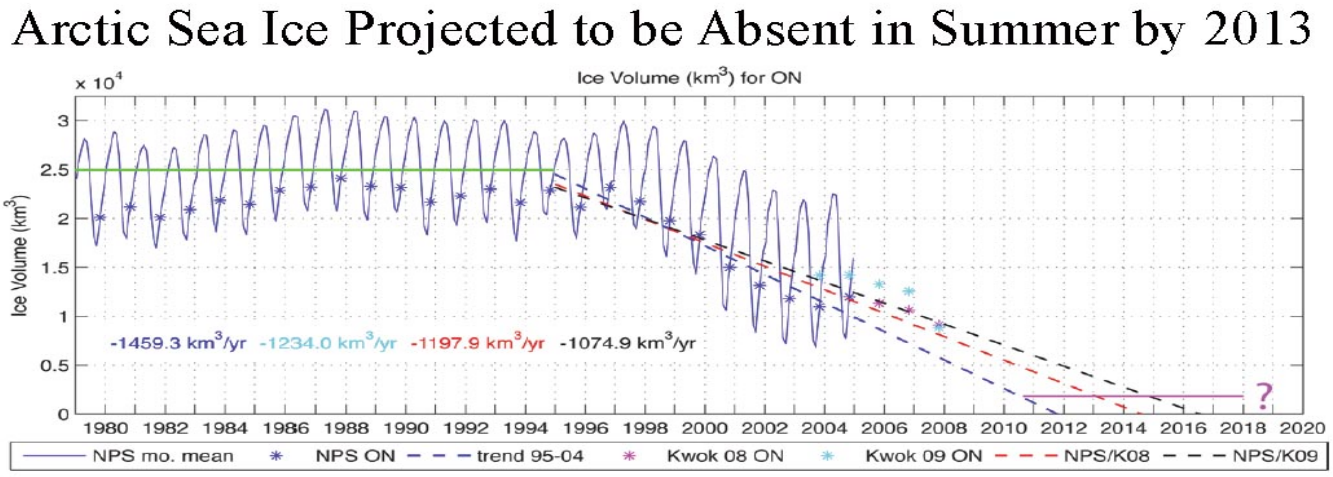
The colored lines are different model's projections of how fast Arctic sea ice will melt given the amount of warming that happens with different scenarios. The warmer scenarios (green, blue and red lines) shows the results of our society choosing to continue with business as usual and the greater melt that comes with that choice. The orange line shows where we do everything in our power to stop climate change. The colored shaded areas show the model error assumptions. 4,250,000 sq km was the record low sea ice coverage in 2007.

Stroeve, et. al., Arctic Sea Ice Decline Faster than Expected Geophysical Research Letters, vol. 34, 2007.

IPCC Fourth Assessment Report, Technical Basis, Chapter 10 Global Climate Projections, November 2007, page 771.

Arctic sea ice has not been absent in summer in 14 million years:
This paper describes a study that looked at sand grains on the floor of the Arctic Ocean. The sand grains are too big to be transported by wind, so a process called ice-rafting, where shore ice picks up sediments from the shoreline, breaks away, then travels throughout the ocean, melting at some point and dropping the sediments to the ocean floor. The sand grains can be identified by chemical tracers, much like they do things forensically on TV. The particular sand grains that this scientist looked at carried a specific iron chemical signature that was traced to the coast of Siberia. The rationale for the paper was that each sediment layer is an annual record of what happened in the water above the sediment. If there is are no sand grains, then there was no melting. The study showed no melting for 14 million years prior to today.
Darby, Arctic perennial ice cover over the last 14 million years, Paleoceanography, February 2008.

Artic sea ice may disappear by 2013:
Arctic sea ice is in trouble and the implications of the global feedback caused by the lack of sea ice are extreme. Open water absorbs eight times more heat than does ice. Ice reflects the heat harmlessly back to space. Water keeps the heat to melt more ice and to add heat to the atmosphere that then stays in the atmosphere because of the greenhouse effect. Polar ice is the Earth's air conditioner. The warming feedback caused by melting polar ice, because of this unprecedented ice melt in the Arctic, is not represented in the global climate models.



