Policy Study The Heartland Institute

No. 149 — March 2018

A Critique of the U.S. Global Change Research Program's 2017 Climate Science Special Report

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Contributions from other scholars

Introduction

For many years, the U.S. government, United Nations, and other national and international organizations have issued reports sounding the alarm about the alleged dangers of global warming. Domestic policies meant to curb the use of fossil fuels, such as the Clean Power Plan in the United States, and international efforts, such as the Paris climate accord, are premised on these fears. The latest addition to this alarmist literature is the November 2017 *Climate Science Special Report* (CSSR). According to CSSR, "As a key part of the Fourth National Climate Assessment, the U.S. Global Change Research Program (USGCRP) oversaw the production of this stand-alone report of the state of science relating to climate change and its physical impacts."[1]

Domestic policies meant to curb the use of fossil fuels, such as the Clean Power Plan in the United States, and international efforts, such as the Paris climate accord, are premised on the alleged dangers of global warming.

CSSR suffers from many of the same shortcomings and biases apparent in the previous work produced by the USGCRP. For instance, the report relies heavily on information from the U.N. Intergovernmental Panel on Climate Change (IPCC), which has a long history of producing failed predictions and deeply flawed reports. Further, CSSR perpetuates the misperception widespread in public policy circles and popular culture that "the science is settled" on the issue of the role played by human activities in producing climate change. CSSR's authors suggest

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[1] D.J. Wuebbles *et al*., eds., *Climate Science Special Report: Fourth National Climate Assessment,* Vol. 1, U.S. Global Change Research Program, November 2017, p. 1, https://science2017.globalchange.gov/downloads/CSSR2017_FullReport.pdf.

governments across the world, including the United Nations, should devise policies they say will slow or stop global warming.

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Part One of this paper explains foundational problems with CSSR, including how its authors hide scientific uncertainty about the causes and consequences of global warming, the pervasive politicization of climate change throughout the report, CSSR's over-reliance on computer models, and its authors' failure to comply with the principles of the scientific method. These are substantial deficiencies, not minor flaws, that no number of pages, coauthors, or footnotes can fully offset.

Part Two provides basic facts about the role of carbon dioxide (CO_2) in climate change, many of which are missing from the CSSR report.

Part Three reviews nine assertions made by CSSR authors who believe climate change is now and will continue to have serious life- and health-threatening consequences, and it reveals why many of these claims should be rejected as fallacious.

Part Four offers a summation of the CSSR Task Force's analysis of the CSSR report.

Part One
Foundational Problems

CSSR might appear to the casual reader to be an exhaustive review of the literature on climate science. It has 477 pages and three coordinating lead authors, 29 lead authors, three review editors, 19 contributing authors, six volume editors, an eight-member Science Steering Committee, and 17-member Subcommittee on Global Change Research.[2] However, a closer look reveals the report is far from an objective and authoritative review of climate science; it suffers from severe foundational framing and methodology problems.

A. Hiding Scientific Uncertainty

CSSR attempts to describe the current status and maturity of climate science, a relatively new field whose primary research focus for the past 40 years has been to prove the hypothesis human activities, rather than naturally occurring phenomena and cycles, are the major causes of the global climate changes observed since the beginning of the Industrial Age, which began about two centuries ago.

[2] *Ibid.*, pp. iv–v.

Climate scientists who have adopted this narrow focus often fail to properly contextualize the more recent climate changes, which are not significantly dissimilar to those that have occurred over the past two millennia and longer. This is notable, because Earth's vacillating cooling and warming climate periods occurring hundreds and thousands of years ago could not have been caused by pre-Industrial Revolution human activities. (More details later in this paper.) It is far more likely recent climate changes have been caused by poorly understood and complex interactions of physical, chemical, geological, oceanographic, and biological forces, rather than by humans' carbon-dioxide emissions.

Despite the wealth of evidence available, no admissions about the many uncertainties in climate science can be found in CSSR. Instead, it emphasizes an alleged "consensus among scientists" concerning the assumptions on which the global warming hypothesis is based. Yet science is not about consensus. Consensus, in this case, is mostly about politics.

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Even some serious scientists who believe global warming is a problem admit there is much uncertainty. For instance, Phil Jones of the University of East Anglia's (UEA) Climatic Research Unit acknowledged in a 2010 interview when asked whether most believe the debate on climate change is over, "I don't believe the vast majority of climate scientists think this. There is still much that needs to be undertaken to reduce uncertainties."

When asked specific questions about global temperature, Jones said, "Temperature data for the period 1860–1880 are more uncertain, because of sparser coverage, than for later periods in the 20th Century. … for the two periods 1910–40 and 1975–1998 the warming rates are not statistically significantly different."[3] This is clearly not what consensus looks like.

Jones' colleague at UEA, Mike Hulme, an IPCC contributor, acknowledged, "What is causing climate change? By how much is warming likely to accelerate? What level of warming is dangerous? – [these] represent just three of a number of contested or uncertain areas of knowledge about climate change. … Uncertainty pervades scientific predictions about the future performance of global and regional climates."[4] This, too, is not a consensus.

Sandrine Bony, a climate researcher at the Laboratory of Dynamic Meteorology in Paris, and her colleagues wrote in 2015, "Fundamental puzzles of climate science remain unsolved because of our limited understanding of how clouds, circulation and climate interact."[5] This is also not consensus.

[3] "Q&A: Professor Phil Jones," BBC, February 13, 2010, http://news.bbc.co.uk/2/hi/8511670.stm.

[4] Mike Hulme, *Why We Disagree About Climate Change: Understanding Controversy, Inaction and Opportunity*, (New York, NY: Cambridge University Press, 2009), pp. 75, 83.

[5] Sandrine Bony *et al*., "Clouds, Circulation and Climate Sensitivity," *Nature Geoscience*, Vol. 8, 2015, pp. 261–68, https://www.nature.com/articles/ngeo2398.

The Nongovernmental International Panel on Climate Change has produced four volumes in its *Climate Change Reconsidered* series, including separate volumes examining the physical science and biological implications associated with climate change. The volumes constitute thousands of pages of analysis and data provided by theoretical and research scientists and scholars.[6] It is valid for others to present different perspectives, but not to ignore or refuse to acknowledge thousands of articles in the peer-reviewed literature contesting the claim Earth's atmosphere is warming as a result of human activities or that the warming is occurring at a dangerous pace.

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Michael Crichton, in a 2003 lecture delivered at the California Institute of Technology titled "Aliens Cause Global Warming," called consensus the "first refuge of scoundrels."[7] As Crichton noted, claiming consensus is often a strategy used to avoid debate. In science, what ought to matter is the presence of reproducible results, not claims of consensus. It's worth remembering the greatest scientists in history—including Albert Einstein, Galileo Galilei, and Isaac Newton—broke with the scientific consensus of their time.

B. Pervasive Politicization

From its inception, climate science gained the attention of social activists, politicians, and special-interest groups who saw in the issue a way to achieve ideological, political, and commercial objectives.[8] It's common for scientific fields to encounter uncertainties concerning their subject matter; indeed, their goal is to investigate a range of hypotheses that might explain natural phenomena. It's imperative these uncertainties be confronted objectively and the process remain free from bias imposed by funding sources and political influence—a significant problem in climate science.

MIT atmospheric physicist Richard Lindzen observed, "Outside any given specialty, there are few – including scientists – who can distinguish one scientist from another, and this leaves a great deal of latitude for advocates and politicians to invent their own 'experts.' … In effect, once political action is anticipated, the supporting scientific position is given a certain status

[6] These volumes can be obtained at http://climatechangereconsidered.org/; Also see Craig D. Idso, Robert M. Carter, S. Fred Singer, *Why Scientists Disagree About Global Warming,* 2nd ed. (Arlington Heights: The Heartland Institute, 2015), https://www.heartland.org/_template-assets/documents/Books/Why%20Scientists%20Disagree%20Second%20Edition%20with%20covers.pdf

[7] Michael Crichton, "Aliens Cause Global Warming: A Caltech Lecture," Delivered at the California Institute of Technology, January 17, 2003, http://s8int.com/crichton.html.

[8] Rupert Darwall, *Green Tyranny: Exposing the Totalitarian Roots of the Climate Industrial Complex* (New York: Encounter Books, 2017).

whereby objections are reckoned to represent mere uncertainty, while scientific expertise is strongly discounted,"[9] noting how easy it is for the scientific process to be corrupted.

As a candidate, Barack Obama famously said, "So, if somebody wants to build a coal-powered plant, they can; it's just that it will bankrupt them because they're going to be charged a huge sum for all that greenhouse gas that's being emitted."[10] As president, Obama fulfilled his campaign promise, launching an aggressive war on fossil fuels. Paul Driessen summarized Obama's politicization of the scientific method well, writing, "Under the Obama Administration, the [Environmental Protection Agency] has become more politicized and agenda-driven, more controlled by environmental activists, and more determined to use its vast regulatory power to determine America's energy, industrial, technological and economic future."[11]

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In a March 18, 2009, three-page email with the subject line "Strategic Communications Conversation," sent to Environmental Protection Agency (EPA) Administrator Lisa Jackson, EPA's Allyn Brooks-LaSure noted, "The number of Americans who say the global warming threat has been exaggerated is at an all-time high." The suggested action offered was revealing: "If we shift from making this about polar caps and about our neighbor with respiratory illness we can potentially bring this issue to many Americans."[12] This approach was especially disingenuous, because at that time the email was authored, EPA did not have (and still doesn't have) data linking respiratory problems to global warming.

As the Brooks-LaSure email makes clear, EPA's strategy focused on creating an emotional narrative. Scientific studies, objective research, and fair analyses were pushed to the backburner or eliminated entirely.

The remarkable and tragic situation involving Roger Pielke Jr. further illustrates the political, rather than scientific, agenda of global warming alarmists and climate alarmist politicians. On December 11, 2013, Pielke offered testimony before Congress titled "A Factual Look at the

[9] Richard Lindzen, "Chapter 5. Science and politics: Global warming and eugenics," in Robert W. Hahn, ed., *Risks, Costs, and Lives Saved: Getting Better Results from Regulation* (New York, NY: Oxford University Press, 1996), pp. 86–87.

[10] An interview with Barack Obama by the *San Francisco Chronicle*, January 17, 2008, https://www.youtube.com/watch?v=DpTIhyMa-Nw.

[11] Paul Driessen, "The EPA's Unrelenting Power Grab," Committee for a Constructive Tomorrow, 2011, p. 4, https://www.heartland.org/_template-assets/documents/publications/The-EPA-Unrelenting-Power-Grab.pdf.

[12] Allyn Brooks-LaSure, "Strategic Communications Conversation," March 18, 2009, obtained by the Competitive Enterprise Institute under the Freedom of Information Act and posted by *Watts Up With That* (website), https://wattsupwiththat.files.wordpress.com/2015/01/march-09-epa-strategy-memo-to-lpj.pdf.

Relationship of Climate to Weather." Most of his testimony focused solely on hard data.[13] But as Pielke explained in a subsequent appearance before Congress:

> Several months after I testified before this committee in December, 2013, the White House posted on its website a 6-page essay by the President's Science Advisor, John Holdren, which claimed falsely that my testimony before this committee was "not representative of mainstream views on this topic in the climate-science community" and was "seriously misleading." … One year later, Congressman Raul Grijalva (D-AZ) opened a formal investigation of me and six other professors … In his letter to my university's president, Mr. Grijalva justified the investigation of me by relying on the science advisor's false claims. … The communications director for the House Natural Resources Committee explained how we seven academics were chosen to be investigated by Mr. Grijalva: "The way we chose the list of recipients [of Mr. Grijalva's letter] is who has published widely, who has testified in Congress before, who seems to have the most impact on policy in the scientific community."[14]

The harassment endured by Pielke is clear proof politicians armed with government's power and threats of censorship—rather than scholars and scientists who utilize objectively collected and analyzed data and facts—have dominated the climate change debate.

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CSSR is unquestionably a political document. It was compiled by EPA holdovers from the Obama administration who are more interested in achieving their political objectives than relying on the scientific method. This critique of CSSR is made necessary because EPA and its many publications, reports, and projects were heavily and often unapologetically politicized during Obama's tenure.

C. Overreliance on Computer Models

Computer simulations are the primary tool climate science researchers use in their published reports. There are few, if any, traditional experiments using physical systems and data that play an integral role in most alarmist climate reports. These complex computer models have not only

[13] Roger Pielke Jr., "A Factual Look at the Relationship of Climate to Weather," testimony before the Subcommittee on Environment of the Committee on Science, Space, and Technology, U.S. House of Representatives, December 11, 2013, http://sciencepolicy.colorado.edu/admin/publication_files/2013.38.pdf.

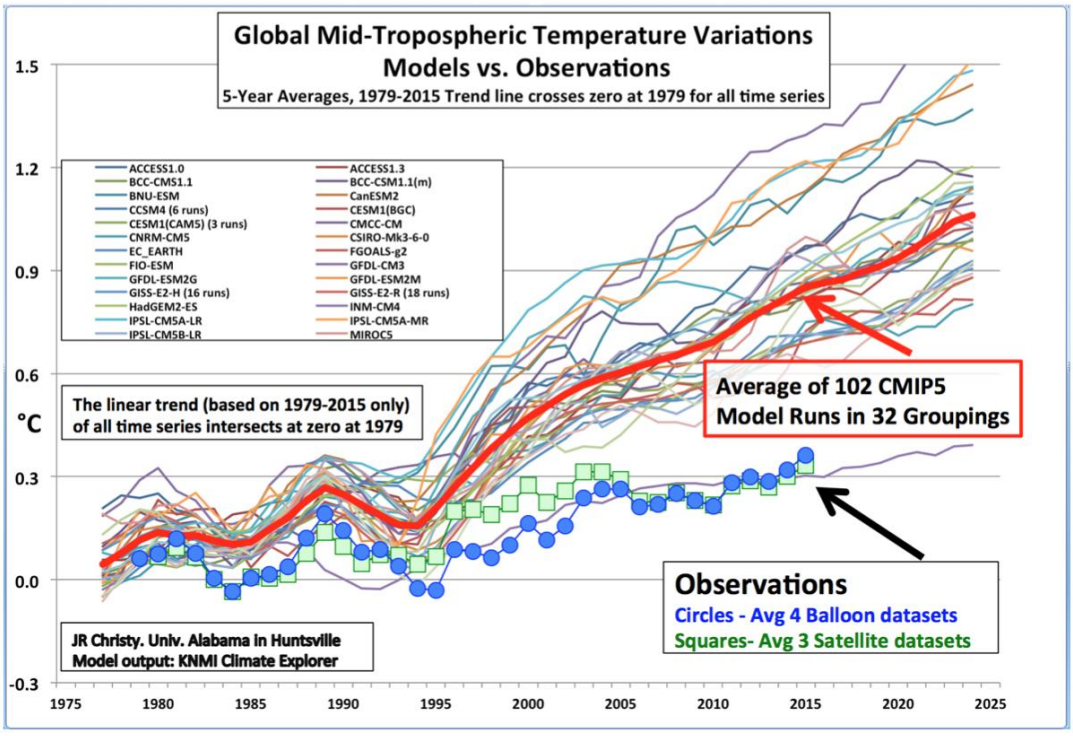
[14] Roger Pielke Jr., "Climate Science: Assumptions, Policy Implications, and the Scientific Method," testimony before the Committee on Science, Space, and Technology of the U.S. House of Representatives, March 29, 2017, pp. 1–2, https://science.house.gov/sites/republicans.science.house.gov/files/documents/HHRG-115-SY-WState-RPielke-20170329.pdf.

failed to predict future changes with accuracy, they have also failed to explain past climate changes.

Climate models' unreliability was displayed vividly in research conducted by John R. Christy, Ph.D., the head of climate research at the University of Alabama at Huntsville.[15] Christy reviewed 102 climate model predictions contained in the *Fifth Assessment Report* (AR-5), which was published by the IPCC. AR-5 is an important resource used by the researchers who created CSSR.

Christy found the AR-5 models did not accurately predict tropical mid-troposphere temperature measurements collected with weather balloons and satellites. (See Figure 1.) The average of the model results Christy examined over-predicted measured temperatures by more than a factor of three.

Figure 1
IPCC Models vs. Physical Data



The graph displays global average mid-tropospheric temperature variations (5-year averages) for 32 models (lines) representing 102 individual simulations. Circles (balloons) and squares (satellites) depict the observations. The Russian model (INM-CM4) was the only model close to the observations. *Source*: John R. Christy, U.S. House Committee on Science, Space, and Technology, February 2, 2016, p. 12, http://docs.house.gov/meetings/SY/SY00/20160202/104399/HHRG-114-SY00-Wstate-ChristyJ-20160202.pdf.

[15] John Christy, testimony before the U.S. House Committee on Science, Space and Technology, March 29, 2017, https://www.heartland.org/_template-assets/documents/publications/Christy%20science%20as%20a%20method%20testimony.pdf.

