U.S. Global Change Research Program

Fourth National Climate Assessment, Vol II — Impacts, Risks, and Adaptation in the United States

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NOAA NCA4 Seminar Series
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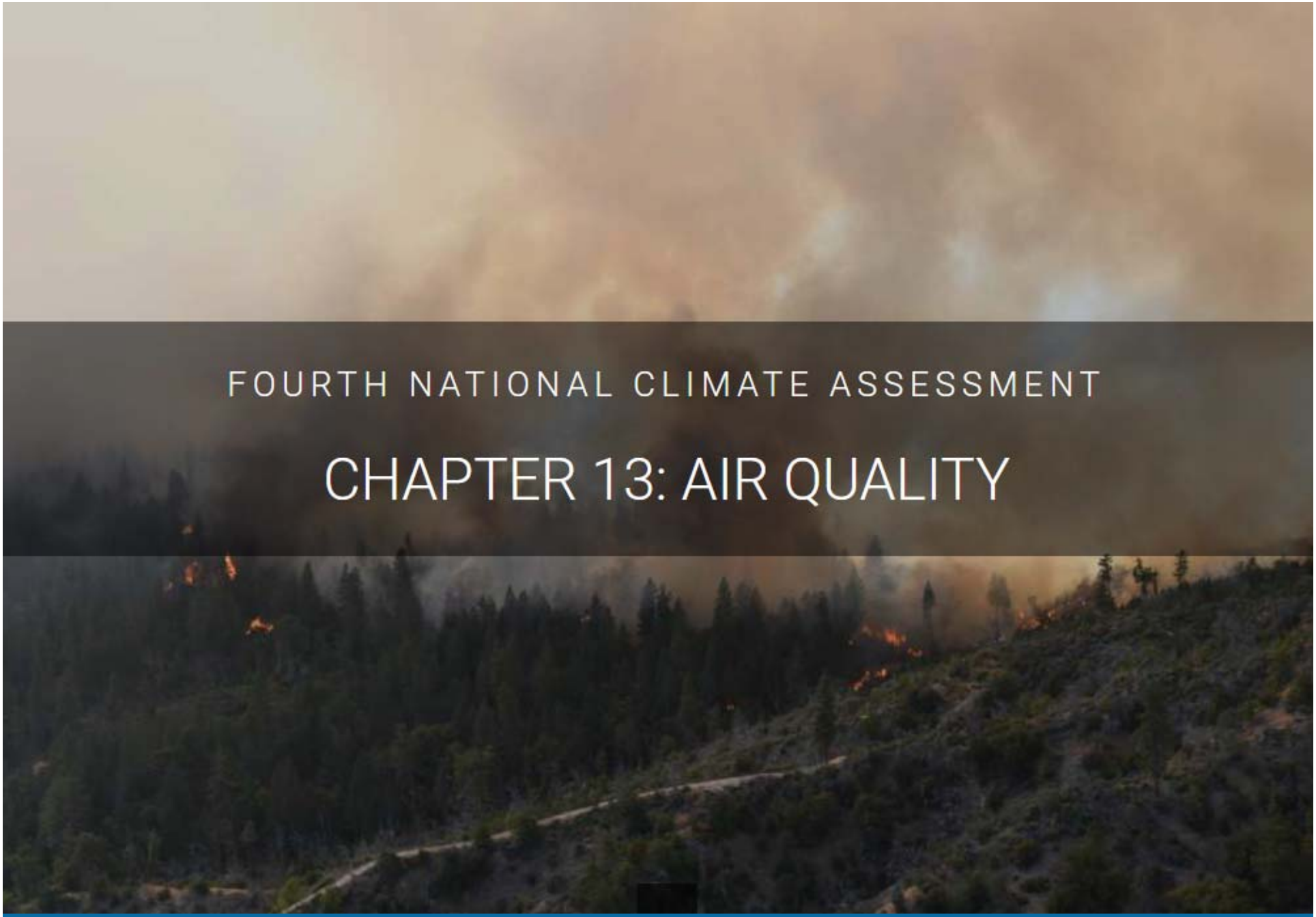

