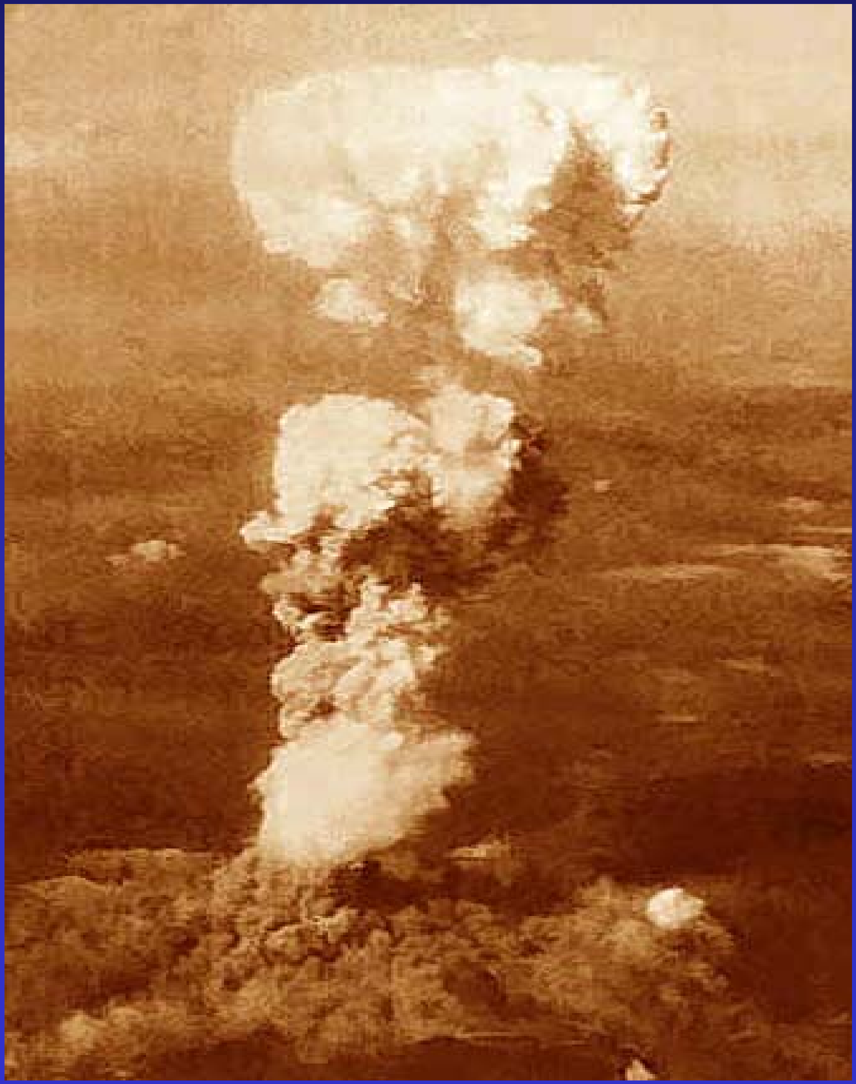
FIGHTING EPA'S PREDICTABLE DISTORTION OF SCIENCE

Patrick J. Michaels
Director
Center for the Study of Science
Cato Institute

THE MANHATTAN PROJECT
AN EXPLOSIVE SUCCESS!



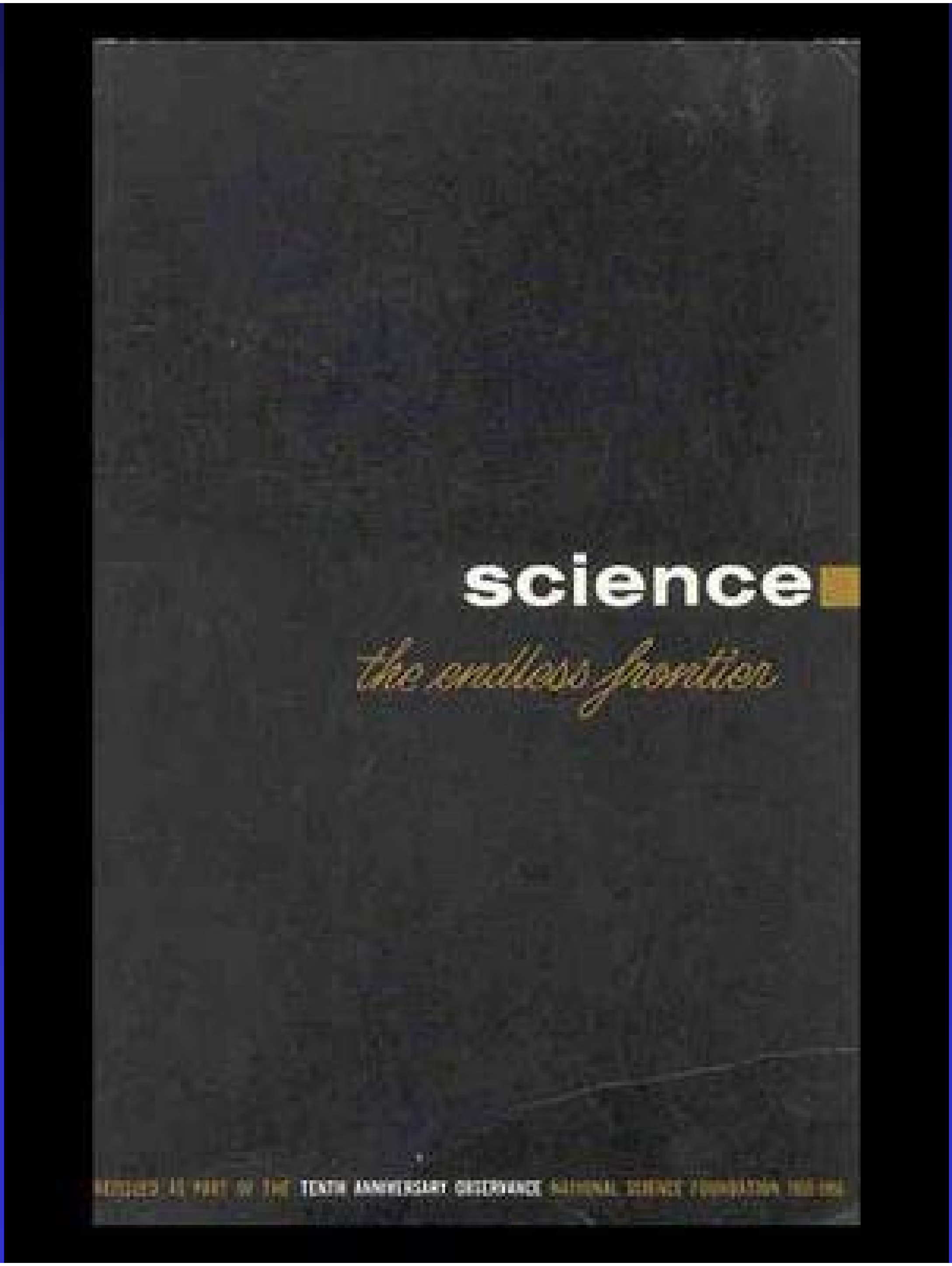
FDR to Vannevar Bush 17 November 1944

Dear Dr. Bush:

The Office of Scientific Research and Development, of which you are the Director, represents a unique experiment of team-work and cooperation I coordinating scientific research and in applying existing scientific research and in applying existing scientific knowledge to the solution of the technological problems paramount in war…

There is, however, no reason why the lessons to be found in this experiment cannot be profitably employed in times of peace…The information, techniques and research experience developed by the [OSD] should be used in the days of peace ahead for…the creation of new enterprises bringing new jobs, and the betterment of the national standard of living…

New frontiers of the mind are before us, and if they are pioneered with the same vision, boldness, and drive with which we have waged this war we can create a fuller and more fruitful employment and a fuller and more fruitful life…


science
the endless frontier
TENTH ANNIVERSARY OBSERVANCE

State Science Institute

Eisenhower's Farewell Address, January 17. 1961

Famous statement on "Military-Industrial Complex"

In the councils of government, we must guard against the acquisition of unwarranted influence, whether sought or unsought, by the military-industrial complex. The potential for the disastrous rise of misplaced power exists and will persist.

Un-noticed next section:

The free university, historically the fountainhead of free ideas and scientific discovery, has experienced a revolution in the conduct of research. Partly because of the huge costs involved, a government contract becomes virtually a substitute for intellectual curiosity…

Yet, in holding scientific research and discovery in respect, as we should, we must also be alert to the equal and opposite danger that public policy could itself become the captive of a scientific-technological elite. The prospect of domination of the nation's scholars by Federal employment, project allocations, and the power of money is ever

"Outcomes may turn out better than our best current prediction, but it just as possible that environmental and health damages will be more severe than best predictions…"

-Statement of Climate Scientists, Mass. v. EPA, Supreme Court 2006-07

LITERATURE SURVEY

- 13 Months of *Science* and *Nature*

- Articles classified “better,” “worse,” or “neutral/can’t classify”

- Predictions should have an equal probability of “better” or “worse”

RESULTS

- 115 articles on climate change or its impact
- 23 were neutral
- 9 were “not as bad as we thought”
- 83 were “worse than we thought”

PROBABILITY OF UNBIASED RESEARCH

- Same as flipping a coin 92 times and getting 9 or fewer "heads"

Chance that the literature is unbiased:

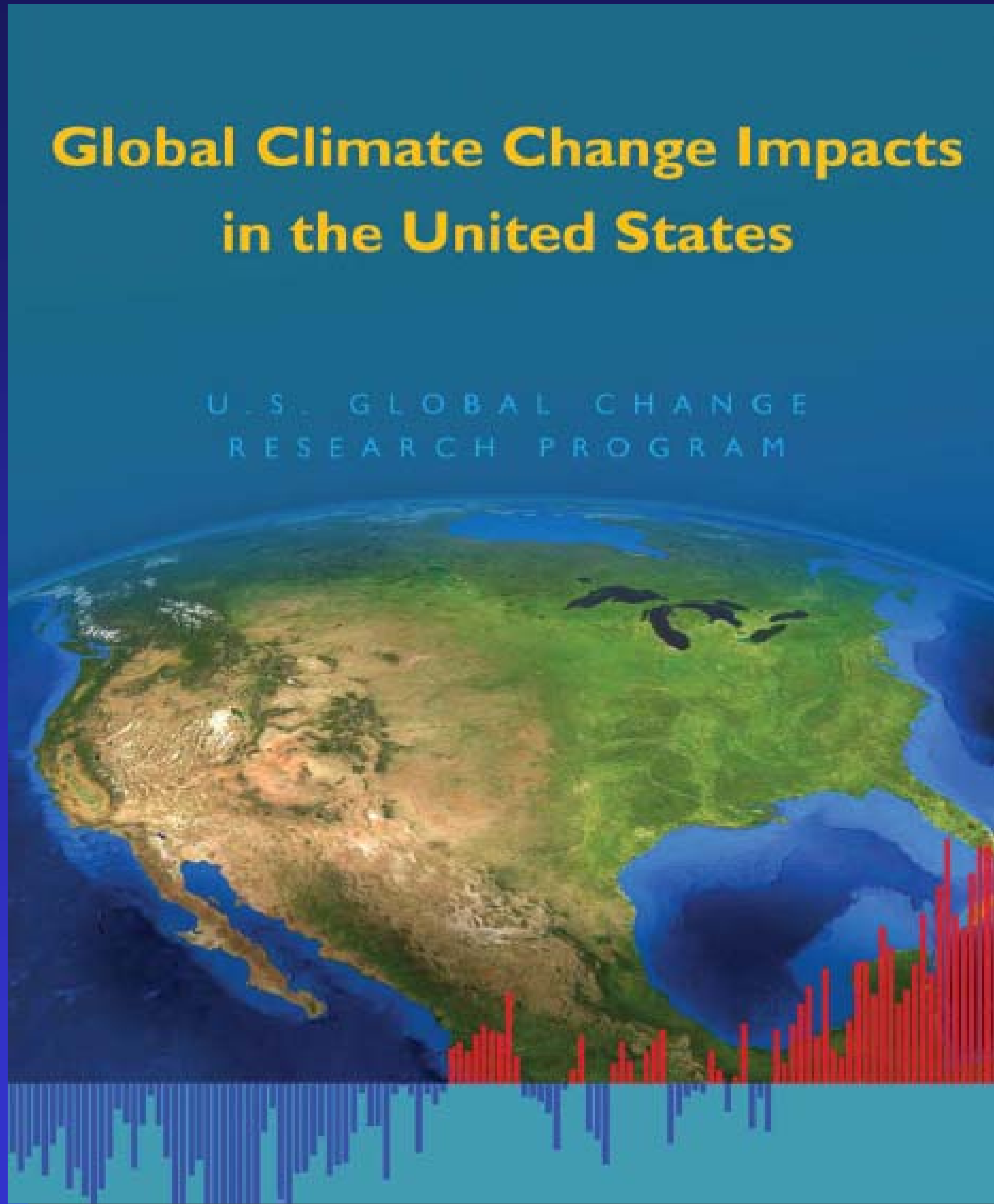
One in 100,000,000,000,000,000

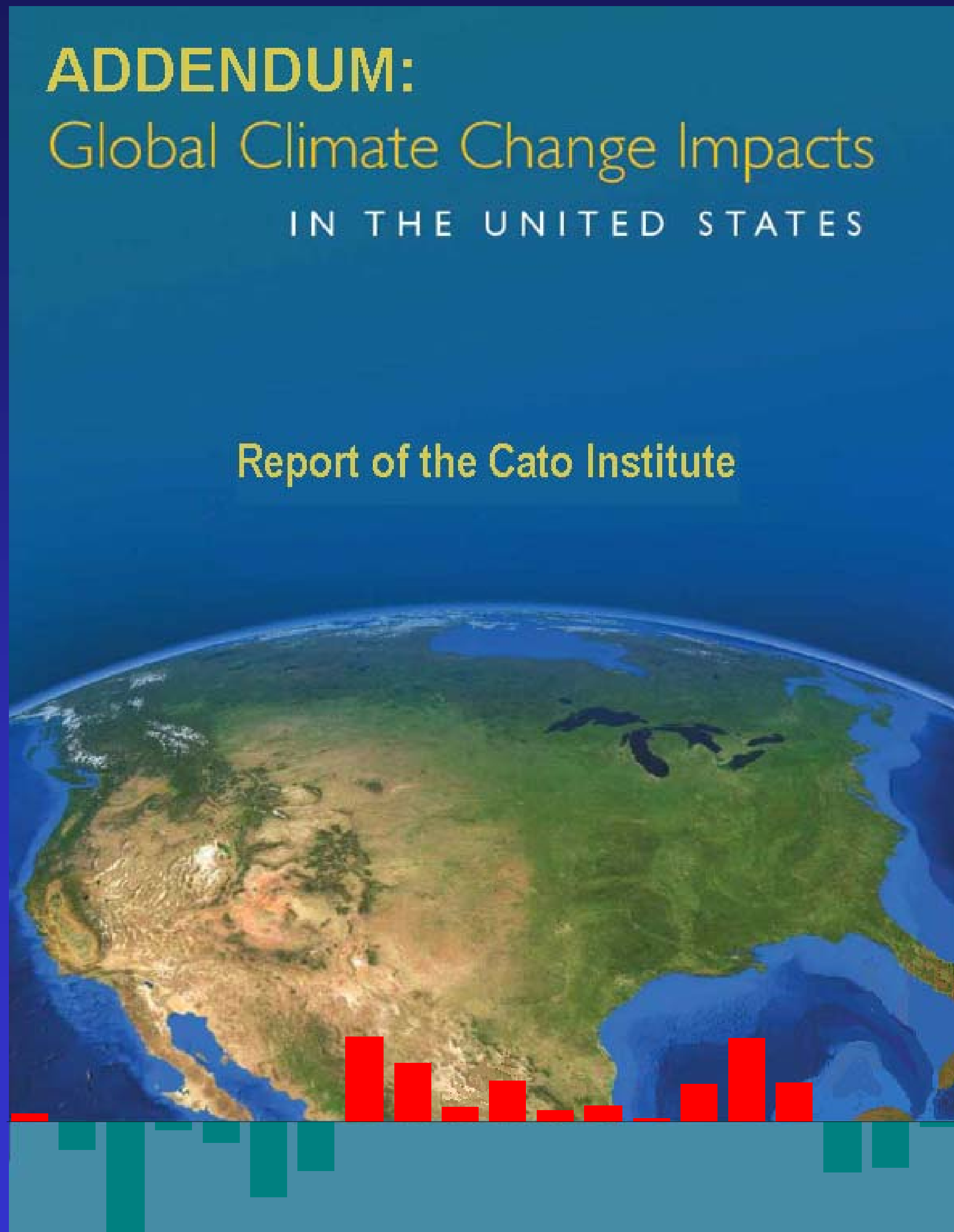
FROM CONGRESS TO THE EPA

- Massachusetts v. EPA, 2007
- “Proposed Finding of Endangerment”, April 2009
- Failure of Cap-and-Trade in the Senate, 2009-10
- “Endangerment Finding”, December 7, 2009
  (First day of UN Climate Meeting in Copenhagen)

CHANGING EPA POLICY

- *Mass v. EPA* REQUIRES EPA to regulate carbon dioxide if it found to “endanger”
- President can therefore not simply “order” it to stop
- The “endangerment finding” has to be vacated
- Cato project is the handbook for reversal


Global Climate Change Impacts
in the United States
U.S. GLOBAL CHANGE
RESEARCH PROGRAM


ADDENDUM:
Global Climate Change Impacts
IN THE UNITED STATES
Report of the Cato Institute

Cato Report

Key Findings

1. Climate change is unequivocal and human activity plays some part in it.
There are two periods of warming in the 20th century that are statistically indistinguishable in magnitude. The first had little if any relation to changes in atmospheric carbon dioxide, while the second has characteristics that are consistent in part with a changed greenhouse effect. (p. 16)

2. Climate change has occurred and will occur in the United States.
US temperature and precipitation have changed significantly over some states since the modern record began in 1895. Some changes, such as the amelioration of severe winter cold in the northern Great Plains, are highly consistent with a changed greenhouse effect (pp. 34-55, 189-194)

3. Impacts of observed climate change have little national significance.
There is no significant long-term change in US economic output that can be attributed to climate change. The slow nature of climate progression results in *de facto* adaptation as, as can be seen with sea level changes on the East Coast. (pp. 44-45, 79-81, 157-160, 175-176)

4. Climate change will affect water resources.
Long-term paleoclimatic studies show that severe and extensive droughts have occurred repeatedly throughout the Great Plains and the West. These will occur in the future, with or without human-induced climate change. Infrastructure planners would be well-advised to take them into account. (pp. 56-71)

5. Crop and livestock production will adapt to climate change.
There is a large body of evidence that demonstrates substantial untapped adaptability of US agriculture to climate change, including crop-switching that can change the species used for livestock feed. In addition, carbon dioxide itself is likely increasing crop yields and will continue to do so in increasing increments in the future. (pp. 102-118)

6. Sea level rises caused by global warming are easily adapted to.
Much of the densely populated East Coast has experienced sea level rises in the 20th century that are more than twice those caused by global warming, with obvious adaptation. The mean projections from the United Nations will likely be associated with similar adaptation. (pp. 175-176)

7. Life expectancy and wealth are likely to continue to increase.
There is little relationship between life expectancy, wealth and climate. Even under the most dire scenarios, people will be much wealthier and healthier than they are today in the year 2100.(pp. 141-147, 160-162)

8. Climate change is a minor overlay on US society.
People voluntarily expose themselves to climate changes throughout their lives that are much larger and more sudden than those expected from greenhouse gases. The migration of US population from the cold North and East to the much warmer South and West is an example. Global markets exist to allocate resources that fluctuate with the weather and climate. (pp. 156-171)

9. Species and ecosystems will change with or without climate change.
There is little doubt that some ecosystems, such as the desert west, have been changing with climate, while others, such as cold marine fisheries, move with little obvious relationship to climate. (pp. 119-140)

10. Policies enacted by the developed world will have little effect on global temperature.
Even if every nation that has obligations under the Kyoto Protocol agreed to reduce emissions over 80 percent, there would be little or no detectable effect on climate on the policy-relevant timeframe, because emissions from these countries will be dwarfed in coming decades by the total emissions from China, India, and the developing world. (pp. 27, 212)

USGCRP Report

Key Findings

1. Global warming is unequivocal and primarily human-induced.
Global temperature has increased over the past 50 years. This observed increase is due primarily to human-induced emissions of heat-trapping gases. (p. 13)

2. Climate changes are underway in the United States and are projected to grow.
Climate-related changes are already observed in the United States and its coastal waters. These include increases in heavy downpours, rising temperature and sea level, rapidly retreating glaciers, thawing permafrost, lengthening growing seasons, lengthening ice-free seasons in the ocean and on lakes and rivers, earlier snowmelt, and alterations in river flows. These changes are projected to grow. (p. 27)