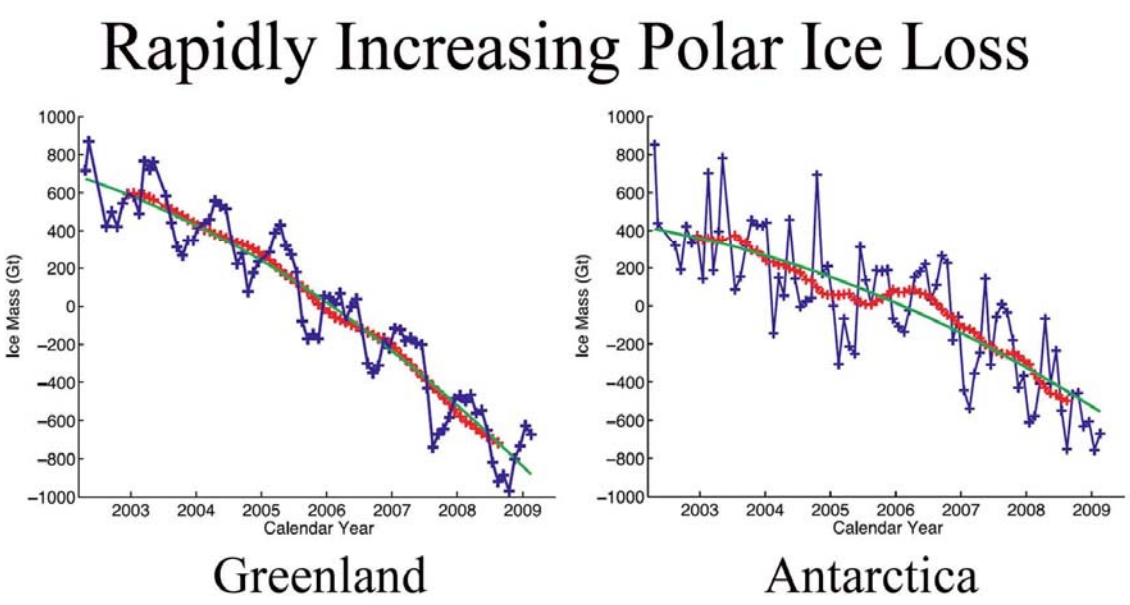
Modeled monthly mean sea ice volume (blue line) over the Arctic Ocean for the period '79-'04. Green line is the mean model ice volume for '79-'95. Stars show minimum October-November values from model (blue) and observational estimates (magenta (Kwok and Cunngham, 2008) and cyan (Kwok et al., 2009)). Red and black dashed lines: Calculated (NPS/K08 and NPS/K09) linear trend through '95-'07. Blue dashed line: Model trend through '95-'04. Projecting the trend into the future indicates that autumn could become near ice free between 2011 and 2016 (Maslowski, 2009) Purple line: An unknown minimum amount of ice volume expected to survive summer melt beyond that time.

Kwok, R., and G. F. Cunningham (2008), ICESat over Arctic sea ice: Estimation of snow depth and ice thickness, J. Geophys. Res., 113, C08010, doi:10.1029/2008JC004753.
Kwok, R., G. F. Cunningham, M. Wensnahan, I. Rigor, H. J. Zwally, and D. Yi (2009), Thinning and volume loss of the Arctic Ocean sea ice cover: 2003–2008, J. Geophys. Res., 114, C07005, doi:10.1029/2009JC005312.
Maslowski, W., J. Clement Kinney, J. Jakacki, "Toward Prediction of Environmental Arctic Change", Computing in Science and Engineering, vol. 9, no. 6, pp. 29-34, Nov./Dec. 2007, doi:10.1109/MCSE.2007.125.
Maslowski, W., State and Future Projections of Arctic Sea Ice, Changes of the Greenland Cryosphere Workshop and the Arctic Freshwater Budget International Symposium, Nuuk, Greenland, 25-27 August, 2009.

Also see: *Maslowski, Ebb and Flow Arctic Sea Ice 13 years Arctic Regions Supercomputing Center, April, 2008.*

Al Gore was falsely attacked about this issue at Copenhagen in December 2009 by radical climate skeptics. Gore stated Maslowski's findings during his speech at Copenhagen. This prompted the radical climate skeptics to pronounce Gore's statements as fiction. The media reported the fanatics' claims without checking their facts. This event shows three things: 1) The scientists are not at all connected to the real world; if they were the knowledge of the dangerous impacts of climate change currently ongoing would be widespread, 2) Journalism has sunk to a new investigative low in effort, ethics, diligence and short term memory. Maslowski's story was widespread in the media just a few years ago. A quick Google tells the story. 3) It shows the radical skeptics will use any opportunity to move their beliefs forward, regardless of how wrong they are, or more brazen, how recently the news that they are disputing had widespread media coverage. Here is a blog entry that I found that has a half dozen Maslowski quotes, from the different media sources from the last few years.
http://www.theclimatecommunity.com/2009/12/firestorm-in-the-arctic-al-gore-vindicated-on-comments-in-copenhagen-a-lesson-in-journalism-and-science/

Greenland Melt has quadrupled; Antarctica is 100 years ahead of projections:
In 2009, the new gravity measuring satellites, launched in 2003, were revealing stunning amounts of melt from the ice caps. These new satellites are 100 times more sensitive than their predecessors. In the mid 1990s the ice discharge from the Greenland ice sheet was around 50 cubic kilometers per year. Greenland lost 230 cubic kilometers last year. This is a quadrupling of ice loss in little over a decade. Antarctica lost 140 cubic kilometers of ice in 2009.