FOURTH NATIONAL CLIMATE ASSESSMENT

CHAPTER 13: AIR QUALITY

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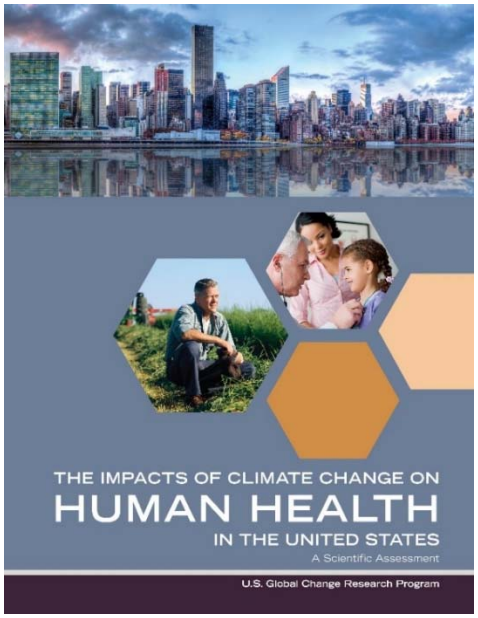
New in NCA4

- Several new sectoral chapters, including Air Quality
- Risk-Based Framing: what Risks does climate change pose for air quality?
  - Health Impacts
  - Aesthetic considerations: visibility, natural beauty, outdoor recreation

