

# FOURTH NATIONAL CLIMATE ASSESSMENT

## Volume II: Impacts, Risks, and Adaptation in the United States

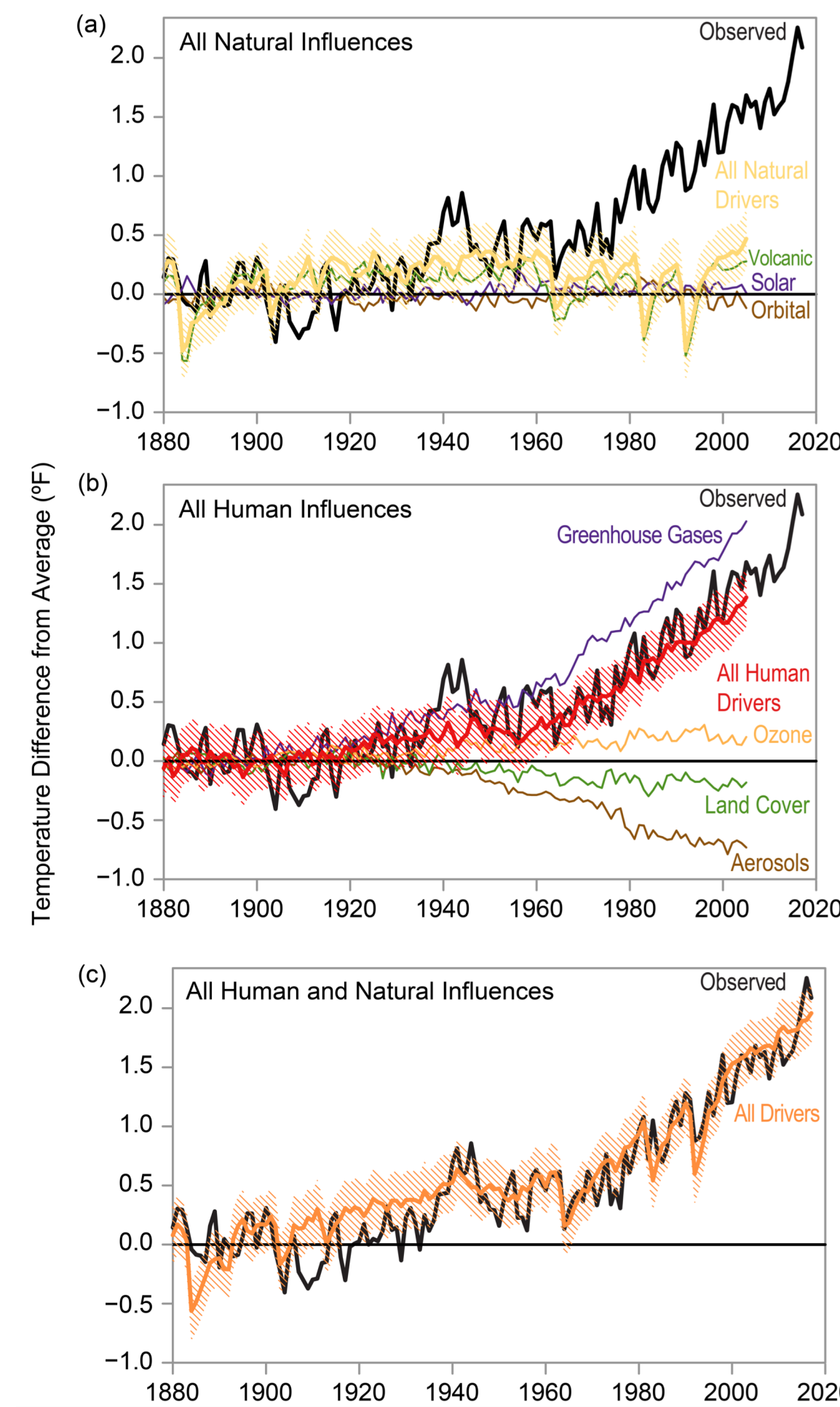
### Ch. 1: Overview

PA31D-1150

## I. OBSERVATIONS, CAUSES, AND FUTURE CHANGE

1. Observations collected around the world provide significant, clear, and compelling evidence that global average temperature is much higher, and is rising more rapidly, than anything modern civilization has experienced.
2. The warming trend observed over the past century can only be explained by the effects that human activities, especially emissions of greenhouse gases, have had on the climate.
3. Earth's climate will continue to change over this century and beyond. After mid-century, how much the climate changes will depend primarily on global emissions of greenhouse gases and on the response of Earth's climate system to human-induced warming.