Ignoring Feedback Loops

The inaccuracies produced by most computer climate models are due in part to the estimates made about the effects of feedback loops and mechanisms. A feedback mechanism describes how a natural process changes due to its underlying causal characteristics and other factors. A wildfire, for example, begins with a positive feedback loop. With plenty of fuel on which to draw, it grows larger, which means it can consume even more fuel and at a faster rate. However, as fuel runs low and other factors, such as temperature and precipitation, change, the feedback loop becomes negative and the fire dwindles. In nature, most positive feedback loops become negative as natural phenomena return to equilibrium.

Concerning climate, if CO_2 emissions produce a higher global temperature and a higher temperature produces more CO_2—an unchecked positive feedback loop—then Earth's atmosphere would have heated up much more than it has, possibly endangering all life, including humans. We are often told Earth is approaching a tipping point or "point of no return," during which normal negative feedbacks of the climate system will suddenly turn positive, in defiance of logic and all historical precedent.

Climate modelers usually include large positive feedback loops in their simulations, assuming the atmosphere is extremely sensitive to CO_2 while ignoring data and other causal factors that suggest this is not the case.

Climate modelers usually include large positive feedback loops in their simulations, assuming the atmosphere is extremely sensitive to CO_2 while ignoring data and other causal factors that suggest this is not the case. (Interestingly, if they were to include large *negative* feedback loops, climate scientists' models would forecast a new ice age.)

Climate modelers ignore the fact that the heating effects of CO_2 are not linear. This means that whatever impact the near doubling of CO_2 has had during the past two centuries, it will have dramatically less impact with the next doubling. (More on this later in this paper.)

Weather and Climate

The discussion of global warming must also be considered with a proper understanding of weather and climate. Weather is defined as the instantaneous state and/or conditions of the atmosphere. Variables such as temperature, pressure, density, moisture content, cloud cover, and precipitation describe the thermodynamic or dynamic state of the atmosphere. Climate, on the other hand, is the long-term mean state of the atmospheric conditions, including the variability, extremes, and recurrence intervals. "Long-term" is defined as at least a 30-year period by the World Meteorological Organization.[16]

While these definitions suggest weather and climate are different, each is governed by the same underlying physical causal factors. These factors are represented by seven mathematical

[16] "What is Climate?" World Meteorological Organization, accessed February 8, 2018, http://www.wmo.int/pages/prog/wcp/ccl/faqs.php.

equations, commonly referred to as the "primitive equations," which form the dynamic core of computer models that attempt to make weather forecasts and climate projections.[17]

Primitive equations, while important, represent physical processes for which there are no precise formulations that allow for accurate predictions—processes such as cloud formation, heat exchange between Earth's surface and the atmosphere, precipitation generation, and solar radiation. Therefore, the variables in the equations must be represented by "parameterizations," or ranges.

Because physical processes in the atmosphere are not well-understood, scientists make educated guesses about the values of the variables in their equations. Then they must "tune" these parameters until they get an answer that matches data, once they become available. Much of the work researchers do with computer models involves this fine-tuning.[18]

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A lack of data that can be used to improve the accuracy of computer models is a significant reason why weather forecasts often vary substantially from initial estimates, typically in as few as three to five days. Weather forecasts are made with data measured as infrequently as twice per day in the United States, and only once per day in most other locations. Further, most measurements are gathered over land, even though three-quarters of Earth's surface is covered with water. Additionally, weather instruments cannot measure atmospheric quantities with infinite precision. These, plus other factors, explain why weather predictions made two weeks or more in advance are hopelessly inaccurate.

Climate predictions utilize these same imperfect weather forecasting equations, which, in part, is why climate scientists have not been able to make predictions decades in advance that match high-quality data. (See examples later in this paper.)

D. Failure to Follow the Scientific Method

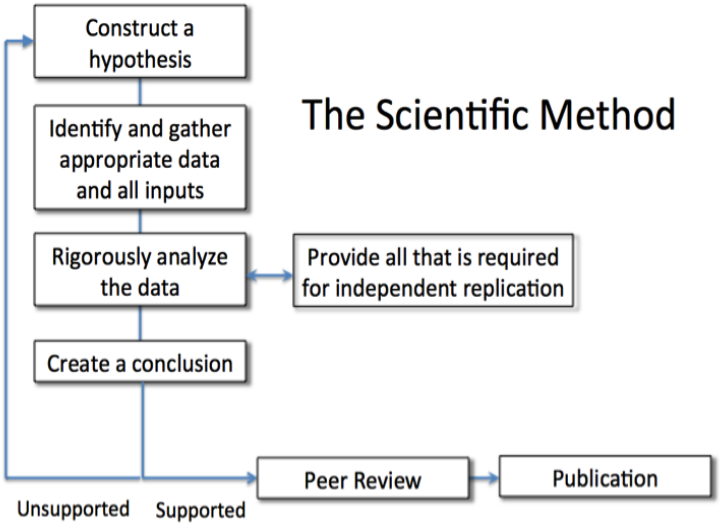
Another problem with the climate science literature CSSR uses is much of it plays fast and loose with the scientific method, a well-established iterative process for acquiring knowledge. (See Figure 2.) The scientific method begins with a theory or hypothesis. The data needed to test the hypothesis and all possible factors involved are identified and gathered. The data are then processed and the results rigorously tested. The data and methods are then made available for independent replication.

[17] "Primitive Equations," San Francisco State University, accessed February 16, 2018, http://tornado.sfsu.edu/Geosciences/classes/e465/PE_Equations/Primitive_equations.html.

[18] Frédéric Hourdin, "The Art and Science of Climate Model Tuning," *Bulletin of the American Meteorological Society*, March 2017, https://journals.ametsoc.org/doi/abs/10.1175/BAMS-D-15-00135.1.

Reviewers of the proposed theory must have the requisite skills in the topic and in the proper statistical analysis of the data to judge its validity. If it passes the tests and replication efforts, a conclusion is made and the theory may be turned into a paper for publication. If it fails the tests, the hypothesis or theory must be rethought or modified.

Figure 2
The Scientific Method



Source: Jay Lehr, December 2017, constructed based on a model by Karl Popper.

A refutation of a previously accepted theory, even one that has been published and widely accepted, can follow the same route. It takes only one experiment to falsify any theory, or at least demonstrate its need for revision.

In the field of climate science, the scientific method, coupled with a strong peer-review element, has not been used with the rigor required to ensure scientific findings are accurate and objective. In CSSR's "Executive Summary," for example, we read, "Global average sea levels are expected to continue to rise—by at least several inches in the next 15 years and by 1–4 feet by 2100. A rise of as much as 8 feet by 2100 cannot be ruled out."[19]

Let's assume "several" means roughly 3 inches of sea level rise occurring over the next 15 years. This figure should be scientifically compared to the steady trend observed since 1800 of about 0.06 inches per year, or 0.9 inches every 15 years (6 inches per century), as measured by global tide gages in tectonically inert areas.[20] The prediction of 1 foot of sea level rise by 2100 is twice

[19] D.J. Wuebbles *et al.*, *supra* note 1, p. 10.

[20] Nils-Axel Mörner "Chapter 12 – Sea Level Changes as Observed in Nature," in Don Easterbrook, ed., *Evidence-Based Climate Science*, 2nd ed. (Amsterdam, Netherlands: Elsevier, 2016), pp. 219–31, https://doi.org/10.1016/B978-0-12-804588-6.00012-4.

the extremely steady trend since 1800. The prediction of 4 feet is eight times higher, a deviation well out of sync with the past two centuries of available physical data. The claim that "cannot be ruled out" of 8 feet strains credulity. Given these extreme estimates, it's not surprising CSSR does not offer the data, analysis, or context that would constitute a scientific justification for such assertions.

Part Two
Carbon Dioxide in the Atmosphere

CSSR has been described by alarmists as a reflection of the best available science, but basic facts about the role CO_2 plays in climate change are strangely absent from CSSR. Further, the authors do not include in their report recent research suggesting Earth's climate is less sensitive to CO_2 than previously thought, or that there is well-tested science suggesting CO_2 generated by human activities cannot physically have the warming effects claimed by many climate scientists and their models.

A. Atmospheric CO_2

CO_2 is an invisible, odorless, tasteless, non-toxic gas that is naturally present in the air and essential for the existence of all plants, animals, and humans on Earth. In the photosynthesis process, plants remove CO_2 from the atmosphere and release oxygen, which humans and animals breathe in. If the authors of the CSSR had at least mentioned these obvious facts, it might have removed the implied, emotive assumption CO_2 is a pollutant that endangers human life.

CO_2 is a trace gas that makes up only about 0.04 percent, by volume, of all gases in the atmosphere, up from about 0.03 percent in 1910.

The CO_2 emitted into Earth's atmosphere from burning fossil fuels is less than 4 percent of the ongoing large natural exchange of CO_2 between Earth's atmosphere, land masses, and oceans. CO_2 is a trace gas that makes up only about 0.04 percent, by volume, of all gases in the atmosphere, up from about 0.03 percent in 1910.

CO_2 in the atmosphere does not harm humans directly. In confined spaces, such as in submarines or spacecraft, CO_2 concentrations can build up and threaten human health and safety—but only at concentrations that are more than 20 times the current trace levels in our atmosphere. Nuclear submarines commonly contain 5,000 parts per million (ppm) of CO_2 when submerged, and only after more than a month.[21]

[21] Ola Persson and Lars Wadsö, "Indoor air quality in submarines," Hal Levin, ed., Ninth International Conference on Indoor Air Quality and Climate, 2002, pp. 806–11, http://portal.research.lu.se/portal/sv/publications/indoor-air-quality-in-submarines(354e50b5-7e4f-467d-a5ae-6c3c0e2e77c5).html.

Life on Earth would begin to fade at half of today's CO_2 levels, and much of it would almost die out completely at one-quarter of today's values. Geologic history shows life flourished abundantly at double and triple the current levels.[22] The recent increase in the amount of CO_2 in Earth's atmosphere has produced a significant greening effect and reduced the amount of water needed for growth. Transpiration of water from plants declines significantly as CO_2 concentrations increase.

A study of satellite photographs by Rang Myeni and a team of researchers at Boston University found during the past 30 years, 20 percent of Earth's surface became greener. Only 3 percent of Earth browned.[23] This finding is extremely important, because as CO_2 increases, so does plant growth, and plants produce more oxygen, pushing the system toward equilibrium.

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The magnitude of the greenhouse effect associated with an atmospheric component depends on its capacity to modify heat radiated to space by Earth's surface and atmosphere. For the CO_2 molecule, the dominant and only effective absorption band lies at the wavelength of 15 microns in the infrared.[24] There is already so much CO_2 in Earth's atmosphere that adding additional CO_2 would likely make relatively little difference to the radiative forcing. The forcing is no longer proportional to the CO_2 concentration, as it would be for much smaller concentrations; instead, it's proportional to the logarithm of the concentrations. Thus, if doubling CO_2 were to increase the forcing by 4 watts per square meter (Wm^{-2}), a number often used by IPCC,[25] one would have to quadruple the CO_2 concentration to get twice as much forcing, or 8 Wm^{-2}.

No one knows if 4 Wm^{-2} is the correct forcing for a doubling of CO_2. It is a purely theoretical number that involves averaging factors over the entire surface of Earth, from the warm tropics to the frigid poles. One must also average the complicated altitude profiles of temperature, pressure, and clouds. One reason climate models have been so poor at predicting future climatic changes is likely a result of scientists making incorrect guesses about the values of many key parameters, including those just mentioned.

Similarly, additional amounts of CO_2 added to the atmosphere absorb correspondingly less radiant heat from the surface and produce a reduced amount of warming from the greenhouse

[22] An interview with William Happer, "Focused Civil Dialogue on Global Warming," The Heartland Institute, p. 27, (Originally published by TheBestSchools.org, 2017), https://www.heartland.org/_template-assets/documents/policy-documents/William%20Happer%20Interview%20on%20Global%20Warming.pdf.

[23] *Ibid.*, p. 39.

[24] W.D. Collins *et al*., "Radiative forcing by well-mixed greenhouse gases*:* Estimates from climate models in the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report (AP4)," *Journal of Geophysical Research*, Vol. 111, 2006, doi:10.1029/2005JD006713.

[25] Gunnar Myhre *et al*., "New estimates of radiative forcing due to well-mixed greenhouse gases," *Geophysical Research Letters*, Vol. 15, 1998, pp. 2,715–18.

effect. Indeed, the first 20 ppm of CO_2 added produces more warming than the next 400 ppm.[26] This saturation effect means that nearly all the warming potential of CO_2 has been realized at concentrations in the atmosphere of less than 100 ppm. Concentrations higher than 100 ppm produce negligible warming, including the pre-Industrial level of 280 ppm and the feared doubling to 560 ppm. Atmospheric CO_2 is not capable of producing catastrophic global warming because warming potential is essentially exhausted after relatively low levels of additional CO_2 have been added.[27]

Because these facts are often omitted from alarmists' climate models, the models fail to describe the actual, measurable temperature of Earth's atmosphere.

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B. Climate Sensitivity

Properly calculating the sensitivity of global mean surface temperature (GMST) to atmospheric concentrations of CO_2 and other so-called greenhouse gases (GHGs) that can absorb infrared radiation from Earth's surface is crucial in determining whether those gases will warm the atmosphere. It has been shown using simple experiments GHGs can absorb such radiation, but it has not been proven this absorption causes a temperature increase in the gas itself.

IPCC uses two primary metrics—equilibrium climate sensitivity (ECS) and transient climate response (TCR)—to describe the sensitivity for doubling CO_2 concentrations in the atmosphere. Despite decades of research, the climate science community has made no progress in reducing the uncertainty range of its ECS metric. Even the CSSR acknowledges, "Various lines of evidence constrain the likely value of climate sensitivity to between 2.7°F and 8.1°F (1.5°C and 4.5°C)."[28] Several published papers that used physical data to determine ECS and TCR concluded ECS is within or below the lower half of this uncertainty range.[29]

Although CSSR's authors acknowledged such research findings exist, they chose to promote climate simulation models as a valid method for determining ECS and TCR, and, therefore, continued to emphasize global warming concerns and predictions resulting from climate models that represent ECS sensitivity at or beyond the upper limit of the uncertainty range. Christopher

[26] Based on work by Richard Lindzen and Yong-Sang Choi, "On the determination of climate feedbacks and Its Implications," *Asia-Pacific Journal of Atmospheric Sciences*, Vol. 47, No. 4, 377–90, 2011, http://www-eaps.mit.edu/faculty/lindzen/236-Lindzen-Choi-2011.pdf.

[27] J.K. Ward *et al*., "Carbon starvation in glacial trees recovered from the La Brea tar pits, southern California," *Proceedings of the National Academy of Sciences of the United States of America*, Vol. 102, No. 3, January 18, 2005, 690–94, http://www.jstor.org/stable/3374310?seq=1#page_scan_tab_contents.

[28] D.J. Wuebbles *et al*., *supra* note 1, p. 148.

[29] See Alexander Otto, *et al*., "Energy budget constraints on climate response," *Nature Geoscience*, Vol. 6, May 19, 2013, pp. 415–16, http://www.nature.com/articles/ngeo1836; Nicholas Lewis and Judith Curry, "The implications for climate sensitivity of AR5 forcing and heat uptake estimates," *Climate Dynamics*, Vol. 45, Nos. 3–4, 2015, pp. 1009–23, https://link.springer.com/article/10.1007/s00382-014-2342-y.

Monkton and his coauthors identified 27 peer-reviewed articles "that report climate sensitivity to be below current central estimates"[30]

If CSSR were the honest overview of the state of climate science its authors claim it is, this work would have been cited and reviewed, not ignored.

C. Trajectory of GHG Concentrations in the Atmosphere

CSSR's authors do not attempt to credibly calculate the most probable atmospheric greenhouse gas concentration trajectory, a calculation that is essential for accurately predicting global warming. Instead, they base their atmospheric GHG projections on hypothetical future scenarios presented in the IPCC's *Fifth Assessment Report* (AR-5). The future global emissions scenarios analyzed in the AR-5 report were called "representative concentration pathways" (RCPs) and included numerical ratings that indicated their projected global temperature forcing strength in the year 2100 relative to the year 1750 baseline (measured in units of Watts/m^2 of Earth's surface area).

As demand for energy and energy prices rise, fossil-fuel supplies would be strained, making other energy sources more economical. Technological advances will also make fossil-fuel use more efficient.

The only scenario presented that did not assume some degree of worldwide GHG emissions controls would be implemented (the only "business as usual" scenario) was given the designation "RCP8.5," indicating this scenario would create 8.5 Watts/m^2 GHG forcing of global temperature in 2100. However, RCP8.5 is not a "middle of the road," "business as usual" scenario. It assumes abnormally high estimates of world population growth and energy usage. It further assumes there will be few, if any, technological improvements in energy efficiency that would result in lower per-capita atmospheric CO_2 and other GHG concentration growth that would achieve the 90th percentile level of any emissions scenario ever published in the technical literature.[31]

The RCP8.5 scenario does not take into account the potential for fossil-fuel supply and demand changes or price elasticity; as demand for energy and energy prices rise, fossil-fuel supplies would be strained, making other energy sources more economical.

