US Global Change Research Program

Global Change Research Act (GCRA 1990):

“To provide for development and coordination of a comprehensive and integrated United States research program which will assist the Nation and the world to understand, assess, predict, and respond to human-induced and natural processes of global change.”

More information at 
http://www.globalchange.gov
...not less frequently than every 4 years, the Council... shall prepare... an assessment which –

• integrates, evaluates, and interprets the findings of the Program (USGCRP) and discusses the scientific uncertainties associated with such findings;

• analyzes the effects of global change on the natural environment, agriculture, energy production and use, land and water resources, transportation, human health and welfare, human social systems, and biological diversity; and

• analyzes current trends in global change, both human-induced and natural, and projects major trends for the subsequent 25 to 100 years.
Previous National Climate Assessments

Climate Change Impacts on the United States (2000)

Climate Change Impacts in the United States (2009)

http://nca2009.globalchange.gov/
For example: Climate change is only one of multiple factors affecting water supply availability.
The NCA Process, What’s New? (cont.)

New topics covered
Oceans, Coasts, Urban, Rural, Land use
Cross-sector links like Energy/Water/Land

New format
Digital products and interactive website
Highlights, GCIS, traceable accounts

Extensive Review and Transparency
– National Academy of Sciences, agencies, public review, responses to all comments
– Links to underlying data and references, traceable accounts
Sectors

• Water Resources
• Energy Supply and Use
• Transportation
• Agriculture
• Forestry
• Ecosystems and Biodiversity
• Human Health
Responses

• Decision Support
• Mitigation
• Adaptation
• Research Needs
• The Sustained Assessment Process
Human-induced climate change has moved firmly into the present.
Impacts are apparent in every region and in important sectors including health, water, agriculture, energy, and more.
Americans are already feeling the effects of increases in some types of extreme weather and sea level rise.
There are many actions we can take to reduce future climate change and its impacts and to prepare for the impacts we can’t avoid.
There are Many Indicators of A Warming World

- Air Temperature Near Surface (Troposphere)
- Water Vapor
- Temperature Over Oceans
- Sea Surface Temperature
- Sea Ice
- Ocean Heat Content
- Sea Level
- Glaciers and Ice Sheets
- Snow Cover
- Temperature Over Land
Temperature Change by Decade

2001-2012 even warmer. Every year warmer than 1990s average.

1990s even warmer. Every year warmer than 1980s average.

1980s warmest decade on record at the time.
Observed Increases in Frost-Free Season

Change in Annual Number of Days

- 0-4
- 5-9
- 10-14
- 15+
Observed U.S. Precipitation Change
Certain Types of Extreme Events Becoming More Common

Trends are likely to continue.

- Heat waves are generally increasing; will likely become longer and more severe.
- Cold waves are decreasing.
- More precipitation coming as larger events.
- Increasing risk of floods in some regions (NE, MW).
- Droughts increasing in some regions (SW, SE).
- Increasing intensity of Atlantic hurricanes is likely.
Observed U.S. Trends in Heavy Precipitation
Trends in Flood Magnitude
Texas Heat Wave and Drought: Twice as likely due to Climate Change

No longer true to say “we can’t attribute any particular event…”
Surface Temperature and Sun’s Energy
Human Activity is the Primary Cause
Projected Global Temperature Change
Projected Temperature Change

Lower Emissions (B1)  

Higher Emissions (A2)  

Temperature Change (°F)

3  4  5  6  7  8  9  10  15
Projected Precipitation Change by Season
Past and Projected Changes in Global Sea Level
As Oceans Absorb CO$_2$
They Become More Acidic
Carbon Emissions in the Industrial Age

The graph illustrates the increase in carbon emissions from various sources between 1850 and 2000. The emissions are categorized into Coal, Oil, Gas, and Cement. The data shows a significant rise in emissions, particularly after 1950, reflecting the growth of industrialization and fossil fuel consumption.
## Report Findings: Regions

<table>
<thead>
<tr>
<th>Region</th>
<th>Findings</th>
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</thead>
<tbody>
<tr>
<td>Northeast</td>
<td>Communities are affected by heat waves, more extreme precipitation events, and coastal flooding due to sea level rise and storm surge.</td>
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<tr>
<td>Southeast and Caribbean</td>
<td>Decreased water availability, exacerbated by population growth and land-use change, causes increased competition for water. There are increased risks associated with extreme events such as hurricanes.</td>
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<tr>
<td>Midwest</td>
<td>Longer growing seasons and rising carbon dioxide levels increase yields of some crops, although these benefits have already been offset in some instances by occurrence of extreme events such as heat waves, droughts, and floods.</td>
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<tr>
<td>Great Plains</td>
<td>Rising temperatures lead to increased demand for water and energy and impacts on agricultural practices.</td>
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<td>Region</td>
<td>Findings</td>
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<td>Southwest</td>
<td>Drought and increased warming foster wildfires and increased competition for scarce water resources for people and ecosystems.</td>
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<tr>
<td>Northwest</td>
<td>Changes in the timing of streamflow related to earlier snowmelt reduce the supply of water in summer, causing far-reaching ecological and socioeconomic consequences.</td>
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<tr>
<td>Alaska</td>
<td>Rapidly receding summer sea ice, shrinking glaciers, and thawing permafrost cause damage to infrastructure and major changes to ecosystems. Impacts to Alaska Native communities increase.</td>
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<tr>
<td>Hawai‘i and Pacific Islands</td>
<td>Increasingly constrained freshwater supplies, coupled with increased temperatures, stress both people and ecosystems and decrease food and water security.</td>
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