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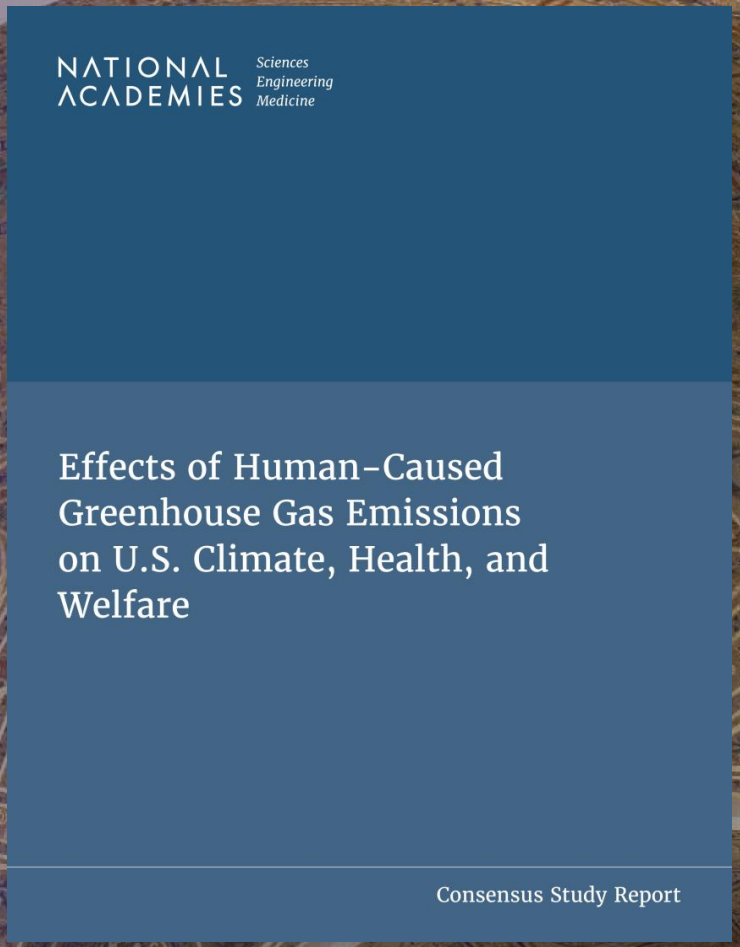
Effects of Human-Caused Greenhouse Gas Emissions on U.S. Climate, Health, and Welfare

Report Release Briefing

Wednesday, September 17, 2025



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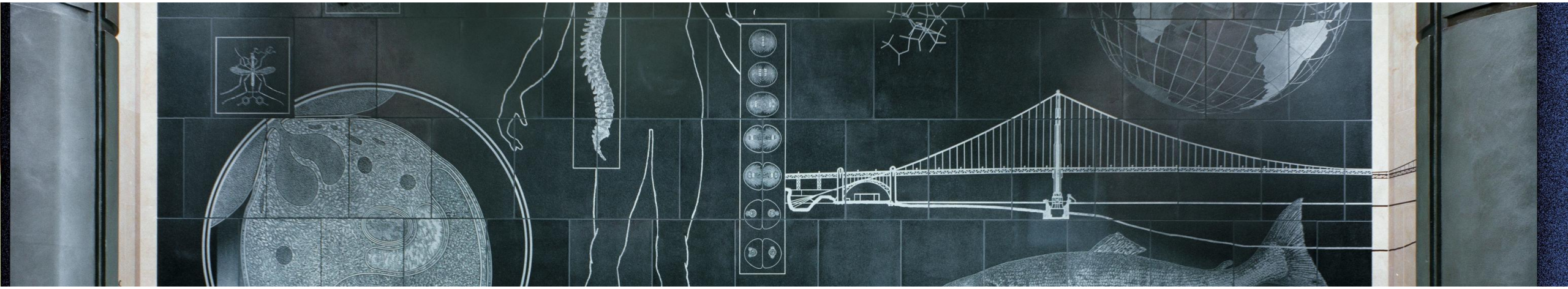

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The report is peer reviewed and represents the consensus view of the committee.

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Context

"Endangerment and Cause or Contribute Findings for Greenhouse Gases Under Section 202(a) of the Clean Air Act" (EPA, 2009)

> "six greenhouse gases taken in combination endanger both the public health and the public welfare of current and future generations"

EPA published Federal Register Notice: "Reconsideration of 2009 Endangerment Finding and Greenhouse Gas Vehicle Standards" (8/1/2025)

> Proposed rescinding that "Endangerment Finding," citing doubt about the reliability of the evidence, and requested input from the public.

About this Study

- The Clean Air Act says EPA shall consider input from the National Academy of Sciences.
- Reviewed evidence for whether anthropogenic emissions of greenhouse gases to the atmosphere are reasonably anticipated to endanger public health and welfare in the United States, focusing on updates since 2009.
- Conducted to meet the timeline for submitting public comments (due September 22, 2025).
- Supported by NAS endowment: Arthur L. Day Fund and Ralph J. Cicerone and Carol M. Cicerone Fund

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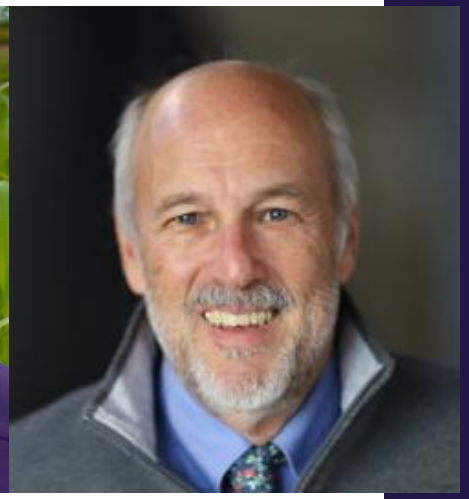