The RCP8.5 scenario ignores these facts. Further, the scenario assumes by 2100, there will be 930 ppm of CO_2 in the atmosphere. This is 55 percent more than the 600 ppm of CO_2 that could be generated by burning all the currently known worldwide reserves of coal, oil, and natural gas, according to the U.S. Energy Information Administration's estimates.[32]

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[30] Christopher Monckton *et al*., "Keeping it simple: the value of an irreducibly simple climate model," *Science Bulletin*, Vol. 60, No. 15, August 2015, pp. 1378–90, footnotes 7–33.

[31] Keywan Riahi *et al.*, "RCP 8.5—A scenario of comparatively high greenhouse gas emissions," *Climatic Change*, Vol. 33, No. 109, November 2011, https://link.springer.com/article/10.1007/s10584-011-0149-y.

[32] Harold H. Doiron, "Recommendations to the Trump Transition Team Investigating Actions to Take at the Environmental Protection Agency (EPA): A Report of The Right Climate Stuff Research Team," November 30, 2016, p. 20,

The Right Climate Stuff (TRCS) research team of retired NASA scientists and engineers developed and validated a simple algebraic model for forecasting global mean surface temperature and the threat of manmade global warming as a function of any proposed future atmospheric CO_2 concentration projection. [33,34] The TRCS model uses the transient climate sensitivity (TCS) variable for warming resulting from a doubling of atmospheric CO_2, but unlike other models, the TRCS model bases its variable rise rate of atmospheric CO_2 concentration on what has been discovered in the historical record. Additionally, a constant, "beta," is included with the TCS metric that's also based on historical data to account for warming effects of greenhouse gases other than CO_2 and aerosols.[35] The derivation and validation of this model is presented in a report the TRCS team submitted to the Trump Transition Team in November 2016.[36]

The TRCS research team developed two scenarios, RCP6.0 and RCP6.2, both of which avoid the flaws of the RCP8.5 scenario used by IPCC and adopted by the CSSR researchers. The RCP6.0 and RCP6.2 models project CO_2 concentrations of 585 ppm and 600 ppm, respectively, by the year 2100.

These scenarios determined a market-driven transition to alternative energy sources would need to begin by 2060 to meet the growing worldwide energy demand for rising prices for declining reserves of coal, oil, and natural gas.

These scenarios determined a market-driven transition to alternative energy sources would need to begin by 2060 to meet the growing worldwide energy demand for rising prices for declining reserves of coal, oil, and natural gas. The RCP6.0 scenario projects this transition to alternative fuels will be complete by 2130 and the RCP6.2 scenario considers that this transition will be completed in 2100. The IPCC AR-5 report also presented an RCP6.0 scenario that assumed only modest CO_2 emissions controls would be implemented before 2100. The two RCP6.0 scenarios, both the one by IPCC and the TRCS team's model, projected similar trajectories of CO_2 concentration in the atmosphere by 2100, but the IPCC assumes worldwide controls on the use of fossil fuels, while the TRCS projection considers market forces of supply and demand and a depleting supply of worldwide reserves of coal, oil, and natural gas.

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http://nebula.wsimg.com/1ca304a328496c0c011ac02790fc56ed?AccessKeyId=4E2A86EA65583CBC15DE&disposition=0&alloworigin=1.

[33] See therightclimatestuff.com.

[34] Harold H. Doiron, *supra* note 32.

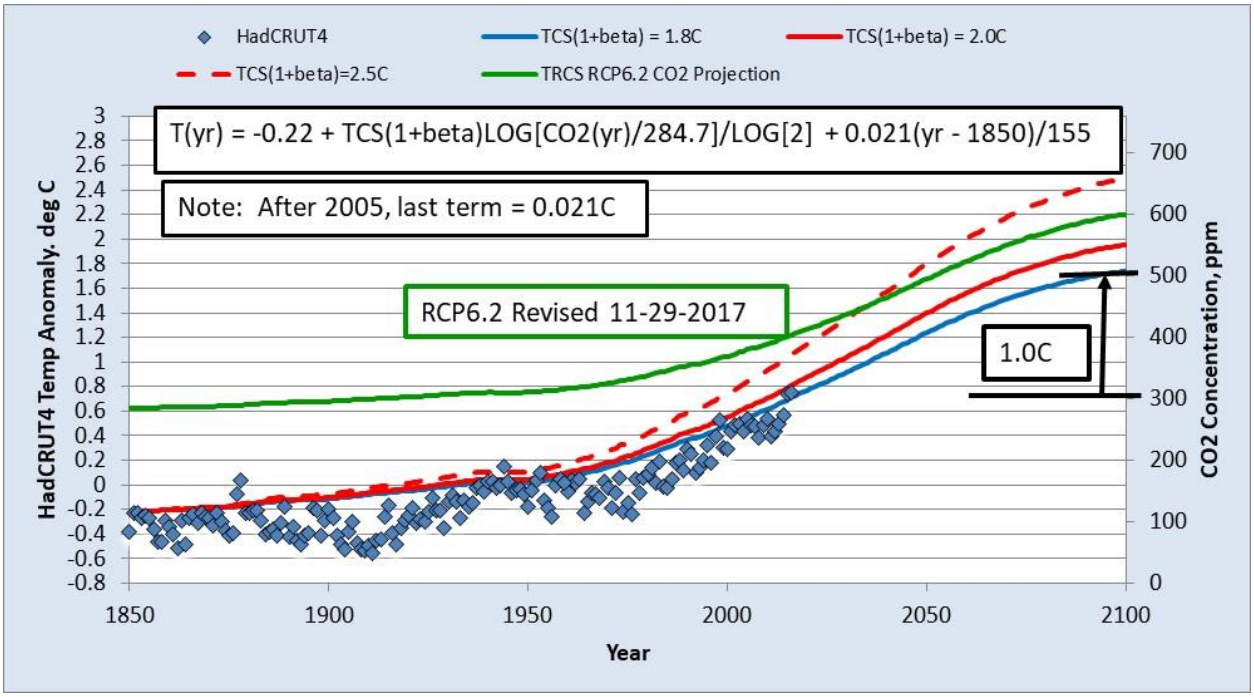
[35] The sensitivity variable is known as the transient climate sensitivity metric, and in the TRCS model, it is equivalent to the IPCC's TCR metric, except that TCS is based on accurate recorded data. With the *beta* variable, the sensitivity metric is TCS(1+beta)=1.8 degrees Celsius in warming for a doubling of CO_2, where beta accounts for the warming of GHG other than CO_2.

[36] Harold H. Doiron, *supra* note 32.

Large U.S. energy companies are much better at forecasting the availability of fossil fuels in the future than IPCC climate scientists. Energy companies must invest billions of dollars based on their forecasts, so they have a much stronger incentive to develop accurate models. The 25-year forecasts for coal, oil, and natural gas consumption published by Exxon Mobil[37] and British Petroleum[38] for 2040 align closely with the fossil-fuel consumption estimates included in TRCS' RCP6.0 and RCP6.2 scenarios.

Figure 3 shows the extent to which the TRCS model for forecasting global mean surface temperature matches historical data, as well as the model's GMST forecast for 2100, based on the RCP6.2 scenario.

Figure 3
Temperature Data and Best Predictive Model



TRCS validated model with RCP6.2 greenhouse gas and aerosol projections. *Source:* The Right Climate Stuff team, therightclimatestuff.com, accessed February 16, 2018, http://nebula.wsimg.com/1ca304a328496c0c011ac02790fc56ed?AccessKeyId=4E2A86EA65583CBC15DE&disposition=0&alloworigin=1.

[37] "The Outlook for Energy: A View to 2040," Exxon Mobil, 2016, http://cdn.exxonmobil.com/~/media/global/files/outlook-for-energy/2016/2016-outlook-for-energy.pdf.

[38] "BP Energy Outlook to 2035," British Petroleum, 2016, https://www.bp.com/content/dam/bp/pdf/energy-economics/energy-outlook-2016/bp-energy-outlook-2016.pdf.

The temperature anomaly database, HadCRUT4, which dates back to 1850, was used to estimate global mean surface temperature. The CO_2 concentration since 1850 and the RCP6.2 projection for the remainder of this century are represented by the green curve in Figure 3, with the CO_2 concentration in ppm displayed on the right side on the vertical axis. The sensitivity metric in the model—TCS(1+beta)=1.8 degrees Celsius—is represented by the blue curve. It was found to provide the best fit of the model to the data's long-term temperature increase trends.

The blue curve, the sensitivity metric, threads the narrow path between upper ranges of the temperature data and anomalous data points known to be associated with Super El Niño weather events. Model results with higher values of the sensitivity metric, represented by the red curve and red dashed curve in Figure 3, are clearly too sensitive based on historical CO_2 and global temperature measurements. The GMST increase above current conditions for the TRCS model forecasting the RCP6.2 scenario is limited to less than 1 degree C by 2100.

By contrast, the IPCC's much more complex climate simulation projections, which have temperature sensitivity set at two to three times greater than what is used in the TRCS model, simulate the unlikely IPCC RCP8.5 used by CSSR's authors. The global temperature increase projected for 2100 is 3–5 degrees C, giving the false impression serious global warming is likely.

Part Three
Fallacious Assertions

Throughout the CSSR, multiple claims are made that cannot be verified and/or that fly in the face of scientific evidence.

Throughout the CSSR, multiple claims are made that cannot be verified and/or that fly in the face of scientific evidence. These assertions are not unique to CSSR; many also appear in U.N. and U.S. government reports and are repeated by policymakers, educators, news reporters, celebrities, and opinion leaders—most of whom blindly accept the claims as true without weighing the ample evidence to the contrary. It is crucial scientists, researchers, and others with an interest in discussing objective scientific evidence concerning the causes and consequences of climate change dispel these popular myths and provide inquirers with the best available objective evidence.

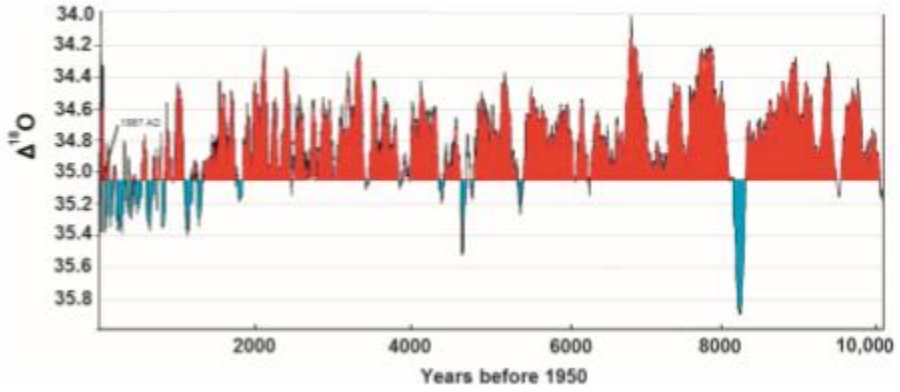
Claim 1: Earth Has Never Been Warmer

The CSSR report's authors assert since at least the end of the 1800s—and especially since the 1960s—there has been a particularly high global temperature increase that's unquestionably associated with human activities.[39] Geologic data, however, put this contention in a fuller context, revealing there has been much more warming in the past resulting from natural causes than from human causes.

[39] D.J. Wuebbles *et al., supra* note 1, p. 126.

The CSSR report alleges annually calculated global average surface air temperature increased by about 1 degree C, or 1.8 degrees Fahrenheit, during the 115-year period from 1901 to 2016,[40] making this era the warmest in the history of modern civilization.However, Greenland Ice Sheet Project Two (GISP2) ice cores show 1,500 to 10,000 years ago, global temperature was 1.1–2.8 degrees C warmer than at present.[41] (See Figure 4.) These findings are validated by global glacial advances and retreats, oxygen isotope data from cave deposits, tree ring data, and historic records. The most recent interglacial period, about 120,000 years ago, was considerably warmer than the present period, but those data are ignored by CSSR.

Figure 4
Temperatures from Greenland Ice Cores



Greenland GISP2 oxygen isotope curve for the past 10,000 years. The vertical axis is $\delta^{18}O$, which is a temperature proxy. The red areas represent temperatures several degrees warmer than present. Blue areas are cooler times. Note the abrupt, short-term cooling 8,200 years ago and cooling from about 1500 A.D. to present. *Source*: Don Easterbrook, 2016, "Using Patterns to Predict Future Climate Changes," in *Evidence-based Climate Science*, Second Edition, *Elsevier*, p. 398. https://www.elsevier.com/books/evidence-based-climate-science/easterbrook/978-0-12-804588-6.

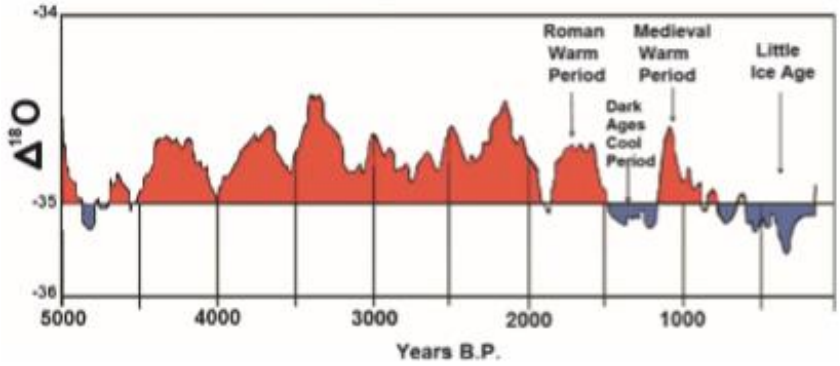
As Don Easterbrook notes, "Within the past 5,000 years, the Roman Warm Period appears prominently in the GISP2 ice core, about 1,500–1,800 years ago. (See Figure 5.) During that period, ancient Romans wrote of grapes and olives growing farther north in Italy than had been previously thought possible, as well as of there being little or no snow or ice."[42]

[40] *Ibid.*, p. 39.

[41] Don Easterbrook, 2016, "Using Patterns to Predict Future Climate Changes," in *Evidence-based Climate Science*, Second Edition, *Elsevier*, p. 398. https://www.elsevier.com/books/evidence-based-climate-science/easterbrook/978-0-12-804588-6.

[42] Don Easterbrook, "Comments on the Fourth National Climate Assessment Climate Science Special Report (NCA-4)," n/d, p. 3.

Figure 5
Recent Warm and Cool Periods

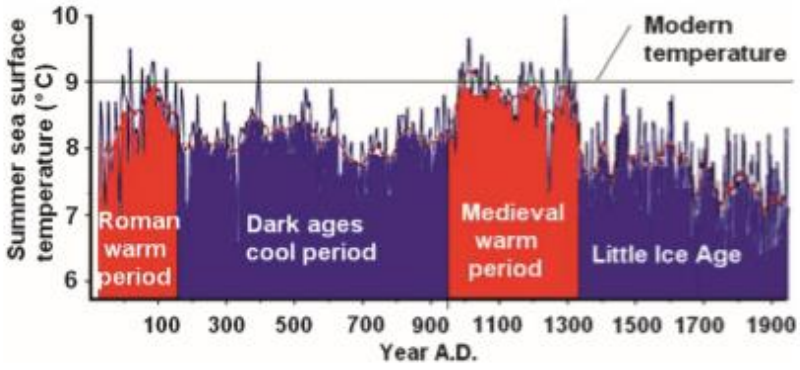


Greenland GISP2 oxygen isotope ratios for the 5,000 years. Red areas are warm periods, blue areas represent cool periods. During the past 5,000 years, global climate was warmer than present until about 1,500 years ago, when cooling occurred. *Source*: Don Easterbrook, "Using Patterns to Predict Future Climate Changes," in *Evidence-based Climate Science*, Second Edition, 2016, *Elsevier*, p. 399.

Elsewhere, Easterbrook elaborates, "Oxygen isotope data from the GISP2 Greenland ice core clearly show a prominent [Medieval Warm Period] between 900 and 1300 AD... It was followed by global cooling and the beginning of the Little Ice Age. The MWP is also conspicuous on reconstruction of sea surface temperature near Iceland … Its effects were evident in Europe, where grain crops flourished, alpine tree lines rose, many new cities arose, and the population more than doubled. The Vikings took advantage of the climatic amelioration to colonize Greenland."[43] (See Figure 6.)

[43] *Ibid*, p. 4.

Figure 6
Warm and Cool Periods from Iceland Data



Summer sea surface temperature near Iceland. *Source*: Don Easterbrook, "Using Patterns to Predict Future Climate Changes," in *Evidence-based Climate Science*, Second Edition, 2016, *Elsevier*, p. 399, modified from Marie-Alexandrine Sicre *et al*., "Decadal variability of sea surface temperatures off North Iceland over the last 200 yrs.," *Earth Planet Science Letters*, Vol. 268, Nos. 3–4, August 2008, pp. 137–42.

