

Comment by:

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on the

**Draft Impacts of Climate Change on Human Health in the United States: A Scientific
Assessment**

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Comment:

Summary

What is clear from this report, *The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment*, and all other similar ones that have come before, is that the USGCRP simply chooses not to accept the science on human health and climate and instead prefers to forward alarming narratives, many based on science fiction rather than actual science. To best serve the public, this report should be withdrawn. By going forward without a major overhaul, its primary service would be to misinform and mislead the general public and policymakers alike.

Background

The authors of the USGCRP draft of the *The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment* report have an outstanding imagination for coming up with ways that climate change may negatively impact the health and well-being of Americans, but a profound lack of understanding in the manner in which health and well-being is impacted by climate (including climate change).

In modern American society, we have largely insulated our health and welfare from the climate. The United States has a population of nearly than 320 million people living across a diverse range of climates—a range that is an order of magnitude (or more) larger the projected impacts of human-cause climate change—and yet the health and well-being differences of the population across these diverse climates is extremely minimal. Those differences with a direct component of climate associated with them are even smaller. For example, in examining trends and patterns of temperature-related mortality in America, Davis et al. (2004) concluded “The overarching implication of this result indicates that there is no net mortality benefit to one’s place of residence derived from the location’s climate.”

Rather than speculate on how human-caused climate change from greenhouse gas emissions may impact our health and well-being in the future—speculation which is open to influence of preconceived notions, policy preferences, and other matters of personal belief, any or all of which may differ from individual to individual—a more grounded approach is to look across existing climate space and examine the character of the response. In doing so, it is readily obvious that Americans, across all climates, are well-adapted to the prevailing climate (and its inherent weather events, both mild and extreme).

However, this adaptation remains imperfect, as evidenced by the number of Americans still negatively impacted by components of the climate that they live in. Less than perfect, yes, but static, no.

For example, research such as the Davis et al., (2003a, 2003b) shows that while heat waves still lead to elevated daily mortality totals in some cities across the United States (mostly Midwestern and Northeastern cities where heat waves are still relatively uncommon), the sensitivity of urban populations to extreme heat events has been on the decline since at least the mid-1960s (Figure 1). More recent research (e.g., Bobb et al., 2014) shows that these declines have continued. Not only has our adaptive response greatly lowered our sensitivity to extreme elements of climate, but we continue to make improvements going forward.

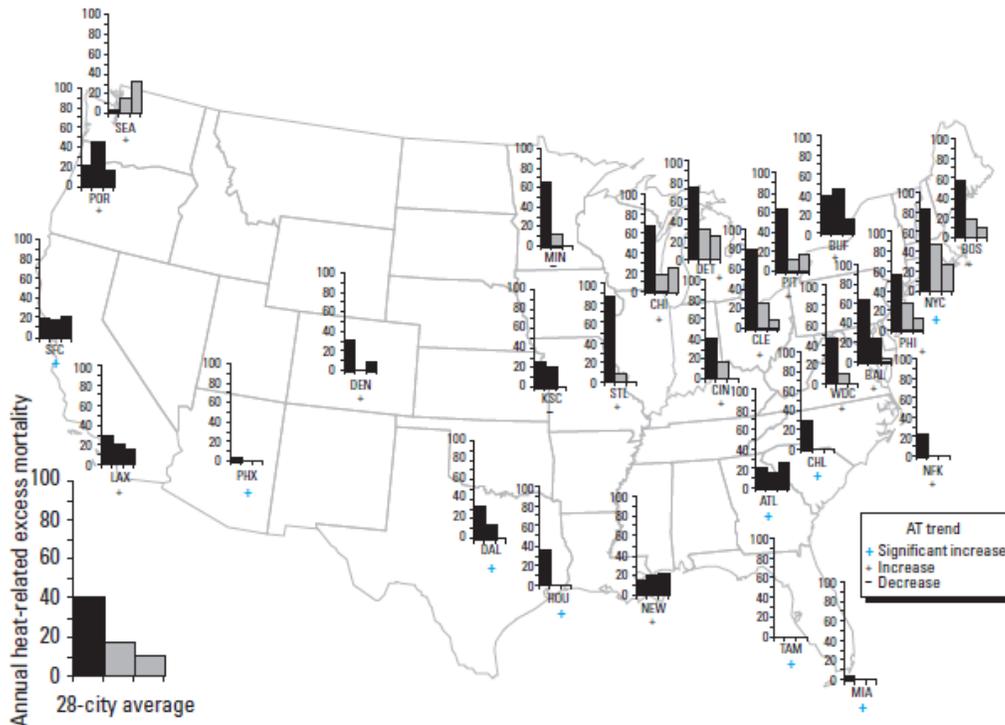


Figure 1. Annual heat-related mortality rates (excess deaths per standard million population on days in which the decadal-varying threshold apparent temperature (AT) is equaled or exceeded) by city and decade, and long-term trend in summer afternoon AT. Each histogram bar indicates a different decade: from left to right, 1960s–1970s, 1980–1989, and 1990–1998. Decades without histogram bars exhibit no threshold ATs and no heat-related mortality. Decades with gray bars have mortality rates that are statistically significantly different from the decades indicated by black bars. The average excess deaths across all 28 cities is shown at the lower left. AT trends are indicated beneath each city abbreviation (from Davis et al., 2003).