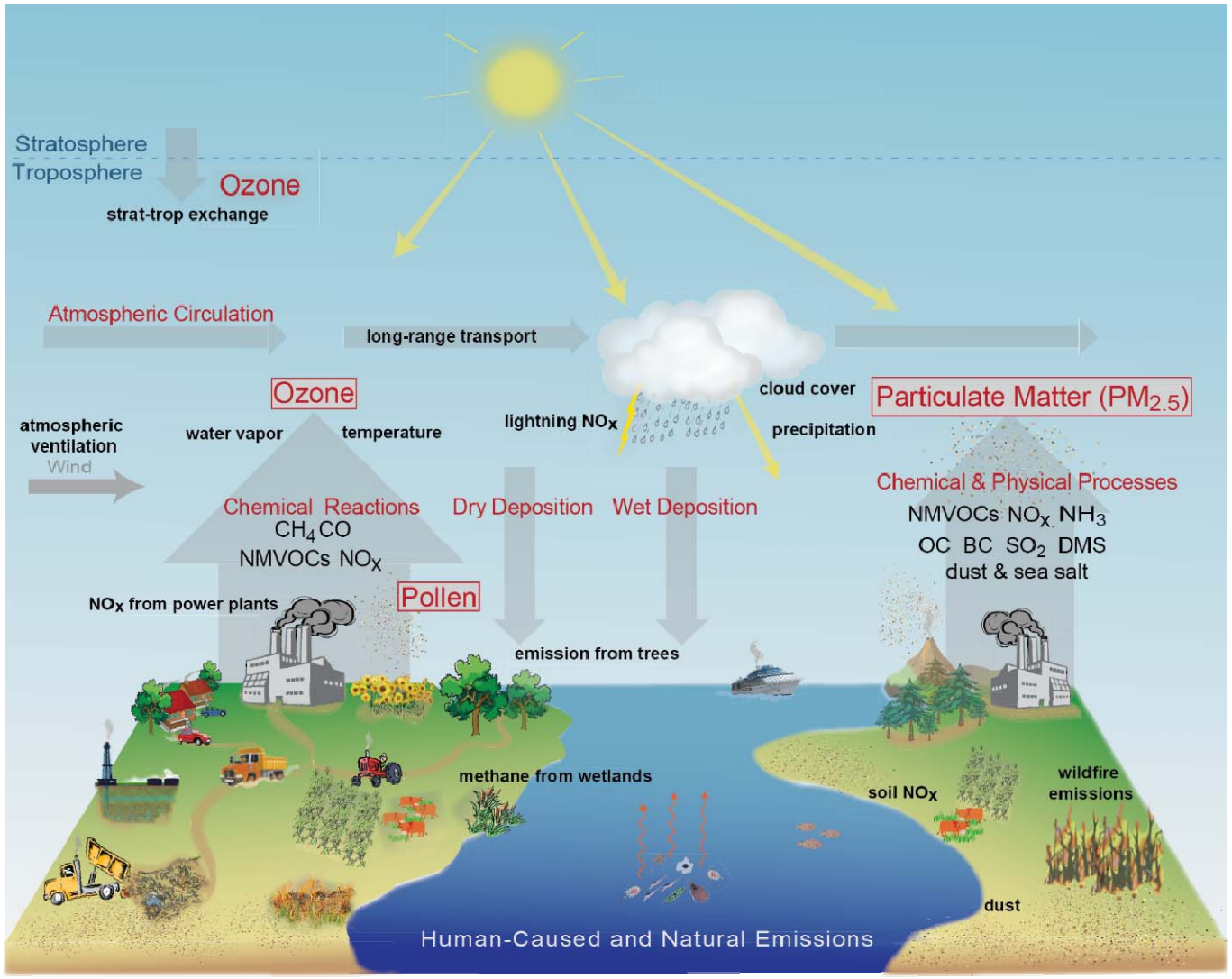


health2016.globalchange.gov

Air Pollution 101

- Air quality refers to concentrations of a set of designated air pollutants relative to health-based standards. The main air pollutants of interest are ozone (O_3) and fine particulate matter ($PM_{2.5}$), though larger pollen and dust particles can be important also.
- Air pollutant concentrations depend on (1) meteorological conditions (weather: temperature, clouds, humidity and precipitation, wind speeds, vertical mixing) and (2) precursor emissions, which can have natural (or biogenic) sources or be from human activities (anthropogenic).
- Ozone is not emitted, but is formed in the lower atmosphere through atmospheric chemical reactions between nitrogen oxides (NOx) and volatile organic compounds (VOCs).
  - Also formed naturally in the stratosphere ("ozone layer"), which protects us from harmful UV. That is (generally) not what we're talking about here!
- Particulate matter can be directly emitted (e.g., black carbon, or soot) and can be formed in the atmosphere from gas-phase precursors (e.g., sulfate, nitrate, ammonium, organic carbon)

