



The World Bank Report "Turn Down the Heat": Is it Really this Bad?

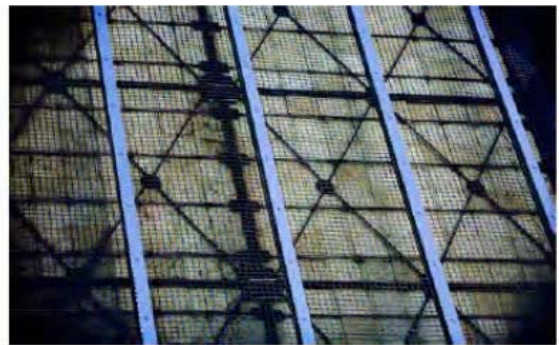
By Bruce Melton PE, November 27, 2012

As incredible as it sounds, the effects of climate change are worse than the World Bank Report says. *Turn Down the Heat: Why a 4 degree C world Must be Avoided* is a summary of the latest findings in climate science (1). Much of this work is based on 1998 climate change scenarios and the Intergovernmental Panel on Climate Change consensus position from 2007. Because science takes years and years to happen, a lot of this research is based on a world where Kyoto was still a part of the deal. But in our world today, instead of working on climate pollution emissions reductions, we are now emitting more than was imagined in the 1998 worst-case scenario (2). Even though much of the work in the World Bank Report (Heat) is the latest and greatest, it is still largely based in research on one of the "middle of the road" climate change scenarios.

This is why these consensus reports are so dangerous. It's not that they project global catastrophe, it is that those projections are based on a consensus opinion. Whenever you get more than one specialist of any kind agreeing on a position that satisfies more than that one specialist, the result is almost always a group opinion that is watered down. So alone, the scientific consensus on climate change is not as extreme as any of its given parts. It's easy to agree on the middle of the road scenario now that the "best-case" scenario is so obviously a pipe dream.

Cover image caption: This is Disco Bay at Ilulissat Greenland, about 200 miles north of the Arctic Circle on the west Coast of Greenland. Ilulissat is one of the main areas to access the Greenland Ice Sheet and has become of busy place these days as climate research reaches frenzied pace. There were once more sled dogs in Ilulissat than people. But worsening winter ice conditions—thinner, fragile conditions and no ice years caused by warmth—have diminished the need for sled dogs and the traditional way of life.

The consensus opinion includes the solutions as well as the impacts. What the latest forward leaning findings are now reporting is that treating climate pollution using existing technologies will be no more difficult than supplying Earth with clean drinking water every day. This is hardly a path that destroys our economies. These existing technologies are things like efficiency improvements, electric and hybrid vehicles, fluorescent light bulbs, wind, solar, wave, tidal, carbon capture and storage (CSS), carbon sequestration and integrated gasification combined cycle (IGCC), natural gas combined cycle (NGCC), saline aquifer sequestration, mineral



**Global Thermostat plant at SRI*

This pilot plant at SRI removes about 700 tonnes of CO₂ per year

(SRI International is a nonprofit research institute in Menlo Park California.)

sequestration, oil field disposal—the list is a mile long.

Caption: New technologies now in the field proving stages are in addition to the economic evaluations that show the cost of treating climate pollution being no different than that for supplying our society with clean drinking water. These “new” technologies have the promise of being far less expensive than existing technologies.

More interesting and likely far more valuable is the up and coming technology of air capture. Traditionally, air capture has been seen as infeasible because of the low concentration of CO₂ compared to smokestack concentrations from energy generation or industrial processes. But this is changing. Billionaires across the globe are investing in carbon capture and sequestration technologies to meet the climate change challenge. Outfits like Global Thermostat in California are looking to capitalize on the vast amount of money soon to be spent on cleaning up climate pollution by sucking CO₂ straight out of the air (3). The future is indeed bright.

While "Heat" is a vast scientific summary of all the major research, it focuses on global average temperature change and largely leaves out what is likely the most important thing about climate change impacts. It is a little

thing involving the calculation of averages, but it means a lot to us humans who live on land. Earth's oceans cool our climate considerably. This is why "Heat's" projection of seven degrees Fahrenheit of warming will be so catastrophic. Seven degrees is a lot to ecosystems but not to air-conditioned humans. Warming over land, however, is much greater than over oceans and this skews the average considerably. What we humans on land will actually experience is a lot more warming than the average global warming projections reported by "Heat" suggest. (I fill in the details farther below.)