Charley Driscoll
Syracuse University

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Consensus Study Process


Committee Appointments


Information Gathering


Report Writing


Report Peer Review

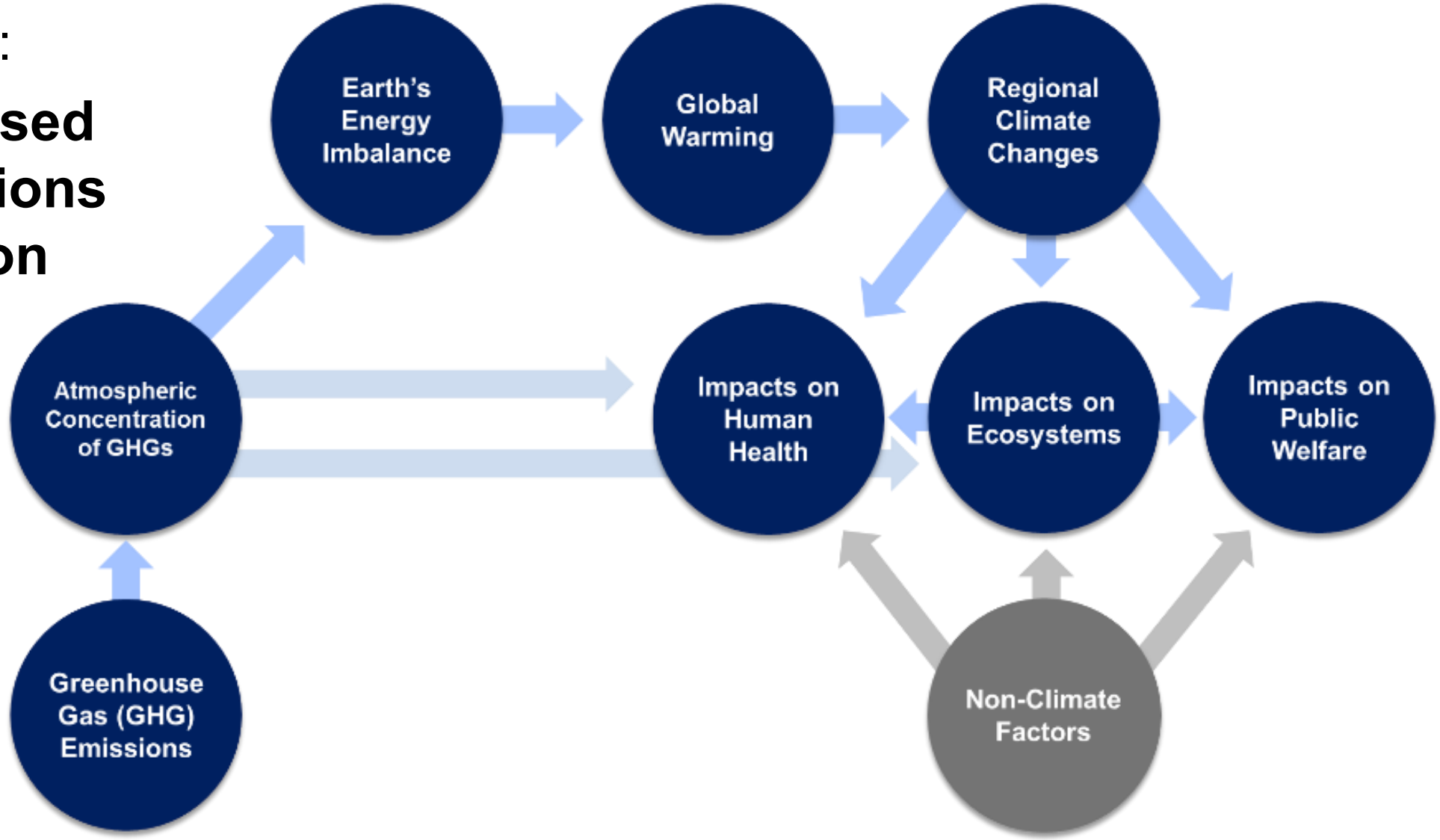

Report Release

Committee's Approach

- Summarized changes in evidence since 2009.
- Prioritized observational evidence (direct measurements, satellite data, health studies).
- Considered multiple lines of evidence; strongest conclusions where independent lines agree.
- Relied on peer-reviewed literature, scientific assessments, and more than 200 public comments.
- Focused on impacts to human health and welfare in the United States.

Causal Chain:

Human-Caused GHG Emissions to Impacts on Human Health and Public Welfare

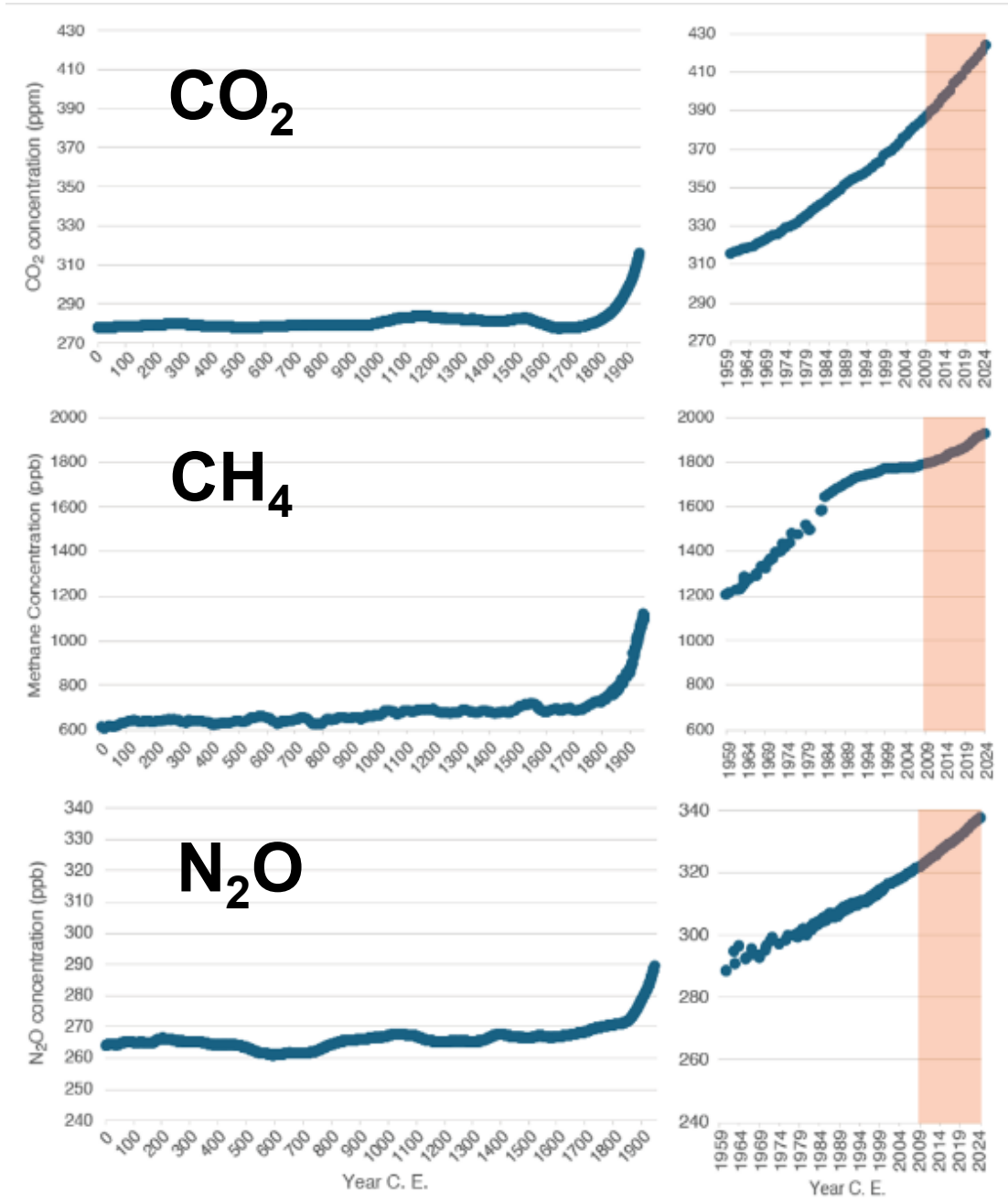


Committee's Overarching Conclusion:

EPA's 2009 finding that the human-caused emissions of greenhouse gases threaten human health and welfare was accurate, has stood the test of time, and is now reinforced by even stronger evidence.

Emissions of greenhouse gases from human activities are increasing the concentration of these gases in the atmosphere.

Human activities, such as the extraction and burning of fossil fuels, cement and chemical production, deforestation, and agricultural activities, emit GHGs, which include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and fluorinated gases (F-gases), to the atmosphere.



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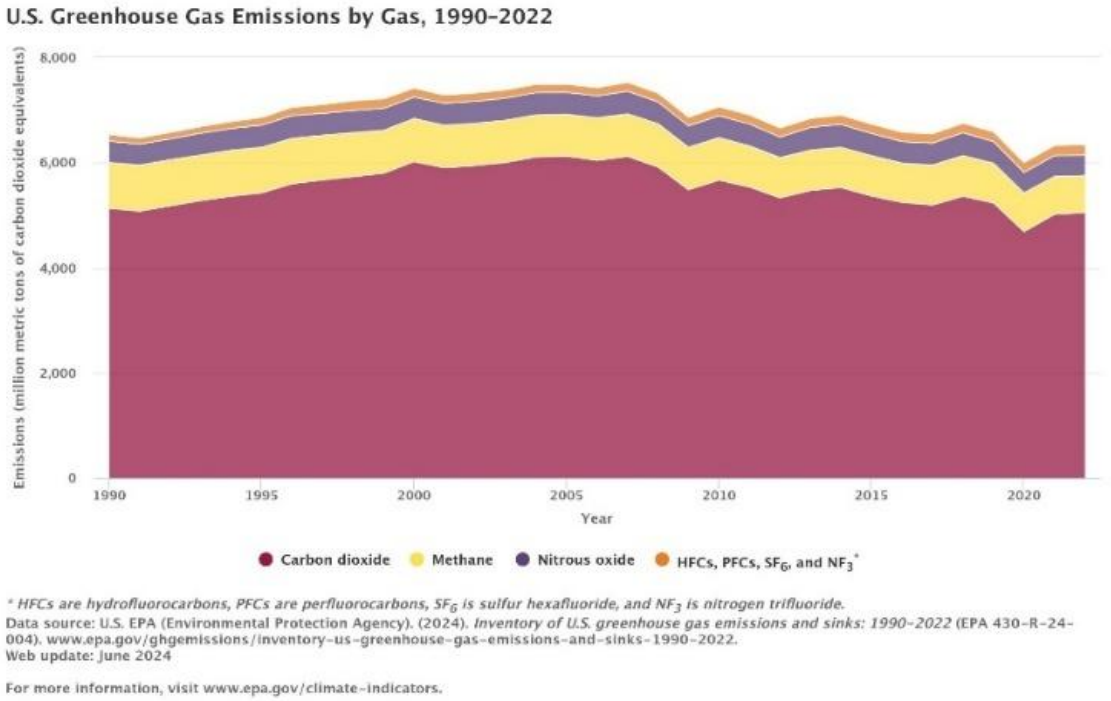
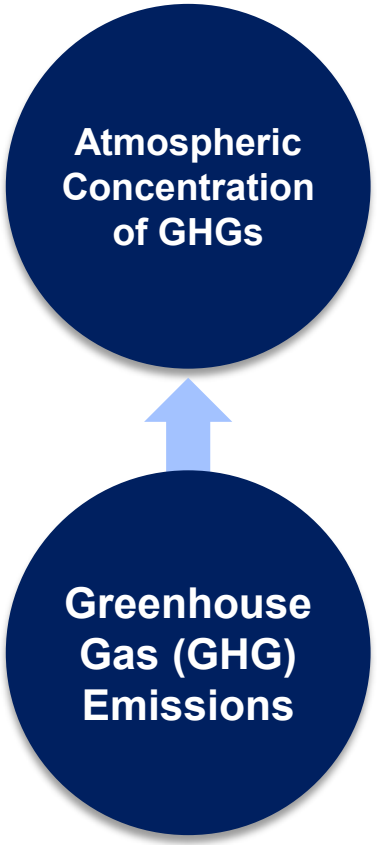
DATA SOURCES: Ahn, 2023 (left; ice core), Lan and Dlugokencky, 2022 (right; NOAA GML)