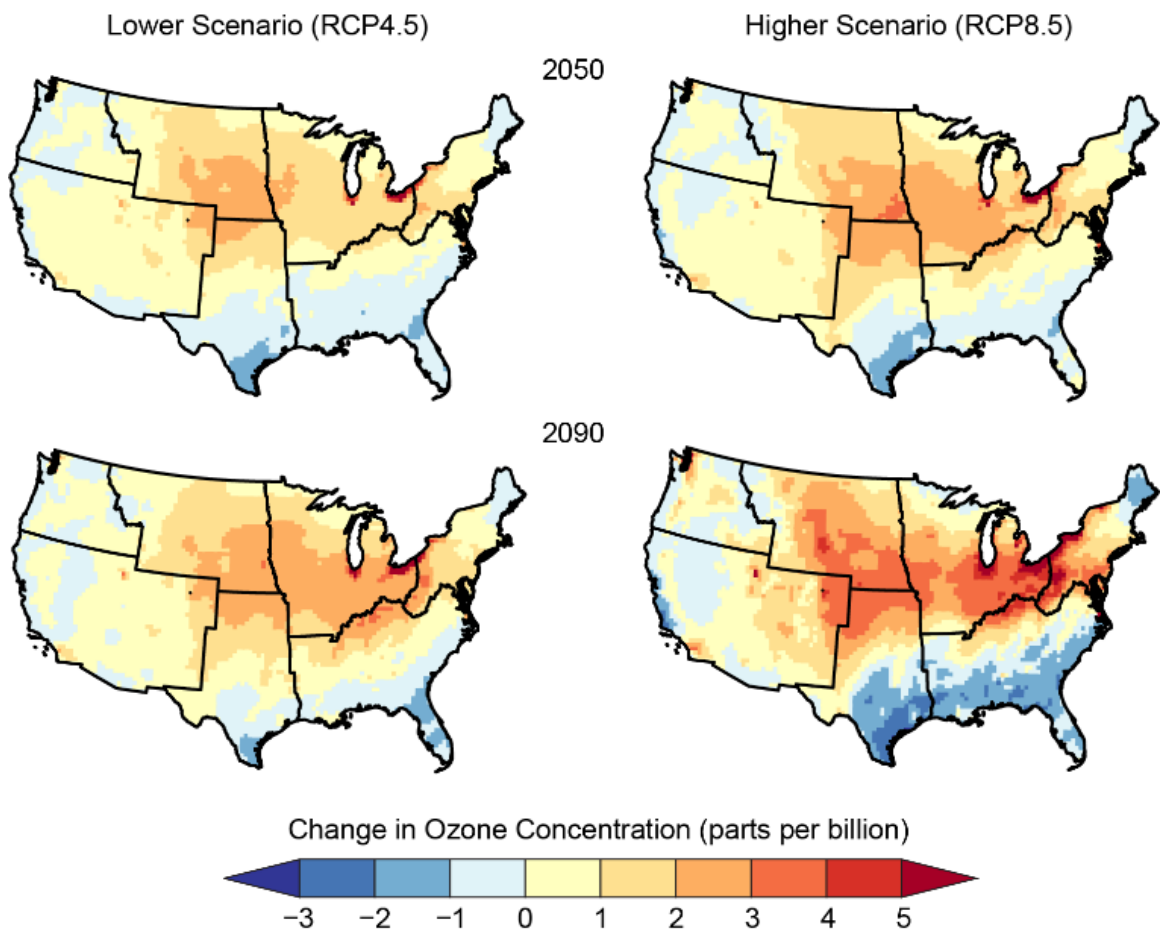
Climate Change and Air Quality



Projected Changes in Summer Season Ozone

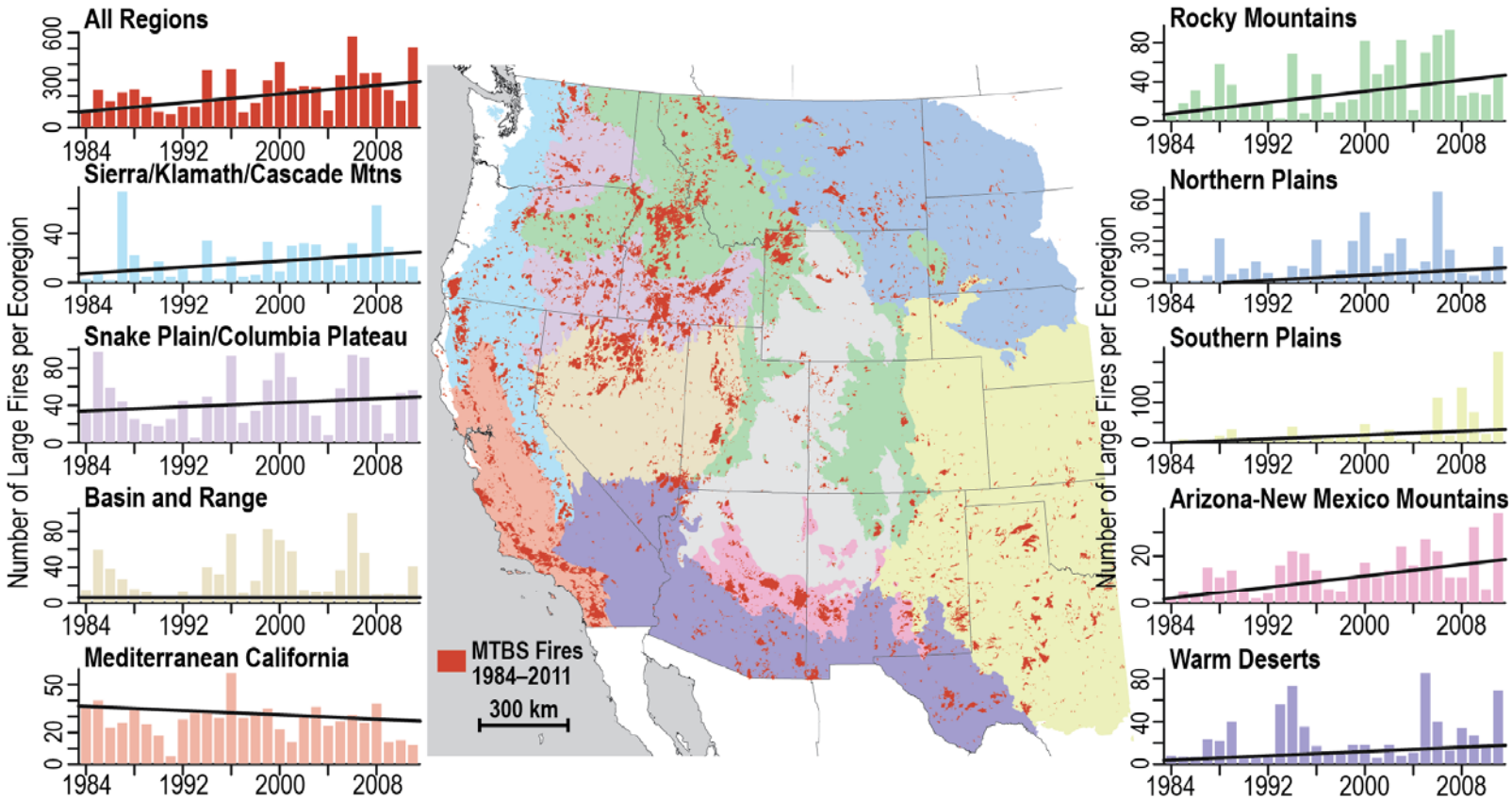
Key Messages

1. **Increasing Risks from Air Pollution**
2. Increasing Impacts of Wildfires
3. Increases in Airborne Allergen Exposure
4. Co-Benefits of Greenhouse Gas Mitigation



Increasing Trend in Wildfires