Claim 2: CO_2 Is the Dominant Cause of Global Warming

According to CSSR, "This assessment concludes, based on extensive evidence, that it is extremely likely that *human activities, especially emissions of greenhouse gases, are the dominant cause of the observed warming since the mid-20th century*. [Emphasis in original.] For the warming over the last century, there is no convincing alternative explanation supported by the extent of the observational evidence."[44]

CSSR's claim doesn't align well with what scientists now know about the historic CO_2 record. At the time emissions began to rise sharply in the late 1940s, the amount of CO_2 in the atmosphere was minuscule, about 0.030 percent.[45] Since accurate CO_2 measurements first started to be taken, at Mauna Loa in Hawaii in 1957, atmospheric CO_2 has risen at a constant rate, up to about 0.040 percent by 2017.[46] (See Figure 7.) As Easterbrook observed, this is still a relatively tiny amount. "In every 100,000 molecules of air, 78,000 molecules are nitrogen, 21,000 are oxygen, 2,000 to 4,000 are water vapor, and only 40 are CO_2."[47]

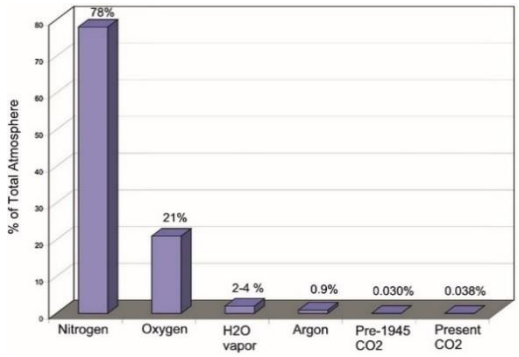
[44] D.J. Wuebbles *et al*., *supra* note 1, p. 10.

[45] Easterbrook, *supra* note 42, p. 5.

[46] Mauna Loa Atmospheric Observatory, NOAA Earth System Research Laboratory, Global Monitoring Division, accessed January 30, 2018, https://www.esrl.noaa.gov/.

[47] Easterbrook, *supra* note 42, p. 6.

Figure 7
Composition of the Atmosphere



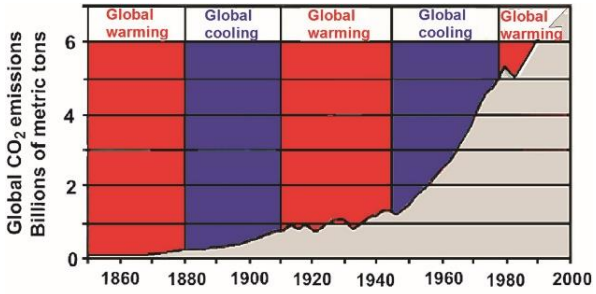
Composition of the atmosphere. CO_2 makes up only 0.04 percent of the atmosphere. *Source*: Easterbrook, *supra* note 41, p. 6.

What, if any, physical evidence exists that might help explain the causes of global warming and cooling? Proponents of the hypothesis CO_2 is a primary driver of global warming contend the presence of both the warming that's occurred since 1978 and rising CO_2 levels shows, without question, CO_2 is the principal cause of the warming. However, correlation does not equate to causation, and it's worth noting the temperature record even fails to perfectly correlate with rising CO_2 emissions—far from it, in fact.

Easterbrook explains, "After 1945, CO_2 emissions soared for the next 30 years, but the climate cooled rather than warmed, showing a total lack of correlation between CO_2 and climate. Then, in 1977, temperature increased, but it did so without any changes to the rate of increase of global CO_2 [emissions]."[48] (See Figure 8.)

[48] *Ibid*.

Figure 8
Rise in CO_2 vs. Warming and Cooling



CO_2 emissions from 1850 to 2000. Note that CO_2 emissions were low during the global warming period from 1850 to 1880 and rose slowly during the deep global cooling period from 1880 to about 1915. Emissions were fairly constant during the strong global warming period from 1915 to 1945. While emissions soared from 1945 to 1977, the global climate cooled rather than warmed, as it should have if CO_2 emissions were the cause of global warming. *Source*: Don Easterbrook, "Using Patterns to Predict Future Climate Changes," in *Evidence-based Climate Science*, Second Edition, 2016, *Elsevier*.

Of the greenhouse gases, CO_2 does not have the greatest warming effect. Water vapor is by far the most important greenhouse gas, accounting for up to 95 percent of the greenhouse effect. Water vapor emits and absorbs infrared radiation at many more wavelengths than any of the other greenhouse gases, and there is substantially more water vapor in the atmosphere than any of the other greenhouse gases.

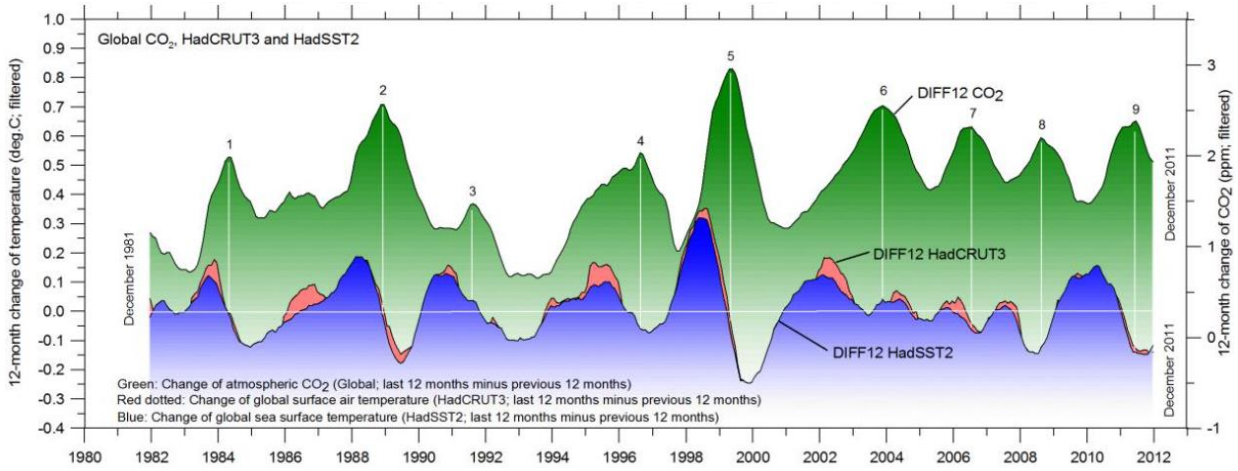
Easterbrook explains, "The effect of water vapor on temperature is especially important because of the United Nations Intergovernmental Panel on Climate Change … claim that CO_2 can cause catastrophic global warming. Because CO_2 is not capable of causing significant global warming by itself, their contention is that increased CO_2 raises temperature slightly and that produces an increase in water vapor, which does have the capability of raising atmospheric temperature. If that is indeed the case, then as CO_2 rises, we should observe a concomitant increase in water vapor. However, … water vapor between 10,000 and 30,000 feet declined from 1948 to 2014."[49]

Supporters of the global warming hypothesis often argue there is a lag time between the rise in CO_2 in the atmosphere and the warming effects it produces, but data show the opposite could be the case. Ole Humlum *et al*., relying on atmospheric CO_2 and global temperature data for the period January 1980 to December 2011, investigated potential leads/lags between temperature and CO_2. They found changes in CO_2 always lagged behind changes in temperature by 9–10 months. They also determined CO_2 levels lagged sea surface temperature by 11–12 months.[50] (See Figure 9.) If these findings are accurate, increases in temperature might cause higher levels of atmospheric CO_2.

[49] *Ibid.*, p. 7.

[50] Ole Humlum, Kjell Stordahl, and Jan-Erik Solheim, "The phase relation between atmospheric carbon dioxide and global temperature," *Tech Knowledge*, 2012, p. 29, http://tech-know-group.com/papers/Carbon_dioxide_Humlum_et_al.pdf.

Figure 9
CO_2 Levels Lag Behind Temperature Increases

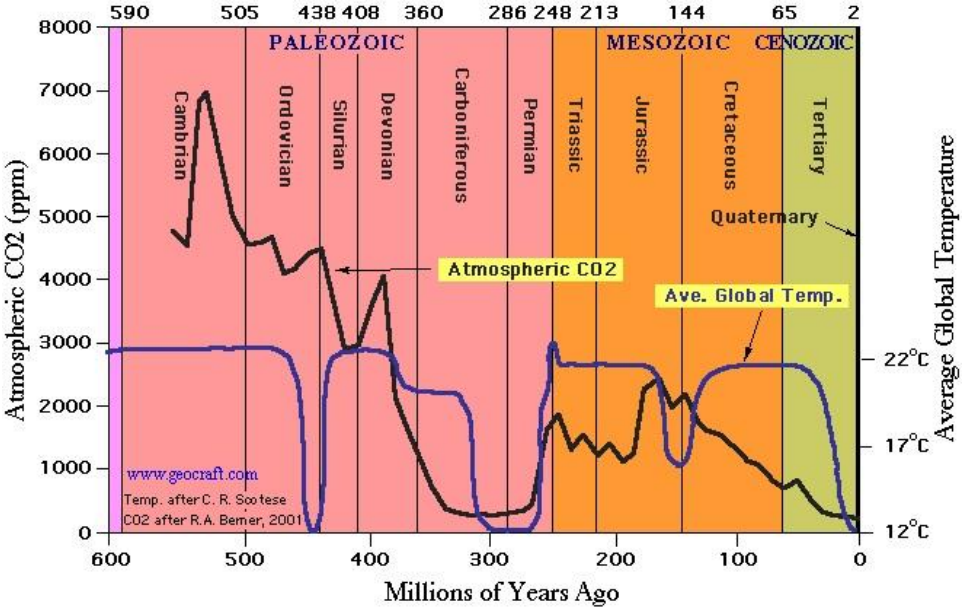


Twelve-month change of global atmospheric CO2 concentration (NOAA; green), global sea surface temperature (HadSST2; blue) and global surface air temperature (HadCRUT3; red dotted). The figure shows filtered values, with DIFF12 being the difference between the average of the last 12 month and the average for the previous 12 months for each data series. *Source*: Image and image description from Ole Humlum, Kjell Stordahl, and Jan-Erik Solheim, "The phase relation between atmospheric carbon dioxide and global temperature," *Tech Knowledge*, 2012, p. 29, http://tech-know-group.com/papers/Carbon_dioxide_Humlum_et_al.pdf.

As Easterbrook explains, "During most of the past 150 million years, atmospheric carbon dioxide levels were 3-5 times higher than they are today. … During this time, life flourished. During the Cretaceous Period (~140 to 65 million years ago), CO_2 levels began to drop sharply, from about 0.20% to something much to 0.04% today. About 2.5 million years ago, the Ice Ages began, with the growth of gigantic ice sheets that advanced and retreated multiple times. During the glacial phases, CO_2 dropped to dangerous low levels to a point close to the minimum required to sustain life. Carbon dioxide levels over the past several million years have been at all-time low."[51]

[51] Easterbrook, *supra* note 41, p. 11.

Figure 10
Highest CO_2 Concentration During the Past 600 Million Years



Throughout the past 600 million years, almost one-seventh of the total age of the Earth, the mode of global surface temperature has been about 22 degrees C, even when carbon-dioxide concentrations peaked at 7,000 parts per million volume, which is almost 20 times greater than today's near-record-low concentration. *Source*: Temperature reconstruction by C.R. Scotese, *Paleo Map Project*, accessed February 20, 2018, http://www.scotese.com/climate.htm; CO_2 reconstruction after Robert A. Berner and Zavareth Kothavala, "Geocarb III: A Revised Model of Atmospheric CO_2 Over Phanerozoic Time," *American Journal of Science*, Vol. 301, February, 2001, pp. 182–204, http://earth.geology.yale.edu/~ajs/2001/Feb/qn020100182.pdf; Chart produced by www.geocraft.com.

Claim 3: Sea Levels Will Rise 1–8 Feet by 2100

Another claim highlighted by CSSR's authors and by many other global warming alarmists is sea levels will rise 1–8 feet by 2100,[52] a prediction completely contradicted by real-world data. To bolster their assertion about rising sea levels, alarmists rely heavily on anecdotal examples, focusing on places such as Bangladesh, Kiribati, Maldives, and the Tuvalu islands.

Consider the situation in Tuvalu.[53] (See Figure 11.) Tide gauge data show a small sea level rise occurred from 1975 to 1985. Some of this rise could have resulted from land subsidence.[54] There

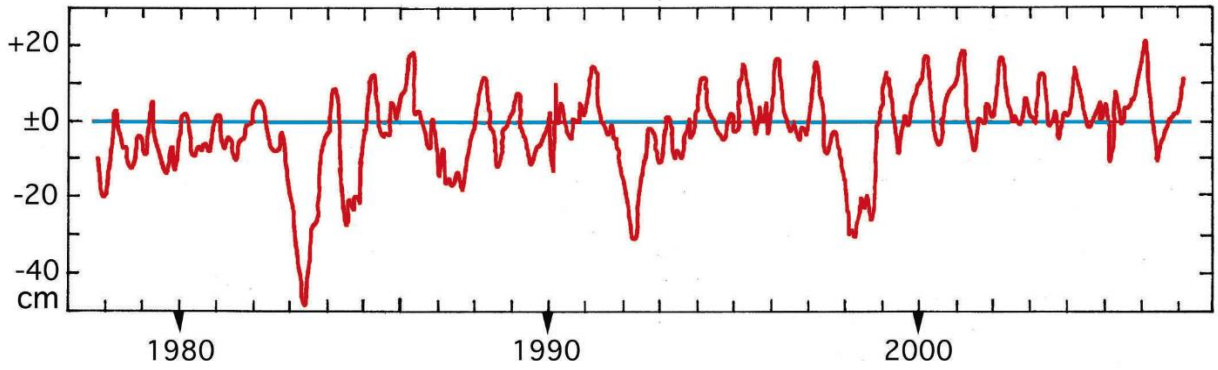
[52] D.J. Wuebbles *et al.*, *supra* note 1, p. 10.

[53] Nils-Axel Mörner, "The Sun rules climate. There's no danger of global sea level rise," *21st Century*, Fall 2007, pp. 31–34; Nils-Axel Mörner, "Some problems in the reconstruction of mean sea level and its changes with time," *Quaternary International*, Vol. 221, 2010, pp. 3–8.

[54] For a discussion of this phenomenon, see Roger Bezdek, "Will Global Warming Overflow the Chesapeake Bay?" *Policy Brief*, The Heartland Institute and Nongovernmental International Panel on

is no pattern of sea level rise after 1985. Four major El Niño Southern Oscillation events (occurring in 1983, 1992, 1998, and 2010) are associated with significant drops in sea level.[55] The same conclusion was reached by researchers at the new high-resolution SEAFRAME tide gauge station in Funafuti, Tuvalu's capital.[56]

Figure 11
Sea Levels at the Islands of Tuvalu



The tide gauge record since 1978 for Tuvalu. *Source*: Nils-Axel Mörner, "Chapter 12 – Sea Level Changes as Observed in Nature," in Don Easterbrook, ed., *Evidence-Based Climate Science*, 2nd ed. (Amsterdam, Netherlands: Elsevier, 2016), pp. 219–31, https://doi.org/10.1016/B978-0-12-804588-6.00012-4.

In a recent study for Nongovernmental International Panel on Climate Change, Dennis Hedke reviewed sea level rise from the beginning of the twentieth century to today and examined projections of sea level rise in 10 coastal cities worldwide. Hedke graphed past sea level increases against CO_2 concentrations and found no pattern of accelerated sea level rise. Most cities showed steady, minor increases consistent with the pattern witnessed in previous centuries, or no sea rise at all. Hedke also found no correlation between sea level rise and CO_2 concentrations.[57]

Sea levels, as calculated in various locations, have been changing steadily for many years, rising or falling at very nearly the same linear rate since about 1800, when Little Ice Age ended. Unlike

Climate Change, October 12, 2017, https://www.heartland.org/_template-assets/documents/policy-documents/Bezdek%20Sea%20Level%20Chesapeake%20Bay.pdf.