Although U.S. emissions of CO_2 have decreased slightly in recent years largely due to changes in energy production and consumption...

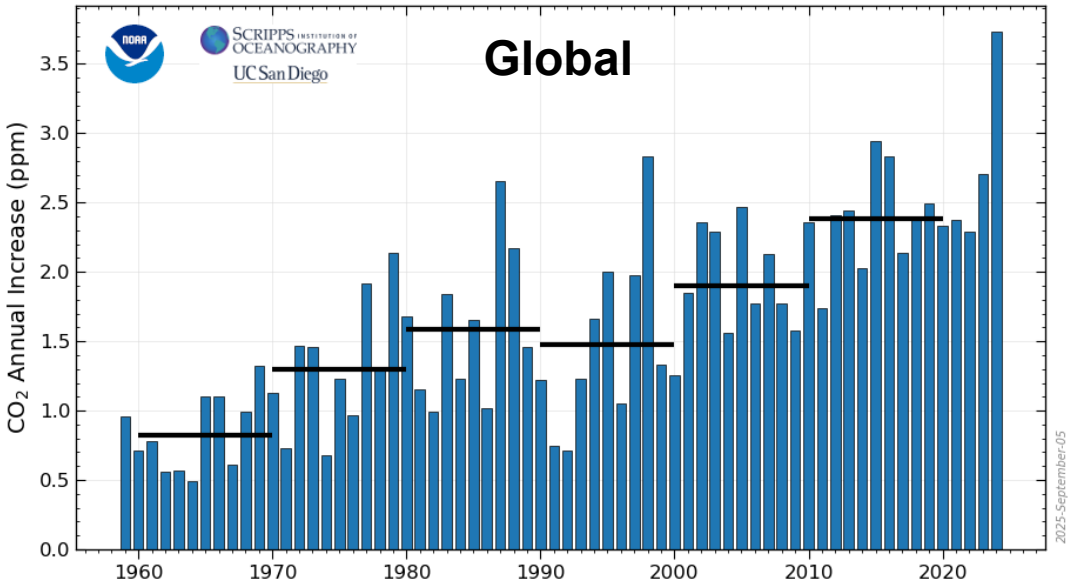


SOURCE: EPA

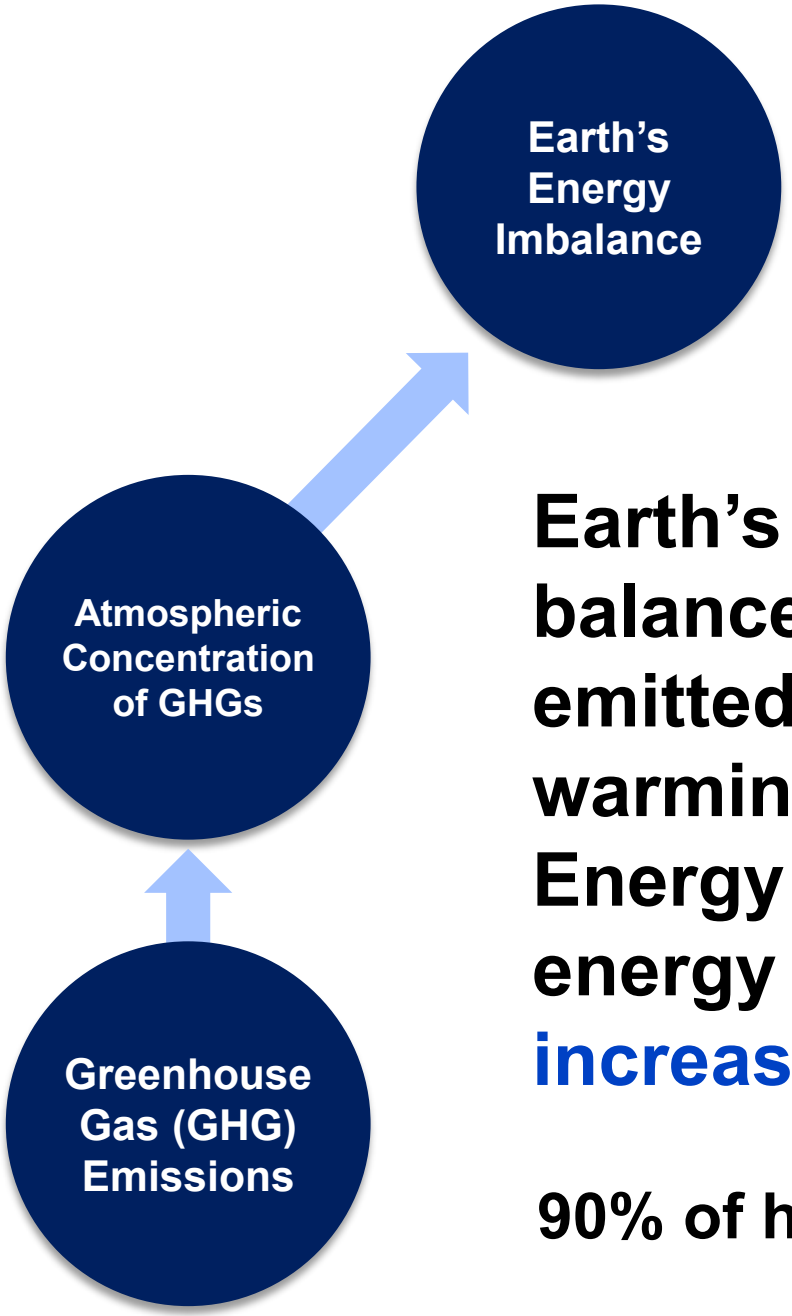
…the United States still has the highest cumulative emissions and among the highest per capita emissions of GHGs in the world.



The most recent decade (2010–2019) marked the largest decadal increase in global CO_2 emissions on record.