Human and Natural Influences on Global Temperature



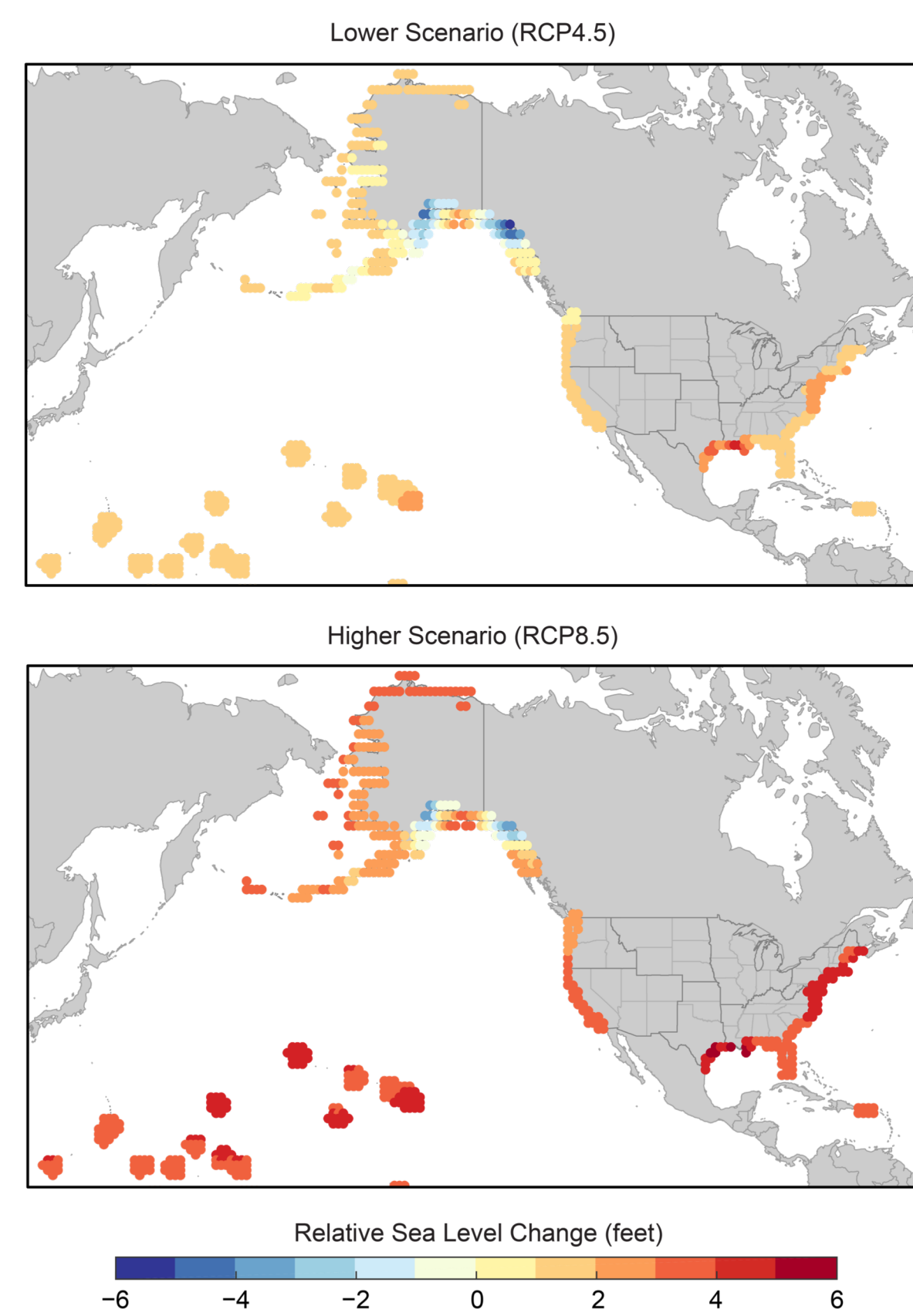
The **top panel (a)** shows the temperature changes simulated by a climate model when only natural factors (yellow line) are considered. The other lines show the individual contributions from observed changes in Earth's orbit (brown line), the amount of incoming energy from the sun (purple line), and changes in emissions from volcanic eruptions (green line).