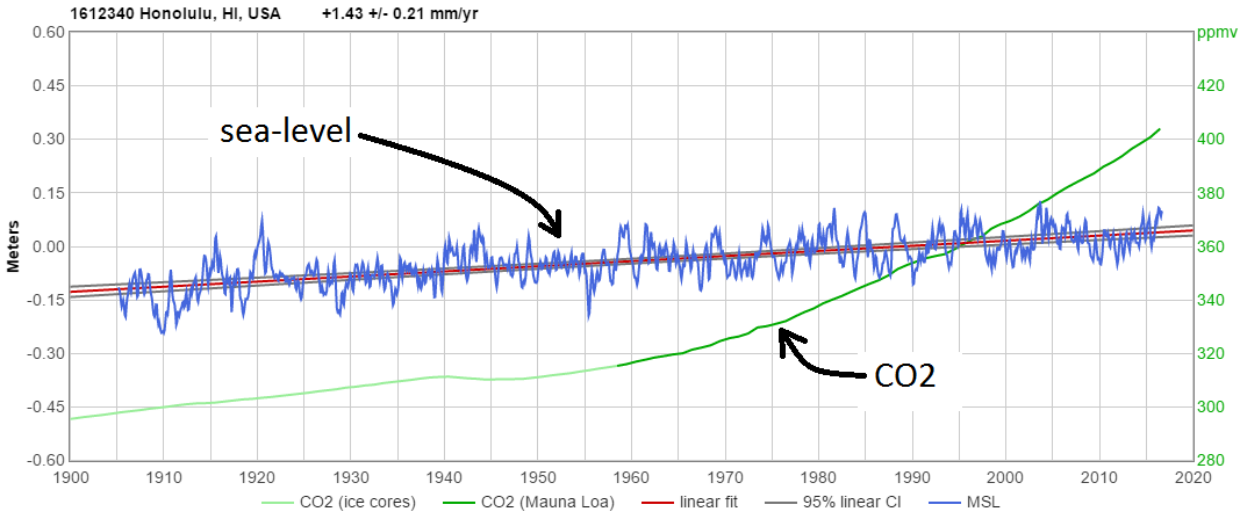
[55] Nils-Axel Mörner, 2007, *supra* note 53; Nils-Axel Mörner, "Sea Level Changes and Tsunamis: Environmental Stress and Migration over the Seas," *Internationales Asienforum*, Vol. 38, 2007, pp. 353–74; Nils-Axel Mörner, "The Maldives: A measure of sea level changes and sea level ethics," *Evidence-Based Climate Science*, Elsevier, 2011, pp. 249–63, doi: 10.1016/B978-0-12-3859563.10007-5.

[56] *Ibid*., Nils-Axel Mörner, 2011.

[57] Dennis Hedke, "Data versus Hype: How Ten Cities Show Sea Level Rise Is a False Crisis," *Policy Brief*, The Heartland Institute and Nongovernmental International Panel on Climate Change, September 18, 2017, https://www.heartland.org/_template-assets/documents/policy-documents/Hedke%20Sea%20Level%20Rise%20Ten%20Cities.pdf.

the more rapid rise of CO_2 in the atmosphere, which has occurred since about 1960, there has been no measurable acceleration seen in tide gauge data. For example, the tide gauge record of the sea level near Honolulu shows no correlation between CO_2 increases and the rate of sea level rise.[58] (See Figure 12.)

Figure 12
Sea Levels in Honolulu



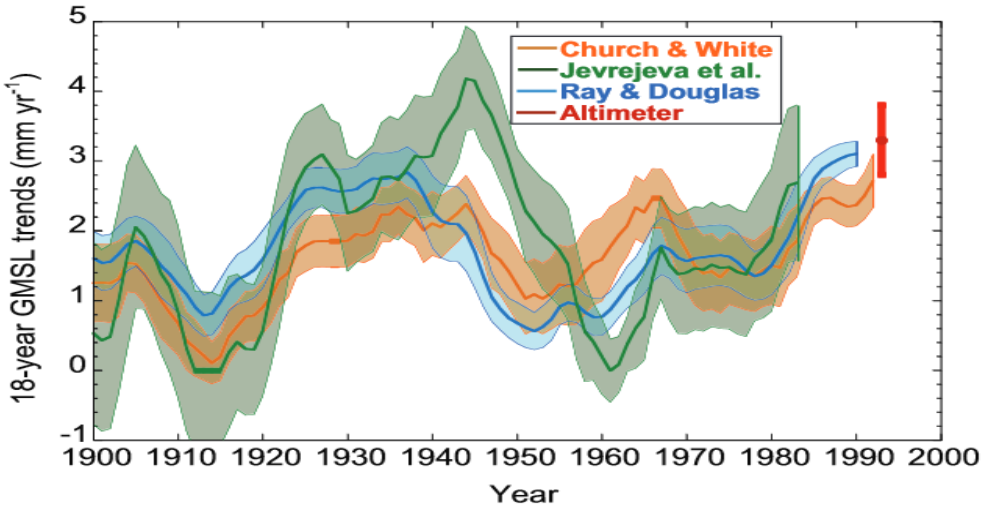
Source: U.S. National Oceanic and Atmospheric Administration, Earth System Research Laboratory, Global Monitoring Division, accessed February 1, 2018, ftp://aftp.cmdl.noaa.gov/products/trends/co2/co2_annmean_mlo.txt and ftp://aftp.cmdl.noaa.gov/products/trends/co2/co2_mm_mlo.txt.

Claims that sea level rise has accelerated during the past two decades rely on recent data only, ignoring the historical context completely. An examination of the historical record dating back to the beginning of the twentieth century—or, indeed, back to the nineteenth century—shows ups and downs of sea level rise, with no obvious long-term acceleration pattern.[59] (See Figure 13.)

[58] Data from the U.S. National Oceanic and Atmospheric Administration and Permanent Service for Mean Sea Level, accessed February 1, 2018, compiled at Sealevel.info.

[59] *Fifth Assessment Report*, Intergovernmental Panel on Climate Change, 2013, Working Group I, Figure 3.14, https://www.ipcc.ch/report/ar5/.

Figure 13
Flat Sea Level Trends

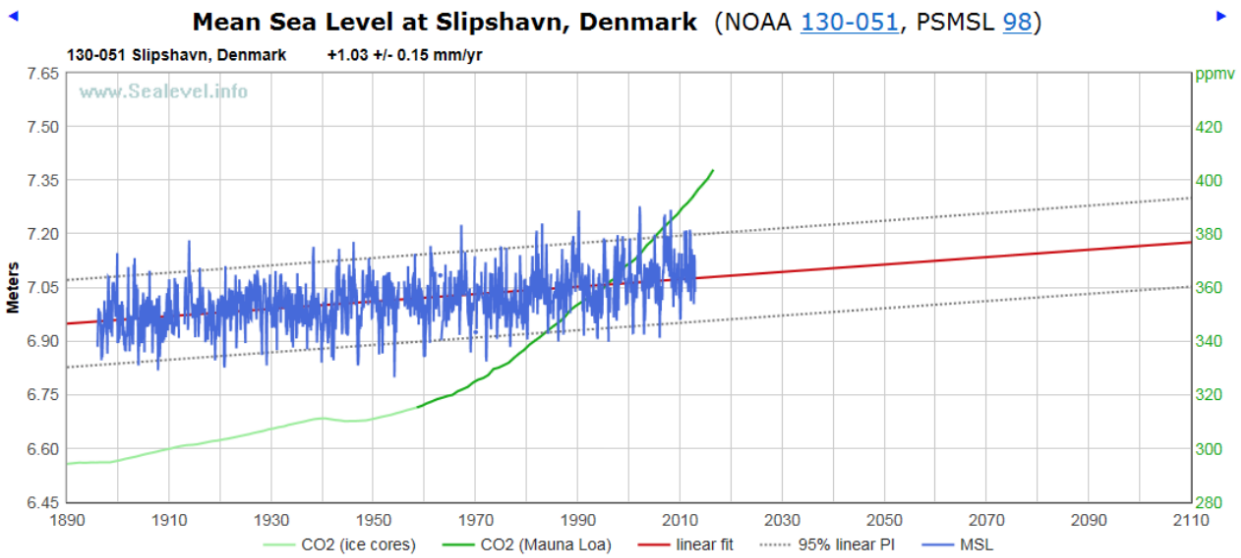


Eighteen-year tends estimated at one-year intervals. The shading represents the 90 percent confidence level. The vertical red bar represents the observed trend since 1993, per satellite altimetry, along with its 90 percent confidence level. *Source*: *Fifth Assessment Report*, Intergovernmental Panel on Climate Change, 2013, Working Group I, Figure 3.14, https://www.ipcc.ch/report/ar5/.

CSSR cites satellite data to support the claim there has been a global 24-year, linear, 3.3-millimeter-per-year sea level rise—nearly three times the actual average rate observed since 1800. These data ignore tectonically inert locations, where the land is neither rising nor falling. In many cases where sea level appears to be rising, land is subsiding, often because of causes that have nothing to do with global warming. For example, over-extraction of groundwater can cause land subsidence.

An example of a tectonically inert location is Slipshavn, Denmark. Records for Slipshavn reveal there has been a linear trend of sea level rise that's one-third of the rate recorded by global satellites.[60] (See Figure 14.) While this is only a single example, to make the case sea level rise will be three times greater than the historical record, proponents of this hypothesis would need to demonstrate the observations are not biased in favor of locations where sea levels seem to be rising for reasons unrelated to higher temperatures. Also note the lack of correlation between the rise in sea level and CO_2 emissions.

Figure 14
Sea Levels in Denmark



Source: Dennis Hedke, "Data versus Hype: How Ten Cities Show Sea Level Rise Is a False Crisis," *Policy Brief*, The Heartland Institute and Nongovernmental International Panel on Climate Change, September 18, 2017, https://www.heartland.org/_template-assets/documents/policy-documents/Hedke%20Sea%20Level%20Rise%20Ten%20Cities.pdf.

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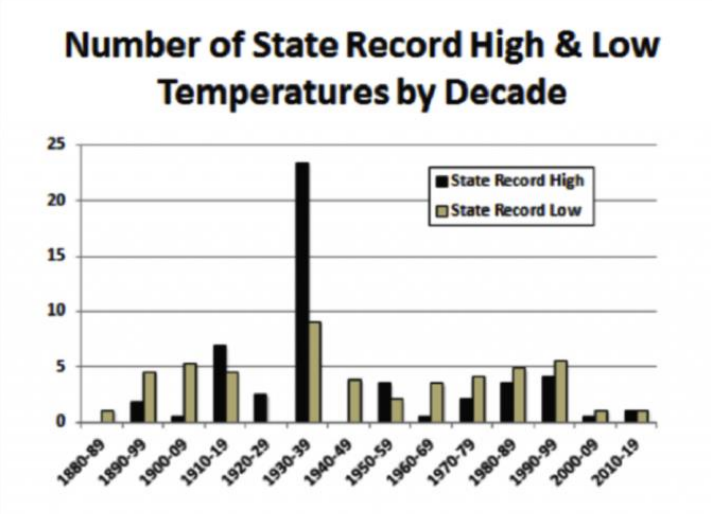
[60] Data from the U.S. National Oceanic and Atmospheric Administration and Permanent Service for Mean Sea Level, *supra* note 58.

Claim 4: Deadly Heat Waves Are Increasing at an Alarming Rate

Global warming alarmists allege global warming is creating a larger number of heat waves and heat-wave-related deaths. The data, however, do not support these claims. The all-time record high for heat waves in the United States happened many years ago—long before CO_2 levels rose because of human activities. Thirty-eight states set their all-time record highs before 1960. Twenty-three states' record highs occurred in the 1930s. (See Figure 15.)

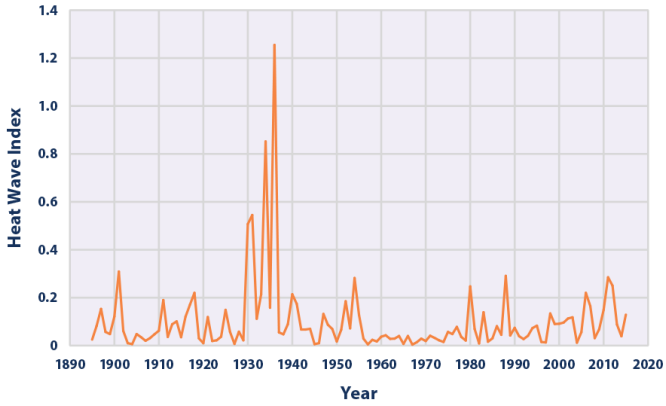
Figure 15
Record High and Low Temperatures



The occurrence of high and low temperature records by decade. The figure shows the decade beginning in 1930 was the most extreme and that since 1960, there have been more all-time cold records set than hot records in each decade. *Source*: Based on data from the U.S. National Oceanic and Atmospheric Administration's National Climatic Data Center, presented by John Christy in testimony before the U.S. House Energy and Power Subcommittee, September 20, 2012, p. 4, https://archives-energycommerce.house.gov/sites/republicans.energycommerce.house.gov/files/Hearings/EP/20120920/HHRG-112-IF03-WState-ChristyJ-20120920.pdf.

In the United States, the number of days per year during which the temperature broke 100 degrees F, 95 degrees F, or 90 degrees F has been steadily declining since the 1930s. Further, the Environmental Protection Agency's Heat Wave Index confirms the 1930s was the decade in the twentieth century with the most heat waves.[61] (See Figure 16.)

Figure 16
EPA's Heat Wave Index Since 1895



This figure shows the annual values of the U.S. Heat Wave Index from 1895 to 2015. These data cover the contiguous 48 states. Interpretation: An index value of 0.2, for example, could mean that 20 percent of the country experienced one heat wave, 10 percent of the country experienced two heat waves, or some other combination of frequency and area resulted in this value. *Source*: K. Kunkel, 2016, updated version of Figure 2.3 in U.S. Climate Change Science Program, "Synthesis and Assessment Product 3.3: Weather and Climate Extremes in a Changing Climate," 2008, www.globalchange.gov/browse/reports/sap-33-weather-and-climate-extremes-changing-climate.

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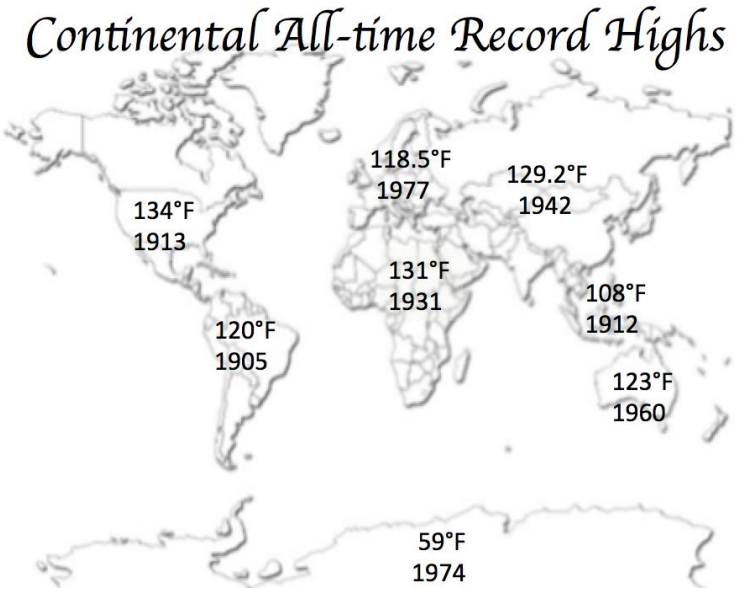
[61] "High and Low Temperatures," Climate Change Indicators, Environmental Protection Agency, accessed February, 17, 2018, https://www.epa.gov/climate-indicators/climate-change-indicators-high-and-low-temperatures.

Some alarmists contend that although heat waves are declining in the United States, they are increasing elsewhere in the world. However, the fact that every continent's record high temperature was recorded before 1980 suggests this contention is open to question. (See Figure 17.)

Figure 17
Record Temperatures Worldwide

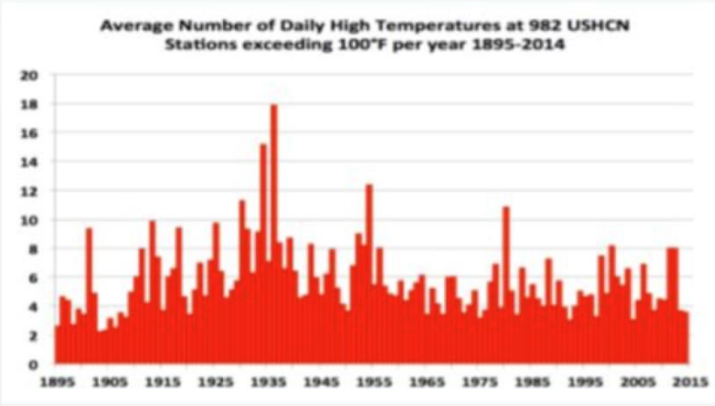


Source: "NRDC latest advocacy group to present the big lie for media consumption," International Climate and Environmental Change Assessment Project, October 23, 2017, http://icecap.us/index.php/go/political-climate/nrdc_latest_advocacy_group_to_present_the_big_lie_for_media_consumption/, citing Tony Heller, "Hot Off The Press: Today's Climate Fraud From NRDC," *The Deplorable Climate Science Blog*, October 24, 2017, https://realclimatescience.com/2017/10/hot-off-the-press-todays-climate-fraud-from-nrdc/.

Data compiled by John Christy also verifies the number of 100 degrees F days recorded in the United States was highest in the 1930s. (See Figure 18.) It is clear from Figure 18 hot days have not increased since the highs of the 1930s, and it is also notable that in recent years, there has been a relative dearth of 100 degree F days. (See Figure 18.)