There is no tenable reason to think that further improvements will not continue to be achieved and a greater level of adaptation to extreme heat events attained—along with ever less impact on human health and well-being.

Looking beyond extreme temperature impacts on mortality, Goklany (2009), in a major study, found that for the entire collection of extreme weather impacts, mortality has greatly declined over the course of the past several decades, not only in the U.S., but for the globe in general. These findings are extremely relevant to the proper understanding of climate and health in the U.S. Goklany (2009) summarizes:

Current deaths and death rates from extreme weather events for both the U.S. and the globe are, in general, lower than in previous decades. Predictably, annual death rates have declined more rapidly than annual deaths, confirming results from previous studies. This indicates that the total risk of death from such events has actually declined, notwithstanding any increases in the number or intensity of extreme weather events that some claim to have occurred. Globally, as well as for the United States, the aggregate contribution of extreme weather events to the mortality burden is currently minor—on the order of 0.06%.

In the U.S, more lives are lost in an average year to extreme temperatures—both heat and cold—than to more heavily publicized events such as tornados, hurricanes, and floods. According to CDC data, extreme cold, on average, claims more lives than extreme heat, tornados, floods, lightning, and hurricanes combined. In general, mortality and mortality rates from the various categories of extreme events examined here are lower today than in the past. Mortality during the 2000s was lower than in earlier peak periods by 59%–81% for floods, lightning, tornados, and hurricanes, while mortality rates were 72%–94% lower. However, there are no consistent trends for mortality due to floods.

These improvements have occurred despite increases in the populations at risk, in large part because of greater access to the capital and technology necessary to protect against and to cope with adversity in general and extreme weather events in particular. Even if the number of events has increased—and the long-term record is inadequate for ascertaining whether it has—wealth, technology, and human and social capital for the most part have, despite notable exceptions, apparently been of greater importance than any global warming or changes in climatic variability in determining mortality.

Finally, despite population increases, over the long term cumulative mortality from extreme weather events has declined both globally and for the United States, even as total (all-cause) mortality has increased. This indicates that humanity is coping better with extreme weather events than with far more important health and safety problems.

Through our increasing ability to shelter ourselves from the climate, we have greatly reduced the overall impact that the elements of climate have on our overall health/mortality.

Another feature of modern American society is that it is extremely mobile—which means, we can choose the climate in which we live (a form of adaptation as well as an expression of preference). As planes, trains, and automobiles replaced the horse and buggy, Americans became more mobile, and where we live was no longer connected primarily with proximity to where we were born. Instead, we have become much freer to choose our place of residence based on considerations other than ease of getting there.

Where has our new-found freedom of mobility led us? Figure 2 shows the rate of population change from 1900-2010 in each of contiguous 48 states.

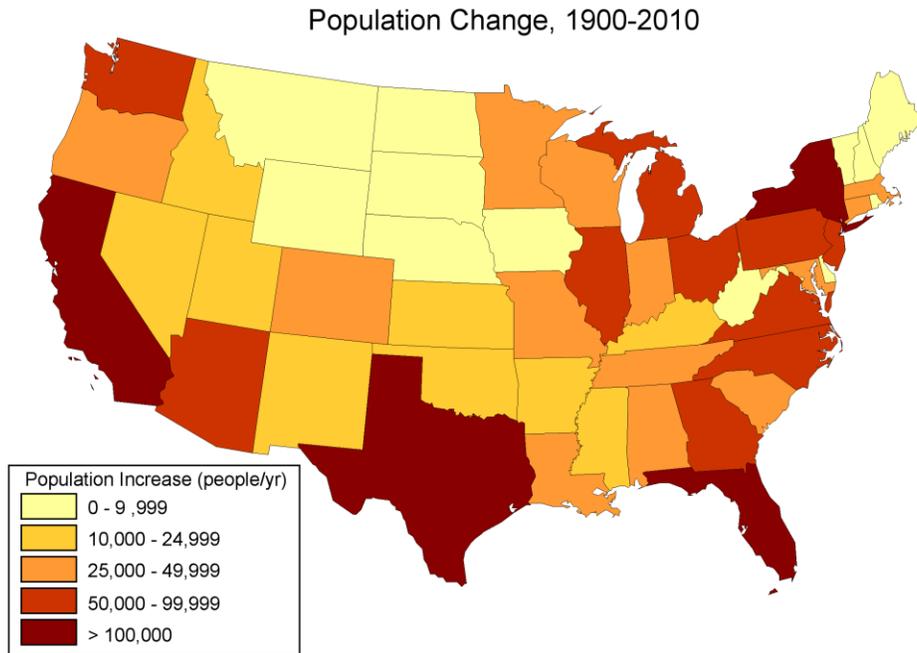


Figure 2. The state-by-state population trend (people/year) from 1900 to 2010.