More evidence of the conservative (small "c") climate consensus can be found in "Heat." As Heat tells us, the Amazon will be devastated by global warming in the future. But a report in April 2011, by a team from the University of Boston, NASA's Ames Research Center and the University of Viçosa, Brazil, tells us that the Amazon has already changed from a carbon sink to a carbon source emitting greenhouse gases instead of absorbing them. Over the next decade the result is that the Amazon will emit twice as many greenhouse gases as the U.S. does every year. The cause is the death of over two billion trees say the paper's authors. They were killed by two massive droughts: a 100-year drought in 2005 and one even more extreme in 2010 (4).



Caption: The Amazon has unexpectedly flipped from a carbon sink to a carbon sources nearly as big as all emissions from the United States. The reason is drought: a 100-year drought in 2005 and one four times more extreme in 2010 have killed over 2 billion trees.

Billions more have been killed across North America. Over 85 million acres have been impacted in the Rockies in the US and Canada where a devastating bark beetle outbreaks remains uncontrolled. Extreme cold is the beetle's only enemy and extreme cold has gone away. Warming is twice as much or more than the global average in the Rockies and high latitudes because of the snow and ice feedback. This is caused by a little warming that melts snow a little earlier, allowing there to be a longer hot season. Because snow reflects nine

times more energy harmlessly back into space than earth, rock, water or vegetation, more warming is created. This feeds back into more snowmelt even earlier and the cycle continues in a rapid warming spiral (5).

The Texas Forest Service tells us that the drought in the South Central US in 2011 killed 301 million trees in Texas (6). Findings in *Nature Geoscience*, by a team from the University of Guelph, Ontario, Canada, and including scientists from the US Geological Survey and the US Forest Service tells us that the black spruce forest of Alaska (much of the forested area in Alaska) has now changed from a carbon sink to a carbon source. The team tells us that Alaska's annual CO₂ emissions from increased forest fires due to climate warming between 2000 and 2009 was more than twice that from each of the previous five decades (7).

Research published in *Nature Climate Change* tells us that forests in the Canadian Rockies are dying ten times faster than they did fifty years ago and another piece of research by the US Geological Survey in 2009 reveals that in about the same time frame, forest mortality across the western United States increased five times. Both studies are careful to mention that the big pine beetle outbreak and increased forest fires are not included in their work. Both studies in the Rockies look at long-term evaluation (100 years plus) of old growth forests not impacted by logging (8, 9).

What this means is that tree death has increased from roughly 0.5% percent per year to 5% per year in western Canada and to about 1.5 percent in the U.S. West. In 20 years the average tree age and its associated carbon sequestration capacity will be one quarter what it is today - in just twenty years - not only across high altitudes and high latitudes in North America, but likely across the world in high mountain regions and high latitudes.

"Heat" tells us the average global temperature will rise by seven degrees by the end of the century across the planet. This is not really a whole lot of warming to you and me. But the crazy part is not about how much damage seven degrees of warming will do to many global ecosystems. Seven degrees is the average across the planet. It will warm much more over land areas.

Our oceans are the reason why our climate has not caught up to our greenhouse gas emissions. We all hear that there is a lot more warming "in the pipeline." In other words, greenhouse gases already emitted will cause additional warming even if we stopped all emissions tomorrow morning. Cool ocean water and cooling from polar ice are both responsible. The refrigerator door has been left open and it will take decades to generations for the oceans to warm up. So they cool our climate in the mean-time. Different studies from NASA, Columbia and the University of California Santa Barbara tell us the additional warming will be between 2.5 and 8 degrees Fahrenheit. Then again, these evaluations are based on the middle of the road scenario, so the actual warming in the pipeline is probably a lot more (10).

In September 2009, research workers at the Oak Ridge National Laboratory, Notre Dame, and the National Center for Atmospheric Research (Ganguly 2009) tell us that because emissions are now along the path of the worst-case scenario, we should be focusing our understanding of future (and current) changes based on this scenario, not the middle-of-the road A1B scenario. What Ganguly 2009 tells us in the first few sentences of the report is telling: "Recent observations of global-average emissions show higher trajectories than the worst-case A1FI scenario reported in IPCC AR4 (Intergovernmental Panel on Climate Change 2007 Report). Average A1FI temperatures trend higher than the best-case B1 as well as the relatively worse-case A2 scenario." (The IPCC "scenarios include 40 different futures.)