This data shows ice lost from Greenland and Antarctica. The information comes from the new GRACE satellites. These satellites are gravity measuring satellites that are 100 times more sensitive than the previous generation of gravity measuring satellites. What this data shows is a continuous loss of ice from both ice sheets, but more importantly, the loss rate is accelerating. Greenland lost 230 gigatons and Antarctica lost 140 gigatons in 2009. The acceleration in 2009 was 56 gigatons per year. A gigaton is one billion tons. The City of Los Angeles uses one gigaton of water per year. Combined, the ice loss raises sea level by 1.1 mm per year, every year, and this rate is increasing by 15% per year. This means that we will crass the barrier island stability threshold about 2012 or 2013. Reference: *Velicogna, Increasing rates of ice mass loss from the Greenland and Antarctic ice sheets revealed by GRACE, Geophysical Research Letters, October 2009.*

The 2001 IPPC report said that the mass balance of Antarctic ice would remain stable at least until 2100. That is, Antarctica would not lose any ice at all (any amount greater than the amount of snow that fell) for one hundred years. They were wrong by about one hundred years. But the IPCC scientists are not as backward as they seem. The base scientific publications for these massive IPCC reports is all completed years ahead of publication of the IPCC report. The work for the scientific reports was done years before that those discoveries were published, so

much of the work for the IPCC report, if I get my math right, was done at least five or six years before 2001. If we have crossed a threshold where climate is moving faster, conservative science has little chance of reporting accurately with the timescale of such an undertaking as the IPCC assessments. This is what the IPCC had to say about Antarctica in their 2001 report:

> *The Antarctic ice sheet is likely to gain mass because of greater precipitation, while the Greenland ice sheet is likely to lose mass because the increase in runoff will exceed the precipitation increase. The West Antarctic Ice Sheet (WAIS) has attracted special attention because it contains enough ice to raise sea level by 6 m and because of suggestions that instabilities associated with its being grounded below sea level may result in rapid ice discharge when the surrounding ice shelves are weakened. However, loss of grounded ice leading to substantial sea level rise from this source is now widely agreed to be very unlikely during the 21st century, although its dynamics are still inadequately understood, especially for projections on longer time-scales.*

The GRACE satellites show that today the two ice sheets combined are responsible for 1.1 mm of the 3.7 mm per year of sea level rise that we are experiencing today. The US Geological Survey says that our barrier islands and coastal wetlands have a threshold of sea level rise where they can no longer dynamically regenerate. This threshold is the disintegration threshold. Once sea level rise increases beyond this threshold, our barrier islands and coastal wetlands will begin to disintegrate and then disappear. Their regeneration will not be able to keep up. All that will remain is water.

Velicogna (2010) says that sea level rise from Antarctica and Greenland is 1.1 mm per year and accelerating at 0.085 mm per year. At this rate, if the acceleration stays constant, we will cross the 7 mm per year threshold in 2018. But sea level rise acceleration has been increasing rapidly since the turn of the century and there is no reason to believe it will slow. The threshold crossing is more likely to be several years earlier, or by as early as 2015.

Scientific reticence and conservative voice have changed little in the 2007 IPCC report. Their estimate of a maximum of 23 inches of sea level rise this century is laughable. It is really bad to criticize the IPCC so sternly, but it will appear that I am doing so. The authors' make caveat's throughout the report saying that too little is known about ice sheet processes to make estimates of the contribution of the ice sheets to sea level rise and that this contribution to sea level rise has been capped at the rate that was occurring at levels found to be currently in the report (from about 2005 or just prior). Their estimate is an average of a little over 6 mm of rise per year for 90 years. We will surpass 6mm per year at the latest in about 2018, and we have only warmed the planet a little more than a degree.

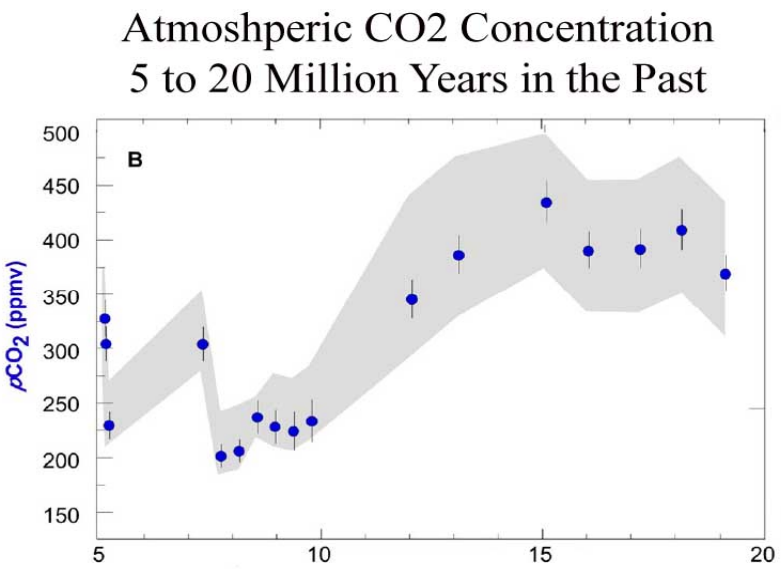
Velicogna, Increasing rates of ice mass loss from the Greenland and Antarctic ice sheets revealed by GRACE, Geophysical Research Letters, October 2009.
Rignot, et. al., Change in the Velocity structure of the Greenland Ice Sheet, Science, February 2006.
Velicogna, Increasing rates of ice mass loss from the Greenland and Antarctic ice sheets revealed b y GRACE, Geophysical Research Letters, October 2009.pdf
Intergovernmental Panel on Climate Change, Third Assessment Report, Working Group I, The Scientific Basis, F8, 2001.
Intergovernmental Panel on Climate Change, Fourth Assessment Report, Working Group I, The Physical Science Basis, Summary for Policy Makers, 2007.