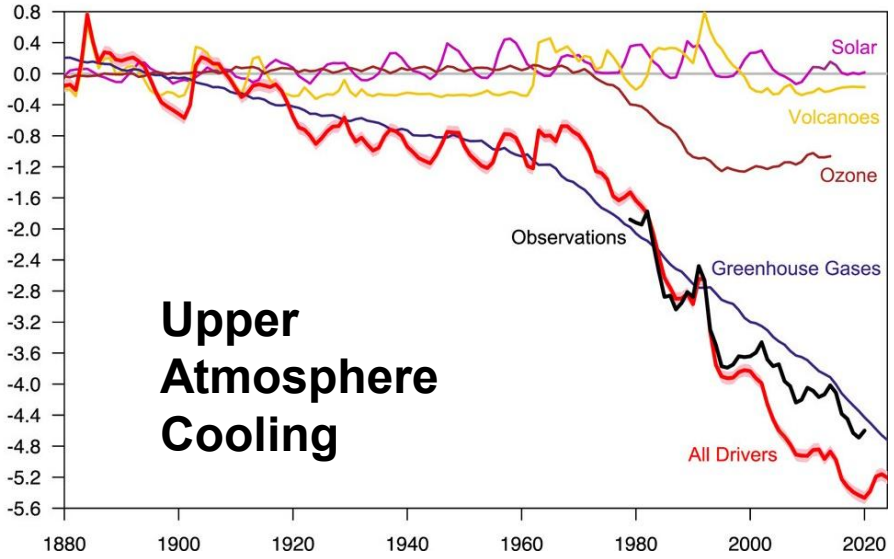


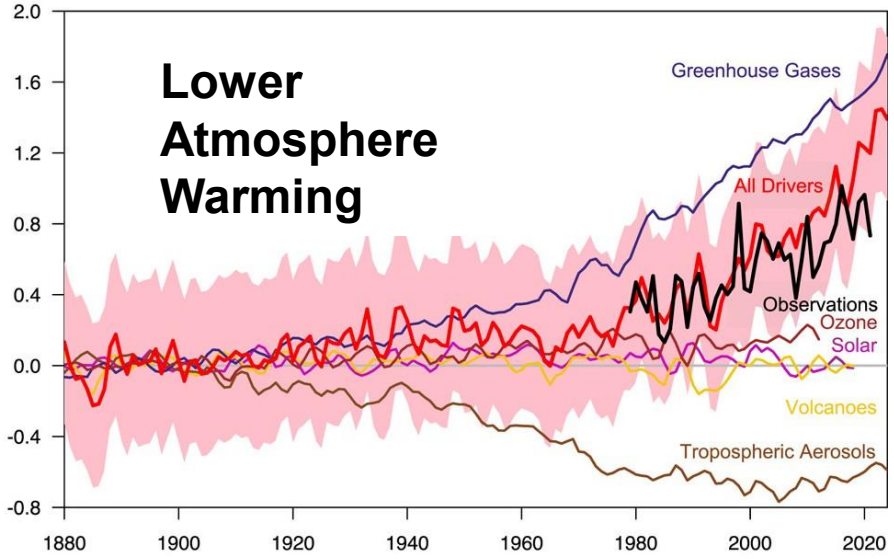
SOURCE: [NOAA Global Monitoring Lab]



Earth's climate is regulated by its energy balance. More energy has been absorbed than emitted back into space, which has led to warming of the climate since 1750. Earth's Energy Imbalance is still positive (more energy is being absorbed); the imbalance is increasing.

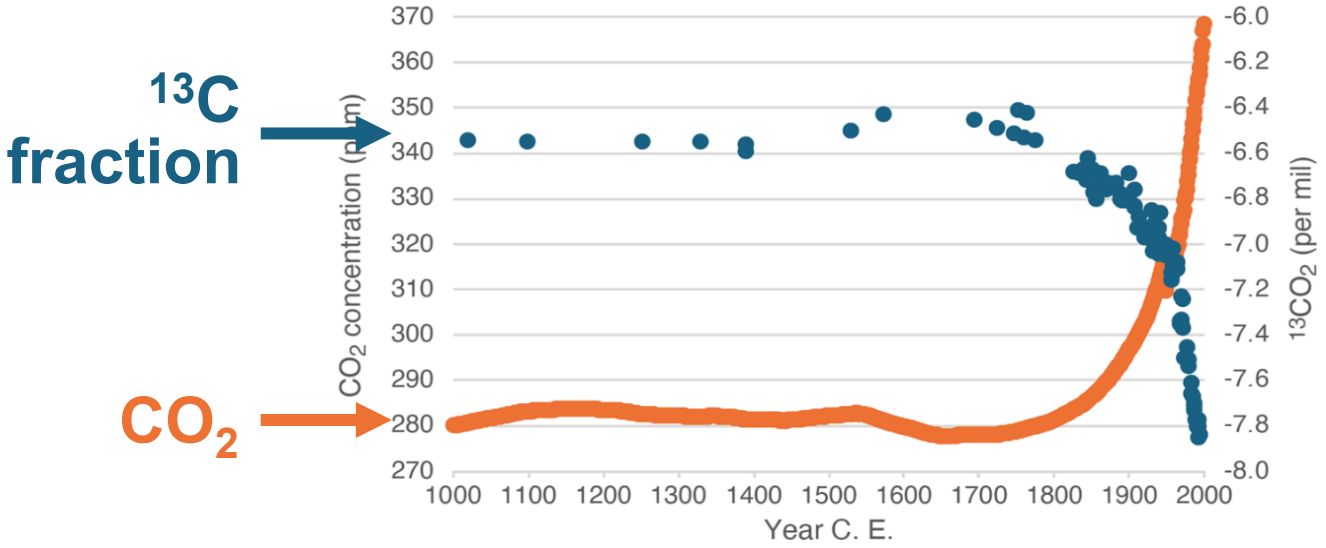
90% of heat uptake is in the oceans.



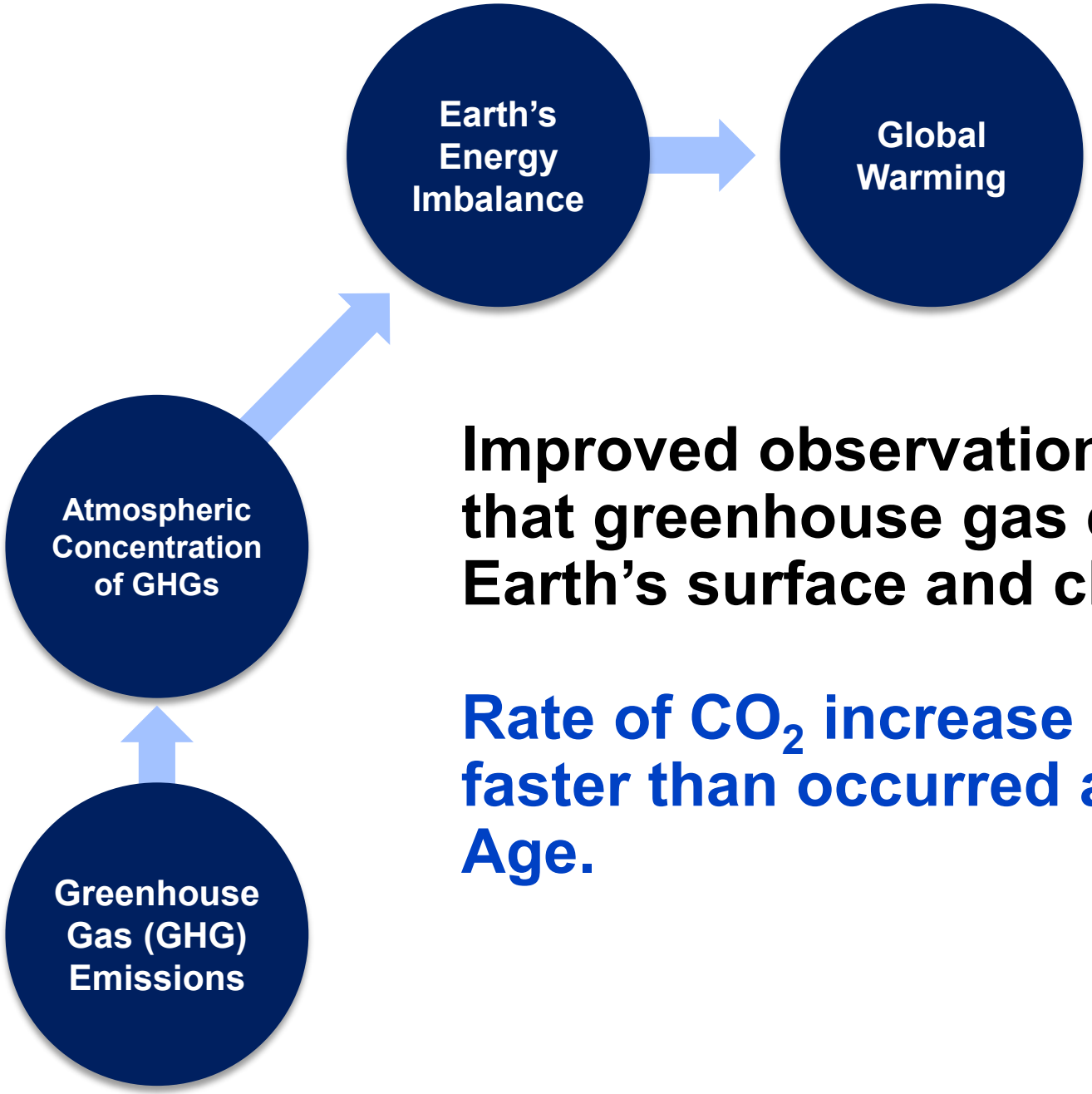


SOURCE: [Casas et al., 2023]

Multiple lines of evidence show that GHG emissions from human activities are the primary driver of the observed long-term warming trend. No known natural forces can account for observed changes.