Wildfire smoke degrades air quality, increasing the health risks to tens of millions of people in the United States.



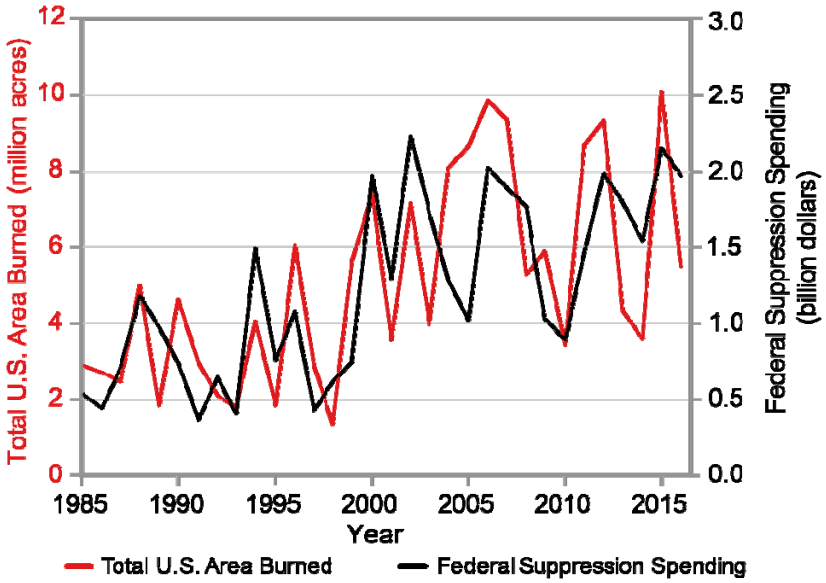
The incidence of large forest fires in the western United States and Alaska has increased since the early 1980s (*high confidence*) and is projected to further increase in those regions as the climate warms, with profound changes to certain ecosystems (*medium confidence*). [CSSR (Vol I) Ch. 8 Droughts, Floods, and Wildfire]