The **middle panel (b)** shows the simulated changes in global temperature when considering only human influences (dark red line), including the contributions from emissions of greenhouse gases (purple line) and small particles (referred to as aerosols, brown line) as well as changes in ozone levels (orange line) and changes in land cover, including deforestation (green line).

The **bottom panel (c)** shows the temperature change (orange line) simulated by a climate model when both human and natural influences are included. The result matches the observed temperature record closely, particularly since 1950, making the dominant role of human drivers plainly visible.

Figure 2.1, Ch. 2: Our Changing Climate. Source: NASA GISS.

Projected Relative Sea Level Change in the U.S. by 2100



The maps show projections of change in relative sea level by 2100 (as compared to 2000) under lower and higher scenarios. Globally, sea levels will continue to rise from thermal expansion of the ocean and melting of land-based ice masses. Regionally, however, the amount of sea level rise will not be the same everywhere. Where land is sinking (as along the Gulf of Mexico coastline), relative sea level rise will be higher, and where land is rising (as in parts of Alaska), relative sea level rise will be lower. Changes in ocean circulation and gravity effects due to ice melt will also alter the heights of the ocean regionally. Source: adapted from [CSSR](#), [Figure 12.4](#)

## II. CURRENT AND FUTURE RISKS

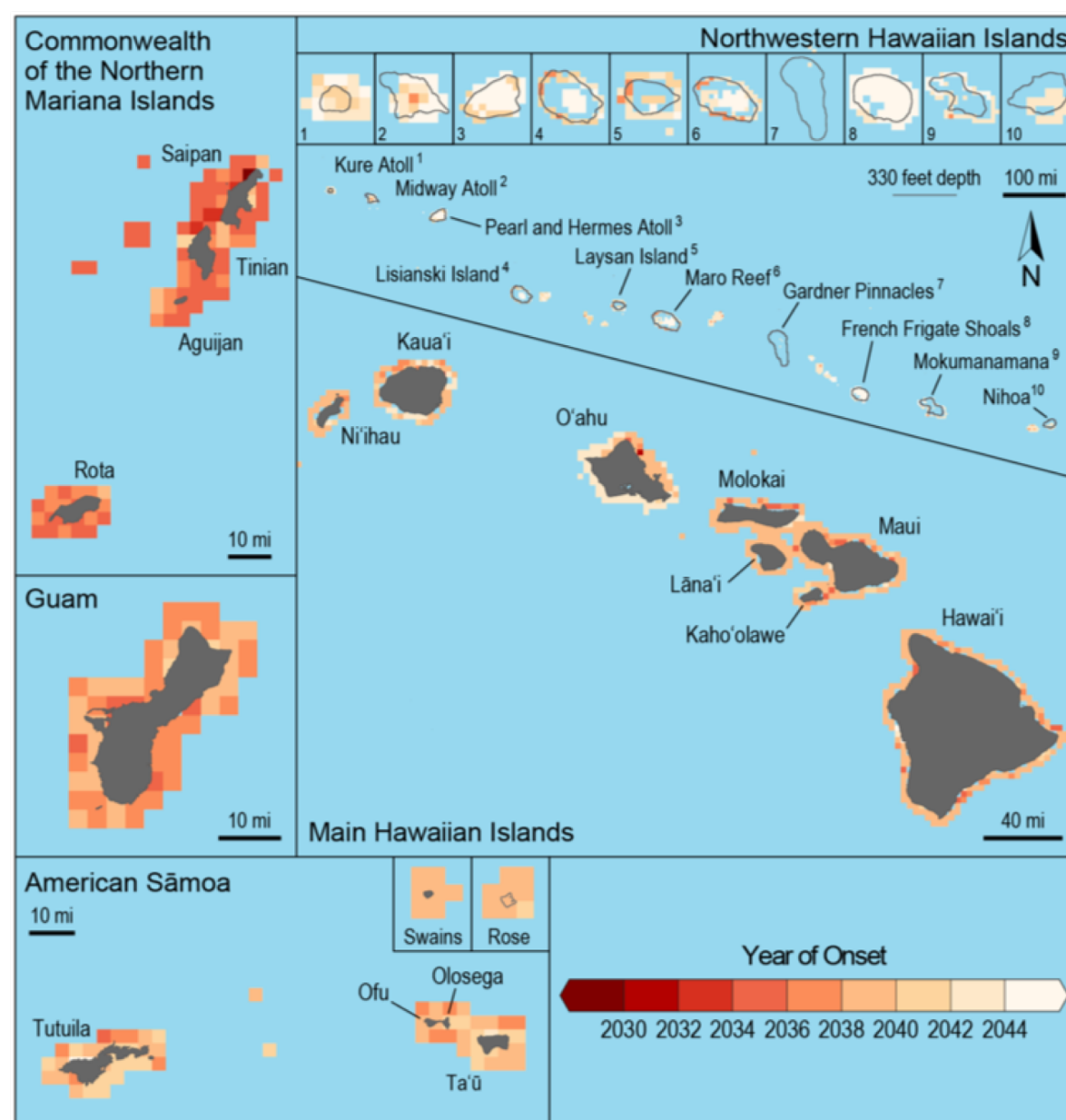
### ECONOMY AND INFRASTRUCTURE

1. Many extreme weather and climate-related events are expected to become more frequent and more intense in a warmer world, creating greater risks of infrastructure disruption and failure that can cascade across economic sectors