DATA SOURCES: ^{13}C: Rubino et al., 2019; CO_2: Ahn, 2023 & [NOAA GML]



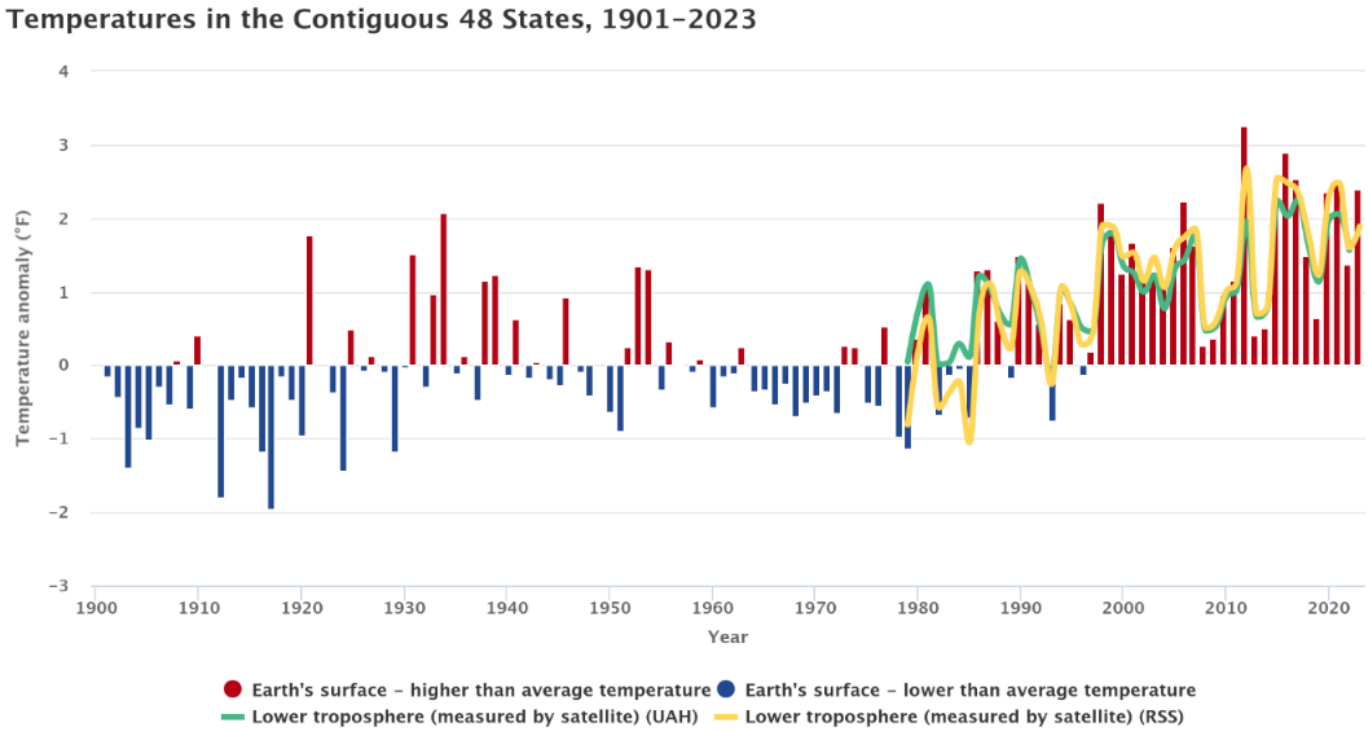
Improved observations confirm unequivocally that greenhouse gas emissions are warming Earth's surface and changing Earth's climate.

Rate of CO_2 increase is more than 100 times faster than occurred at the end of the last Ice Age.

Observed Climate Changes:

Increases in hot extremes alongside declines in cold extremes.

Tripling of average annual heat-wave frequency since the 1960's



DATA: NOAA NCEI; SOURCE: EPA

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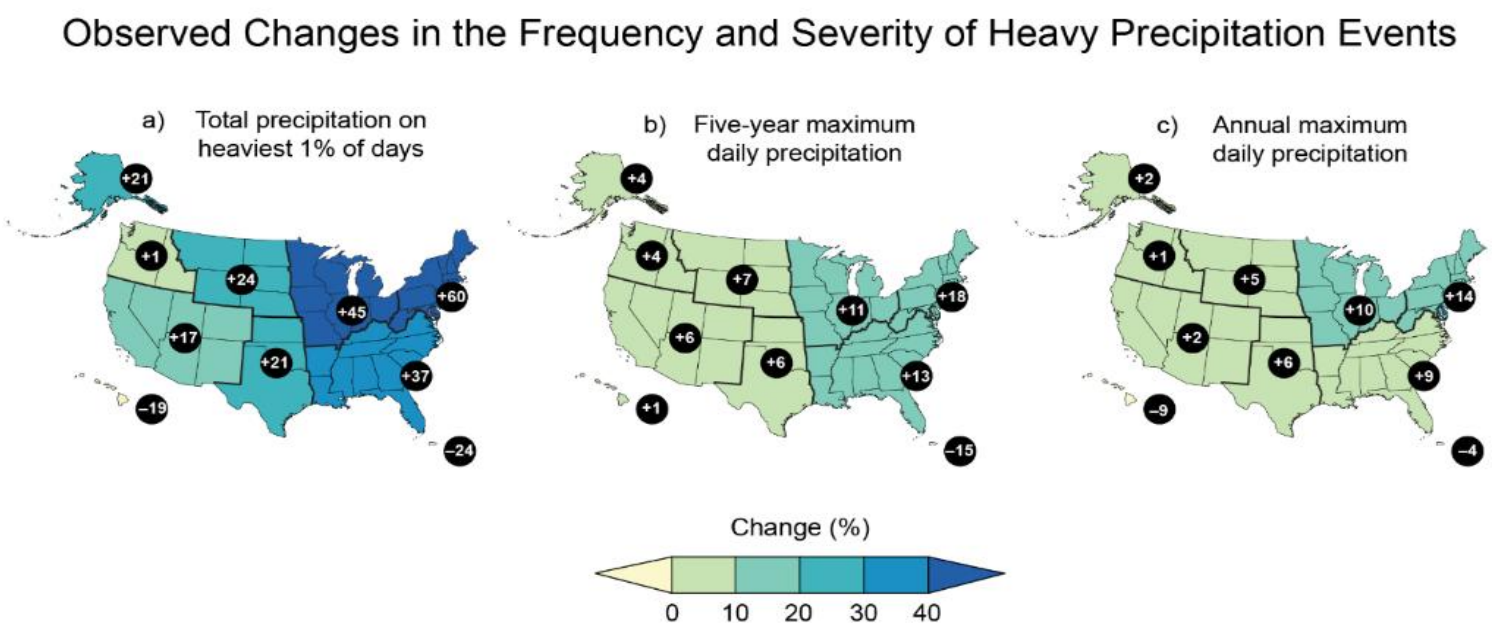
Observed Climate Changes:

Regional shifts in annual precipitation and a higher number of extreme single-day precipitation events have been observed.



SOURCE: [Marvel et al., 2023]

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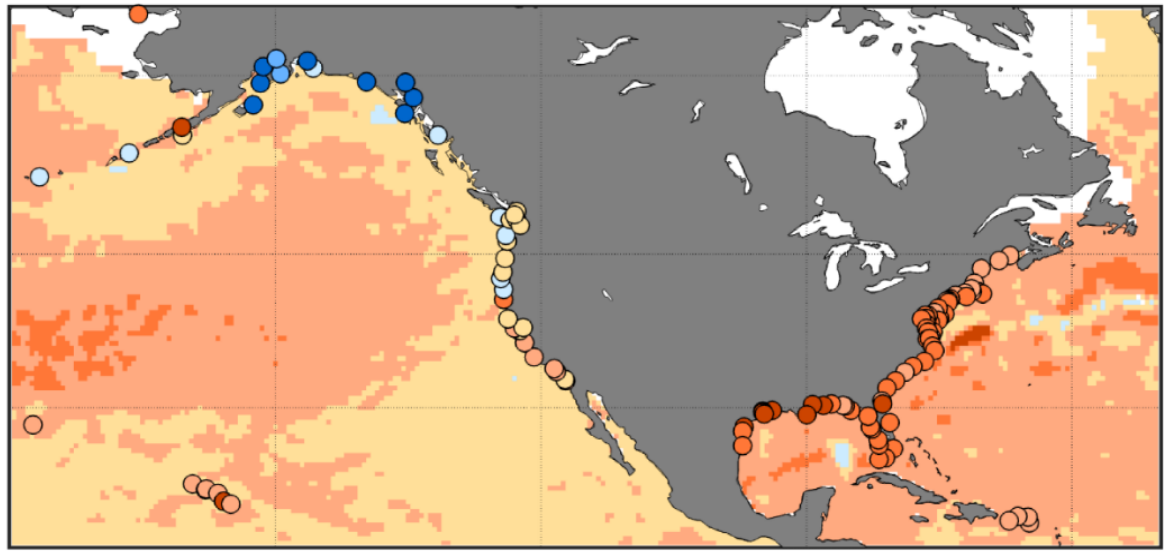
Observed Climate Changes:

Global mean sea level has risen about 7 inches since 1900, and the rate is accelerating.