Figure 18
Average 100+ Degrees F Days Per Year

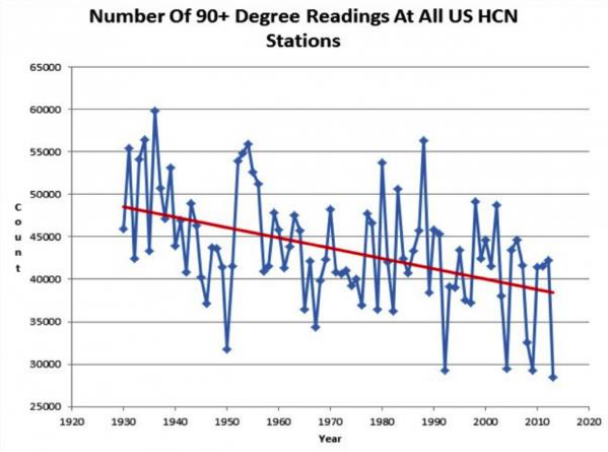
Average number of days per-station in each year reaching or exceeding 100°F in 982 stations of the USHCN database (NOAA/NCEI, prepared by JRChristy).



Average per-station fraction of days in each year reaching or exceeding 100 degrees F in 982 stations of the U.S. Historical Climatology Network database. *Source*: Based on data from the U.S. National Oceanic and Atmospheric Administration's National Centers for Environmental Information, graph prepared by John Christy for testimony before the U.S. House Committee on Committee on Science, Space and Technology, December 11, 2013, p. 2, http://docs.house.gov/meetings/SY/SY18/20131211/101589/HHRG-113-SY18-Wstate-ChristyJ-20131211.pdf.

Data from the U.S. National Oceanic and Atmospheric Administration's (NOAA) U.S. Historical Climatology Network stations also show a downtrend in 90+ degrees F readings. (See Figure 19.)

Figure 19
Downward Trend of 90+ Degrees F Days

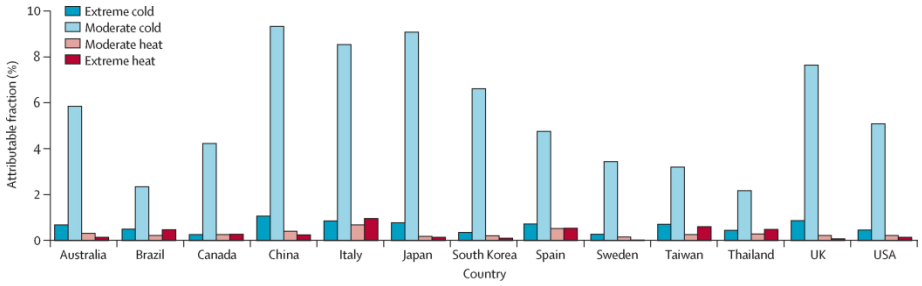


Source: Tony Heller, *The Deplorable Climate Science Blog*, August 28, 2017, based on U.S. National Oceanic and Atmospheric Administration data, https://realclimatescience.com/2017/08/preparing-for-my-paper.

In addition to the temperature record disproving alarmists' assertion about an alleged increase in the number and severity of heat waves, there is an abundance of evidence showing colder weather—and, therefore, climates—are more dangerous than warmer weather.

Twenty times more people die from cold-related rather than heat-related weather events, and an international study published in *The Lancet* that analyzed more than 74 million deaths in 384 locations across 13 countries between 1985 and 2012 found extreme cold weather is much deadlier. "It's often assumed that extreme weather causes the majority of deaths, with most previous research focusing on the effects of extreme heat waves," wrote the lead author of the *The Lancet* paper, Antonio Gasparrini from the London School of Hygiene and Tropical Medicine in the United Kingdom.[62] (See Figure 20.)

Figure 20
Deaths Caused by Cold vs. Heat



Source: Antonio Gasparrini *et al*., "Mortality risk attributable to high and low ambient temperature: A multicountry observational study," *The Lancet*, Vol. 386, July 25, 2015, p. 369, http://www.thelancet.com/pdfs/journals/lancet/PIIS0140-6736(14)62114-0.pdf.

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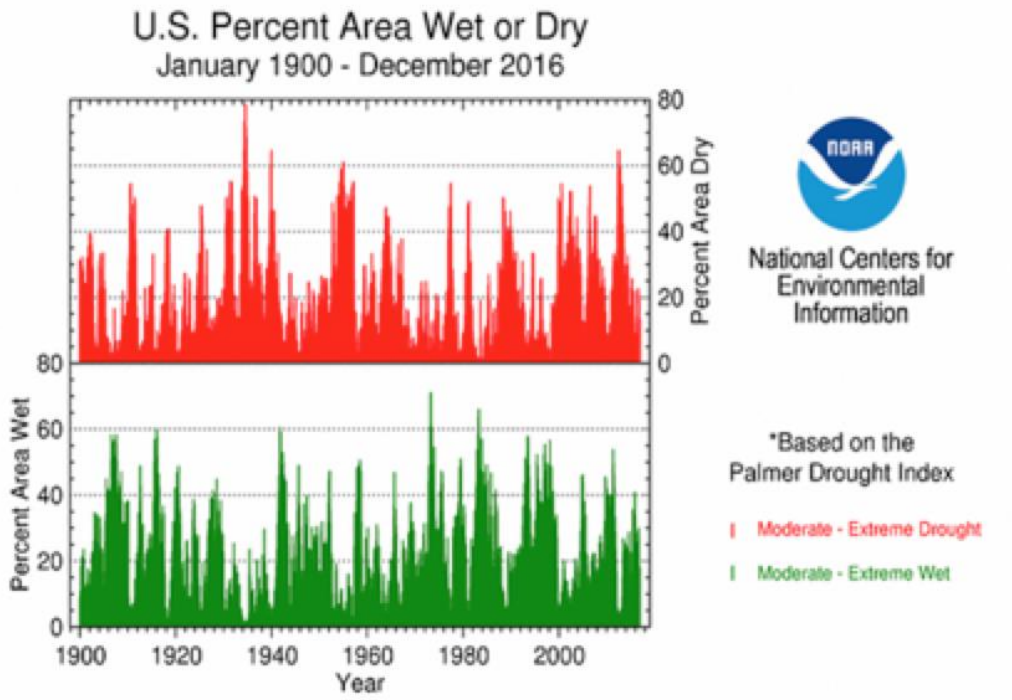
[62] Antonio Gasparrini *et al*., "Mortality risk attributable to high and low ambient temperature: A multicountry observational study," *The Lancet*, Vol. 386, July 25, 2015, p. 369, http://www.thelancet.com/pdfs/journals/lancet/PIIS0140-6736(14)62114-0.pdf.

Claim 5: Droughts and Floods Are Increasing in Magnitude and Frequency

Contrary to the claims made by global warming alarmists, NOAA has found there is no evidence floods or droughts are increasing due to climate change. The number, extent, or severity of these events has been found to increase dramatically for brief periods in some locations, but evidence shows the conditions usually return to normal. (See Figure 21.)

Figure 21
Wet vs. Dry Days in the United States



Source: "U.S. Percentage Areas (Very Warm/Cold, Very Wet/Dry)," National Center for Environmental Information, U.S. National Oceanic and Atmospheric Administration, accessed February 16, 2018, https://www.ncdc.noaa.gov/temp-and-precip/uspa.

In testimony before Congress, Roger Pielke Jr. of the Center for Science and Technology Policy Research at the University of Colorado at Boulder said, "It is misleading, and just plain incorrect, to claim that disasters associated with hurricanes, tornadoes, floods, or droughts have increased on climate timescales either in the United States or globally. Droughts have, for the most part, become shorter, less frequent, and cover a smaller portion of the United State over the last century."[63]

[63] Roger Pielke, testimony before the Committee on Environment and Public Works of the U.S. Senate, July 18, 2013, p. 1, http://sciencepolicy.colorado.edu/admin/publication_files/2013.20.pdf.

David Legates, professor of Climatology at the University of Delaware, said in June 2014 in a requested statement to the Environment and Public Works Committee of the U.S. Senate:

> My overall conclusion is that droughts in the United States are more frequent and more intense during colder periods. Thus, the historical record does not warrant a claim that global warming is likely to negatively impact agricultural activities.

My overall conclusion is that droughts in the United States are more frequent and more intense during colder periods. Thus, the historical record does not warrant a claim that global warming is likely to negatively impact agricultural activities.

> Given the limitations of the models not only in predicting global air temperatures but also in estimating precipitation and soil moisture conditions, it seems that a more reasonable approach is not to rely on the model prognostications, but rather to focus on policies that allow for adaptation to the observed variability in precipitation and soil moisture. Droughts that have happened in the past are likely to occur again, and with likely similar frequencies and intensities; thus, preparation for their return is a better strategy than trying to mitigate them through draconian CO_2 emission control policies.[64]

A 2015 study by Cook *et al.* found megadroughts occurring during the past 2,000 years have been generally worse and lasted longer in periods prior to humans' increased reliance on fossil fuels.[65] Data showing no connection between droughts and climate change have largely been ignored by alarmists, however.

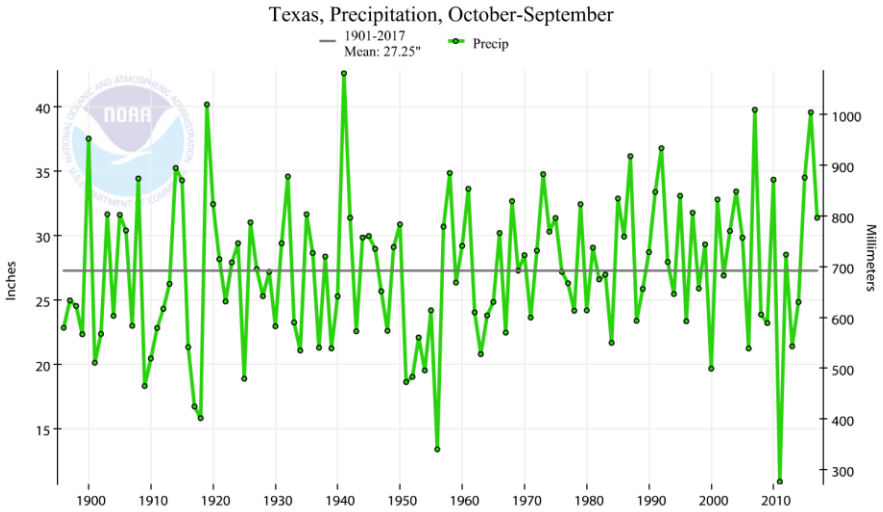
The media and alarmists are often quick to see long-term dangers in short-term, transient event. When an extended drought began in Texas in 2010 and worsened in 2011, there were fears this this event marked the start of a "permadrought." Three wet years followed the Texas drought, culminating in major flooding caused by Hurricane Harvey in 2017. Many alarmists then alleged climate change might be to blame for a new era of severe flood-causing storms.

[64] David Legates, "Statement to the Environment and Public Works Committee," U.S. Senate, June 3, 2014, p. 7, https://www.epw.senate.gov/public/_cache/files/a/a/aa8f25be-f093-47b1-bb26-1eb4c4a23de2/01AFD79733D77F24A71FEF9DAFCCB056.6314witnesstestimonylegates.pdf.

[65] Edward Cook *et al.*, "Old World megadroughts and pluvials during the Common Era," *Science Advances,* Vol. 1, No. 10, November 6, 2015, http://advances.sciencemag.org/content/1/10/e1500561.full.

The most up-to-date precipitation records in Texas reveal there is no precipitation trend, and certainly no correlation between precipitation and increased CO_2 emissions. Instead, it reveals the worst extended period for droughts in Texas, which lasted six years, occurred in the 1950s. (See Figure 22.)

Figure 22
Texas Precipitation Record, October–September

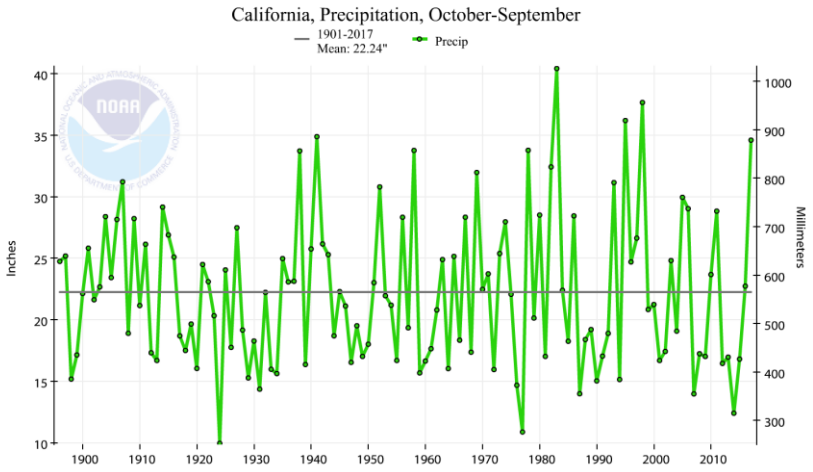


Source: Data and chart from the U.S. National Oceanic and Atmospheric Administration's National Climatic Data Center, https://www.ncdc.noaa.gov.

A similar situation recently occurred in California. After four notably dry years, ending in 2014, global warming alarmists proclaimed the state was facing a permadrought caused by humans' use of fossil fuels. Once again, nature did not take long to disprove alarmists' dire assessment. The California dry period was followed by a record wet and snowy year, which affected much of the U.S. Western region. During the 2016–17 winter season, the Northern Sierra Nevada Mountains experienced heavier snows than at any time in recent years, in complete contradiction to claims made by alarmists.

At one location, there was an accumulation of snow greater than 750 inches. Within months, the alleged California permadrought ended. (See Figure 23.) In late 2017, another dry spell occurred, well in line with the periodic swings in weather that have regularly occurred because of natural cycles.

Figure 23
California Precipitation Record, October–September



Precipitation in California's 2014 "water year" (Oct-Sept). *Source*: Mark Gomez, "California storms: Wettest water year, so far, in 122 years of records," *East Bay Times*, Bay Area News Group, March 8, 2017, reporting based on information from the U.S. National Oceanic and Atmospheric Administration, National Weather Service data, https://www.eastbaytimes.com/2017/03/08/california-storms-wettest-water-year-so-far-in-122-years-of-records.

Claim 6: Global Warming Is Increasing the Frequency and Strength of Hurricanes

Globally, there has been no detectable long-term trend in the amount or intensity of tropical activity, but that hasn't stopped climate change alarmists from suggesting otherwise. The trend in the number of storms making landfall in the United States has been relatively flat since the 1850s. Before the active 2017 hurricane season in the United States, there was a lull in the number of major hurricane landfalls that lasted nearly 12 years, the longest such drought in the United States since the 1860s.[66]

Hurricane activity varies year to year and over multidecadal periods. Activity is affected by numerous factors, including ocean cycles and the El Niño and La Niña oscillations. Data show multidecadal cycles in the Atlantic and Pacific Oceans favor some basins over others.

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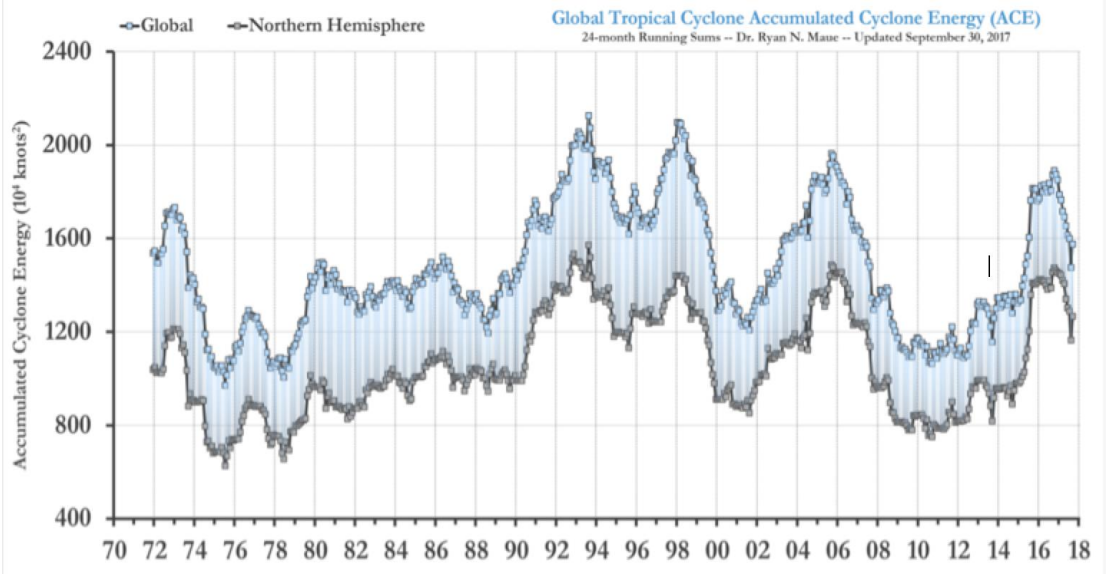
[66] "What is the complete list of continental U.S. landfalling hurricanes?," Hurricane Research Division, Atlantic Oceanographic and Meteorological Laboratory, National Oceanic and Atmospheric Administration, http://www.aoml.noaa.gov/hrd/tcfaq/E23.html.