Comparing a map of the change in population (Figure 2) with a map depicting the average temperature of each state (Figure 3) reveals a pretty strong indication that people seem to be seeking out the warmer states (and the other aspects of climate than come along with higher temperatures).

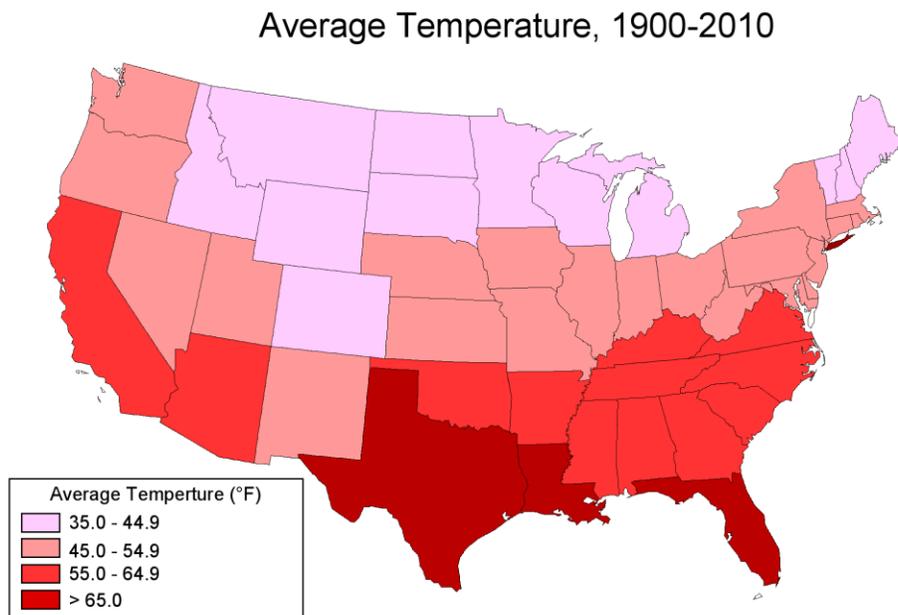


Figure 3. The state-by-state average annual temperature for the period 1900-2010.

A way of looking at human temperature preferences is to calculate what the “average experiential temperature”—that is, the annual temperature that the average person living in the lower 48 states experiences each year. We can calculate this value by first multiplying the average temperature in each state during a particular year by the state’s population in the same year. Then we sum this product across the 48 contiguous states, and finally divide this sum by the total population of the country. In other words, the temperature in states with larger populations weigh more heavily on the national composite experiential temperature than does the temperature in those states with sparser populations. As the population of the country redistributes itself over time, we can track how the average person’s climate changes.

When we do that for each year from 1900 to 2013, we get the result shown in Figure 4—a steadily rising temperature. In fact, the average experiential temperature has risen by a total of about 3.85°F over the course of the last 114 years (a rate of 0.34°F per decade).

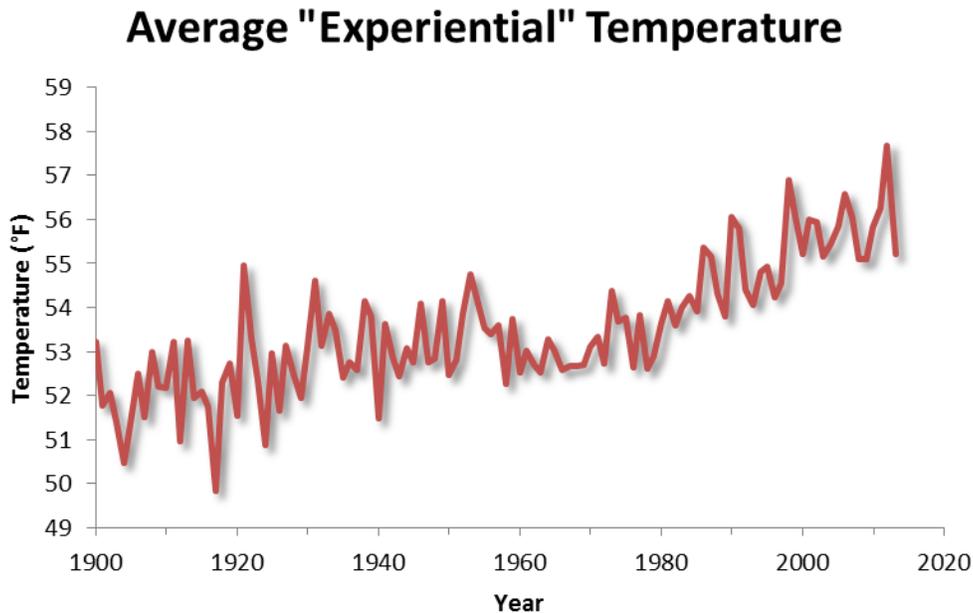


Figure 4. The average experiential temperature of the population of the United States, 1900 to 2013.

But the history of experiential temperatures alone can’t tell us whether the increase has been unwillingly forced upon us by a large-scale warming of the climate from, say, an enhanced greenhouse effect, or whether the change results from Americans seeking out warmer locales on their own accord.