Ocean Temperatures are the warmest ever recorded:
NOAA's global temperature report shows that our Earth's oceans are now warmer than they have been since record keeping began in the 1880s. The combined land/ocean temperature for July 2009 was 1.03 degrees above the 20th century average of 60.4 degrees or the fifth warmest ever recorded. The global ocean temperature was 1.06 degrees F above the 20th century average of 61.5 and beats the previous record set during the last super-El Nino of 1998.
http://www.noaanews.noaa.gov/stories2009/20090814_julyglobalstats.html

CO2 is higher than any time in the last 20 million years:
Chemical proxies are magnificent things. Through the hard work of scientists for decades, we can now see how different chemical relationships are tied to different things in the environment for millions of years back into ancient history. Carbon 14 dating is an excellent example. This rare radioactive isotope of carbon that decays at a very known rate. This means that carbon 14 loses a neutron and changes to the more abundant form of carbon (carbon 13) very predictably. When a living thing dies, it stops making things out of carbon in its body. The carbon 14 ratio is then frozen in that organic material.

A scientist can very easily measure the different amounts of carbon 13 and carbon 14 in an organic material and tell us how old it is. We can do the same thing with temperature and the concentrations of different gases in the atmosphere and oceans as well.

The latest analysis of the boron/calcium relationship for determining atmospheric CO2 concentrations shows that we are right about at the concentration today that we were at 14 to 15 million years ago (388 ppm). At that time (14 to 15 million years ago) atmospheric CO2 concentrations had just peaked. To find higher CO2 concentrations we have to look back 35 to 40 million years. So today, CO2 is as high as it has been in 35 to 40 million years except for one period.
Tripati, et. al., Coupling of CO2 and Ice Sheet Stability Over Major Climate Transitions of the Last 20 million years, Science Express October 8, 2009.



This study looked at boron/calcium ratios in the tiny shells of plankton in ocean sediments to understand more about Earth's ancient history. The researchers found that CO2 concentrations today are about the same as about 14 to 15 million years ago. The blue dots represent different samples and the CO2 concentration represented by that sample. The gray shading is the possible error. This period had the highest CO2 concentration of the last 35 to 40 million years. Reference: Tripati, et. al., Coupling of CO2 and Ice Sheet Stability Over Major Climate Transitions of the Last 20 million years, Science Express October 8, 2009.

CO2 is changing 20,000 times faster than anything in the last 65 million years:
Many climate facts are astoundingly unbelievable, but today, scientists are more certain than ever that what is happening is very real. The rate of CO2 change today is 20,000 times higher than at any time in the last 65 million year - since the great Cenozoic dinosaurs extinction event when a giant asteroid struck the

Yucatan Peninsula. There are two main theories on the events that followed that directly caused the extinctions. One is global fire and ensuing nuclear winter that lasted a few years. The other theory does not deny any of the first theory except the part about when the extinction event took place. The argument is that the asteroid impact caused a massive and abrupt atmospheric CO2 change over several hundred to several thousand years. It was the climate change brought on because of the warming of the additional CO2 in the atmosphere that the second theory holds responsible for the majority of the mass extinction, not the fires and the nuclear winter.

Neither theory really matters though because the rate of CO2 increase is not in question. The key is that today, CO2 is changing 20,000 times faster than any time in the last 65 million years. The highest natural forcing (change rate) of CO2 in the Cenozoic Era (65 million years) was about 100 ppm per million years or 1/10,000 ppm per year. Today's CO2 change rate is 2 ppm per year. Today's change rate is 20,000 times greater than when the dinosaurs went extinct.
Hansen, Bjerknes Lecture, American Geophysical Union, December 2008.

Trees by the thousands died in 2009 in Central Texas:
Tree killing droughts are not common anywhere, but they have happened in the past. The kill in Texas this summer may or may not have been larger than in the past, but to old timers being quoted in the media, this has not happened, on this scale, in living memory. The City of Austin and San Antonio both report separately that hundreds of trees on City property have been killed. It is reported in the Houston/Galveston area that 60,000 trees are dead because of a combination of the drought and impacts from Hurricane Ike. In my own observation in South Austin, this is certainly worse than the worst event that I have ever seen here that happened in the mid 80s. This time was particularly unnerving for me because I had just returned from filming my documentary about the great beetle pandemic in the Rockies where I spent two and half weeks and 6,000 miles filming nothing but dead trees. About 52 million acres of forest have been killed (impacted) so far in North America, 18 million in 2008 alone. My trip was in early to mid August – the most extreme part of the summer. There were certainly a few dead trees here and there when I left Austin, but when I returned, brown, red and yellow trees dotted the landscape like the spots on a Dalmatian. It was not as severe as the Rockies, but unnerving still. I had not anticipated any more dead trees in Austin than were here when I departed. Some of them will live, the elms in particular can turn bright yellow and drop all their leaves in August two months before the usual autumn leaf drop in November. But many of the oaks and hackberries and cedars and others, that were either yellow or red or brown, will not be so lucky.