Air Quality and Wildfires

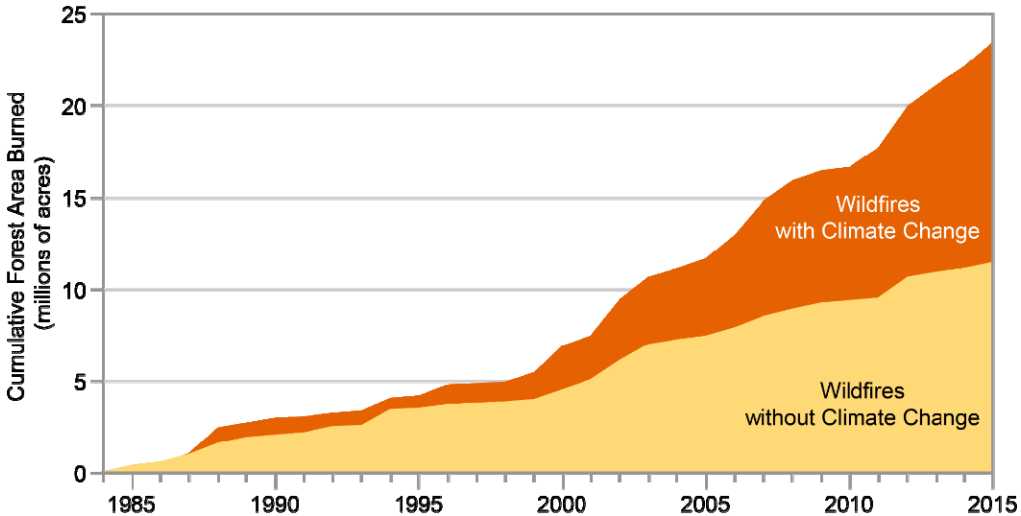
Key Messages

1. Increasing Risks from Air Pollution
2. **Increasing Impacts of Wildfires**
3. Increases in Airborne Allergen Exposure
4. Co-Benefits of Greenhouse Gas Mitigation

Ch. 6 | Forests



Ch. 25 | Southwest



Air Quality

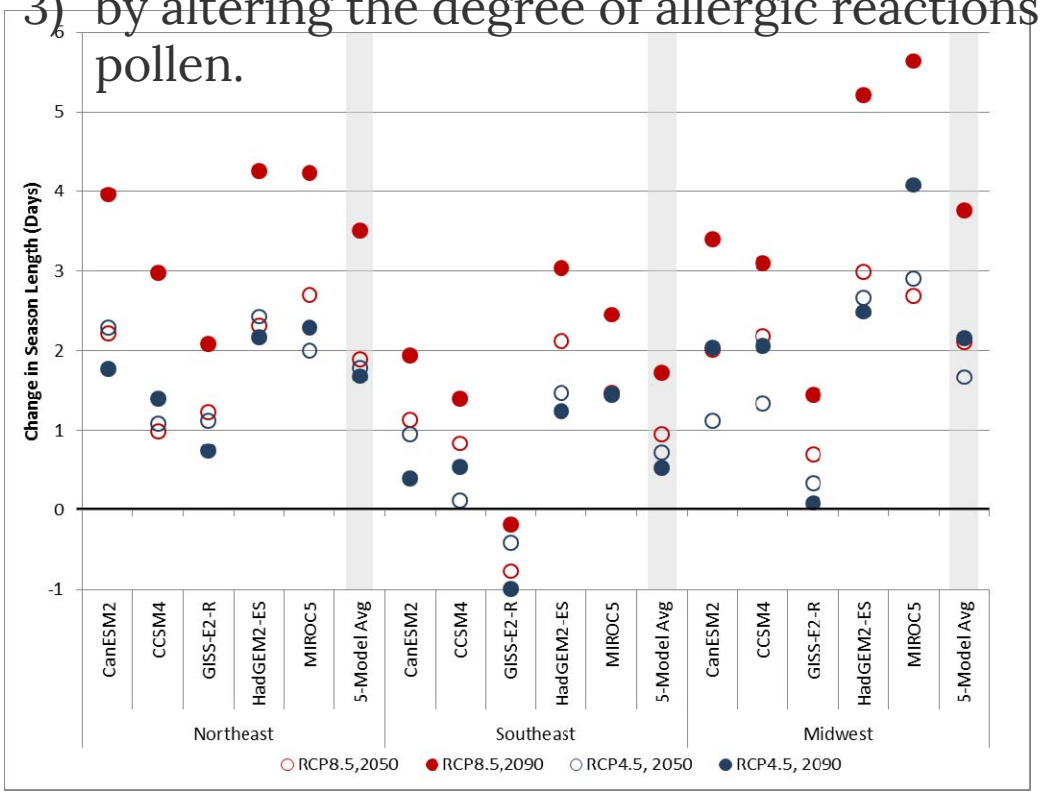
Key Messages

1. Increasing Risks from Air Pollution
2. Increasing Impacts of Wildfires
3. **Increases in Airborne Allergen Exposure**
4. Co-Benefits of Greenhouse Gas Mitigation

Climate change, specifically rising temperatures and increased CO_2 concentrations, can influence plant-based allergens, hay fever, and asthma in three ways:

1) by increasing the duration of the pollen season
2) by increasing the amount of pollen produced by plants
3) by altering the degree of allergic reactions to pollen.