3. Widespread climate-related impacts are occurring now and are expected to increase.
Climate changes are already affecting water, energy, transportation, agriculture, ecosystems, and health. These impacts are different from region to region and will grow under projected climate change. (p. 41-106, 107-152)

4. Climate change will stress water resources.
Water is an issue in every region, but the nature of the potential impacts varies. Drought, related to reduced precipitation, increased evaporation, and increased water loss from plants, is an important issue in many regions, especially in the West. Floods and water quality problems are likely to be amplified by climate change in most regions. Declines in mountain snowpack are important in the West and Alaska where snowpack provides vital natural water storage. (p. 41, 129, 135, 139)

5. Crop and livestock production will be increasingly challenged.
Many crops show positive responses to elevated carbon dioxide and low levels of warming, but higher levels of warming often negatively affect growth and yields. Increased pests, water stress, diseases, and weather extremes will pose adaptation challenges for crop and livestock production. (p. 71)

6. Coastal areas are at increasing risk from sea-level rise and storm surge.
Sea-level rise and storm surge place many U.S. coastal areas at increasing risk of erosion and flooding, especially along the Atlantic and Gulf Coasts, Pacific Islands, and parts of Alaska. Energy and transportation infrastructure and other property in coastal areas are very likely to be adversely affected. (p. 111, 139, 145, 149)

7. Risks to human health will increase.
Harmful health impacts of climate change are related to increasing heat stress, waterborne diseases, poor air quality, extreme weather events, and diseases transmitted by insects and rodents. Reduced cold stress provides some benefits. Robust public health infrastructure can reduce the potential for negative impacts. (p. 89)

8. Climate change will interact with many social and environmental stresses.
Climate change will combine with pollution, population growth, overuse of resources, urbanization, and other social, economic, and environmental stresses to create larger impacts than from any of these factors alone. (p. 99)

9. Thresholds will be crossed, leading to large changes in climate and ecosystems.
There are a variety of thresholds in the climate system and ecosystems. These thresholds determine, for example, the presence of sea ice and permafrost, and the survival of species, from fish to insect pests, with implications for society. With further climate change, the crossing of additional thresholds is expected. (p. 76, 82, 115, 137, 142)

10. Future climate change and its impacts depend on choices made today.
The amount and rate of future climate change depend primarily on current and future human-caused emissions of heat-trapping gases and airborne particles. Responses involve reducing emissions to limit future warming, and adapting to the changes that are unavoidable. (p. 25, 29)

Cato Report

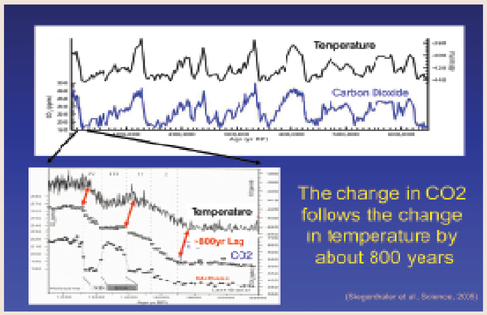
Global Climate Change

Key Messages:

- Human activities have resulted in the emissions of gases that warm the lower atmosphere, as well as particles that counter the resultant warming. We have also changed the surface of the planet in complicated ways that have undetermined net effects on global climate.
- Global average surface temperature measured by an uneven network of thermometers increased approximately 0.7°F early in the 20th century, which was before changing atmospheric composition could have had much influence on climate. In the mid-century, temperatures fell slightly.
- Global average surface temperature rose approximately another 0.7°F from the mid-1970s through the late 1990s, when a very strong El Nino event resulted in the record temperatures measured in 1998. There is conflicting evidence concerning the exact amount of this warming that was caused by changes in atmospheric composition.
- Depending upon the measurement technique used, global sea levels either rose at a constant and modest level during the 20th century, rose at a constant level through the mid, 1990s, followed by a slight increase in the rate of rise, or fell throughout the 20th century.
- Other changes are of dubious importance and attribution, such as in precipitation patterns. Arctic sea ice coverage has dropped in recent decades, but not to levels that were ongoing roughly 6,000-9,000 years ago.
- Climate will continue to change in the coming century. Emissions reductions policies taken by the United States will largely have no effect on these changes. Currently developing economies, powered mainly by fossil fuels, will contribute most of the emissions of this century.

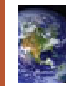
This introduction to global climate change explains very briefly what has been happening to the world's climate, speculates on why these changes have occurred, and what the future might portend. While this report focuses on climate change impacts on the United States, complete understanding of these changes requires an understanding of the global climate system that we currently do not possess. Climate has always changed and will continue to do so, although human activity may amplify or modify such changes.

Carbon Dioxide and Climate in the Ice Age



Twenty years ago, scientists noted a strong correlation between indicators of lower atmospheric temperature from air bubbles trapped in prehistoric ice, and the concentration of atmospheric carbon dioxide and methane.[1] This was thought to be a very strong cause-and-effect link between greenhouse gas changes and climate. However, later, more fine scale research revealed that climatic changes often *precede* greenhouse gas changes.[2] While this bidirectional response does not eliminate carbon dioxide as a cause of planetary surface warming, it does complicate the relationship. The "reverse" carbon dioxide-climate linkage can be explained by a "feedback" in which surface warming reduces the solubility of carbon dioxide in the ocean, which further releases more carbon dioxide into the atmosphere. But, perhaps more important, there is a clear and obvious "brake" on this process, as the Earth has never spiraled into a "runaway" greenhouse effect from continued positive feedback. The existence of this mechanism may explain why observed warming is below what is predicted by most climate models.

USGCRP Report



Global Climate Change

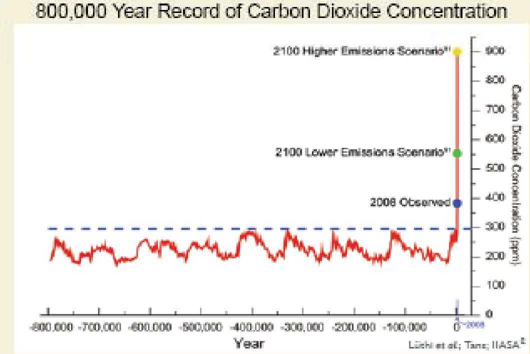
Key Messages:

- Human activities have led to large increases in heat-trapping gases over the past century.
- Global average temperature and sea level have increased, and precipitation patterns have changed.
- The global warming of the past 50 years is due primarily to human-induced increases in heat-trapping gases. Human "fingerprints" also have been identified in many other aspects of the climate system, including changes in ocean heat content, precipitation, atmospheric moisture, and Arctic sea ice.
- Global temperatures are projected to continue to rise over this century; by how much and for how long depends on a number of factors, including the amount of heat-trapping gas emissions and how sensitive the climate is to those emissions.

This introduction to global climate change explains very briefly what has been happening to the world's climate and why, and what is projected to happen in the future. While this report focuses on climate change impacts in the United States, understanding these changes and their impacts requires an understanding of the global climate system.

Many changes have been observed in global climate over the past century. The nature and causes of these changes have been comprehensively chronicled in a variety of recent reports, such as those by the Intergovernmental Panel on Climate Change (IPCC) and the U.S. Climate Change Science Program (CCSP). This section does not intend to duplicate these comprehensive efforts, but rather to provide a brief synthesis, and to integrate more recent work with the assessments of the IPCC, CCSP, and others.

800,000 Year Record of Carbon Dioxide Concentration



Analysis of air bubbles trapped in an Antarctic ice core extending back 800,000 years documents the Earth's changing carbon dioxide concentration. Over this long period, natural factors have caused the atmospheric carbon dioxide concentration to vary within a range of about 170 to 300 parts per million (ppm). Temperature-related data make clear that these variations have played a central role in determining the global climate. As a result of human activities, the present carbon dioxide concentration of about 385 ppm is about 30 percent above its highest level over at least the last 800,000 years. In the absence of strong control measures, emissions projected for this century would result in the carbon dioxide concentration increasing to a level that is roughly 2 to 3 times the highest level occurring over the glacial-interglacial era that spans the last 800,000 or more years.

USGCRP Report

Global Climate Change

Key Messages:

- Human activities have led to large increases in heat-trapping gases over the past century.
- Global average temperature and sea level have increased, and precipitation patterns have changed.
- The global warming of the past 50 years is due primarily to human-induced increases in heat-trapping gases. Human "fingerprints" also have been identified in many other aspects of the climate system, including changes in ocean heat content, precipitation, atmospheric moisture, and Arctic sea ice.
- Global temperatures are projected to continue to rise over this century; by how much and for how long depends on a number of factors, including the amount of heat-trapping gas emissions and how sensitive the climate is to those emissions.

Cato Report

Global Climate Change

Key Messages:

- Human activities have resulted in the emissions of gases that warm the lower atmosphere, as well as particles that counter the resultant warming. We have also changed the surface of the planet in complicated ways that have undetermined net effects on global climate.
- Global average surface temperature measured by an uneven network of thermometers increased approximately 0.7°F early in the 20th century, which was before changing atmospheric composition could have had much influence on climate. In the mid-century, temperatures fell slightly
- Global average surface temperature rose approximately another 0.7°F from the mid-1970s through the late 1990s, when a very strong El Nino event resulted in the record temperatures measured in 1998. There is conflicting evidence concerning the exact amount of this warming that was caused by changes in atmospheric composition.
- Depending upon the measurement technique used, global sea levels either rose at a constant and modest level during the 20th century, rose at a constant level through the mid, 1990s, followed by a slight increase in the rate of rise, or fell throughout the 20th century.
- Other changes are of dubious importance and attribution, such as in precipitation patterns. Arctic sea ice coverage has dropped in recent decades, but not to levels that were ongoing roughly 6,000-9,000 years ago
- Climate will continue to change in the coming century. Emissions reductions policies taken by the United States will largely have no effect on these changes. Currently developing economies, powered mainly by fossil fuels, will contribute most of the emissions of this century.

Cato Report

Agriculture

Key Messages:

- Elevated carbon dioxide increases the productivity and water use efficiency of nearly all plants.
- Higher levels of atmospheric CO_2 ameliorate, and sometimes fully compensate for, the negative influences of various environmental stresses on plant growth, including the stress of high temperature.
- Health promoting substances found in various food crops and medicinal plants have been shown to benefit from rising atmospheric CO_2.
- Elevated CO_2 reduces, and frequently completely overrides, the negative effects of ozone pollution on plant photosynthesis, growth and yield.
- Extreme weather events such as heavy downpours and droughts are not likely to impact future crop yields any more than they do now.
- On the whole, CO_2-enrichment does not increase the competitiveness of weeds over crops; higher atmospheric CO_2 will likely reduce crop damage from insects and pathogenic diseases.
- In addition to enhancing forage productivity, atmospheric CO_2-enrichment will likely not alter its digestibility by animals.