An evaluation of the Accumulated Cyclone Energy (ACE) Index—which takes into account the number, duration, and strength of all tropical storms in a season—shows over the past 45 years, there has been variability but no trend in tropical storms, both in the Northern Hemisphere and globally.[67] (See Figure 24.)

Figure 24
Cyclonic Energy



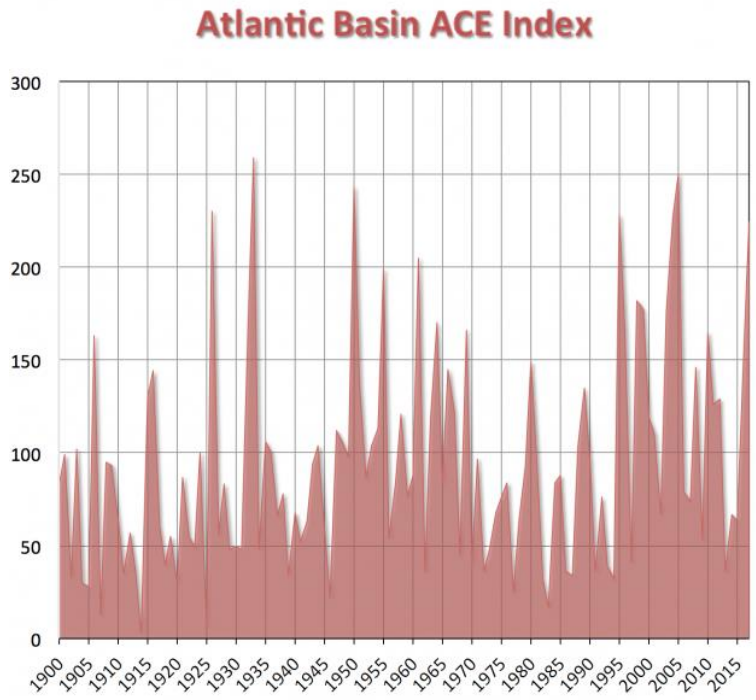
Total count of tropical cyclones of tropical storm (top curve) and hurricane strength, 12-month running sums, 1970 through June 30, 2013. *Source*: See Pielke, *supra* note 63, p. 5, after Ryan N. Maue, "Recent historically low global tropical cyclone activity," *Geophysical Research Letters*, Vol. 38, No. L14803, 2011, http://onlinelibrary.wiley.com/doi/10.1029/2011GL047711/epdf.

[67] Roger Pielke Jr., *supra* note 13, p. 6.

The ACE Index for the Atlantic shows cyclical behavior. There is no long-term trend, but spikes are evident in 1893, 1926, 1933, 1950, 1995, 2004, and 2005. The year 2017 ranks seventh in the ACE Index.

For the Atlantic Basin, ACE displays there has been normal up-and-down variations since 1900. (See Figure 25.)

Figure 25
Atlantic Basin Cyclones



Source: Joseph D'Aleo, "What Made This Hurricane Season So Active in the Atlantic?" *The Patriot Post*, October 9, 2017, https://patriotpost.us/opinion/51739-what-made-this-hurricane-season-so-active-in-the-atlantic, from data provided by the Earth System Research Laboratory, U.S. National Oceanic and Atmospheric Administration.

ACE Index data also show there is no evidence recent storms are significantly more powerful, despite a higher global temperature and additional CO_2 emissions.[68] (See Figure 26.)

Figure 26
Cyclonic Energy Records

Rank	Season	ACE
1	1933	259
2	2005	250
3	1893	231
4	1926	230
5	1995	228
6	2004	227
7	2017	224
8	1950	211
9	1961	205
10	1998	182
** As of November 5*		

Source: Joseph D'Aleo, *supra* Figure 25.

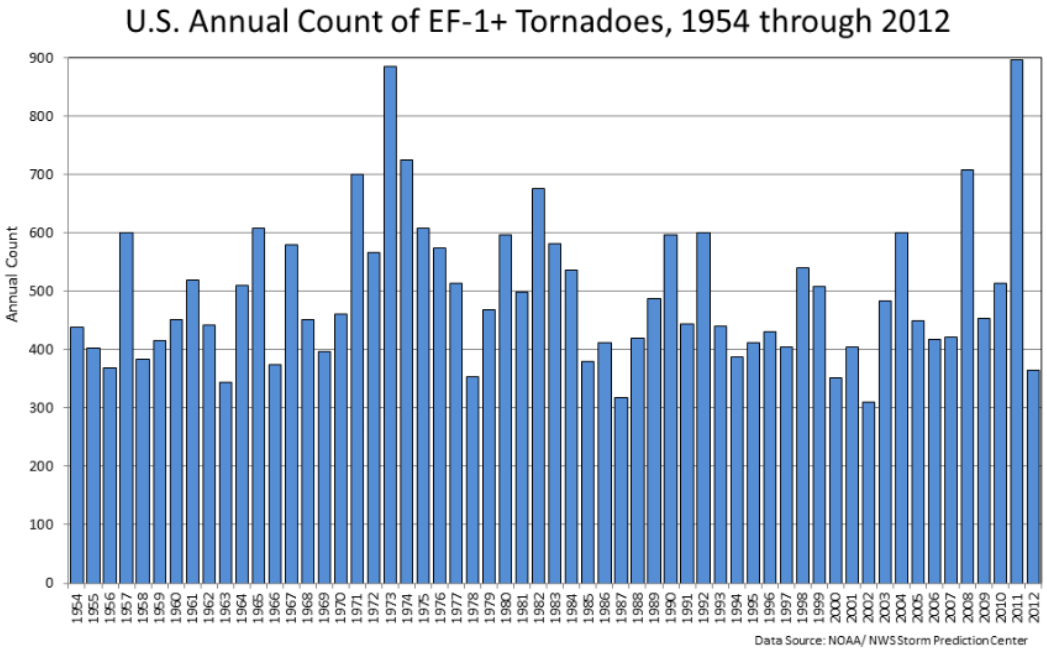
Claim 7: Global Warming Is Increasing the Frequency and Strength of Tornadoes

An increase in the number and severity of tornadoes is another weather-related problem alarmists blame on humans' fossil-fuel use, despite much data to the contrary. Since the 1950s, there has been a drop in the frequency of large tornadoes. The years 2012–16 all experienced below-average—and in some cases, near-record-low—tornado counts in the United States. The 2017 season, the most active in recent years, returned America to its long-term mean.

On the Enhanced Fujita (EF) tornado damage scale, the data reveal there have been additional weak EF-0 tornadoes from 1954 to 2016 compared to previous periods, but the trend has been flat for tornadoes rated as moderate EF-1 or EF-2 storms, as well as for strong tornadoes with an EF-3 intensity rating or higher. (See Figures 27–29.)

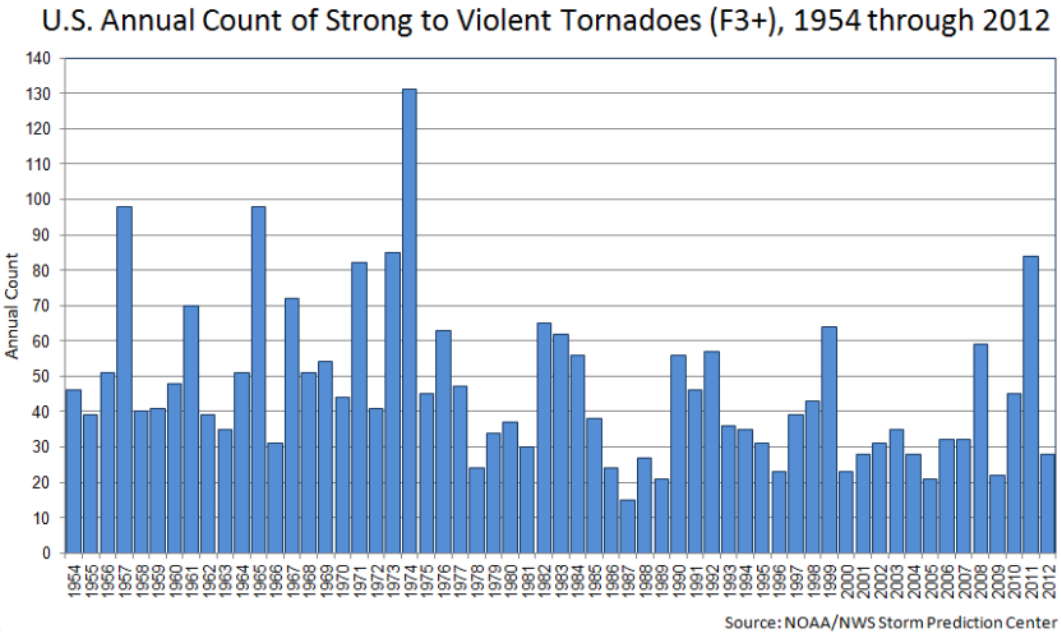
[68] Joseph D'Aleo, "What Made This Hurricane Season So Active in the Atlantic?" *The Patriot Post*, October 9, 2017, https://patriotpost.us/opinion/51739-what-made-this-hurricane-season-so-active-in-the-atlantic, citing data provided by the Earth System Research Laboratory, U.S. National Oceanic and Atmospheric Administration.

Figure 27
Record of Weak Tornadoes



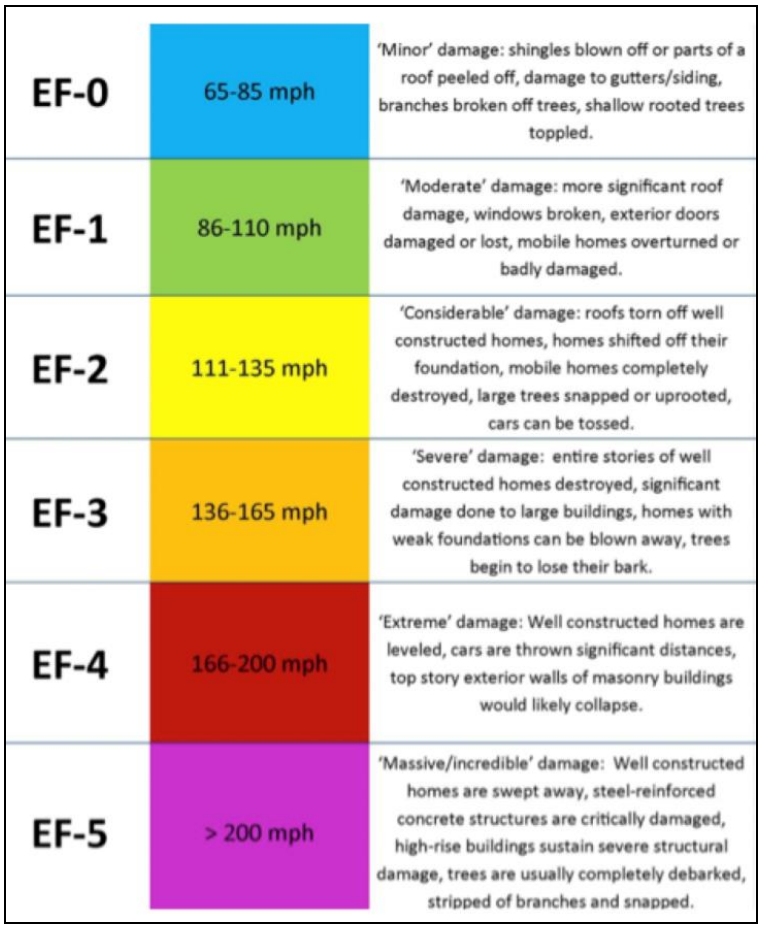
Source: Roger Pielke Jr., from written testimony provided to the House Subcommittee on Environment of the Committee on Science, Space, and Technology, December 11, 2013, http://sciencepolicy.colorado.edu/admin/publication_files/2013.38.pdf.

Figure 28
Record of Strong Tornadoes



Source: Roger Pielke Jr., *supra* Figure 27.

Figure 29
Tornado Classifications

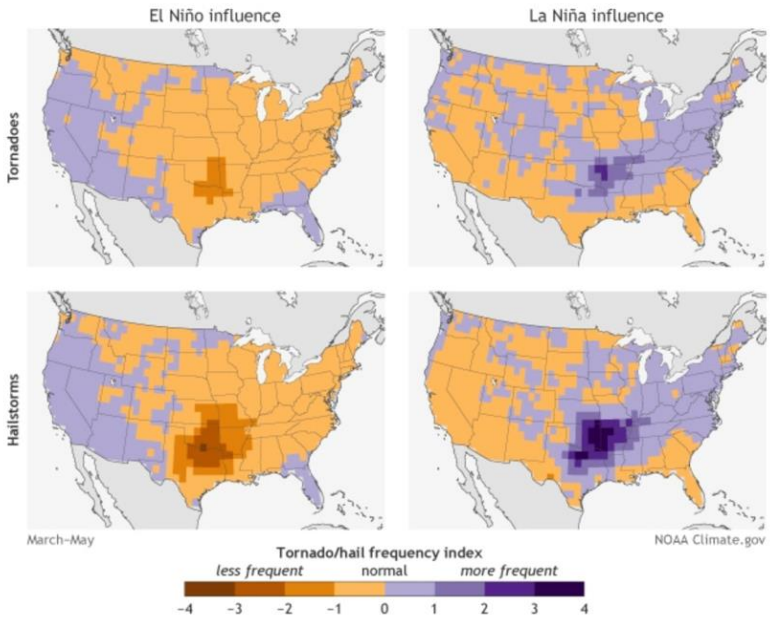


EF-0	65-85 mph	'Minor' damage: shingles blown off or parts of a roof peeled off, damage to gutters/siding, branches broken off trees, shallow rooted trees toppled.
EF-1	86-110 mph	'Moderate' damage: more significant roof damage, windows broken, exterior doors damaged or lost, mobile homes overturned or badly damaged.
EF-2	111-135 mph	'Considerable' damage: roofs torn off well constructed homes, homes shifted off their foundation, mobile homes completely destroyed, large trees snapped or uprooted, cars can be tossed.
EF-3	136-165 mph	'Severe' damage: entire stories of well constructed homes destroyed, significant damage done to large buildings, homes with weak foundations can be blown away, trees begin to lose their bark.
EF-4	166-200 mph	'Extreme' damage: Well constructed homes are leveled, cars are thrown significant distances, top story exterior walls of masonry buildings would likely collapse.
EF-5	> 200 mph	'Massive/incredible' damage: Well constructed homes are swept away, steel-reinforced concrete structures are critically damaged, high-rise buildings sustain severe structural damage, trees are usually completely debarked, stripped of branches and snapped.

Source: Fujita Tornado Damage Scale, U.S. National Oceanic and Atmospheric Administration, National Weather Service, accessed February 20, 2018, http://www.weather.gov/shv/awarenessweek_severe_tornadoes.

Significant tornado outbreaks have been most closely associated with La Niña years, which are more likely to occur when the Pacific Ocean is relatively cold, as it was during the period of the 1950s to the early 1970s, and, more recently, 1999, 2008, 2010, and 2011. (See Figure 30.)

Figure 30
Tornado Outbreak



March–May values of a blend of tornado and hail reports, with a tornado environment index and a hail environment index for El Niño and La Niña years. *Source*: Maps published by climate.gov; data from Michael K. Tippett and Chiara Lepore, "ENSO and Tornadoes," climate.gov, U.S. National Oceanic and Atmospheric Administration, April 27, 2017, https://www.climate.gov/news-features/blogs/enso/enso-and-tornadoes.

The death toll during the strong La Niña of 2011 was the highest experienced since the super outbreak that occurred in 1974, a strong La Niña year.

Some use figures showing costs have increased or more lives have been lost in recent years because of tornadoes. In some regions, that might be true, but it's not because tornadoes are markedly worse or more frequent. Population growth in rural areas has exposed more people to the tornadoes that once roamed harmlessly through open fields. Further, inflation has driven up the perceived cost of repairing tornado-damaged communities.

A warmer climate has not posed additional tornado-related dangers. In fact, fossil-fuel-powered tornado detection systems such as Next Generation Radar (NEXRAD), the growth of trained spotter networks, storm chasers armed with cellular data and imagery equipment, and the proliferation of cell phone cameras and social media have all improved people's chances of survival in the event of a major tornado disaster. Fossil-fuel generation is providing protection from severe storms, not causing them.

Claim 8: Climate Change Is Causing Snow to Disappear *and* Record-Setting Snowfall

Over the past two decades, it has been common for global warming alarmists to say Earth's future will undoubtedly involve ice-free poles and snowless winters—unless, of course, substantial efforts are made to curb fossil-fuel emissions. However, recent record-setting winters have called that contention into question.