To answer this question, we must calculate the area-weighted average temperature of the United States—that is, the combination of the yearly average temperature within each state weighted by that state’s total area. In this case, it is the size of the state, rather than the size of its population, that matters—the bigger the state, the bigger its contribution to the nationwide average.

The result of this calculation is a quite different looking temperature history. In Figure 5, we included the annual U.S. average temperature history along with the annual U.S. “experiential” temperature.” We see that, while the United States has fluctuated a bit, experiencing warm decades such as the 1930s and 1990s and cold ones such as the 1910s and 1970s, the annual average temperature has increased only slightly during the 20th century—about 0.90°F (a rate of 0.08°F/decade).

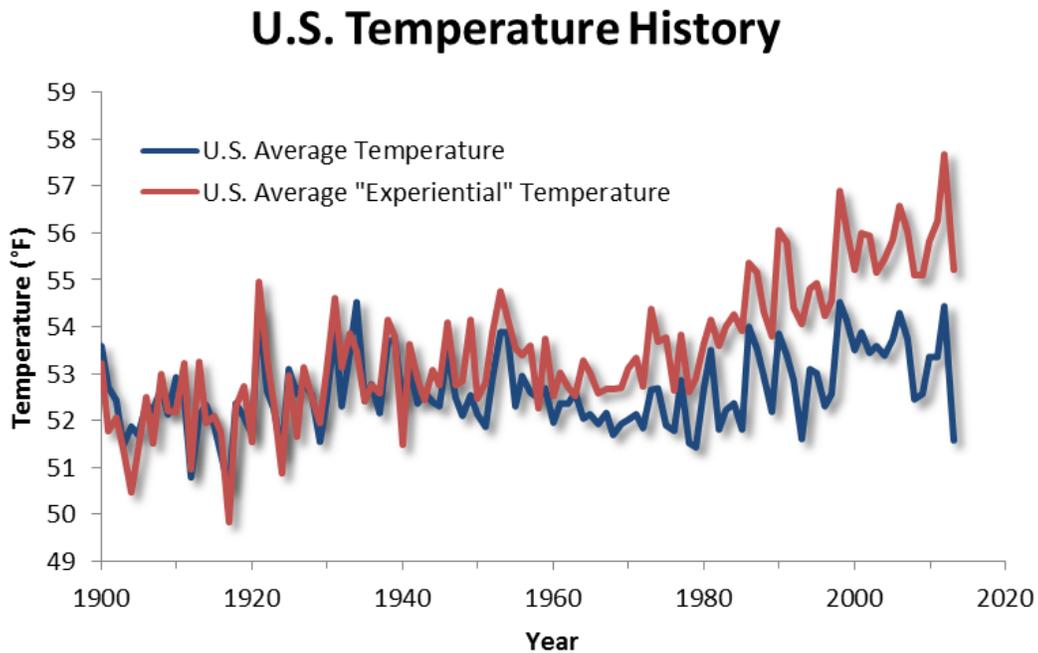


Figure 5. Average temperature and average “experiential” temperature of the United States, 1900 to 2013.

Although there has been a warm-up of the actual temperature, that rise is much less than the increase in the *experiential* temperature. In fact, the average experiential temperature has climbed at a rate more than four times that of the U. S. average temperature—which is the experiential temperature had the population distribution not changed at all. That means that Americans have actively been moving to warmer climates. And there is every indication that they are continuing to do so, as evidenced by the strong rise in experiential temperatures during the past 20 or 30 years.

While climatologists have not generally appreciated this fact, it has been long recognized and appreciated by sociologists. As both people's mobility and their ability to select the climate they prefer have increased throughout this past century, the core of the U.S. population has moved southward—into warmer climates. The overall migration of people into the southern states has created a temperature change over time for the average American that far outstrips any contribution from human-caused climate change for the past century, and rivals the projections for the next.

What all of the above tells us can be summed up like this: climate—and for the matter more relevant to the USGCRP *Climate and Health Assessment*, climate *change*—begets the human adaptive response.

This is being increasingly being recognized in the scientific literature. For example, Knappenberger et al. (2014), in discussing the response to an increasing frequency of extreme heat events, notes:

Some portion of this response probably reflects the temporal increase in the frequency of extreme-heat events, an increase that elevates public consciousness and spurs adaptive response. In this manner, climate change itself leads to adaptation. It is insufficient to ignore this effect when compiling and discussing the impacts of climate change. If an increasing frequency of heat events raises public awareness and gives rise to an adaptive response that lowers the population's relative risk due to extreme heat, this must be properly weighed against any increases in mortality that result from a greater number of mortality-inducing heat events...**Our analysis highlights one of the many often overlooked intricacies of the human response to climate change.** [emphasis added]

And, unfortunately, the USGCRP and the author team of the *Climate and Health Assessment* are among those who have completely overlooked this intricacy.

But this does not come as surprising.