2. Regional economies and industries that depend on natural resources and favorable climate conditions, such as agriculture, tourism, and fisheries, are increasingly vulnerable to impacts driven by climate change
3. Some aspects of our economy may see slight improvements in a modestly warmer world. However, the continued warming that is projected to occur without significant reductions in global greenhouse gas emissions is expected to cause substantial net damage to the U.S. economy, especially in the absence of increased adaptation efforts



**Top:** Flood rescue efforts associated with Hurricane Harvey, 27 August, 2017. Photo credit: Lt. Zachary West, Texas National Guard. **Bottom:** Tubbs Fire burn area, northern California, October 2017. Photo credit: Master Sgt. David Loeffler, U.S. Air National Guard.

### NATURAL ENVIRONMENT AND ECOSYSTEM SERVICES



**Severe Coral Bleaching Projected for Hawai'i and the U.S.-Affiliated Pacific Islands.** Figure shows the years when severe coral bleaching is projected to occur annually in the Hawai'i and U.S.-Affiliated Pacific Islands region under a higher scenario (RCP8.5). Under projected warming of approximately 0.5°F per decade, all nearshore coral reefs in the region will experience annual bleaching before 2050. Source: NOAA.

### HUMAN HEALTH AND WELL-BEING

1. Higher temperatures, increasing air quality risks, more frequent and intense extreme weather and climate-related events, increases in coastal flooding, disruption of ecosystem services, and other changes increasingly threaten the health and well-being of the American people
2. Risks are often highest for those that are already vulnerable, including low-income communities, some communities of color, children, and the elderly
3. Future climate change is expected to further disrupt many areas of life, exacerbating existing challenges and revealing new risks to health (including mental health) and prosperity