Projected change in oak pollen season length in Eastern US

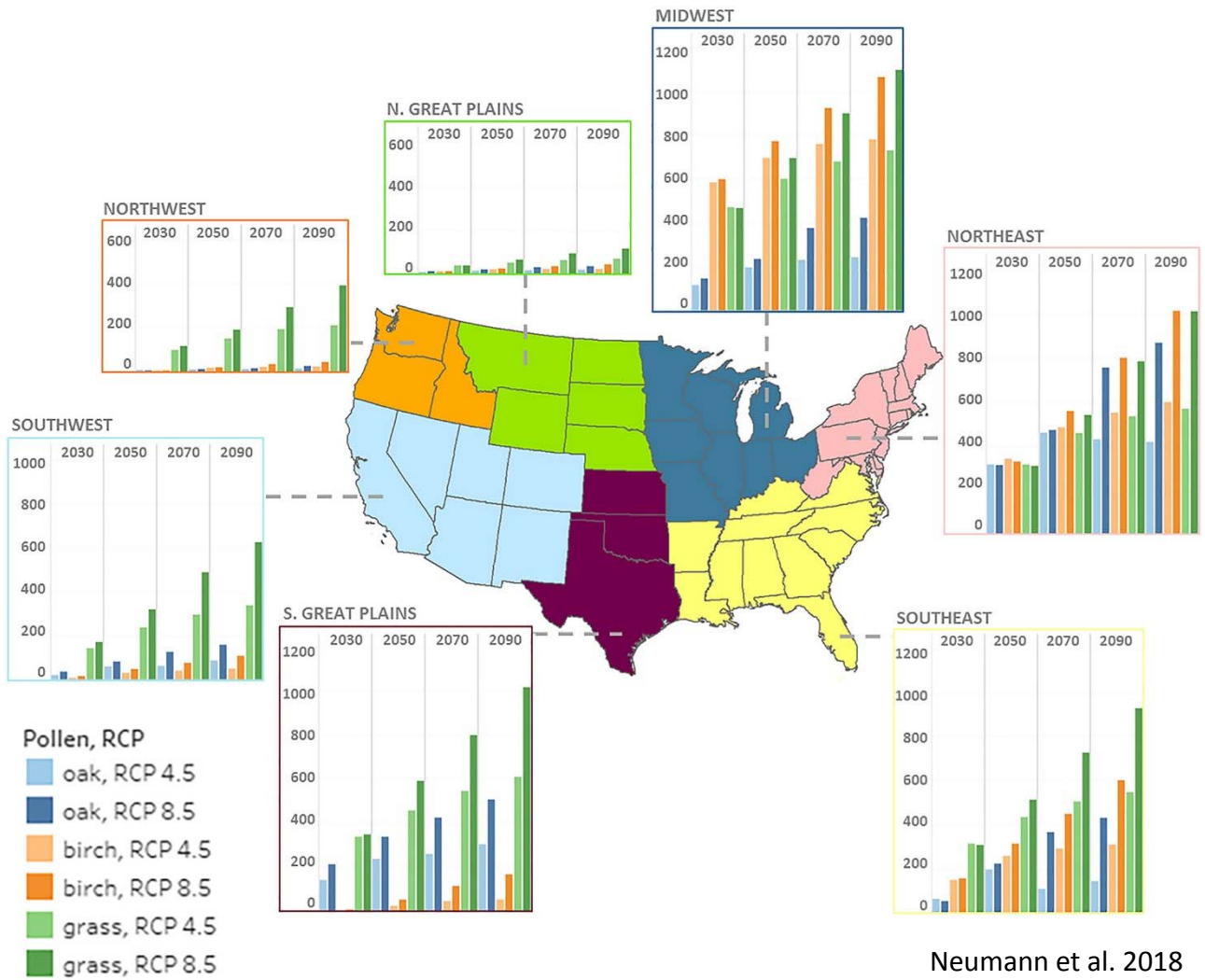


Anenberg et al. 2017

Projected annual pollen-related asthma emergency department visits

Key Messages

1. Increasing Risks from Air Pollution
2. Increasing Impacts of Wildfires
3. **Increases in Airborne Allergen Exposure**
4. Co-Benefits of Greenhouse Gas Mitigation



Neumann et al. 2018

Greenhouse Gas Mitigation Has Large Air Quality Co-Benefits

Key Messages

1. Increasing Risks from Air Pollution
2. Increasing Impacts of Wildfires
3. Increases in Airborne Allergen Exposure
4. **Co-Benefits of Greenhouse Gas Mitigation**