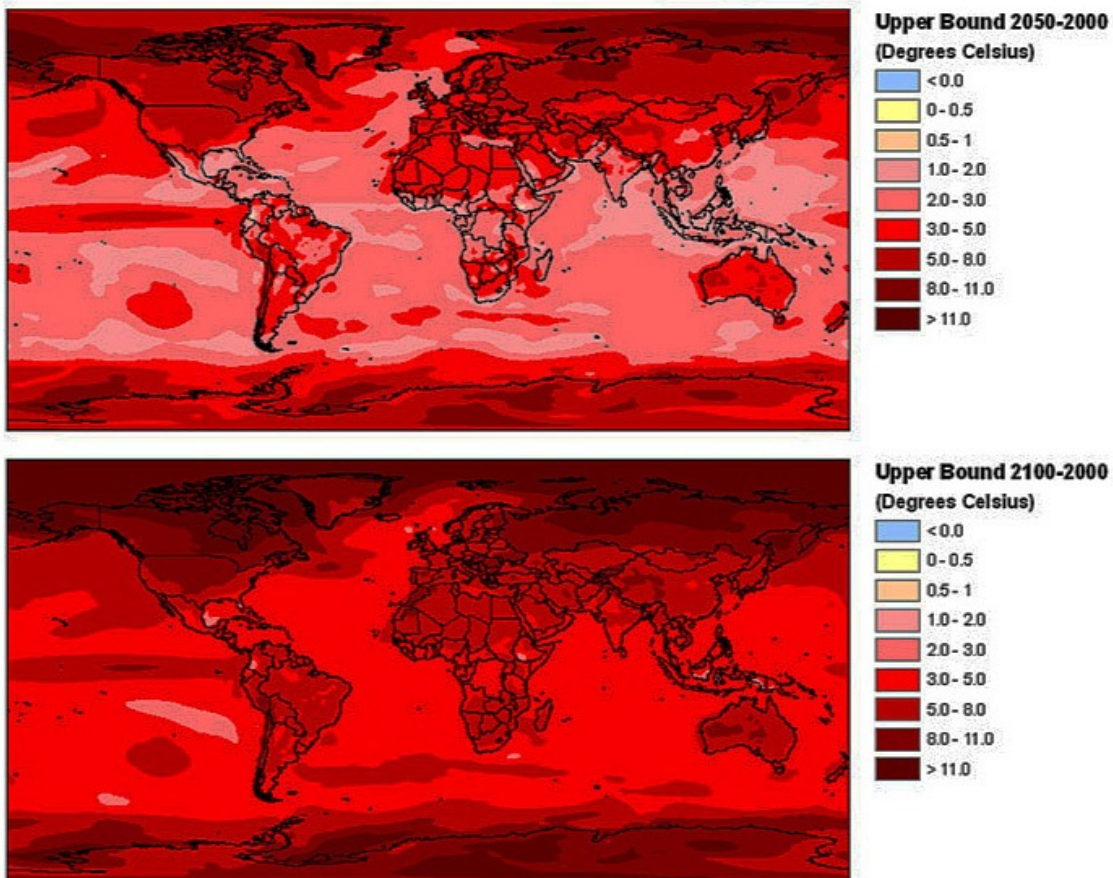
This team went on to model the 1998 worst-case climate scenario from the 2007 IPCC report instead of the middle-of-the-road scenario used in so many of the research works evaluated in "Heat." The latest generation models also use a high resolution framework that can show much greater detail than before. What these models are now telling us backs up the "averaging effect" that the oceans have on the global temperature average. Their overall findings for the global average temperature increase under the worst-case scenario are little

different from the IPCC consensus position that "Heat" says about the IPCC worst-case scenario, it's the difference between warming over land and warming over the oceans that will cause all the chaos.

What Ganguly and colleagues tell us is that across the vast majority of the North American continent and most land masses on Earth, by just 2050 we can expect 14.4 degrees Fahrenheit of warming. By 2100, it's an unthinkable 22 degrees (11).

Caption: Research from Oak Ridge National Laboratory, Notre Dame, and the National Center for Atmospheric Research shows warming over land that is far in excess of what is commonly understood. Much of this is because of the

Warming Over Land



Ganguly et al., Higher trends but larger uncertainty and geographic variability in 21st century temperature and heat waves, PNAS, September 2009.

averaging effect of global temperature differences between those over land and over water.