50% of U.S. sea level rise in past century has occurred in the last 30 years



SOURCE: Marvel et al., 2023

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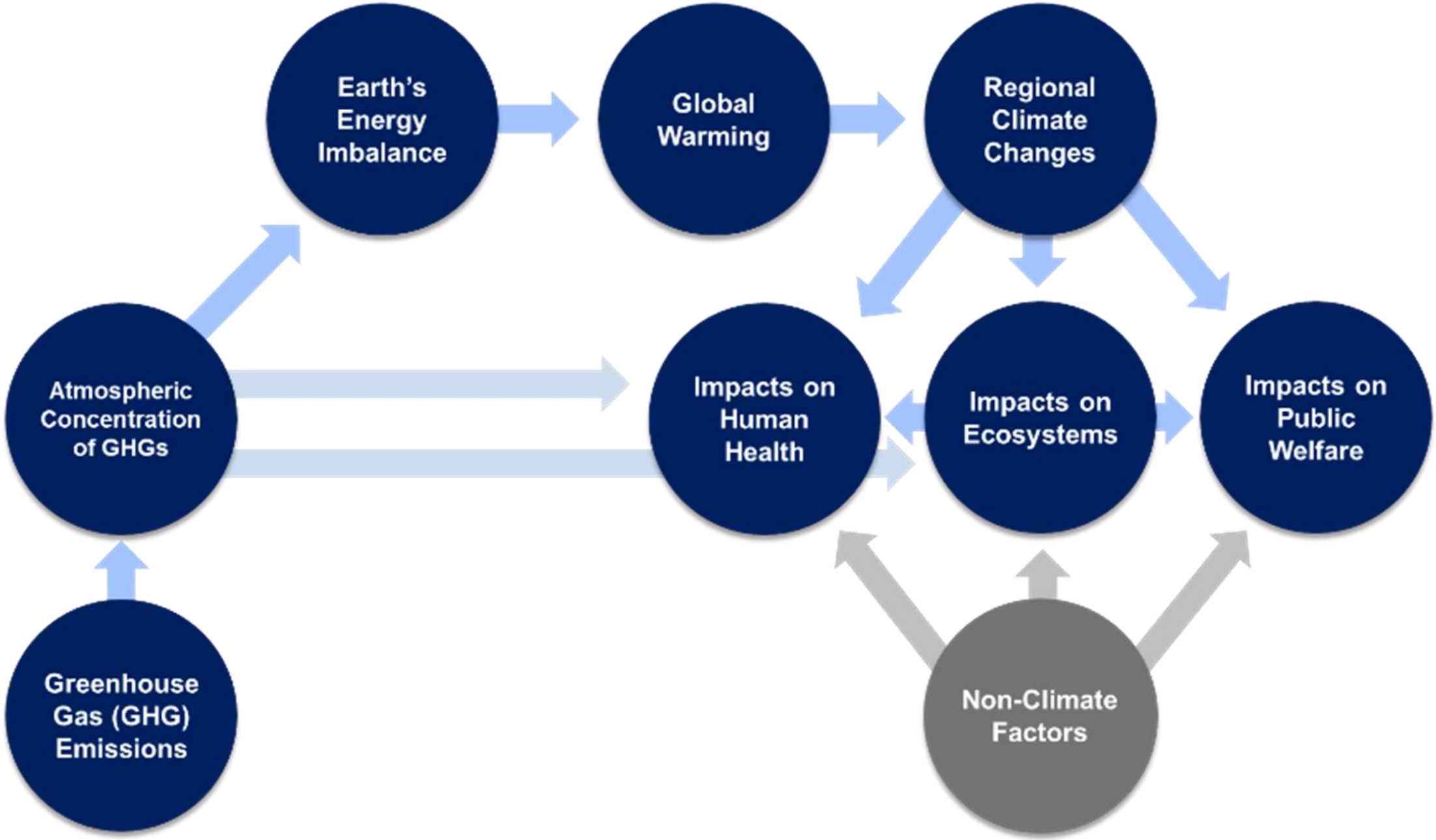
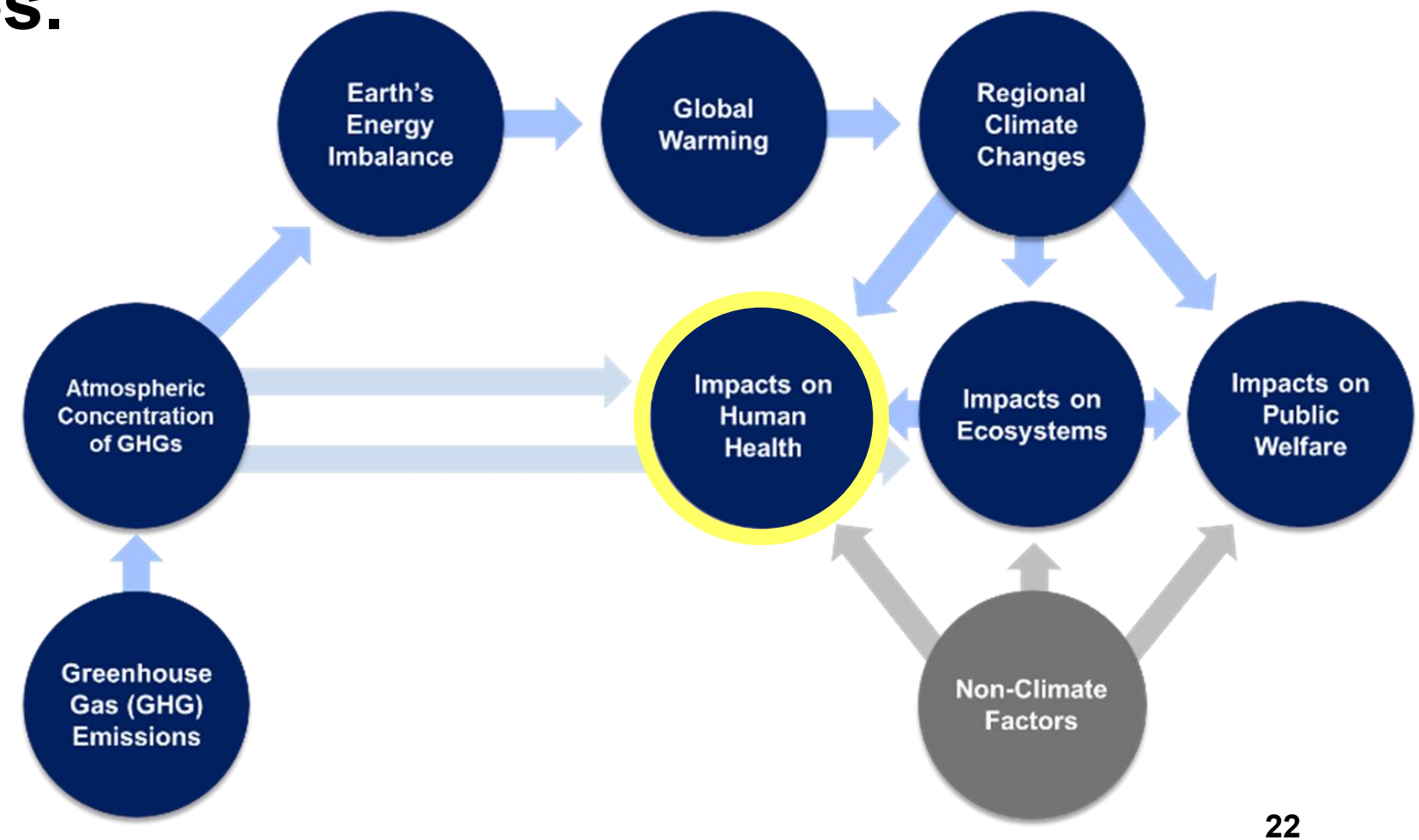
Observed Climate Changes:

There has been an increase in wildfire severity linked to climate change.