Agricultural productivity and yield have been increasing in the U.S. for many decades. Annual yields of the 19 crops that account for 95 percent of total U.S. food production have increased by an average of 17.4% over the period 1995-2009. Such an increase is good news for those concerned about feeding the ever-growing population of the U.S. and the world.

Food security is one of the most pressing societal issues of our time. It is presently estimated that more than one billion people, or one out of every seven people on the planet, is hungry and/or malnourished. Even more troubling is the fact that thousands die daily as a result of diseases from which they likely would have survived had they received adequate food and nutrition. Yet the problem of feeding the planet's population is presently not one of insufficient food production; for the agriculturalists of the world currently produce more than enough food to feed the globe's entire population. Rather, the problem is one of inadequate distribution, with food insecurity arising simply because the world's supply of food is not evenly dispensed among the human population, due to ineffective world markets[1].

As world population continues to grow, however, so too must our capacity to produce food continue to expand,[2,3,4] and our ability to fulfill this task has been challenged by claims that rising air temperatures and CO_2 concentrations will adversely impact future agricultural production. The remainder of this chapter evaluates that claim.

Percent change in yield between 1995 and 2009 (as derived from a linear trend through the data) for the 19 crops that account for 95% of all U.S. food production. Annual crop yield data were obtained from the Food and Agricultural Organization of the United Nations, available at http://faostat.fao.org/site/567/default.aspx#ancor.

Crop	Percent Change
Maize	32.8
Soybeans	17.3
Wheat	13.3
Sugar cane	-2.5
Sugar beet	37.3
Potatoes	22.2
Tomatoes	35.1
Sorghum	5.2
Oranges	-5.8
Seed cotton	31.5
Rice, paddy	26.3
Grapes	0.5
Barley	16.7
Apples	25.6
Lettuce and chicory	8.7
Maize, green	24.4
Onions, dry	28.9
Grapefruit	0.1
Oats	12.4
Average	*17.4*

USGCRP Report

Agriculture

Key Messages:

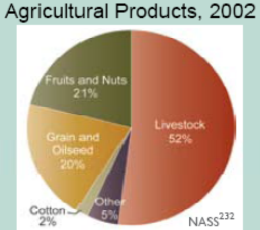
- Many crops show positive responses to elevated carbon dioxide and low levels of warming, but higher levels of warming often negatively affect growth and yields.
- Extreme events such as heavy downpours and droughts are likely to reduce crop yields because excesses or deficits of water have negative impacts on plant growth.
- Weeds, diseases, and insect pests benefit from warming, and weeds also benefit from a higher carbon dioxide concentration, increasing stress on crop plants and requiring more attention to pest and weed control.
- Forage quality in pastures and rangelands generally declines with increasing carbon dioxide concentration because of the effects on plant nitrogen and protein content, reducing the land's ability to supply adequate livestock feed.
- Increased heat, disease, and weather extremes are likely to reduce livestock productivity.

Agriculture in the United States is extremely diverse in the range of crops grown and animals raised, and produces over $200 billion a year in food commodities, with livestock accounting for more than half. Climate change will increase productivity in certain crops and regions and reduce productivity in others (see for example *Midwest* and *Great Plains* regions).[193]

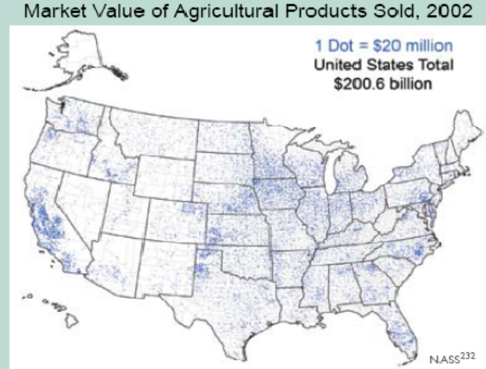
While climate change clearly affects agriculture, climate is also affected by agriculture, which contributes 13.5 percent of all human-induced greenhouse gas emissions globally. In the United States, agriculture represents 8.6 percent of the nation's total greenhouse gas emissions, including 80 percent of its nitrous oxide emissions and 31 percent of its methane emissions.[231]

Increased agricultural productivity will be required in the future to supply the needs of an increasing population. Agricultural productivity is dependent upon the climate and land resources. Climate change can have both beneficial and detrimental impacts on plants. Throughout history, agricultural enterprises have coped with changes in climate through changes in management and in crop or animal selection. However, under higher heat-trapping gas emissions scenarios, the projected climate changes are likely to increasingly challenge U.S. capacity to as efficiently produce food, feed, fuel, and livestock products.

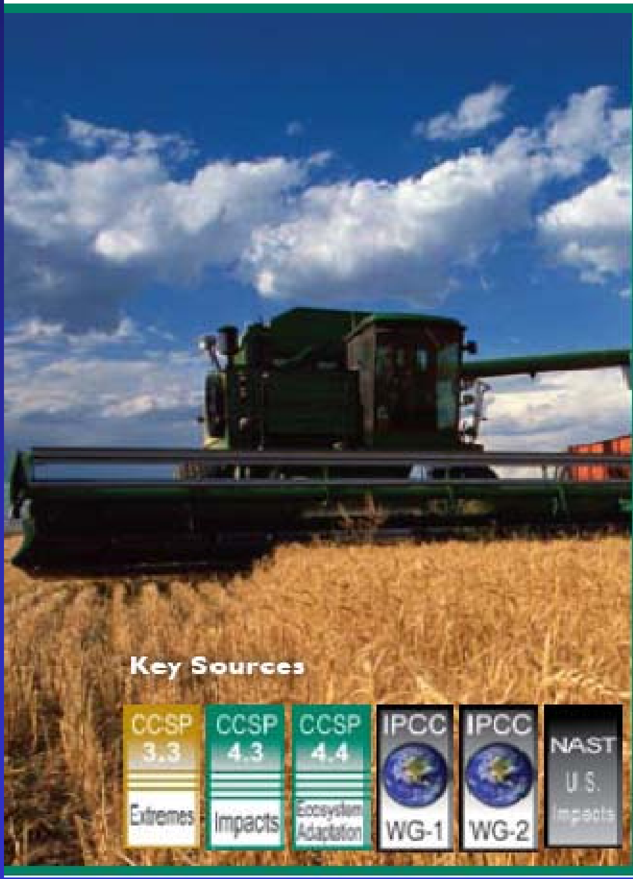
Relative Contributions to Agricultural Products, 2002



Market Value of Agricultural Products Sold, 2002



USGCRP Report



Agriculture

Key Messages:

- Many crops show positive responses to elevated carbon dioxide and low levels of warming, but higher levels of warming often negatively affect growth and yields.
- Extreme events such as heavy downpours and droughts are likely to reduce crop yields because excesses or deficits of water have negative impacts on plant growth.
- Weeds, diseases, and insect pests benefit from warming, and weeds also benefit from a higher carbon dioxide concentration, increasing stress on crop plants and requiring more attention to pest and weed control.
- Forage quality in pastures and rangelands generally declines with increasing carbon dioxide concentration because of the effects on plant nitrogen and protein content, reducing the land's ability to supply adequate livestock feed.
- Increased heat, disease, and weather extremes are likely to reduce livestock productivity.

Cato Report

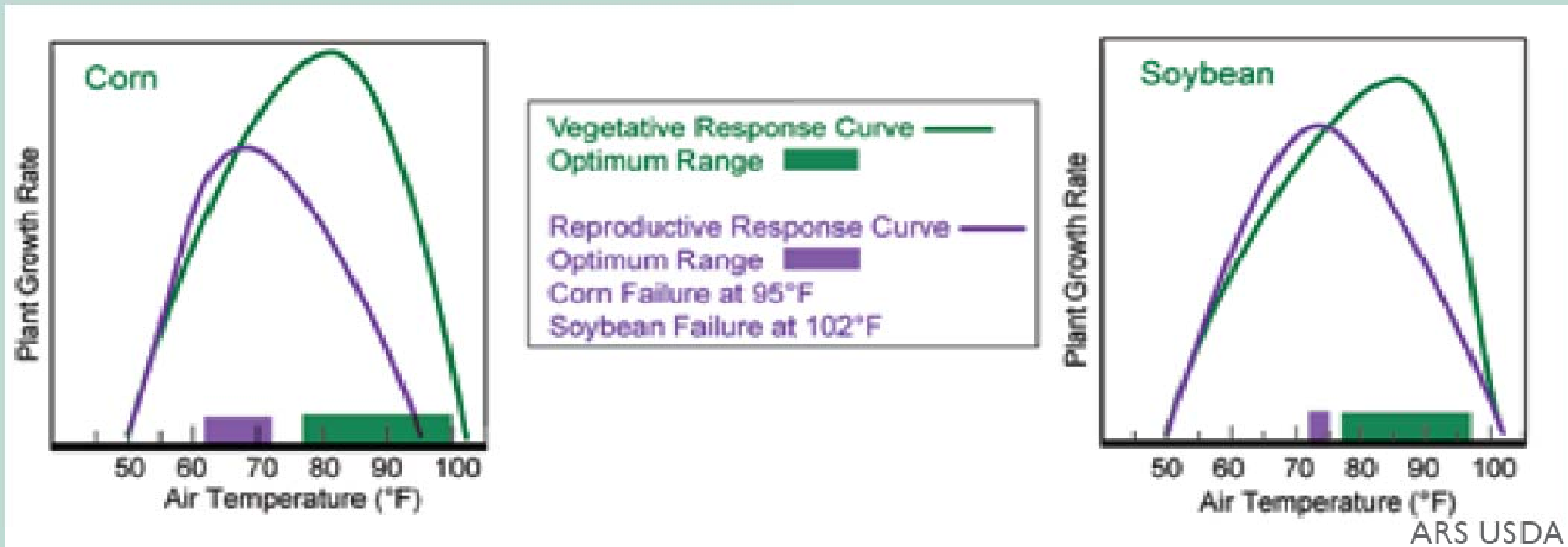
Agriculture

Key Messages:

- Elevated carbon dioxide increases the productivity and water use efficiency of nearly all plants.
- Higher levels of atmospheric CO_2 ameliorate, and sometimes fully compensate for, the negative influences of various environmental stresses on plant growth, including the stress of high temperature.
- Health promoting substances found in various food crops and medicinal plants have been shown to benefit from rising atmospheric CO_2.
- Elevated CO_2 reduces, and frequently completely overrides, the negative effects of ozone pollution on plant photosynthesis, growth and yield.
- Extreme weather events such as heavy downpours and droughts are not likely to impact future crop yields any more than they do now.
- On the whole, CO_2-enrichment does not increase the competitiveness of weeds over crops; higher atmospheric CO_2 will likely reduce crop damage from insects and pathogenic diseases.
- In addition to enhancing forage productivity, atmospheric CO_2-enrichment will likely not alter its digestibility by animals.