So now we can begin to see why this World Bank Report is so strident in its findings. Only, what will happen in reality is likely much worse than what the World Bank Report recites.

But all is not lost. I already mentioned that the solutions will be no more difficult than supplying humanity with clean drinking water and I will get back to that, but first I need to add a little bit of non-consensus knowledge to an assertion that "Heat" makes. Even before that let me clarify a little about the research findings I am reporting.

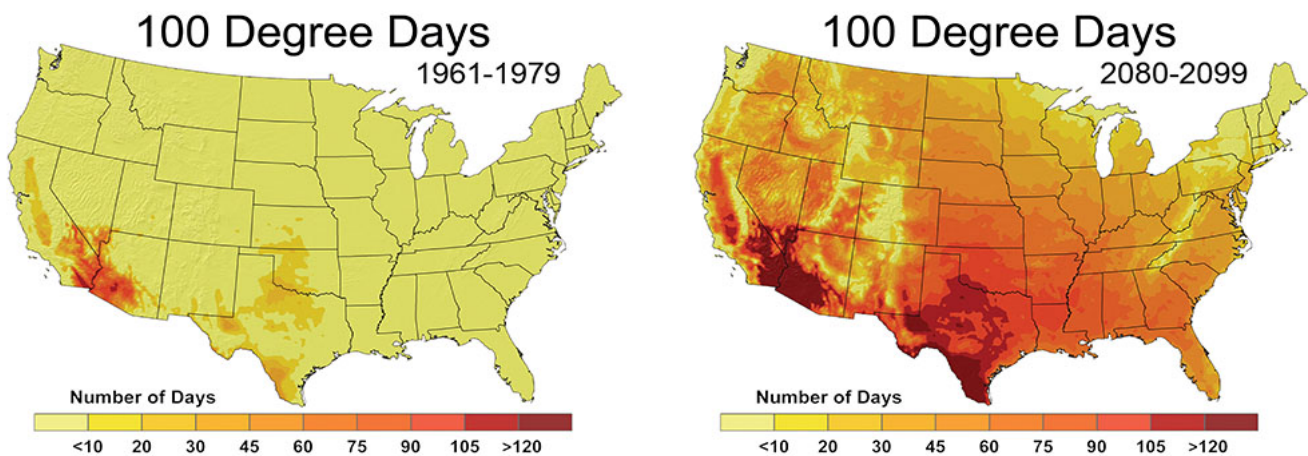
These individual findings are on the leading edge of science. As is often the case with leading edge science, there is dissent in the scientific community about validity. What we have been seeing in this forward leaning climate change literature is what climate scientists have been warning us would happen for a couple of decades now. This is that if we did not reduce emissions, impacts would be more extreme and happen faster. Much of the consensus knowledge about climate change today is relatively old. It takes a half decade or more for enough knowledge to be gained so that the consensus can begin to acknowledge the changes. This is what is happening across climate science these days. The latest reports are validating the warnings. Yet, the body of science is still young; the conservative consensus is reticent to change.

So "Heat" tells us that Earth will see large scale displacement of populations caused by warming. The warming that we will actually endure is a lot more than anticipated in "Heat" because our emissions are so much greater. Remember, much of the work reviewed in "Heat" is based on the middle of the road A1B Scenario. We are now on the worst-case scenario emissions path (A1FI). Data from the World Resource Institute's Climate Analysis Indicator Tool reveals that our global emissions are fifty percent greater than in 1988 and since 1988 we have emitted 87 percent of the total amount of greenhouse gases mankind has emitted since we started emitting.

The 4 degrees C. world in 2100 (7 degrees F) that "Heat" focuses on is misleading. We must understand that warming over land, where most humans live, will be over 14 degrees by mid-century and over 20 degrees F—triple the 4 degrees C scenario—by 2100. Or at least this is what the most forward leaning climate science is saying these days, not the consensus work represented by "Heat." Once we understand this phenomenon, the seriousness of our situation becomes much clearer (as if what "Heat" reports was a walk in the park).

Let me cite one last mega report to emphasize what I have already reported. This one is by the U.S. Global Change Research Program (USGCRP). Thirteen United States 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, is overseen by the Executive Office of the President and was founded by Reagan in 1989. This report, *Global Climate Change Impacts in the United States*, is a classic consensus science review based largely on the middle of the road A1B scenario. Way down about half-way through this 196 page behemoth is a little graphic that seared my soul when I first saw it.