In 2009, just one year after many global warming alarmists had predicted there would soon be snowless winters, the entire Mid-Atlantic region experienced record snowfall, in what was then called "Snowmaggedon." (See Figure 31.)

Figure 31
All-Time Record Snowfall

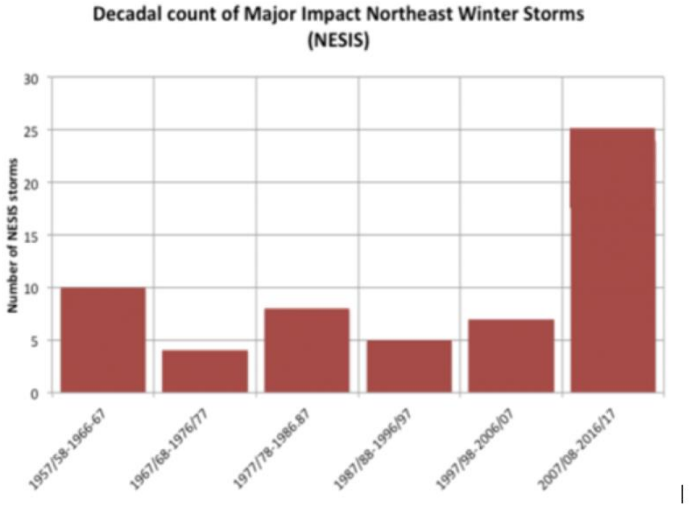
2009/10 All-Time Record Snowfall

City	Snowfall (in)	Previous Record (Year)
Baltimore	79.9	62.5" (1995-1996)
Washington (Dulles International Airport)	72.8	61.9" (1995-1996)
Washington (Reagan National Airport)	55.9	54.4" (1898-1899)
Wilmington, Del.	66.7	55.9" (1995-1996)
Philadelphia	71.6	65.5" (1995-1996)
Atlantic City, N.J.	49.9	46.9" (1966-1967)

Source: Joseph D'Aleo, "Snow drought early season part of a trend?" Junkscience.com, 2012, p. 3, http://junkscience.com/wp-content/uploads/2012/01/snow_201112.pdf.

In some parts of the United States, including the Great Lakes Region, the 2013–14 winter was the coldest and snowiest recorded since the 1800s. Similarly, Northeast communities experienced record-setting snow years and 25 major impact snowstorms during the 10-year period that ended in 2017. No other decade has had had more than 10 major impact snowstorms.[69] (See Figure 32.)

Figure 32
Number of Major U.S. Northeast Winter Storms



Source: Joseph D'Aleo, "Even with warm 2015/16 winter, US 20+ year trends are still down," December 14, 2016, http://icecap.us/index.php/go/joes-blog/even_with_warm_2016_17_winter_us_20_year_trends_are_still_down, using data from U.S. National Oceanic and Atmospheric Administration's Northeast Snow Impact Scale, https://www.ngdc.noaa.gov/docucomp/page?xml=NOAA/NESDIS/NCDC/Geoportal/iso/xml/C00453.xml&view=getDataView&header=none.

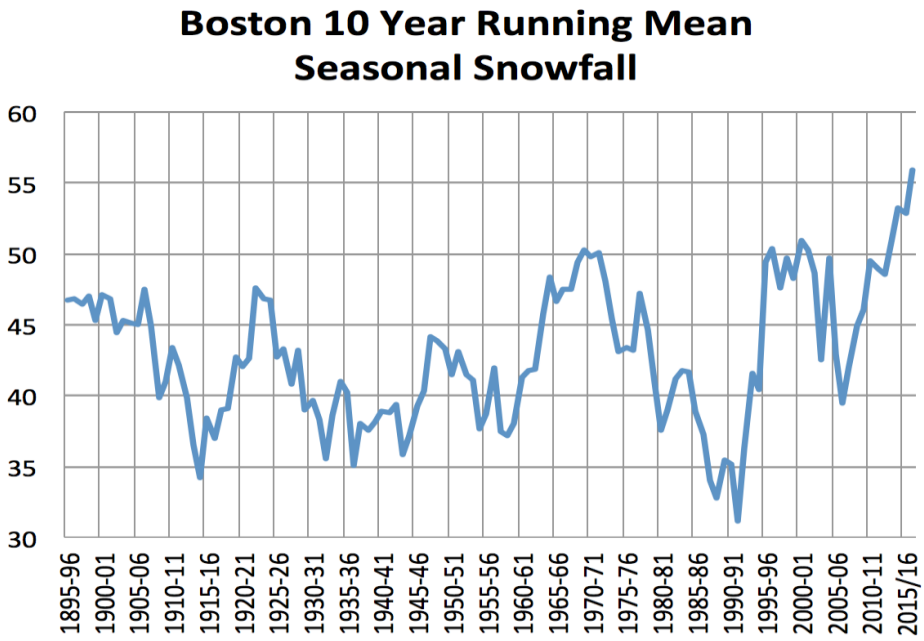
The 2014–15 winter season in Boston, MA broke snowfall records dating back to 1872. In six weeks, more than 100 inches of snow fell in the Boston area. It was also the coldest January–March period in the history of Boston and much of the Northeast.[70]

[69] Joseph D'Aleo, "Even with warm 2015/16 winter, US 20+ year trends are still down," December 14, 2016, http://icecap.us/index.php/go/joes-blog/even_with_warm_2016_17_winter_us_20_year_trends_are_still_down, using data from U.S. National Oceanic and Atmospheric Administration's Northeast Snow Impact Scale, https://www.ngdc.noaa.gov/docucomp/page?xml=NOAA/NESDIS/NCDC/Geoportal/iso/xml/C00453.xml&view=getDataView&header=none.

[70] Eric Fisher, "The Most Extreme Winter Month Ever Observed in New England?" CBS Boston, February 27, 2015, http://boston.cbslocal.com/2015/02/27/the-most-extreme-winter-month-ever-observed-in-new-england.

Boston's 10-year running mean snowfall was at its highest point in recorded history at the end of the 2015–16 winter. The record book dates to the 1880s. (See Figure 33.)

Figure 33
Boston 10-Year Running Mean Snowfall



Source: Joseph D'Aleo, *supra* Figure 32.

The story isn't much different in the United Kingdom and much of Europe. Beginning in 2008, those regions started to receive massive snowfalls relative to previous decades, as well as periods of extreme cold not seen since the days of Charles Dickens in the early 1800s. December 2010 was the second-coldest December recorded in Central England's temperature data, which date back to 1659.

Recent record snowfalls have forced many alarmists to switch their tactics. Now, instead of arguing global warming will soon create snowless winters, they allege climate change is causing larger snowfalls.

Alarmists say the increased moisture created by a higher annual global temperature is one of the primary causes of the larger snowfalls, but this ignores the fact recent major snowstorms have usually occurred in colder winters with dry arctic air, and often with higher snow-to-water equivalent ratios.

For instance, in only one of Boston's 14 winters during which the city endured greater than 60 inches of snowfall was the average temperature warmer than usual.[71] In the 39 days that composed the heart of the 2014–15 winter, when Boston had 100.2 inches of snowfall, melted precipitation was measured at just 5.69 inches, a ratio of 17.6 inches of snow to 1 inch of water. Typically, the snow-to-melted-precipitation ratio is about 10–12 inches to 1 inch.[72]

Claim 9: Wildfires Are Becoming More Common and Extreme Due to Climate Change

The wildfires that swept through California in October 2017 killed at least 40 people, burned 200,000 acres of forest, and destroyed or damaged more than 14,000 homes. It was widely reported these fires were the worst, most extensive, deadliest ever recorded, and that they were in large part due to climate change.[73]

> Weather and seasonal variations occurring from year to year can cause conditions to be more prone to wildfires and/or for wildfires to become more extreme, but there's no evidence climate change is making conditions more dangerous.

While the 2017 wildfires were tragic events, the number of deaths and structures destroyed must be put in context when determining whether these fires should be considered proof of the claim wildfires are becoming more extreme. From 1930 to 2017, there was a seven-fold increase in California's population, from about 5.7 million to 39.5 million, according to the U.S. Census Bureau. The population increase means more people and homes are now in the path of wildfires, but it also means there is a greater likelihood humans will start a wildfire.

Historically, wildfires have typically been caused by lightning strikes and campfires, but today, most are caused by power lines that have ignited nearby trees. The number of power lines has increased proportionately with California's growing population, so it can be reasoned much of the damage caused by wildfires in California is a result of the state's population growth, not climate change.[74]

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[71] "Observed Weather Reports," National Weather Service Forecast Office for Boston, MA, accessed February 1, 2018, http://w2.weather.gov/climate/index.php?wfo=box.

[72] Joe D'Aleo, "Fact Check UCS Press Release - two years later," International Climate and Environmental Change Assessment Project, January 19, 2016, http://icecap.us/index.php/go/joes-blog/union_of_concerned_scientists_at_unh_continue_to_fail_big_time/.

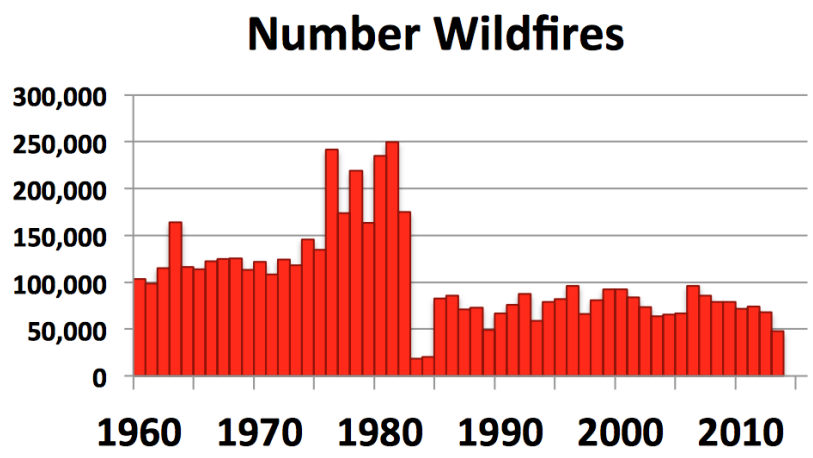
[73] Richard Winton Shelby Grad, "Losses from Northern California wildfires top $3 billion; 14,000 homes destroyed or damaged," *Los Angeles Times*, October 31, 2017, http://www.latimes.com/local/california/la-me-california-wildfire-insurance-claims-20171031-story.html.

[74] Ivan Penn, "Power lines and electrical equipment are a leading cause of California wildfires," *Los Angeles Times*, October 17, 2017, http://www.latimes.com/business/la-fi-utility-wildfires-20171017-story.html.

Weather and seasonal variations occurring from year to year can cause conditions to be more prone to wildfires and/or for wildfires to become more extreme, but there's no evidence climate change is making conditions more dangerous.

Contrary to many media reports, since 1985 in the United States, the number of wildfires and acreage affected are down slightly compared to the previous period, though the amount of acreage burned had increased prior to leveling off during the past 20 years. Further, the National Weather Service (NWS) tracks the number of days during which conditions are conducive to wildfires, and NWS reports little has changed over the past three decades.[75] (See Figure 34.)

Figure 34
Wildfire Data



Number of U.S. wildfires. As the management of these events has changed, the number of wildfires has also changed. However, the number of events since 1985 has remained constant. *Source*: John Christy, testimony before the Commerce, Science, and Transportation Subcommittee on Space, Science and Competitiveness, December 8, 2015, p. 6, https://www.commerce.senate.gov/public/_cache/files/fcbf4cb6-3128-4fdc-b524-7f2ad4944c1d/80931BD995AF75BA7B819A51ADA9CE99.dr.-john-christy-testimony.pdf, citing data from the National Interagency Fire Center, https://www.nifc.gov/fireInfo/nfn.htm.

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[75] Paige St. John, "Gov. Brown's link between climate change and wildfires is unsupported, fire experts say," *Los Angeles Times*, October 18, 2015, http://www.latimes.com/local/politics/la-me-pol-ca-brown-wildfires-20151019-story.html, citing data from Matt Jolly, U.S. Forest Service, Department of Agriculture.

Part Four
Concluding Remarks

CSSR's authors claim their report is "designed to be an authoritative assessment of the science of climate change, with a focus on the United States, to serve as the foundation for efforts to assess climate-related risks and inform decision-making about responses." It is not.

For decades, serious scientists have produced sound work challenging every aspect of global warming alarmists' climate change dogma.

The study suffers from a number of foundational problems. It hides behind the assertion the theory humans are primarily responsible for global warming is "settled science," and it refuses to acknowledge the high degree of uncertainty and many disagreements in the field, making it anything but "authoritative." For decades, serious scientists have produced sound work challenging every aspect of global warming alarmists' climate change dogma, which relies on cherry-picked data and highly questionable assumptions. But alarmists, including those that created the CSSR report, often refuse to address climate realists' research and instead have chosen to politicize climate science, often to their professional and financial benefit.

CSSR also ignores evidence showing many of the computer models the IPCC and others rely on have failed to produce accurate results that match real-world data. The CSSR team plays fast and loose with the scientific method, concealing or omitting important contextual issues so that it can come to the conclusion it had when it began its study: Humans are responsible for climate change, climate change is catastrophic, and only radical government controls will have a measurable impact on climate change projections.

Similarly, CSSR makes several major mistakes concerning the role CO_2 likely plays in the atmosphere. Its authors ignore the limits of CO_2 to absorb heat and effect atmospheric warming, and they make crucial errors about water vapor that greatly impact their final conclusions about CO_2. CSSR's authors promote unsupported assumptions about the sensitivity of global temperature to CO_2 concentrations, and the variables used in the equations the CSSR team relies on to plot the trajectory of future temperature are not based on actual historical data or realistic market assumptions about fossil-fuel use, technological innovation, electricity consumption, population growth, and other vital factors.

CSSR's authors also propagate a series of fallacious claims concerning the alleged impact of global warming, including that Earth has never been warmer; droughts, floods, and wildfires are increasing; and hurricanes and tornadoes are stronger and more frequently observed.

The CSSR team's failure to present its evidence objectively—which would require including data in its report that contradict commonly used global warming alarmist assertions—warrants putting this flawed report alongside the many other flawed reports, studies, and research produced by alarmist U.S. government agencies, the United Nations, and other government bodies that are more interested in using global warming as a political tool than conducting fair scientific analyses.

# # #

About the Editor

Jay Lehr, Ph.D., is science director at The Heartland Institute and one of the nation's most respected and widely cited experts on air and water quality, climate change, and biotechnology. He has testified before Congress dozens of times and helped write the Clean Water Act. For 25 years, he headed the Association of Ground Water Scientists and Engineers.

Dr. Lehr is the author of more than 1,000 magazine and journal articles and 30 books. He is editor of *Rational Readings on Environmental Concerns* (1992), *McGraw-Hill's Handbook on Environmental Science, Health and Technology* (2000), *Wiley's Remediation Technologies Handbook* (2004), *Environmental Instrumentation and Analysis Handbook* (2005), the six-volume *Water Encyclopedia* (Wiley Interscience, 2005), and *Nuclear Energy Encyclopedia: Science, Technology, and Applications* (Wiley Interscience, 2011). He is at work on a new Wiley Interscience volume on shale gas and renewable energy.

Of special note is Dr. Lehr's speaking ability. He has addressed more than 1,000 audiences and currently speaks before approximately 100 audiences per year. He invariably gets the highest approval rating from audiences and often receives a standing ovation. Dr. Lehr brings enthusiasm and humor to a wide range of environmental topics, disarming critics and informing the public about issues often thought too arcane or difficult to communicate.

Acknowledgements

The editor wishes to thank the following scholars for contributing materials and information to or reviewing early drafts of this policy paper.

John R. Christy, Ph.D., is the distinguished professor of atmospheric science and director of the Earth System Science Center at the University of Alabama at Huntsville, where he began studying global climate issues in 1987. Since November 2000, he has been Alabama's state climatologist. He and Dr. Roy Spencer, a former NASA senior scientist and now UAH principle research scientist, received NASA's Exceptional Scientific Achievement Medal for their global temperature monitoring work with satellites.

John Coleman (1934–2018) was a founder of The Weather Channel and the original weathercaster on ABC's *Good Morning America* with David Hartman and Joan Lunden. Prior to passing away, on January 20, 2018, Coleman served as a policy advisor for The Heartland Institute.

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Thomas Wysmuller owns and operates colderside.com. He is a meteorologist, having forecasted weather at Amsterdam's Royal Dutch Weather Bureau and worked at NASA during Apollo. He studied at New York University and Stanford. Wysmuller was administrative director of government relations for Pratt & Whitney. He also produced the polynomial regression mathematics and algorithms used by most climate scientists. In 2016 he chaired the Oceanographic Section of the massive *World Congress on Oceans* at Qingdao, China, and in 2017 keynoted at the Rome Climate Conference.

About The Heartland Institute

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- We produce three monthly public policy newspapers – *Budget & Tax News*, *Environment & Climate News*, and *School Reform News* – which present free-market ideas as news rather than research or opinion.

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