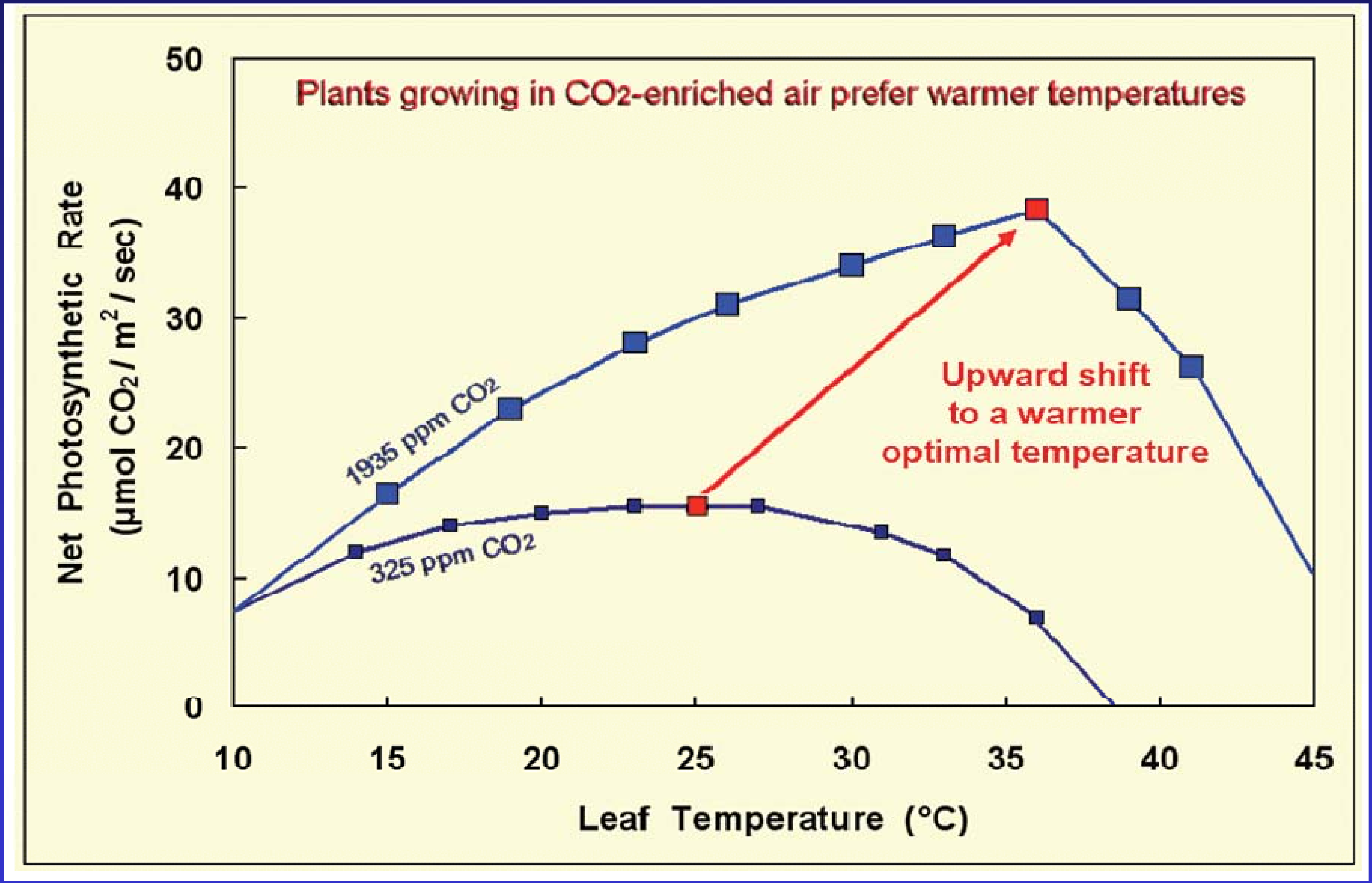
USGCRP Report

Corn and Soybean Temperature Response



For each plant variety, there is an optimal temperature for vegetative growth, with growth dropping off as temperatures increase or decrease. Similarly, there is a range of temperatures at which a plant will produce seed. Outside of this range, the plant will not reproduce. As the graphs show, corn will fail to reproduce at temperatures above 95°F and soybean above 102°F.

Cato Report



Plants growing in CO2-enriched air prefer warmer temperatures
Net Photosynthetic Rate
(µmol CO2 / m2 / sec)
50
40
30
20
10
0
1935 ppm CO2
325 ppm CO2
Upward shift
to a warmer
optimal temperature
10
15
20
25
30
35
40
45
Leaf Temperature (°C)

USGCRP Report

Herbicide Loses Effectiveness at Higher CO_2

Current CO_2 (380 ppm) Potential Future CO_2 (680 ppm)

The left photo shows weeds in a plot grown at a carbon dioxide (CO_2) concentration of about 380 parts per million (ppm), which approximates the current level. The right photo shows a plot in which the CO_2 level has been raised to about 680 ppm. Both plots were equally treated with herbicide.[233]

Cato Report

Plants Grow Better with Higher CO2 Levels

Cato Report

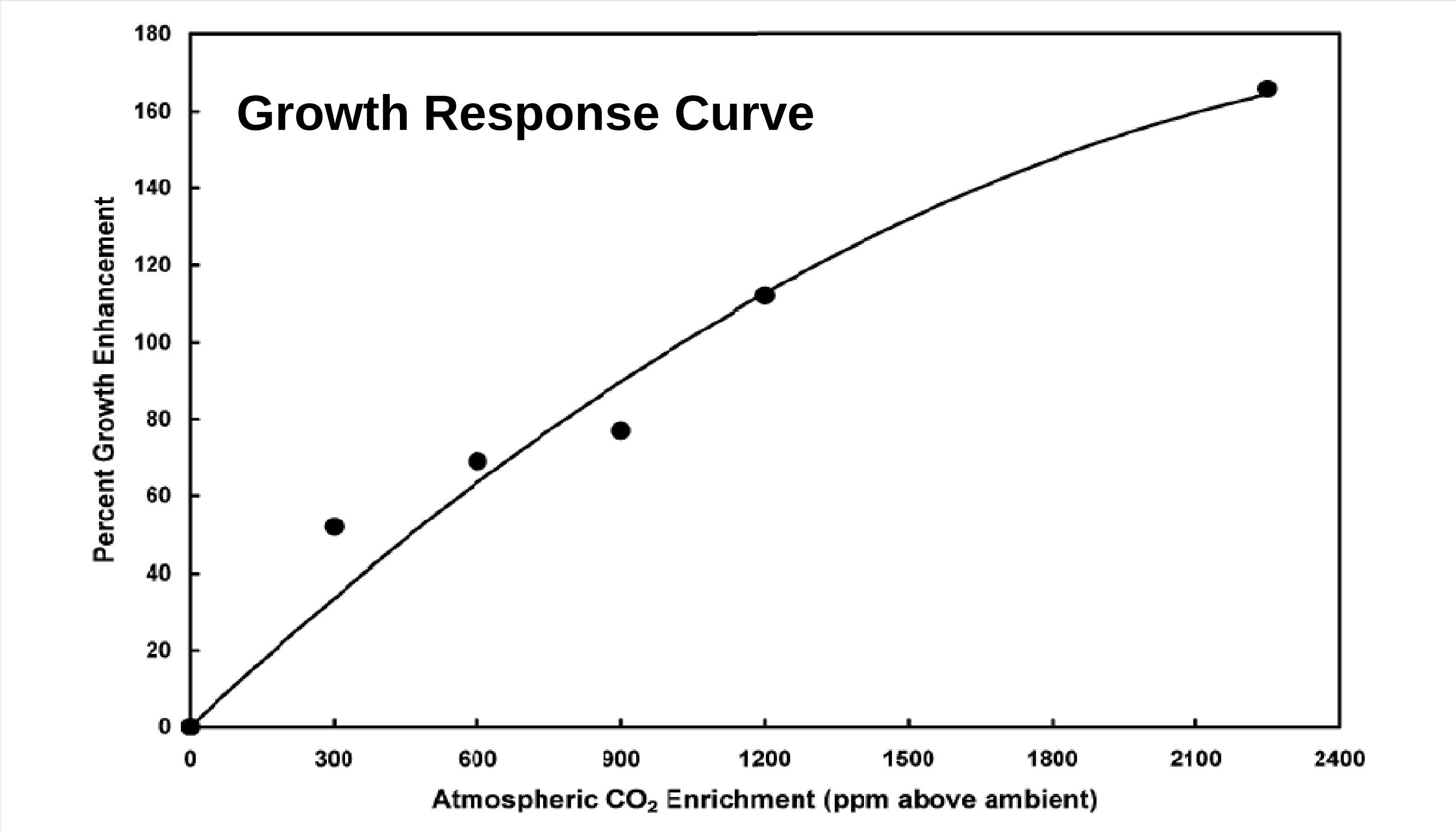


Figure 1. Percent growth enhancement as a function of atmospheric CO_2 enrichment in parts per million (ppm) above the normal or ambient atmospheric CO_2 concentration, showing that the growth benefits continue to accrue well beyond an atmospheric CO_2 concentration of 2000 ppm. These data, representing a wide mix of plant species, were derived from 1,087 individual experiments described in 342 peer-reviewed scientific journal articles written by 484 scientists residing in 28 countries and representing 142 different research institutions.[7]

Cato Report

Energy Supply and Use

Key Messages:

- U.S. energy production and usage are affected not only by weather but also by climate change.
- On the supply side, energy producers anticipate and minimize the impact of severe weather events through best business practices and insurance policies.
- Gradual shifts in climate will not appreciably affect energy production as technological improvements are incorporated in daily operations over time.
- On the demand side, warming will lower in demand for heating energy and increases in demand for cooling energy.
- A reduced diurnal temperature range expected with greenhouse warming mitigates higher peaking demand for electricity capacity.
- Climate change is likely to affect hydropower production in regions subject to changing amounts of precipitation or snowmelt. Significant precipitation increases are forecast for the large hydropower source for US electricity in Quebec, while some decreases are forecast for the Pacific Northwest.