U.S. Global Change Research Program (Global Change Research Act of 1990, Office of the President)



Based on middle of the road emissions scenarios, Texas will see summer temperatures as hot as or fifty percent more extreme as the Sonoran Desert Research station in Arizona today. USGCRP, *Global Climate Change Impacts in the United States*, Thomas R. Karl, Jerry M. Melillo, and Thomas C. Peterson, (eds.), 2009.

This graphic (above) tells us that based on the middle of the road scenario where we can expect to see 6 to 11 degrees Fahrenheit of warming by the end of the century, large parts of the Central U.S. will see as many 100-degree days as the Sonoran Desert Research Station outside of Phoenix, Arizona does today. (12)

So now would someone please tell me how many 100-degree days we will see under the worst-case Scenario? Even as extreme as this future appears, us folks in developed nations will have the capacity to continue life because of air conditioning. Deaths from heat leveled off in the 1970s due to the widespread use of air conditioning. As our country's population grew, deaths from heat did not. In 1978, 44 percent of American households were still without air conditioning whereas in 2005 only 16 percent were without A/C and only 3 percent in the south were without A/C.

In developed nations everything will become more expensive with the warming, but folks in developed nations have the cash to pay for it. Cost will rise because of things like not being able to grow wheat across the central U.S., if the heat is as extreme as the Sonoran Desert Research Station (the one with those giant saguaro cacti with the big arms.)The world however is not made up of only "developed nations." It's hard to imagine that our society could let things go this far but if it does, the warming does not stop in 2100-t gets worse. Hundreds of millions will be displaced. At least this is what "Heat" says. By now you probably understand that as bad as "Heat" reveals things to be, "Heat" is based on a cooler world than we are likely to see.

Now let me finish on a high note, also not reported with gusto in "Heat." Authoritative voices tell us climate change is not real, that it is a scientific conspiracy, that it is a natural cycle soon to end and that it will be good for society. These "authoritative voices" are highlighted in a growing body of research that has identified these "voices" as being biased.

They are information sources such as the Fox News network, The Heartland Institute, Competitive Enterprise Institute, the George C. Marshall Institute and Conservative politics in general (13). These same confused voices that are telling us all of these things at the same time are the voices that tell us that the solutions to climate change will ruin our economies...

The vast majority of credentialed climate specialists say nothing of the sort. Richard Alley, Evan Pugh Professor of Geosciences at Penn State University, one of the lead authors of the 2001 and 2007 IPCC Reports, member of the United States National Academy of Sciences and one of the pivotal international researchers in climate science, tells us in his book *Earth: the Operators' Manual*, that the solutions to fixing climate pollution will cost no more than things our society has been doing for a very long time.

The solutions to cleaning up climate pollution, using existing technologies, will cost about one percent of global gross domestic product (GDP) per year for 100 years The astonishing thing to understand about this one percent of global GDP - this \$540 billion a year - is that it is little different from what we have spent on our efforts to provide safe drinking water across the planet every year for the last 100 years (14).

It is little different from what we spend on the US military every year not counting wars(15), or what we spend on advertising every year across the planet (14). It is little different than the normal economic costs to our nation every year because of normal inclement weather - rain, snow, heat cold, wind, flooding and drought (16). It is four times less than what we spend on health care every year in the United States alone, based on the annual 2000 to 2009 average that does not include Obamacare (17). And remember, this is using existing technologies. New technologies will significantly reduce or even change these costs into profits.

Cleaning up climate pollution across the planet, in ways that we are already doing today, will cost far less than what we spend on health care every year—just in the US alone. The "voices" of vested interests are very powerful. Their money has created doubt that threatens the existence of life on this planet. They did not do this purposefully; they did it because of greed, ignorance, innocence, and the pressures of their respective

industries' economics. Their billions, and their quest for billions more has allowed them to ignore, for whatever reasons, the dire warnings.

There are always a few scientists that disagree. In the last several years research has shown that 97 to 98 percent of actively publishing climate scientists support the consensus position (18). Should we trust the few that represent "the voices" or the many?

[Bruce Melton is a professional engineer, environmental researcher, filmmaker, and author in Austin, Texas. Information on Melton's new book, "Climate Discovery Chronicles" can be found along with more climate change writing, climate science outreach, and critical environmental issue documentary films on his websites. and www.climatediscovery.com Images copyright Bruce Melton 2012 except where referenced otherwise.]