We have been through this exercise repeatedly, having submitted voluminous comments on previous USGCRP reports dealing with health, including the first, second, and third *National Climate Assessment*. While we've seen some changes in response to a few of our specific comments, there is never any response to our most general comment, that the overall tone of the USGCRP on the topic is overly pessimistic in light of demonstrable gains in human well-being, even coming in the face of a change climate.

This *Climate and Health Assessment* is but another in this same mold.

Rather than a point-by-point set of comments going over the entire draft *Climate and Health Assessment* (and effort which we have, in the past, dedicated untold man hours, even going as far as to develop an entire volume dedicated to what the USGCRP second *National Assessment Report* should have looked like if one were to take a dispassionate look at climate change impacts in the US, <http://object.cato.org/pubs/Global-Climate-Change-Impacts.pdf>), in this Comment we take an approach of highlighting the fatal flaw in the main underlying assumption of the USGCRP assessment report. Without the proper attention to this flaw, the entire report should be withdrawn.

But to demonstrate that we do not take this route because we found the specifics within the report to be an acceptable representation of the underlying science, we provide targeted comments

on Chapter 2, “Temperature-related Death and Illness.” We find much wrong with this Chapter, as we do with all the Chapters. The selective and (mis)use of the science is pervasive.

Fatal Flaw in Underlying Assumption

The first sentence of the *Climate and Health Assessment* exposes the report’s fatal flaw “Climate change is a significant threat to the health of the American people.” This statement is based upon the untested assumption that the climate of the mid-to-late 20th century in the United States is the optimal one for the health of Americans. Yet nowhere, to our knowledge, can the basis for such an assumption be found in the scientific literature. Without establishing the ideal climate, it is pure speculation to make a statement like the one noted above. The USGCRP *Climate and Health Assessment* is not a comprehensive review of how climate impacts all aspects of the well-being of Americans, but rather a narrow and selective look at how projected changes in climate (projections that are largely grounded in climate model projections which have known faults and limitations) may impact some narrow and selective facets of human health. Sure, there are negatives associated with any change, but that is not the overarching question. The relevant question, and the one not answered by the USGCRP, is what is the net outcome of climate change on the population of Americans.

Admittedly, answering such a question is exceedingly difficult, if not impossible. There are so many confounding factors in play. Obvious examples include changing population demographics (including age-structure), changing medical technologies, changing health care, changing diets, and changing habits. On the climate side of things, additional complicating factors are to be found including improving weather forecasts, improving warning systems, improving observational systems, and improving preparation. But it is quite likely that it is the non-obvious influences which are most at play.

Compounding the situation is that the impacts of a changing climate are not constant over various timescales. Climate change provokes the development and adoption of adaptive measures—measures which insulate us against future impacts and lowers the future threat. Depending on the types of adaptive measures deployed, these may become effective on timescales from weeks to decades (or even longer). For example, an unusual summer heatwave may increase daily mortality in unprepared localities for a few days, but adaptive measures ranging from simple actions (community awareness programs and cooling centers) with deployment in times in weeks to months, to more elaborate (heat watch/warning systems, building design), with deployment horizons from years to decades.

And one must be careful not to fall prey to confusing climate *change* with climate (including climate variability). Too often reports like these are written with blinders on that mislead the authors into thinking that all impacts are a result of climate changes, when, in fact, climate change plays but a tiny role in the overall climate—with the role of *human-caused* climate change extremely difficult to identify, much less even be anticipated in a robust manner.

Perhaps the largest hurdle the USGCRP has to overcome to establish a growing threat from climate change is that the simplest measure of human well-being, life expectancy, shows a large

increase since the beginning of the 20th century (Figure 6). (Data source: http://www.cdc.gov/nchs/data/nvsr/nvsr64/nvsr64_02.pdf).