Most 100-degree Days:
I have uncovered a possible thermometer record error in Austin, but have not had the time or funds to procure the necessary raw data, then do the statistics to prove my point. Last year we set the number two ranking record (official) for 100-degree days at 68 days. Number one is 69 days. Number two, before 2008, was 66 days. Now here is the part that is appears statistically improbable. The third highest number of 100-degree days prior to 2008 was 42 days. The top nine (enough to get an idea of what the statistical curve looks like) are shown below. The records ranked 3) through 9) stand apart from the top two records by 24 days. There is a very large gap between number two and the rest of the records.

1) 69 days in 1925
2) 66 days in 1923
3) 42 days in 2000
4) 40 days in 1913
5) 40 days in 1963

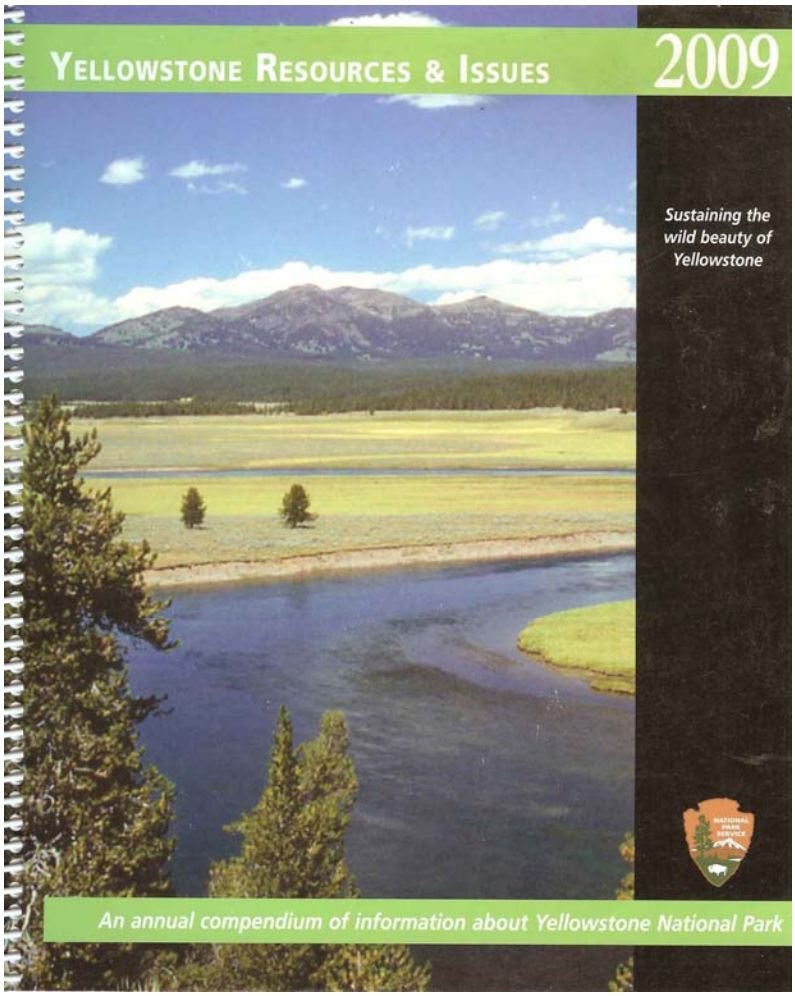
It is impossible to say with certainty, without being able to statistically analyze the entire data set, but my general observation tells me that something is different about the top two records. The statistical analysis would give me a "confidence" result that

6) 40 days in 2001
7) 38 days in 1998
8) 34 days in 1924
9) 34 days in 1956

says whether or not there is something different about these two numbers and if they should be included in the data set or thrown out. Those two records are very suspicious, but I do not have the scientific proof yet, only reasonable doubt.

But I do know a rumor about those top two numbers. This rumor adds to the strength of the reasonable doubt cast because of the huge gap between record number 2) and number 3). It seems that the years (about) 1923 through 1925 coincide with the time that the weather station was moved to a different location. This could be enough information to tell me to throw out these two data points, given how distant they are from the rest of the records. The rest of the rumor goes on to say that the thermometer shelter was placed too close to a building, which would have also skewed the temperature, especially if the thermometer shack was where it could have been warmed by heat trapped by the side of the building. Could 2009 have been the most extreme summer ever recorded in Austin? Maybeso. Here is the ranking of 100-degree days as it stands now:

1) 69 days in 1925
2) 68 days in 2009
3) 66 days in 1923
4) 50 days in 2008
5) 42 days in 2000
6) 40 days in 1913



Mountain Pine Beetle Pandemic:
I spent the fall producing a two-hour documentary about this "event". The movie will be up on my website in another month, by February I hope. In the mean-time, The short film I did last year is there already. It is titled *What Have We Done?*. *http://www.meltonengineering.com* The 52 million acres of dead trees is a prime example of what a changed climate can do to a continental ecosystem. The forest professionals feel that the forests will grow back, similar to the way a forest recovers from fire. This regrowth, or regeneration will take a hundred years.