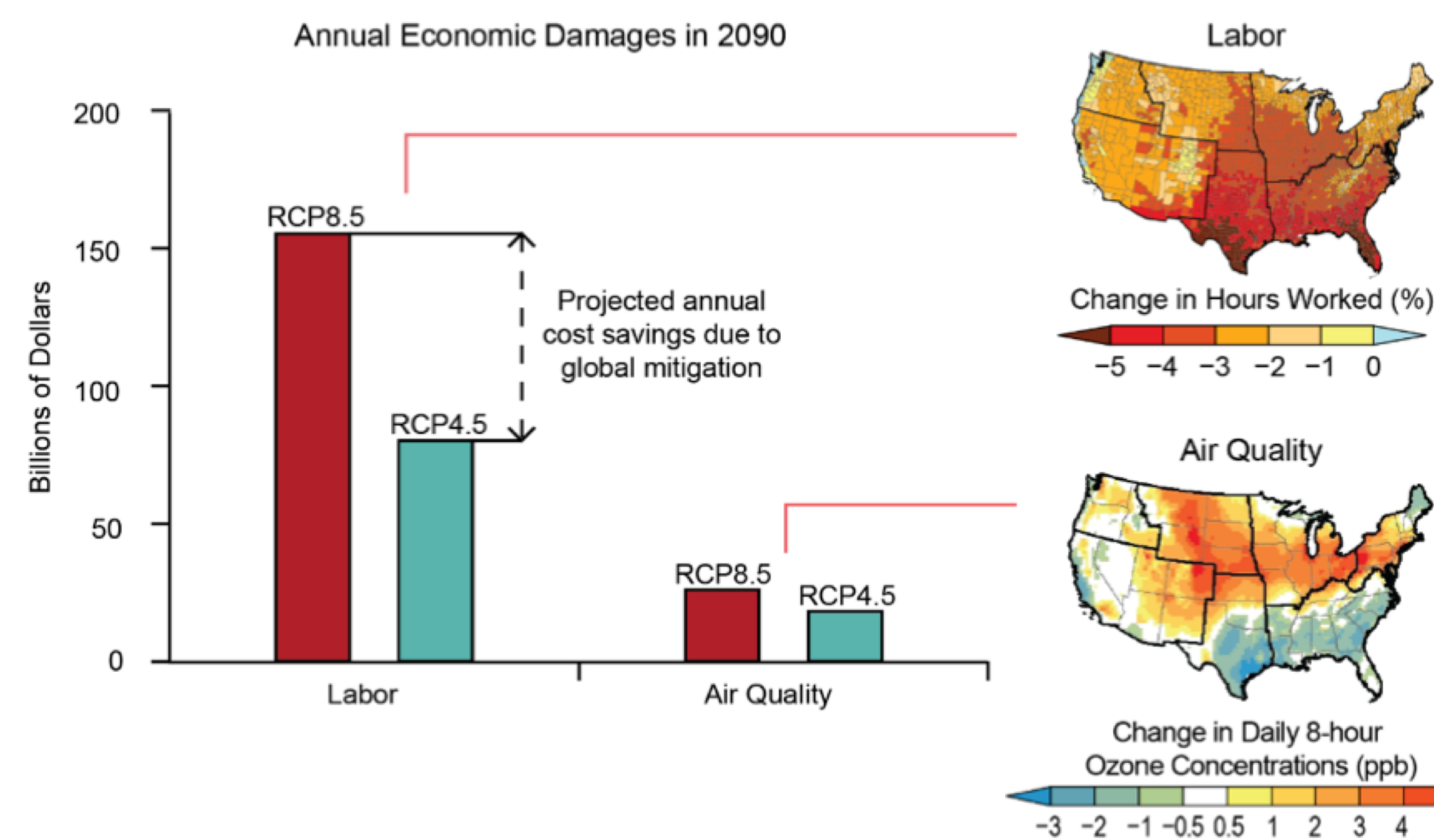


**Community Relocation—Isle de Jean Charles, Louisiana.** (left) A federal grant is being used to relocate the tribal community of Isle de Jean Charles in response to severe land loss, sea level rise, and coastal flooding (photo credit: Ronald Stine). (right) As part of the resettlement of the tribal community of Isle de Jean Charles, residents are working with the Lowlander Center and the State of Louisiana to finalize a plan that reflects the desires of the community (photo provided by Louisiana Office of Community Development).

## III. REDUCING RISKS

### CHARACTERIZING RISK IN NCA4 VOL. II

1. Climate-related risks are projected to intensify—but how much they intensify will depend on actions taken to reduce global greenhouse gas emissions and to adapt to the risks from climate change now and in the coming decades
2. Risks posed by climate variability and change vary by region and sector and by the vulnerability of people experiencing impacts
3. This report characterizes specific risks, vulnerabilities, and impacts across regions and sectors in an effort to help people assess the risks they face, create and implement a response plan, and monitor and evaluate the efficacy of a given action, and provides examples of response actions underway in many communities
4. Many climate change impacts and economic damages in the United States can be substantially reduced through global-scale reductions in greenhouse gas emissions complemented by regional and local adaptation efforts
5. Since the Third National Climate Assessment in 2014, a growing number of states, cities, and businesses have pursued or expanded upon initiatives aimed at reducing greenhouse gas emissions, and the scale of adaptation implementation across the country has increased
6. However, these efforts do not yet approach the scale needed to avoid substantial damages to the economy, environment, and human health expected over the coming decades.



New economic impact studies. Annual economic impact estimates are shown for labor and air quality. (left) National annual damages in 2090 for a higher scenario and lower scenario; the difference between the height of the red and teal bars for a given category represents an estimate of the economic benefit to the U.S. from global mitigation action. (right) Regional variation in annual impacts projected under the higher scenario in 2090. The map on the top shows the percent change in hours worked in high-risk industries as compared to the period 2003–2007. The map on the bottom is the change in ground-level ozone concentrations compared to the period 1995–2005. Source: EPA, 2017. Multi-Model Framework for Quantitative Sectoral Impacts Analysis: A Technical Report for the Fourth National Climate Assessment. U.S. Environmental Protection Agency, EPA 430-R-17-001.

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