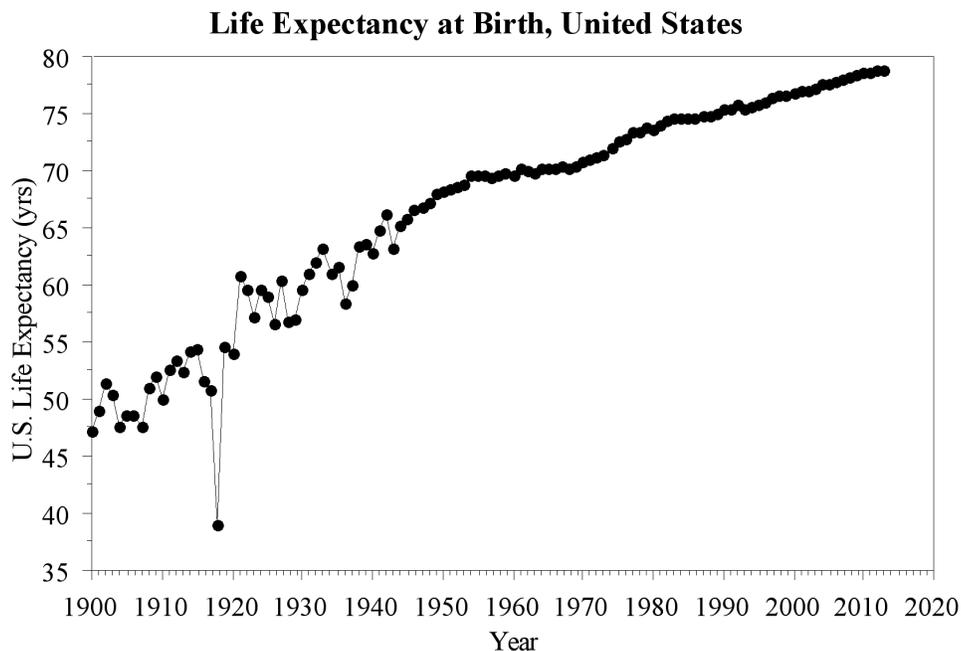


Figure 6. Life expectancy at birth, United States, 1900-2013.

Life expectancy is indicative of the sum total of all influences on the well-being of Americans and shows that the overall climate has been increasing favorable. This has occurred at the same time as a rise in global and national temperatures (from whatever the cause).

But, climate (including variability and change) is eminently more complex than a simple annual average of a large area temperature can indicate (a parameter that no individual experiences). As we try to decrease the temporal and spatial scales to those relevant for human health, the complexities of the climate overwhelms our abilities to project them more than a few days into the future.

Oversimplifications therefore become commonplace, such as using coarse resolution climate model output involving a limited number of variables to downscale to local time and places. This procedure is one is widely recognized as being fraught with uncertainty, and thus produces non-robust and unreliable results.

All of which compounds to produce a nearly intractable situation in which determining the role on anthropogenic climate change in the overall health and well-being of Americans, now and in the future, becomes fraught with nearly unavoidable pitfalls, many of which the USGCRP has stepped directly in. In doing so, the USGCRP has produced a document that serves not to inform the public as to the existing state of robust science on the topic of climate and human health, but rather to misinform them and local, state and national policy as well.

Specific Comments on Chapter 2, “Temperature-related Death and Illness”

Page 51. Lines 2-8, Key Finding #1.

Comment: And pigs could fly. But they don’t. And neither does “as calculated by extrapolating statistical relationships and without considering potential adaptive changes”

This is wrong. Remove all reference to counter-factual studies (i.e., those assuming no adaptation) as there is strong and pervasive evidence in the scientific literature that human populations the world over (including in the U.S.) adapt to (changes in) extreme temperatures. For a recent example, see Knappenberger et al., (2014). Presenting projections that are based on “extrapolating statistical relationships and without considering potential adaptive changes” is not science, but rather, science fiction.

Page 51, Lines 9-15, Key Finding #2,

Comment: “Days that are hotter than normal in the summer or colder than normal in the winter are both associated with increased illness and death... mortality effects are also seen for smaller deviations of even a few degrees from seasonal averages.”

No. See Davis et al., 2003a, 2003b. The variability in daily mortality is such that whatever temperature signal there may be is overwhelmed by the noise on all but a few days of the year with exceptional deviations from the seasonal average (i.e., there exists threshold temperatures).

Page 51, Lines 16-21, Key Finding #3.

Comment: You got this all right except for the last sentence (see below). This should be Key Finding #3. Replace existing Key Finding #1 with this one (including our edit below), as your preference ought to be for science over science fiction.

Page 51. Lines 20-21, Key Finding #3.

Comment: “Including this adaptation trend in human health projections will reduce but not eliminate the increase in future deaths from heat [*Likely, Low Confidence*].”

This is wrong.

In major U.S. cities, during the period from the 1960s through the late 1990s, summer afternoon temperatures increased while mortality rates declined (see Davis et al., 2003 ab). So why suppose that this behavior won’t continue to do so in the future? This general trend has been identified not only in the U.S., but in diverse locations around the world. As we wrote in Knappenberger et al., (2014):

Some portion of this response [to extreme heat events] probably reflects the temporal increase in the frequency of extreme-heat events, an increase that elevates public consciousness and spurs adaptive response. In this manner, climate change itself leads to adaptation.

It is insufficient to ignore this effect when compiling and discussing the impacts of climate change. If an increasing frequency of heat events raises public awareness and gives rise to an adaptive response that lowers the population's relative risk due to extreme heat, this must be properly weighed against any increases in mortality that result from a greater number of mortality-inducing heat events. In the case of Stockholm County, raised awareness from climate change need only be responsible for 288 out of 2,304 (~13%) deaths saved through adaptation to have completely offset the climate-related increase in heat-related mortality identified by Oudin Åström *et al.* For any greater contribution, climate change would have resulted in an overall decline in heat-related mortality in Stockholm County despite an increase in the frequency of extreme-heat events. Such a result would be consistent with findings for other major cities in Europe and the US2–5 and would stand in opposition to the conclusions drawn by Oudin Åström *et al.*

Our analysis highlights one of the many often overlooked intricacies of the human response to climate change.

More properly, instead of “Including this adaptation trend in human health projections will reduce but not eliminate the increase in future deaths from heat [*Likely, Low Confidence*]” you should write “Including this adaptation trend in human health projections will reduce and potentially eliminate the increase in future deaths from heat, as well as drive down heat-related mortality in total [*Likely, High Confidence*].”