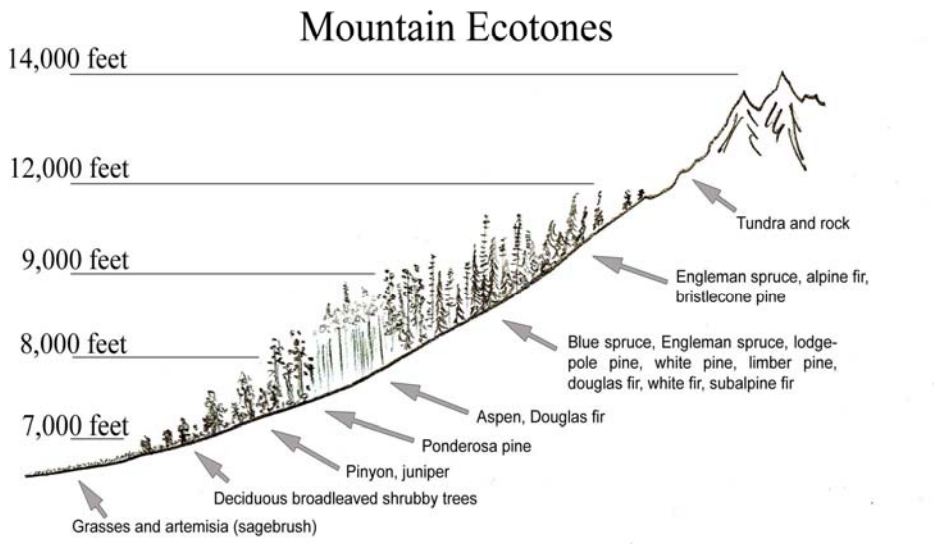
It appears however, that the forest professionals are not communicating very well with the climate professionals. The Yellowstone National Park Ranger's Reference Manual *(Yellowstone Resources & Issues*, 2009) says "Much of the western United States will likely become more arid according to the GCMs (global climate models). Temperatures could increase 4 to 13 degrees F (by 2100), with increases higher in the mountains."
Remember that these 4 to 13 degrees of warming are coming from the climate models. These are the same climate models that have been proven to be conservative. The warming of 4 to 13 degrees is quite likely

to be just as conservative as all of those other climate projections that have already been proven conservative (discussed above - arctic sea ice, carbon dioxide emissions, Greenland and Antarctic ice discharge, etc.)

Forests of the Rockies, like ecosystems everywhere, have developed with the same climate over thousands of years. But in the Rockies, we have the opportunity to see exactly how sensitive a given ecosystem is to temperature and rainfall.

Take a walk up the side of a mountain with me. As we ascend, the temperature decreases and rainfall and snow increase. Temperature increases at a known rate of about 3.6 degrees per 1,000 feet of elevation. So when a warming climate increases the temperature in the mountains of somewhat greater than 13 degrees, say 15 degrees, this is approximately equal to a 4,000 foot elevation change. As the temperature increases, dryness from less rain and more evaporation increases.

What this means is that the climate at 11,000 feet, when warmed by 15 degrees in 80 or 90 years, will be quite similar to the climate at 7,000 feet today. Now notice the different vegetation as we walk up the mountain. At lower elevations, it is too hot and dry for trees to grow, only grasses and sagebrush will survive. As we proceed up the mountain we travel through very distinctive bands of different trees.



These trees all have their very own criteria for temperature moisture. The higher we go, the colder and wetter it gets. As the global temperature rises, much of the vegetation in the mountains will not be able to survive similarly to what will happen everywhere. But the west is a very arid place. It is just too dry at 7,000 feet for trees to grow in most places. At the end of the century, the tops of the mountains will be as warm as the bottoms of the mountains are today where only grass and sagebrush grow. The environment will be vastly different. There is no chance that the same forest will grow back. It is possible that the increased temperature, combined with the abundant aridity in the West, will not allow any forest to grow back – none grow at 7,000 feet today. The same thing is happening in Austin, only at the end of the century our environment will be similar to the Sonoran gravel/thorn desert instead of grasses and sagebrush. The foresst that regenerate after the existing forests die in the heat and dryness will have a really difficult time surviving the full projection of change. Then, after 2100, our climate will likely continue warming.