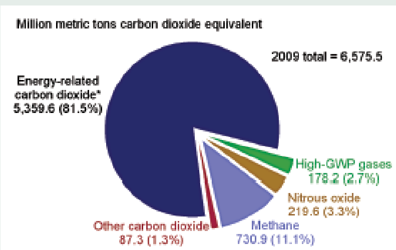
Energy is at the heart of the global warming challenge. 87 percent of U.S. greenhouse gas emissions are from energy production and use. Large scale mitigation—or reduction—of greenhouse gas emissions would reduce energy supply or increase cost, as "renewable" sources (which the exception of hydropower) are significantly more expensive and less dense. On the other hand, Plentiful and reliable carbon-based energy facilitates societal resiliency to weather and climate changes at a lower cost. Adaptation rivals mitigation as a public policy strategy and, indeed, may be seen as its opportunity cost.

One would expect that the trend in the United States should be toward increased energy use per person. Population shifts to the South, especially the Southwest, where air conditioning use is high, an increase in the square footage built per person, increased electrification of the residential and commercial sectors, and increased market penetration of air conditioning would all lead to higher per capita use.

But the opposite has occurred. Energy consumption per person peaked in 1978 and 1979 and has fallen by 14 percent since then.[2] Energy consumption per unit gdp has dropped at approximately 17% per decade.

The decrease in energy use per person has partially occurred by increasing efficiencies of new electric and end-use technologies and a shift to more service oriented industries resulting in decreased energy intensity (energy consumption per unit of Gross Domestic Product).

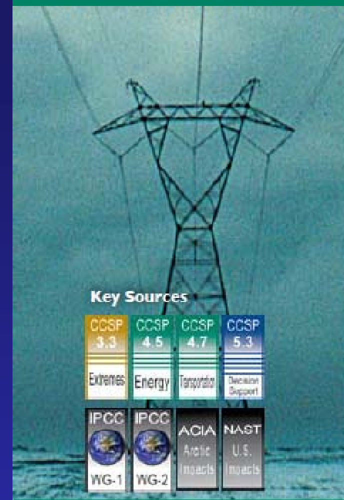
U.S. Greenhouse Emissions by Gas, 2009



*Adjusted by removing emissions from bunker fuels and adding emissions from U.S. Territories.

U.S. greenhouse gas emissions, 2009.[1]

USGCRP Report



Energy Supply and Use

Key Messages:

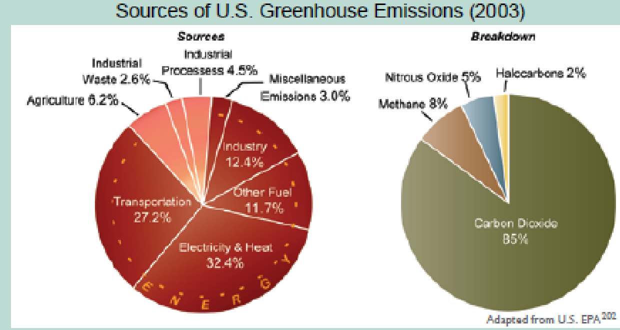
- Warming will be accompanied by decreases in demand for heating energy and increases in demand for cooling energy. The latter will result in significant increases in electricity use and higher peak demand in most regions.
- Energy production is likely to be constrained by rising temperatures and limited water supplies in many regions.
- Energy production and delivery systems are exposed to sea-level rise and extreme weather events in vulnerable regions.
- Climate change is likely to affect some renewable energy sources across the nation, such as hydropower production in regions subject to changing patterns of precipitation or snowmelt.

Energy is at the heart of the global warming challenge.[3] It is humanity's production and use of energy that is the primary cause of global warming, and in turn, climate change will eventually affect our production and use of energy. The vast majority of U.S. greenhouse gas emissions, about 87 percent, come from energy production and use.[200]

At the same time, other U.S. trends are increasing energy use: population shifts to the South, especially the Southwest, where air conditioning use is high, an increase in the square footage built per person, increased electrification of the residential and commercial sectors, and increased market penetration of air conditioning.[201]

Many of the effects of climate change on energy production and use in the United States are not well studied. Some of the effects of climate change, however, have clear implications for energy production and use. For instance, rising temperatures are expected to increase energy requirements for cooling and reduce energy requirements for heating.[164,201] Changes in precipitation have the potential to affect prospects for hydropower, positively or negatively.[201] Increases in hurricane intensity are likely to cause further disruptions to oil and gas operations in the Gulf, like those experienced in 2005 with Hurricane Katrina and in 2008 with Hurricane Ike.[201] Concerns about climate

Sources of U.S. Greenhouse Emissions (2003)



About 87 percent of U.S. greenhouse gas emissions come from energy production and use, as shown in the left pie chart. The right pie chart breaks down these emissions by greenhouse gas.

Cato Report

Society

Key Messages:

- Society is much less sensitive to climate and, therefore, climate change, than it used to be.
- Death rates from climate-sensitive diseases and extreme weather events have declined substantially over the past several decades. There are no upward trends in economic losses from such events, once losses are corrected for growth in population and wealth.
- Whether global warming occurs or not, future populations should be wealthier than they are today and therefore have a wider range of technological options at their disposal. They should therefore be more resilient to adverse effects of climate and climate change.
- Future human well-being would be highest under the warmest IPCC scenario (A1FI) and lowest under the poorest (A2) scenario, even after considering the costs of global warming.
- As a result, fears that climate change will lead to societal breakdown, mass emigration and security threats to the U.S. are inconsistent with the IPCC scenarios of climate change.
- Climate change policies could reduce economic and technological development, which would reduce society's resources and options.
- Agriculture and recreation will adapt to the slow evolution of climate change in this century.
- Increasing development of global markets will mitigate the international effects of climate change on the United States.

Diverse and developed societies, such as that of the United States, have demonstrated only marginal sensitivities to observed climate changes, while poor and underdeveloped ones, such as in sub-Saharan Africa have been much more effected.

Most of the world's civilizations have developed under a wide range of climates, with humans living comfortably in seasonal temperatures from -40° to 120°F. U.S. society is particularly adapted to a very broad range of climates, from the extreme cold of central Alaska to teeming desert cities, like Las Vegas, where temperatures regularly exceed 110°F, and on to the tropical climate of southeastern Florida.

As noted in the last chapter, our society has serially *reduced* its sensitivity to climate extremes. There is no reason to expect, as the rest of the world continues to develop, that the same will not be repeated around the globe. To believe otherwise is to maintain a pejorative view of humanity that does not comport with the american experience.

The notion that poorer countries' vulnerability to climate change imposes major problems because of the interconnectedness of the world indeed eschews the market nature of those connections. No where on earth forever experiences salutary weather and climates. Nations that are not agriculturally productive purchase from those that are, and those in variable environments can alternatively export or import food. Since the advent of modern technological agriculture, there has never been a systematic and worldwide food shortage caused by weather and climate. In fact, it is the diversity and variability of climate that ensures such interweaved security.

Caption Here.

USGCRP Report

Society

Key Messages:

- Population shifts and development choices are making more Americans vulnerable to the expected impacts of climate change.
- Vulnerability is greater for those who have few resources and few choices.
- City residents and city infrastructure have unique vulnerabilities to climate change.
- Climate change affects communities through changes in climate-sensitive resources that occur both locally and at great distances.
- Insurance is one of the industries particularly vulnerable to increasing extreme weather events such as severe storms, but it can also help society manage the risks.
- The United States is connected to a world that is unevenly vulnerable to climate change and thus will be affected by impacts in other parts of the world.

Climate change will affect society through impacts on the necessities and comforts of life: water, energy, housing, transportation, food, natural ecosystems, and health. This section focuses on some characteristics of society that make it vulnerable to the potential impacts of climate change and how the risks and costs may be distributed. Many impacts of climate change on society, for example, sea-level rise and increased water scarcity, are covered in other sections of this report. This section is not a comprehensive analysis of societal vulnerabilities, but rather highlights key examples.

Because societies and their built environments have developed under a climate that has fluctuated within a relatively confined range of conditions, most impacts of a rapidly changing climate will present challenges. Society is especially vulnerable to extremes, such as heat waves and floods, many of which are increasing as climate changes.[313] And while there are likely to be some benefits and opportunities in the early stages of warming, as climate continues to change, negative impacts are projected to dominate.[164]

Climate change will affect different segments of society differently because of their varying exposures and adaptive capacities. The impacts of climate change also do not affect society in isolation. Rather, impacts can be exacerbated when climate change occurs in combination with the effects of an aging and growing population, pollution, poverty, and natural environmental fluctuations.[164,172,274] Unequal adaptive capacity in the world as a whole also will pose challenges to the United States. Poorer countries are projected to be disproportionately affected by the impacts of climate change and the United States is strongly connected to the world beyond its borders through markets, trade, investments, shared resources, migrating species, health, travel and tourism, environmental refugees (those fleeing deteriorating environmental conditions), and security.

Cedar Rapids, Iowa, June 12, 2008

Cato Report

Water Resources

Key Messages:

- Changing composition of the atmosphere will impact the water cycle by generally increasing atmospheric moisture at the global scale.
- Climate models generally predict that hydrological extremes (droughts and floods) may increase in the future, but at present, little empirical evidence supports the prediction.
- The greatest concern is for the Southwest where demand for water may outstrip supplies, with or without climate change.
- The western United States is dependent upon snowpack for water supplies, but trends in snowpack are well within the limits of natural variation.
- Surface and groundwater quality may be influenced by climate change, but they will likely be far more influenced by non-climatic considerations.
- Predictions for major changes in water resources should be taken seriously by policymakers, but scientists should continue to seek empirical evidence to support such predictions.

There is little doubt that the globe and the United States have warmed over the past century and past half century, and any number of studies lead to the conclusions with respect to the hydrologic cycle that:

- the amount of moisture in the atmosphere over the United States has increased
- precipitation amounts have generally increased
- the amount of intense precipitation has increased
- runoff from rivers has increased
- extremes in runoff have not increased
- water temperatures have generally followed air temperature variations and trends
- reductions have occurred in lake and river ice

The conterminous United States covers 1.54 percent of the Earth's surface, and predicting regional variations in hydrological trends within such a small area may be well beyond the capabilities of current climate models.