Continued emissions of greenhouse gases from human activities will lead to more climate changes in the United States, with the severity of expected change increasing with every ton of greenhouse gases emitted.


Earth's Energy Imbalance
Global Warming
Regional Climate Changes
Atmospheric Concentration of GHGs
Impacts on Human Health
Impacts on Ecosystems
Impacts on Public Welfare
Greenhouse Gas (GHG) Emissions
Non-Climate Factors

Human-caused emissions of greenhouse gases and resulting climate change harm the health of people in the United States.



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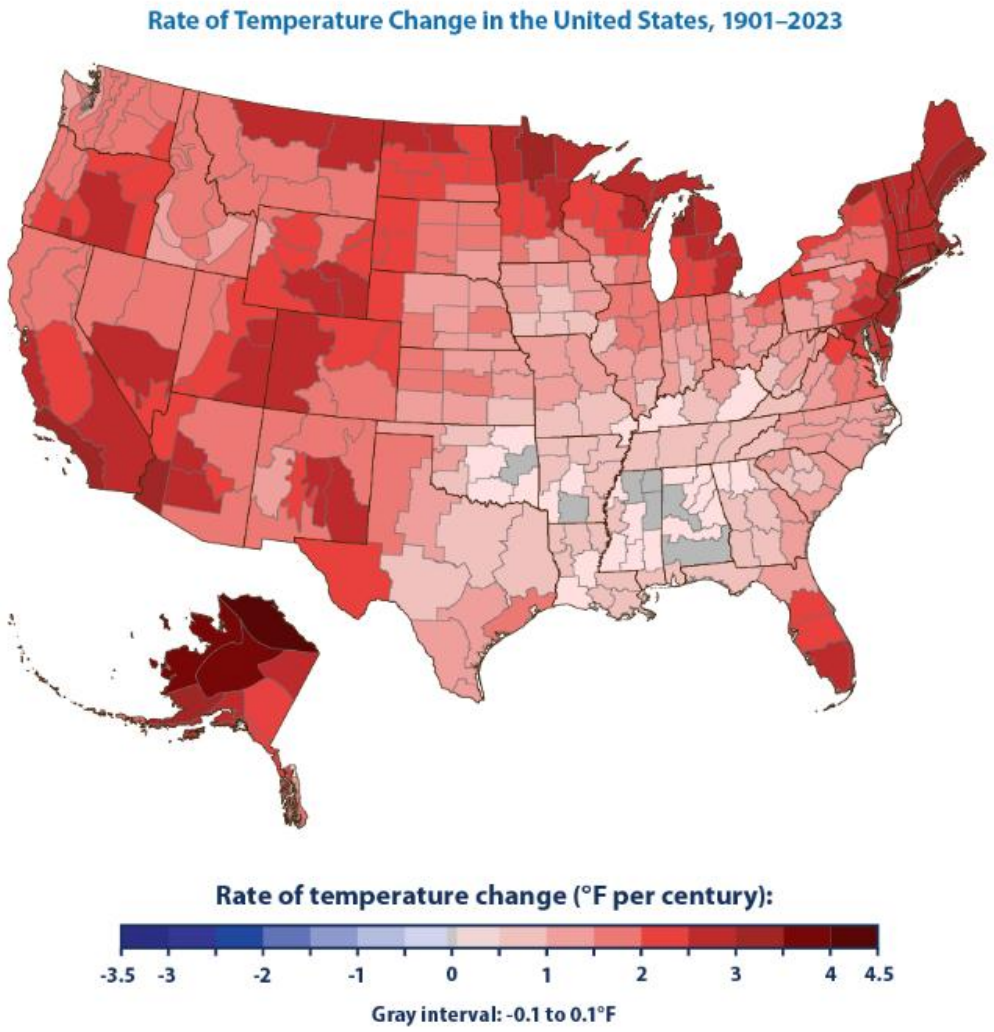
Human Health Impacts:

Climate change intensifies risks to humans from exposure to extreme heat.

- Extreme heat affects morbidity and mortality by directly causing heat exhaustion and heat stroke.
- Heat worsens effects on cardiovascular, respiratory, kidney, mental health, and other disorders.



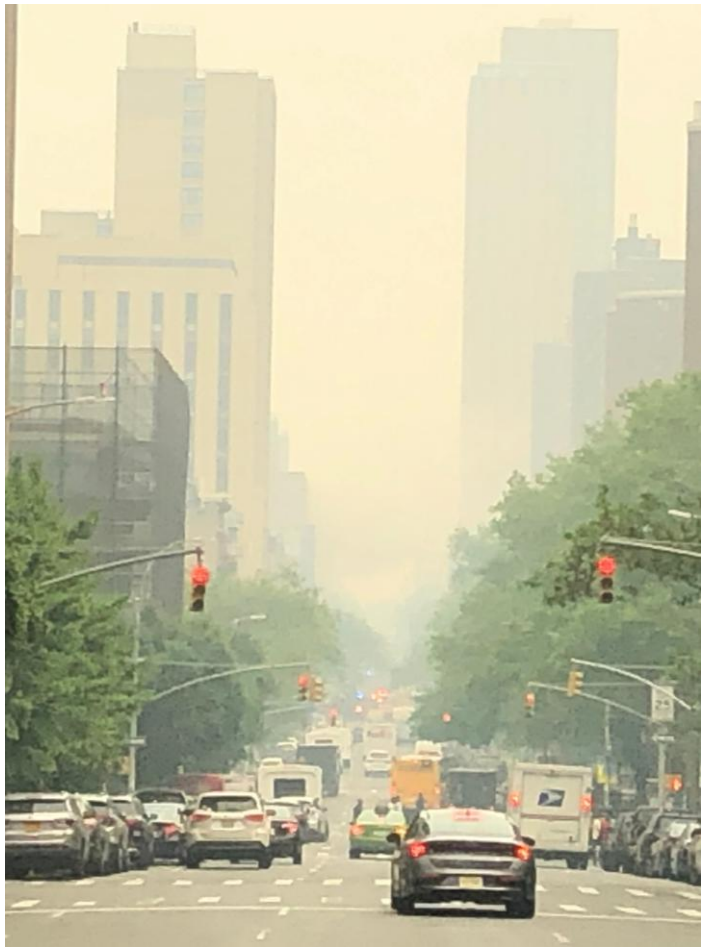
SOURCE: EPA

Human Health Impacts:

Climate change intensifies risks to humans from exposure to ground-level ozone.

Improved understanding of:

- how climate-sensitive drivers increase ozone pollution,
- how long-term ozone exposure leads to health effects beyond those of short-term exposure, and
- how health outcomes are amplified by co-occurrence of ozone exposure with heat and PM exposure.



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Human Health Impacts:

Climate change has intensified risks to humans from exposure to wildfire smoke.

- Wildfire smoke exposure linked to a wide range of adverse human health outcomes, including respiratory disease and premature death.
- Smoke from fires at the wildland-urban interface can contain harmful chemicals and other toxic materials.

Human Health Impacts:

Climate-sensitive infectious diseases—such as those carried by insects and in contaminated water—have increased.

- Increases in the geographic distribution of some tick-borne and mosquito-borne diseases have been observed and attributed to climate warning.
- Climate change is expanding the area of endemicity of some fungal diseases.
- Heavy precipitation, drought, and warming temperatures are linked to a rise in waterborne disease outbreaks.