Now there is one more very important thing about how the death of forests at this scale affect climate. A scientist named Kurz at the Canadian Forest Service has shown that the greenhouse gas emissions from 20 million acres of dead forests in British Columbia will emit the same amount of greenhouse gases as 25% of Canada's entire transportation fleet. (Trees = 990 megatons in 21 years, transportation = 200 megatons carbon per year). So the 52 million acres of dead trees in the Rockies (that was 2008, it's likely

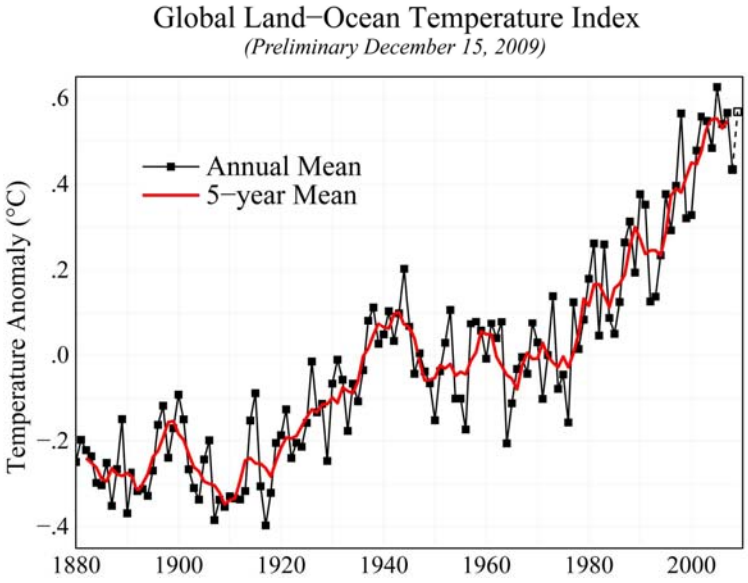
more than 60 million today) emit 2/3rds of the greenhouse gases as all of Canada's transportation fleet combined, every year. The dead trees will continue their emissions for 20 years.

The great threat however is that to the Boreal Forest. This 1.3 billion acre forest across more than half of northern Canada holds 186 gigatons of carbon (a gigaton is a thousand megatons). Much of this carbon will be at risk on a warmer planet, and the closer one gets to the poles, the warmer it will get. 186 gigatons of carbon is 20 years of mankind's annual greenhouse gas emissions. Russia's boreal forest (at risk too) is 3.0 billion acres and holds an additional 429 gigatons of carbon or another 48 years of mankind's emissions.

Kurz et. al., Mountain pine beetle and forest carbon feedback to climate change, Nature, April 2008.
Apps et. al., Boreal forests and tundra. Water, Air, and Soil Pollution 7, 1993.
Yellowstone Resources & Issues, United States National Park Service, 2009.
International Boreal Conservation Campaign, an initiative of the PEW Charitable Trust [*http://www.interboreal.org/globalwarming/*](http://www.interboreal.org/globalwarming/)

The great global cooling influence of three natural cycles:

Climate specialists find themselves constantly going over old arguments that have been settled long ago. The radical skeptics keep bringing up the same old arguments. Academic paper after academic paper is published supporting the arguments until finally, the radicals have started completely anew. Now they are claiming that climate scientists cannot explain why we do not continue to set new global temperature records.

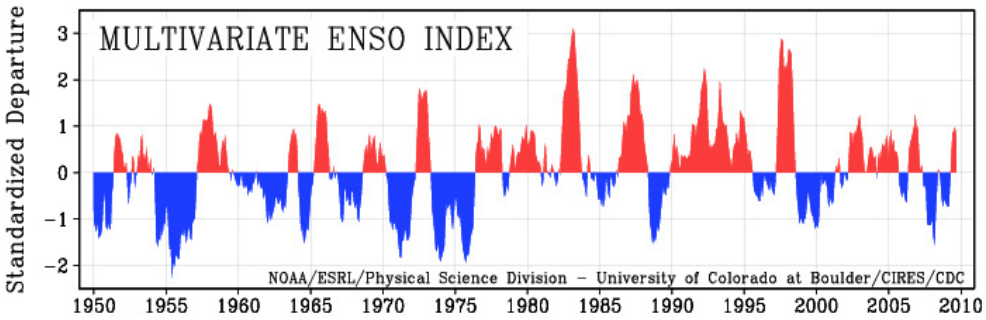


The last several years have seen a few normally cool winters in North America while the rest of the globe bakes. The results have been that we have not set a new global high temperature average since 2005 beat out the

super-El Nino in 1998. The global average temperature is rambling along, with appropriate chaotic variation, and it has been just four years since we set a new global all-time high temperature average. The radical skeptics now say climate change is hooey and that scientists do not know why.