The future will certainly brings floods and droughts to the United States that will undoubtedly affect energy production and use, human health, transportation, agriculture, and ecosystems. Climate change itself will have both positive and negative impacts. The extent to which climate changes can be attributed to human activities will continue to be debated for decades to come, but based on long-term climate reconstructions of the past, floods and droughts are in our future with or without anthropogenerated changes in climate.

Variations in temperature alter the water cycle, and they have done so throughout the history of the Earth.

There is absolutely no doubt that warming of the planet would, with all other things held constant, increase the moisture content of the atmosphere. For every 1°F increase in atmospheric temperature, the water holding capacity increases by approximately 4 percent.

The spatial pattern associated with changes in near surface atmospheric moisture is surprisingly complex with some areas showing an increase, some a decrease; the trends are also

USGCRP Report

Water Resources

Key Messages:

- Climate change has already altered, and will continue to alter, the water cycle, affecting where, when, and how much water is available for all uses.
- Floods and droughts are likely to become more common and more intense as regional and seasonal precipitation patterns change, and rainfall becomes more concentrated into heavy events (with longer, hotter dry periods in between).
- Precipitation and runoff are likely to increase in the Northeast and Midwest in winter and spring, and decrease in the West, especially the Southwest, in spring and summer.
- In areas where snowpack dominates, the timing of runoff will continue to shift to earlier in the spring and flows will be lower in late summer.
- Surface water quality and groundwater quantity will be affected by a changing climate.
- Climate change will place additional burdens on already stressed water systems.
- The past century is no longer a reasonable guide to the future for water management.

Changes in the water cycle, which are consistent with the warming observed over the past several decades, include:

- changes in precipitation patterns and intensity
- changes in the incidence of drought
- widespread melting of snow and ice
- increasing atmospheric water vapor
- increasing evaporation
- increasing water temperatures
- reductions in lake and river ice
- changes in soil moisture and runoff

For the future, marked regional differences are projected, with increases in annual precipitation, runoff, and soil moisture in much of the Midwest and Northeast, and declines in much of the West, especially the Southwest.

Skagit River and surrounding mountains in the Northwest

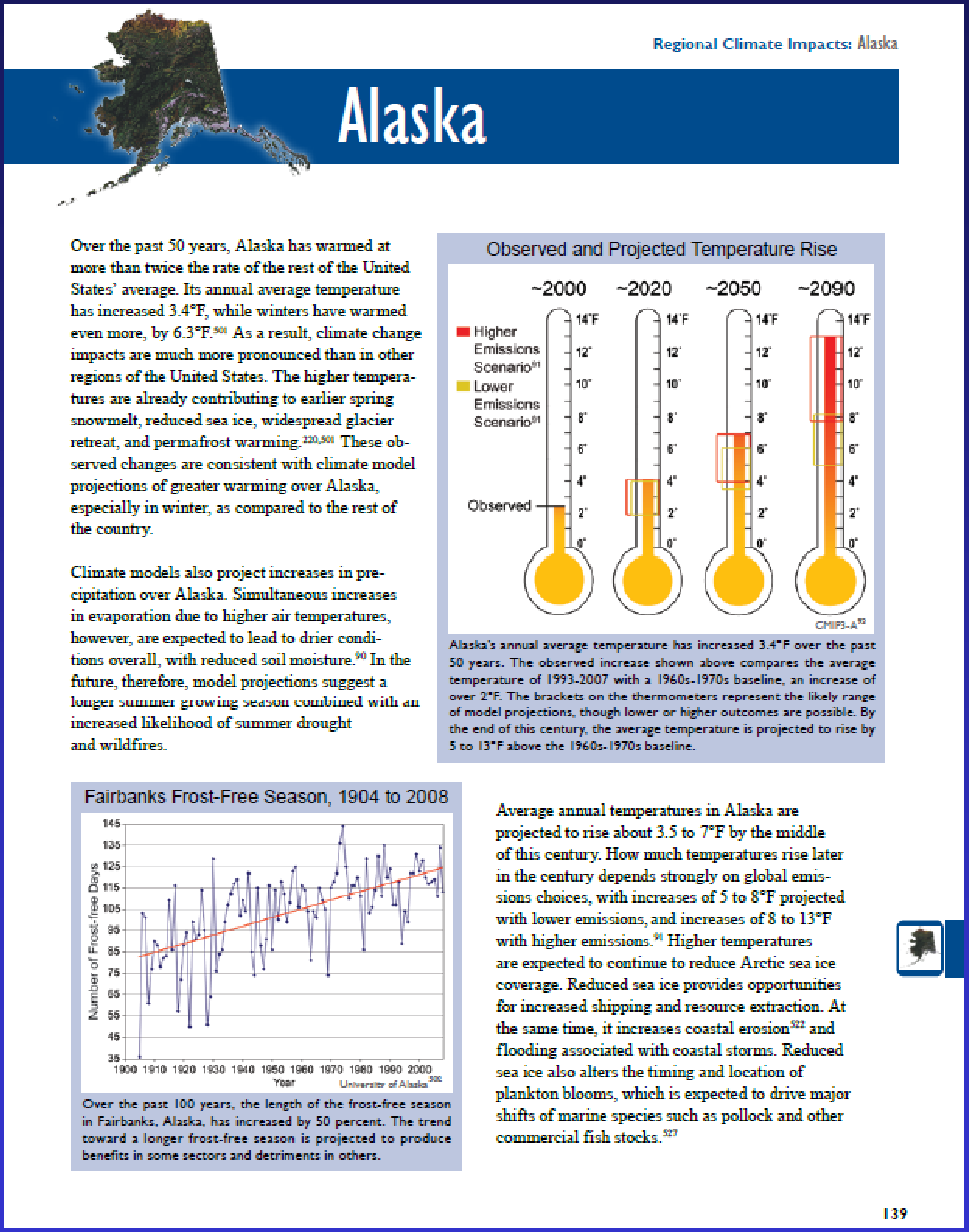
The impacts of climate change include too little water in some places, too much water in other places, and degraded water quality. Some locations are expected to be subject to all of these conditions during different times of the year. Water cycle changes are expected to continue and to adversely affect energy production and use, human health, transportation, agriculture, and ecosystems (see table on page 50).[142]

Climate change has already altered, and will continue to alter, the water cycle, affecting where, when, and how much water is available for all uses.

Substantial changes to the water cycle are expected as the planet warms because the movement of water in the atmosphere and oceans is one of the primary mechanisms for the redistribution of heat around the world. Evidence is mounting that human-induced climate change is already altering many of the existing patterns of precipitation in the United States, including when, where, how much, and what kind of precipitation falls.[68,142] A warmer climate increases evaporation of water from land and sea, and allows more moisture to be held in the atmosphere. For every 1°F rise in temperature, the water holding capacity of the atmosphere increases by about 4 percent.[49]

USGCRP Report

Alaska Region



Regional Climate Impacts: Alaska

Alaska

Over the past 50 years, Alaska has warmed at more than twice the rate of the rest of the United States' average. Its annual average temperature has increased 3.4°F, while winters have warmed even more, by 6.3°F.[501] As a result, climate change impacts are much more pronounced than in other regions of the United States. The higher temperatures are already contributing to earlier spring snowmelt, reduced sea ice, widespread glacier retreat, and permafrost warming.[220,501] These observed changes are consistent with climate model projections of greater warming over Alaska, especially in winter, as compared to the rest of the country.

Climate models also project increases in precipitation over Alaska. Simultaneous increases in evaporation due to higher air temperatures, however, are expected to lead to drier conditions overall, with reduced soil moisture.[90] In the future, therefore, model projections suggest a longer summer growing season combined with an increased likelihood of summer drought and wildfires.

Alaska's annual average temperature has increased 3.4°F over the past 50 years. The observed increase shown above compares the average temperature of 1993-2007 with a 1960s-1970s baseline, an increase of over 2°F. The brackets on the thermometers represent the likely range of model projections, though lower or higher outcomes are possible. By the end of this century, the average temperature is projected to rise by 5 to 13°F above the 1960s-1970s baseline.

Over the past 100 years, the length of the frost-free season in Fairbanks, Alaska, has increased by 50 percent. The trend toward a longer frost-free season is projected to produce benefits in some sectors and detriments in others.

Average annual temperatures in Alaska are projected to rise about 3.5 to 7°F by the middle of this century. How much temperatures rise later in the century depends strongly on global emissions choices, with increases of 5 to 8°F projected with lower emissions, and increases of 8 to 13°F with higher emissions.[91] Higher temperatures are expected to continue to reduce Arctic sea ice coverage. Reduced sea ice provides opportunities for increased shipping and resource extraction. At the same time, it increases coastal erosion[522] and flooding associated with coastal storms. Reduced sea ice also alters the timing and location of plankton blooms, which is expected to drive major shifts of marine species such as pollock and other commercial fish stocks.[527]

139

Cato Report

Alaska Region

Alaska

Alaskan climate change has been enigmatic and complex. One clear signal is that, in general (with one or two notable exceptions), the statewide temperature history is characterized by a step-change in 1976-77, which was recognized in hindsight (nearly twenty years later) as a sudden reorganization of pan-Pacific climate known as the Great Pacific Climate Shift.[1] The ultimate cause of this change, and the reasons for its persistence are currently not known.
The Pacific Climate Shift involved 40 physical variables, including the climatic pattern known as the Pacific Multidecadal Oscillation.[2] As a result, statewide average records tend to show no net warming prior to or subsequent to this change.

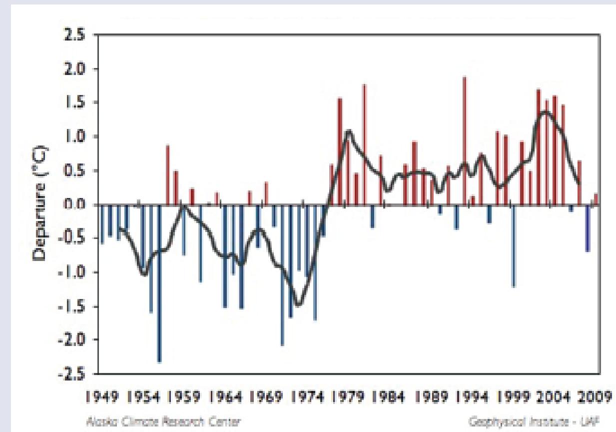
As noted by the Alaska Climate Research Center, at the University of Alaska (Fairbanks), a plot of gross trends is inappropriate because of the step change-nature of the Alaskan climate history. None of this is discussed in the USGCRP chapter, which simply states:

> Over the past 50 years, Alaska has warmed at more than twice the rate of the rest of the United States' average. Its average annual temperature has increased by 3.4°F, while winters have warmed even more, by 6.3°F.