Page 51, Lines 22-27, Key Finding #4.

Comment: “Elderly persons...have a higher risk of dying due to increasing frequency, intensity, and duration of future heat and heat waves.” What you state is true for climate in general, but it is unclear that it is true for climate change. You cite Bobb et al. (2014) elsewhere, but neglect to mention that Bobb et al. (2014) found the sensitivity of elderly population to extreme heat has become indistinguishable from the sensitivity of the below 65 year age group. Quoting from Bobb et al (2014):

We found that mortality risks in the eldest (≥ 75) age group differed from the youngest (< 65) at baseline but were statistically indistinguishable by the end of the study period. This suggests that while the elderly have historically been more susceptible to extreme heat (Basu 2009), interventions that are more broadly targeted to reduce vulnerability to heat over the lifespan should be considered moving forward.

Page 56-57, Lines 36-3.

Comment: “This effect is referred to as mortality displacement. While this effect can be important for relatively modest heat events, it is not seen in more extreme events (such as the Chicago heat wave discussed in Box 1, where there is no corresponding reduction below the average number of deaths following the elevated rate of deaths during the event).”

Huh? Better check your Kaiser et al. (2007) reference again
(<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1854989/>)

From Kaiser et al (2007): “We estimated that there were 692 excess deaths from June 21, 1995, to August 10, 1995; 26% of these deaths were owing to mortality displacement.”

Page 60, lines 15-26.

Comment: “Projecting these trends into the future is challenging, but future changes in adaptive capacity are likely to modestly reduce the future increase in mortality”

Isn't the point of this whole USGCRP *Climate and Health Assessment* to address the challenges of climate change??

So why do you all refuse to do so in this Chapter (as evidenced by the Box contents)? Instead of science fiction (assuming no adaptation), you ought to seriously look at the probable (potential) impacts from adaptation. As is widely recognized, heat-related mortality is preventable, your future assessment of heat-related mortality increases should include a value of zero. Yet that number never appears in the report, which seems to prefer “A warmer future is projected to lead to increases in future mortality on the order of thousands to tens of thousands of additional deaths per year across the United States by the end of this century” (p59, line 10-11). In fact, it is quite possible that future climate changes will lead to the adoption of additional adaptive measures with an overall result which may result in a *decrease* in the rate of heat-related mortality (Knappenberger et al., 2014). Such a result is as readily anticipated as the increases that you all report and yet is never approached in this Assessment.

Page 60 lines 21-23.

Comment: “On the other hand, if current trends of population growth and migration into large urban areas continue, there may be an increasing urban heat island effect which will magnify the rate of warming locally.”

This has nothing to do with greenhouse gas-induced climate change.

Nor does this “the changing proportions of vulnerable populations, including the elderly, in the future.”

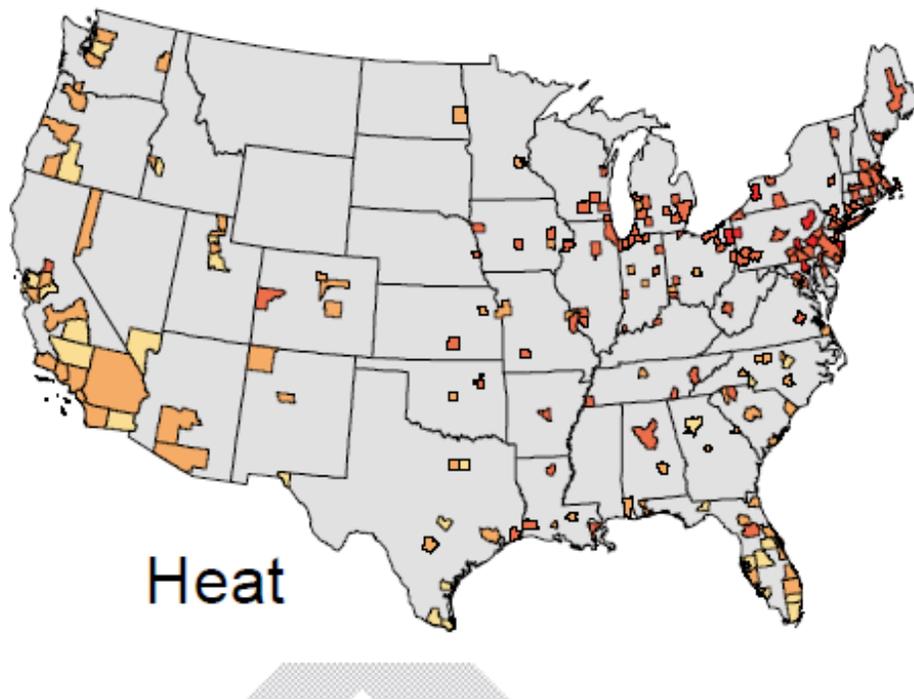
Remove these statements. If you think they are relevant, it indicates that you do not understand the nature of the issue that you are discussing. Changes in heat-related mortality that are the result of changing population demographics don't belong in a discussion of climate (change) related impacts.