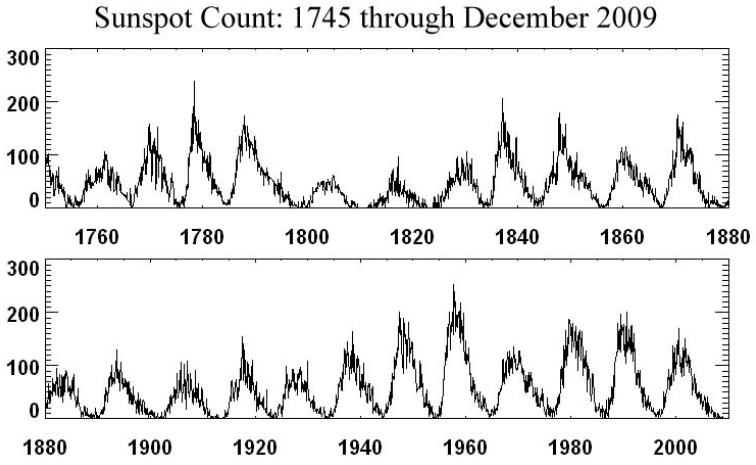
So human nature goes along with the radical skeptics when virtually every stitch of science says the trend has not changed one little bit. Yes, the last four years have been cooler than 2005, but the six years following 1998 were cooler than 1998. This is normal climate variation.

So just to show you how serious the situation is, we have had four years of almost record heat in-spite of the fact that we have had three major natural global cycles masking the warming produced by all of the extra greenhouse gases in our atmosphere. El Nino and La Nina, make up what is called the El Nino Southern Oscillation. El Nino is what we call ENSO's warm phase, when the southern Pacific is warmer than normal. La Nina is what we call the cool phase. We have just transitioned from La Nina (cool) to El Nino (warm). It takes a few months for global climate to react (there is a time lag). The lag time is similar to the seasonal lag in temperatures. The shortest day of the winter is usually December 21st, but the coldest day of the winter does not come until sometimes between late January and mid February.



In the image titled Multivariate ENSO Index, red is warm, blue is cold. Since 2005, we have predominantly been in the cool La Nina phase of ENSO. You can see the super El Nino of 1998. Also notice how we have predominantly been in the El Nino warm phase since the mid 1970s. Ocean cycles are no easier to figure out than sunspot cycles, but one of the things that scientists have been saying for a while is that a warmer planet will probably have more El Ninos. The sunspot cycle is probably the oldest known natural cycle that affects our climate.

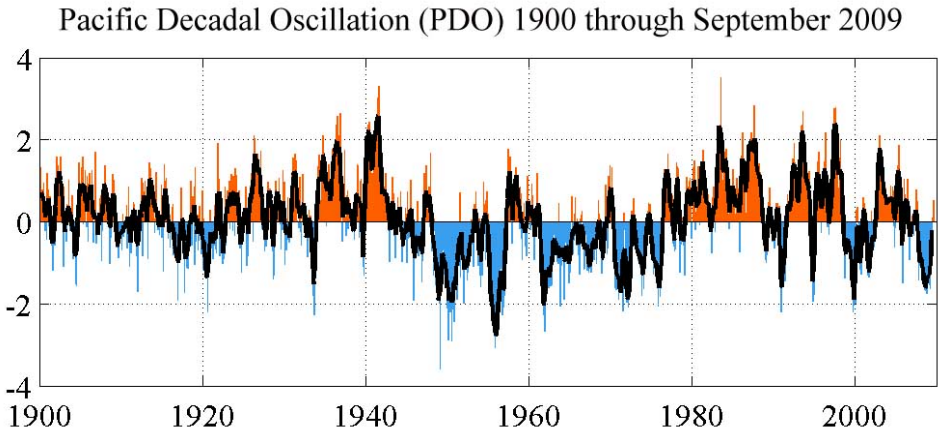
We have been continuously monitoring sunspots basically since the telescope was invented in the early 1600s. Sunspots are cooler than the surrounding sun by 25 percent up to 50 percent. Obviously we get less warmth from the sun when there are more sunspots.



The spots don't make a huge difference but they do impact our climate. This year's minimum is the lowest in 96 years, but you can see from this 265-year record that this year does not greatly differ from the rest of the sunspot minimums.

The time lag for our climate to adjust to the changes in solar irradiance caused by the increase or decrease of sunspots is bit longer than the ENSO lag or the seasonal lag. It takes about two years to adjust. The

Pacific Decadal Oscillation (PDO) is similar to ENSO, but even less is known about the PDO. But we do know that it has a cool phase and a warm phase and we have just exited the cool phase.



There is a new study just out that has given us a great deal of important knowledge about PDO. This knowledge was there staring us in the face all the time. The PDO, like ENSO, is a warming or cooling of the Pacific, except ENSO is the south Pacific, the PDO is the North Pacific. What this new study shows is that North American temperatures are greatly affected by the phase of PDO. The positive phase warms North America and the negative phase cools North America. We have just transitioned from a cool phase of the PDO, likely to a new warm phase. Like all things, the PDO has a lag, but little enough is known about the lag to say.

So here are three huge natural climate adjustment mechanisms that have all just left their cool phases. They have been masking the warming. The scientists say that when the lag times have all adjusted back out, our climate will warm in catch-up mode.

Lean and Rind, what is changing climate solar or CO2, U.S. Global Change Research Program, updated 2003.
Perlwitz, et. al., A strong bout of natural cooling in 2008 Geophysical Research Letters, December 2009.