Human Health Impacts:

Climate Impact on Noncommunicable Disease and Health Issues

- Pulmonary Function
- Cardiovascular Disease
- Mental Health
- Pregnancy outcomes
- Renal function
- Nutrition
- Food Safety

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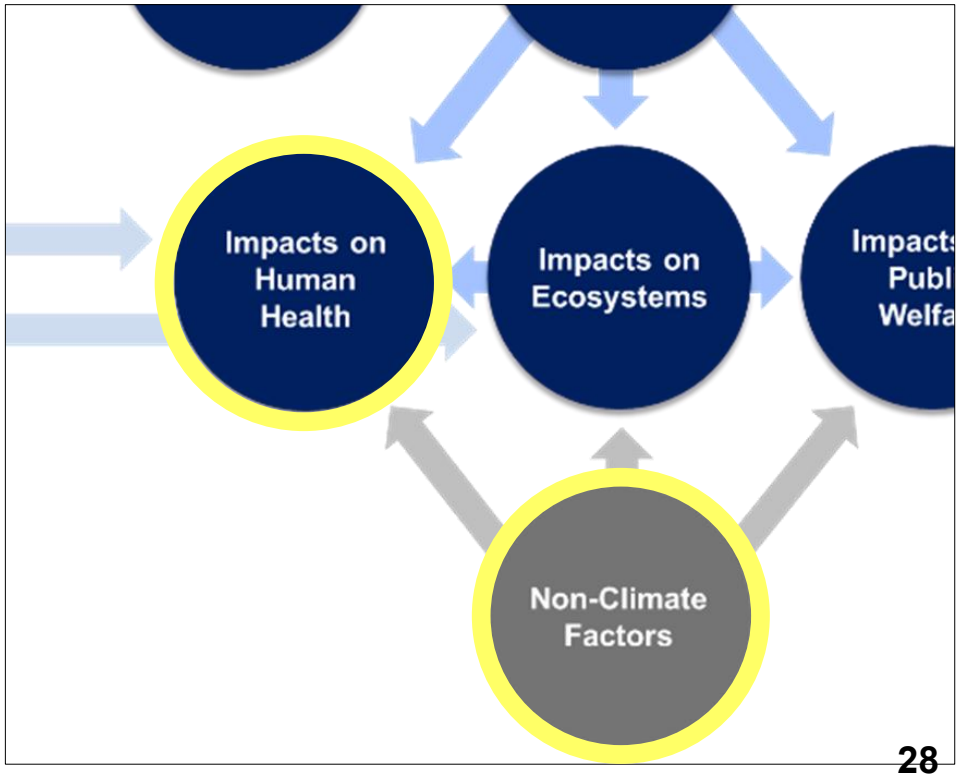
Groups such as older adults, people with preexisting health conditions or multiple chronic diseases, and outdoor workers are disproportionately susceptible to climate associated health effects.

Even as non-climate factors (e.g., adaptation) can help people cope with harmful impacts of climate change, they cannot remove the risk of harm.



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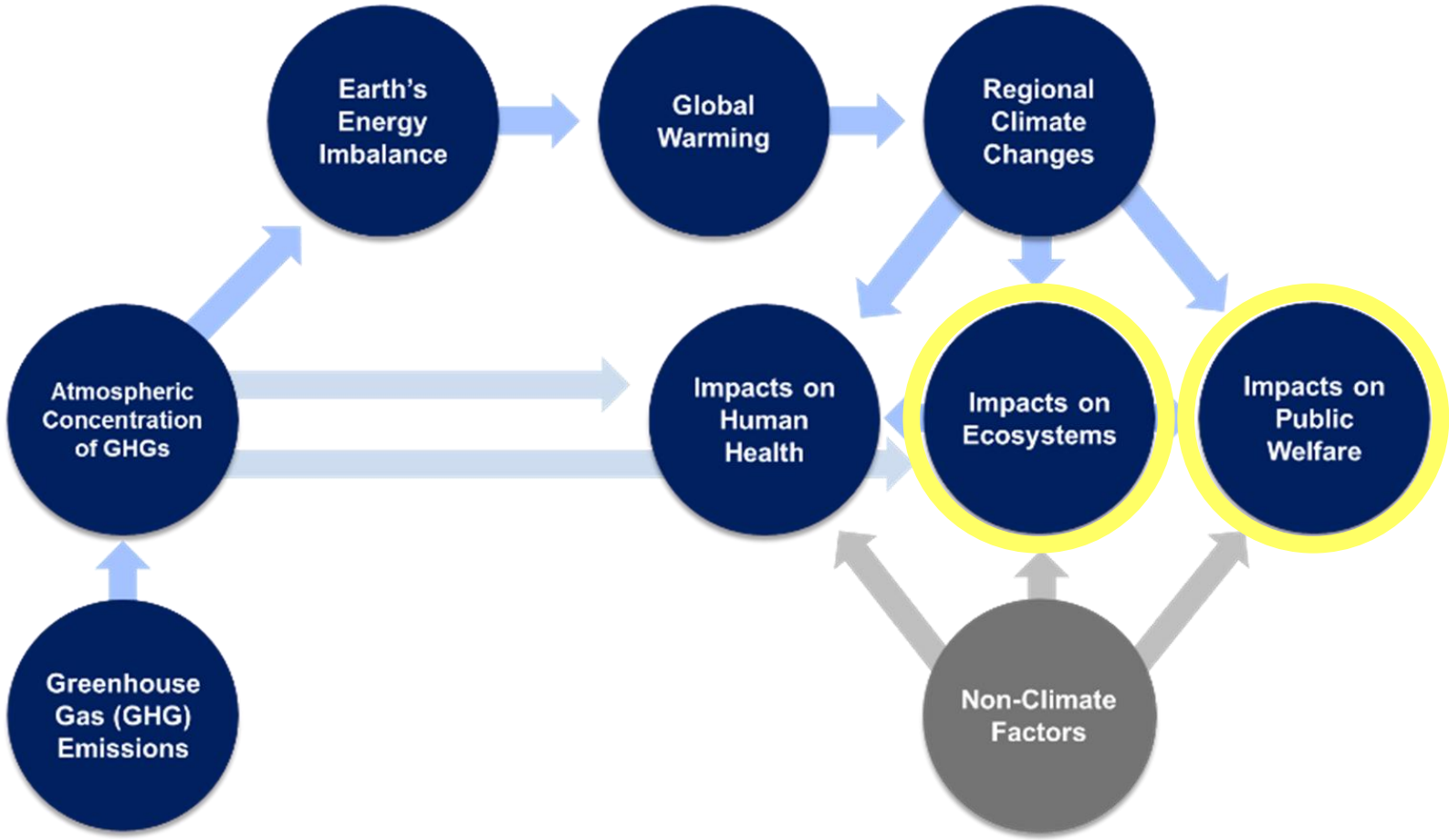
Changes in climate resulting from human-caused emissions of greenhouse gases harm the welfare of people in the United States.



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Public Welfare Impacts:

Climate-driven changes in temperature and precipitation extremes and variability are leading to negative impacts on agricultural crops.

Increasing evidence of:

- effects of excess heat and precipitation extremes on crop yields in the Southeast and Midwest, and
- increasing drought conditions in western U.S. agriculture

Technological and other changes have increased agricultural production.

Public Welfare Impacts:

Climate-driven changes in temperature and precipitation extremes and variability are leading to negative impacts on livestock.

Impacts of heat stress on livestock include:

- animal behavior
- increased susceptibility to disease and mortality, and
- reduced milk production and reproduction rates.

Public Welfare Impacts:

Climate change, including increases in climate variability and wildfires, is changing the composition of forests and grassland ecosystems and the services they provide.

- Shifts observed in phenology, tree range, and interactions with pests and pathogens.
- Forest and grassland productivity has generally increased in the East but has declined in much of the West, where warming is more pronounced and precipitation has decreased.

Public Welfare Impacts:

Climate-related changes in water availability and quality vary across regions in the United States with some regions showing a decline.

- Drought affects the production of food which leads to supply shortages and increased prices, impacting rural communities.
- Reduced water quality in lakes and coastal waters has been linked to increased temperature, oxygen depletion in deeper waters, harmful algal blooms, and effects on freshwater and marine fisheries.

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Public Welfare Impacts:

Climate-related changes in the chemistry and the heat content of the ocean are having negative effects on calcifying organisms and contributing to increases in harmful algal blooms.

- Ocean pH has declined 0.017-0.027 unit per decade and studies of effects on marine organisms are ongoing.
- Incidents of climate-driven impacts of harmful algal blooms have increased greatly since 2009.

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Public Welfare Impacts:

U.S. energy systems, infrastructure, and many communities are experiencing increasing stress and costs owing to the effects of climate change.

- Increased temperatures have reduced efficiency in energy generation and transmission, while U.S. energy demand continues to increase.
- Transport systems have multiple stresses from climate change.
- Communities in Artic regions are facing multiple threats from permafrost thaw, sea level rise, and declines in sea ice extent.
- Sea level rise and extreme weather pose increasing threats to the nearly 40% of the U.S. population who live in coastal counties.

Committee's Overarching Conclusion:

EPA's 2009 finding that the human-caused emissions of greenhouse gases threaten human health and welfare was accurate, has stood the test of time, and is now reinforced by even stronger evidence.

Thank you! In addition to the committee, we are grateful to all who contributed to this report:

- Individuals who responded to the Request for Information and provided public input to the study
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