Our map below shows the distribution of net warming over Alaska, but the accompanying table is necessary to provide needed context.

It is very apparent that since the Pacific Climate Shift there is very little secular temperature change over all of Alaska with the exception of Barrow. The very large Autumn change there is almost certainly related to the decline of sea ice which has a strong local climate influence.

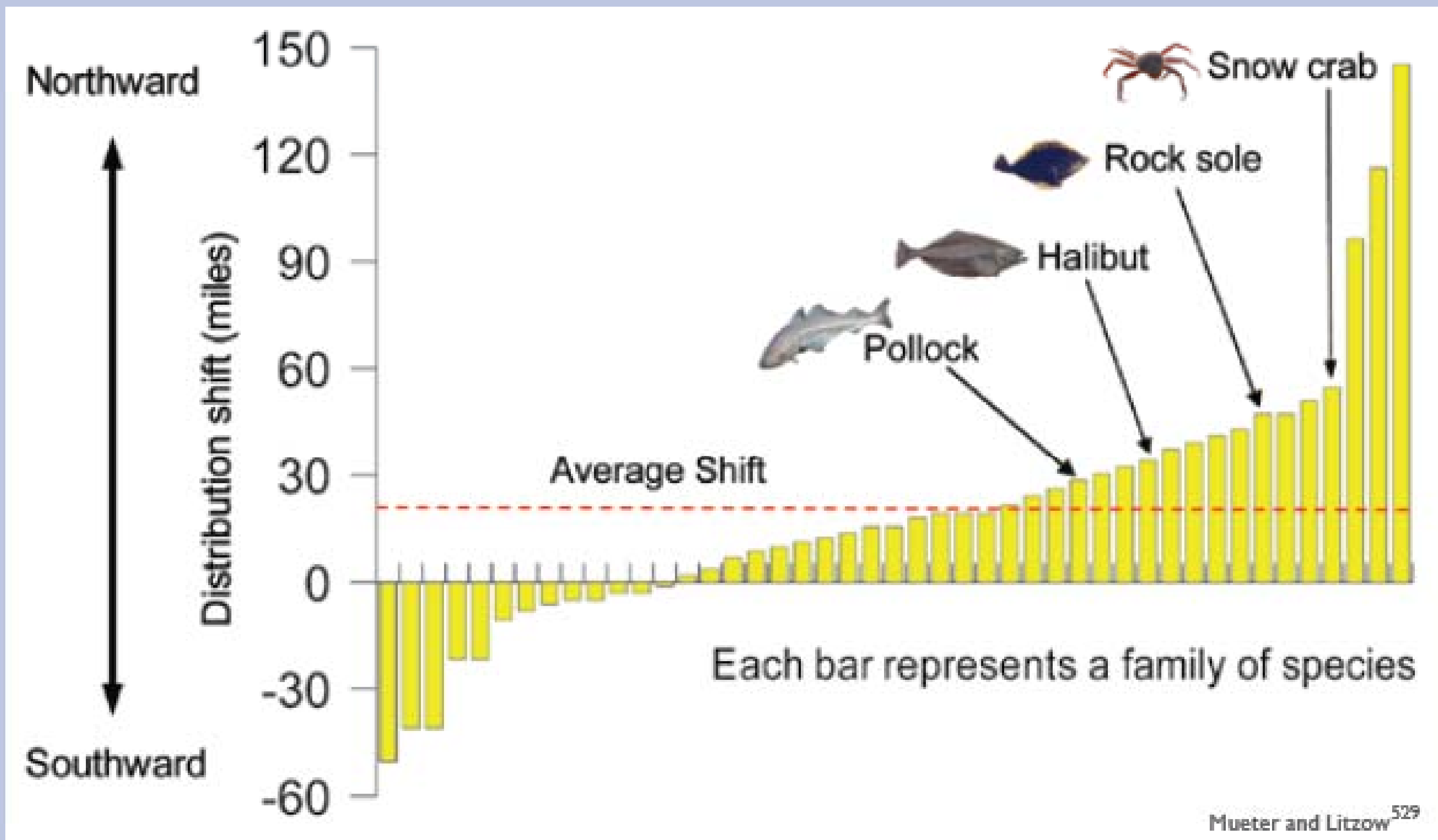
The remaining station that shows a significant increase since 1976 is Talkeetna, but there is likely some type of warming bias at the site. Note that the



The power of the Pacific Climate Shift is evident in this post-1948 temperature history.[3]

USGCRP REPORT

Marine Species Shifting Northward
1982 to 2006



As air and water temperatures rise, marine species are moving northward, affecting fisheries, ecosystems, and coastal communities that depend on the food source. On average, by 2006, the center of the range for the examined species moved 19 miles north of their 1982 locations.

MEUTER AND LETZOW, 2007

From their 2007 paper:

"A nonlinear, accelerating time trend in northward displacement (Fig. 5D), unrelated to temperature or any other climate parameter we tested (at any lag), suggests that mechanisms besides climate must be contributing to distribution shifts in the Bering Sea…The failure of our exploratory attempts to explain variability among species underlines the difficulties of this research problem."


TOM
KARL
AMS PRESIDENT
NOAA/NCDC
Asheville, NC

November 3, 2012
Mr. Thomas Karl, Director
National Climatic Data Center
Asheville, North Carolina

Dear Tom,

I am enclosing a new document that includes the science that was missing from the USGCRP U.S. report. As you can see, it is in precisely the same format as your document.

Imitation *is* a form of flattery!

Best Wishes,

Pat Michaels

AMERICAN TRADITION INSTITUTE

Restoring science, accountability, and liberty to the environmental policy debate.

F.O.I.A.!!

Dean Meredith Woo
University of Virginia

Dear Dean Woo,

I would like to discuss with you an application for a research grant from the Cato Institute to explore the hypothesis that the federal monopoly on environmental science funding provides incentives for our faculty to exaggerate environmental threats, resulting in some very inappropriate policies. When can we meet?

Cheers
Pat Michaels

PS: I realize you are very busy, what with Envi Sci offering Mike Mann the newly endowed Kington professorship!

To: Patrick J. Michaels
Department of Environmental Sciences

Dear Pat,

Many thanks for your note on investigating bias in science. Indeed, you are correct that I am very busy these days, with the multiple FOIA requests that are directed especially towards the Environmental Sciences Department. If you are available, I would like to schedule a meeting in September, 2029.

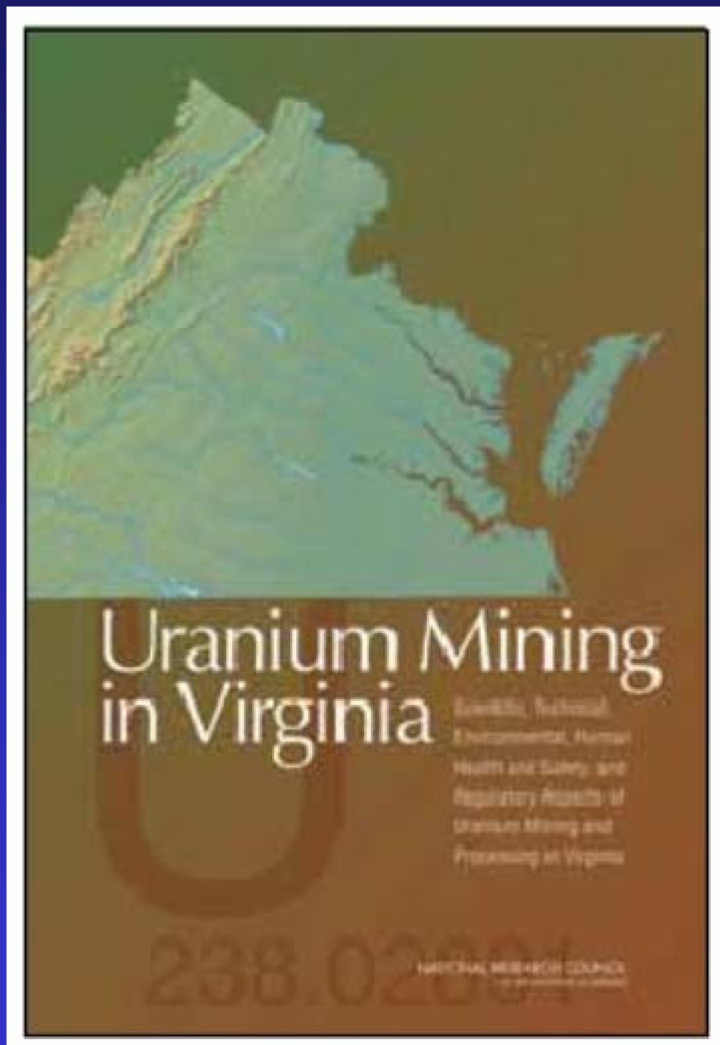
I wish you well until we meet again.

Best,

Meredith Woo
Dean of the College of Arts and Sciences

CASE STUDY #2(a)

- National Research Council report: “Uranium Mining in Virginia”
- Release date: December, 31, 2012
- Protection of Private Property Rights



Uranium Mining in Virginia

Scientific, Technical, Environmental, Human Health and Safety, and
Regulatory Aspects of Uranium Mining and Processing in Virginia

Committee on Uranium Mining in Virginia

Committee on Earth Resources

Board on Earth Sciences and Resources

Division on Earth and Life Studies

NATIONAL RESEARCH COUNCIL
OF THE NATIONAL ACADEMIES

THE NATIONAL ACADEMIES PRESS
Washington, D.C.
www.nap.edu

CASE STUDY #3

- EPA's Attempt to bankrupt the Pebble Partnership
- Largest copper deposit in North America
- Land zoned for mining
- Real value destroyed: Northern Dynasty Minerals stock goes from $20 to $2.

THE pebble PARTNERSHIP

The Pebble Project

The Pebble Partnership is committed to bringing forward a prospective mine development plan outlining the many opportunities the project may enable.

Currently in the exploration and environmental study phases, research is underway to diligently examine and develop methods to responsibly co-exist with the surrounding elements.

External Review Draft | EPA 910-R-12-004a | May 2012

EPA
United States
Environmental Protection
Agency

An Assessment of Potential Mining Impacts on Salmon Ecosystems of Bristol Bay, Alaska

Volume 1 – Main Report

U.S. Environmental Protection Agency, Seattle, WA
www.epa.gov/bristolbay

External Review Draft Do Not Cite or Quote