Page 60-62, Box “Research Highlight: Modeling the Effect of Warming on U.S. Deaths”

Comment: We are often selected by journal editors to be reviewers of papers concerned with heat-related mortality as we have a strong publication record in this field. Without exception, we recommend rejection of each and every paper we review that uses the methodology as laid out in this Box.

We realize that we are beating our head against the wall to try to get you all to understand all this, because you have a predisposition not to. The USGCRP seems bound and determined to push for a large rise in future mortality from extreme heat, when the scientific research employing robust mythologies simply does not support it.

It is interesting to compare the heat results from Figure 3 in the Box (page 84) described as “projected increase in death rates due to warming in the summer months,” with those from Davis et al., 2003b (EHP).



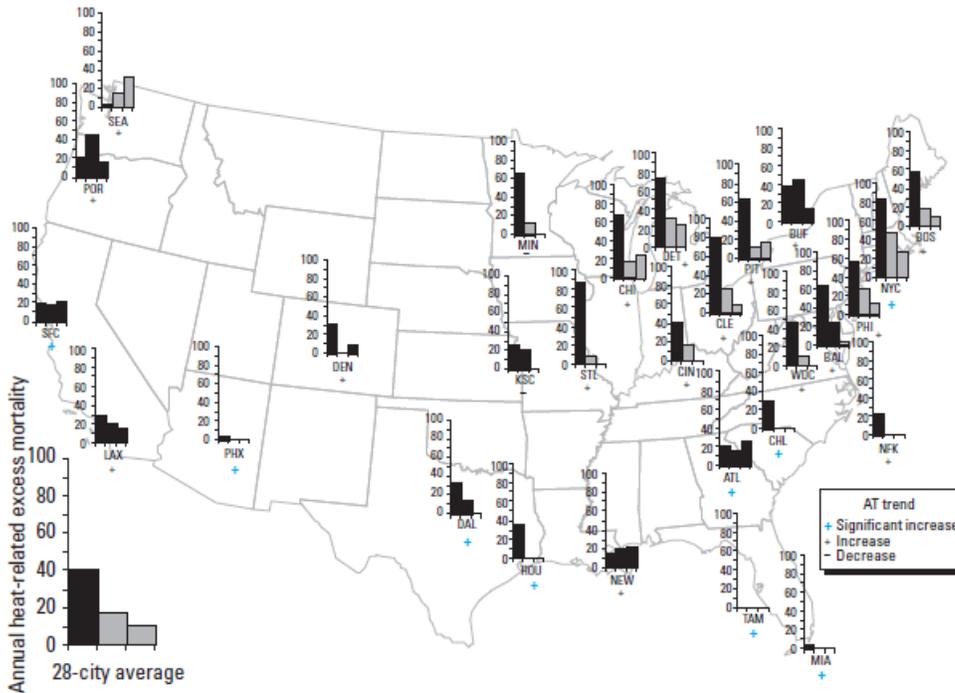


Figure 7. TOP: Results from USGCRP Chapter 2, Figure 3, projecting future changes in the rate of heat-related mortality in U.S. cities. BOTTOM: Results showing observed changes in rate of heat-related mortality in U.S. cities as described by Davis et al., 2003b.

The results from Davis et al., (2003b) show a heat-related mortality decline over time, despite rising afternoon apparent temperatures. With this trend in mind, does it make sense to make “no explicit assumptions or adjustment for potential future adaptation.” We’ll answer that question for you. No.

Also, p84 line13-14 in the caption of Figure 3: “Therefore, these results reflect only the effect of the anticipated change in climate over time.”

This is wrong as well. For example, see Knappenberger et al., 2014, where we suggest that climate changes actually beget an adaptive response (why wouldn’t they?).

[M]uch of the adaptation has likely occurred because of an increased frequency of heat waves. As heat waves become more common, the better adapted to them the population becomes.

Our analysis highlights one of the often overlooked intricacies of the human response to climate change—the fact that the response to climate change can actually improve public health and welfare.

Page 62, Line 7 – Page 64, Line 9, Entire Section 2.9 “Populations of Concern”

Comment: This has nothing to do with climate change and health. Remove this section entirely.

Page 64, Lines 31-34.

Comment: “There have been suggestive links between rapid recent Arctic sea ice loss (Liu et al. 2013) and an increased frequency of cold (Liu et al. 2012) and warm extremes (Francis and Vavrus 2012), but this is an active area of research with conflicting results (Wallace 34 et al. 2014; Barnes 2013).”

Remove this section. This is not the place to address this highly complex issue and invites speculation that is not based in robust science.

Page 64, Lines 34-35.

Comment: “In regions where temperature variability increases, mortality will be expected to increase, and vice versa (Gosling et al. 2008a).”

No. See Davis et al., 2004, which finds:

Temperature currently does not have a major influence on monthly mortality rates in US cities. By the 1990s, there was little evidence of a net mortality benefit to be derived from one’s place of residence.

References

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