- GHG mitigation has very large co-benefits for air quality and human health.
- Mitigating GHGs can lower emissions of PM, ozone and PM precursors, and other hazardous pollutants
- Because methane is both a greenhouse gas and an ozone precursor, reductions in methane emissions have potential to simultaneously mitigate climate change and improve air quality

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Recommended chapter citation

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Read the full chapter

https://nca2018.globalchange.gov/chapter/air-quality

Questions or Comments

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Chapter 14 | Human Health

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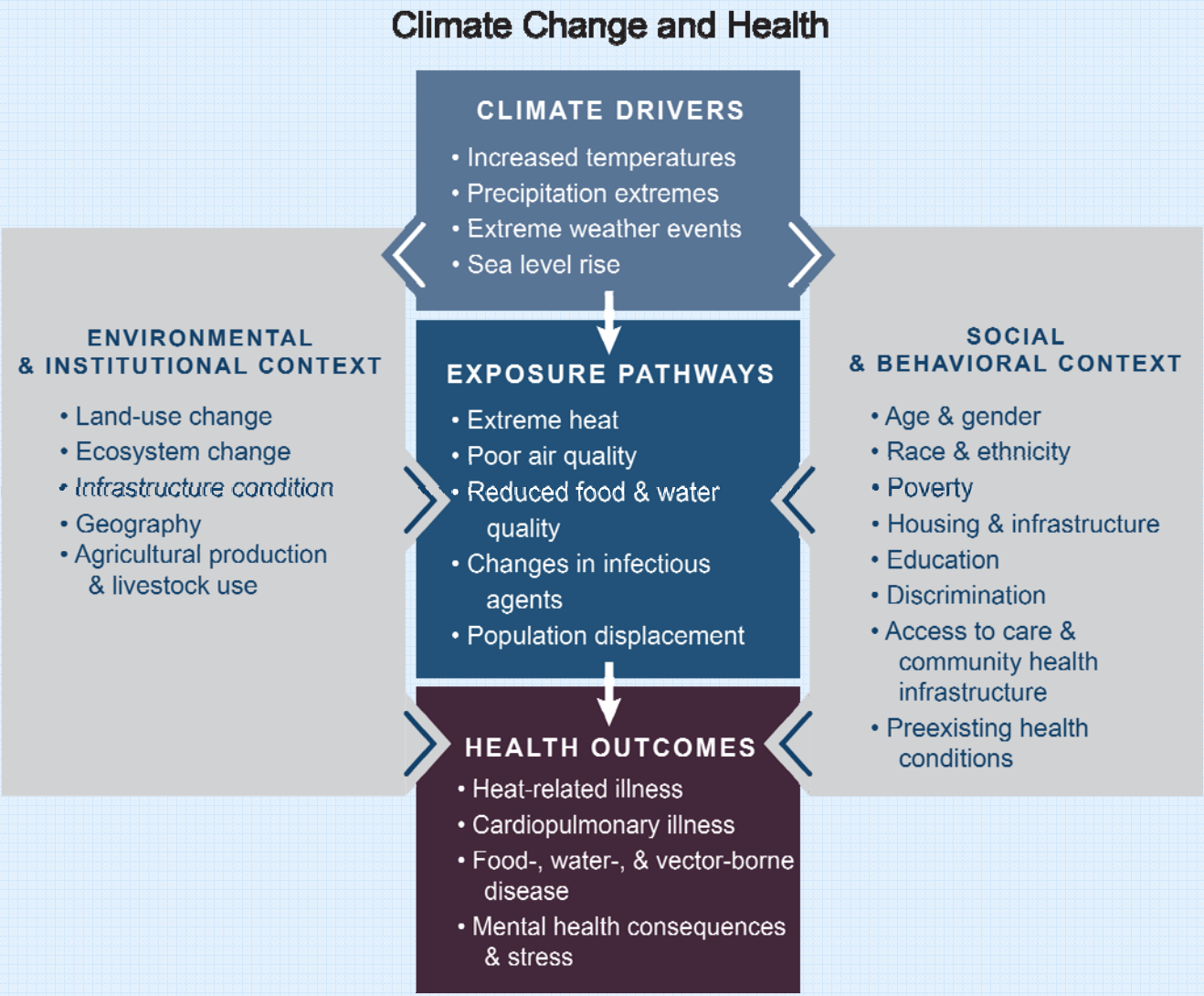
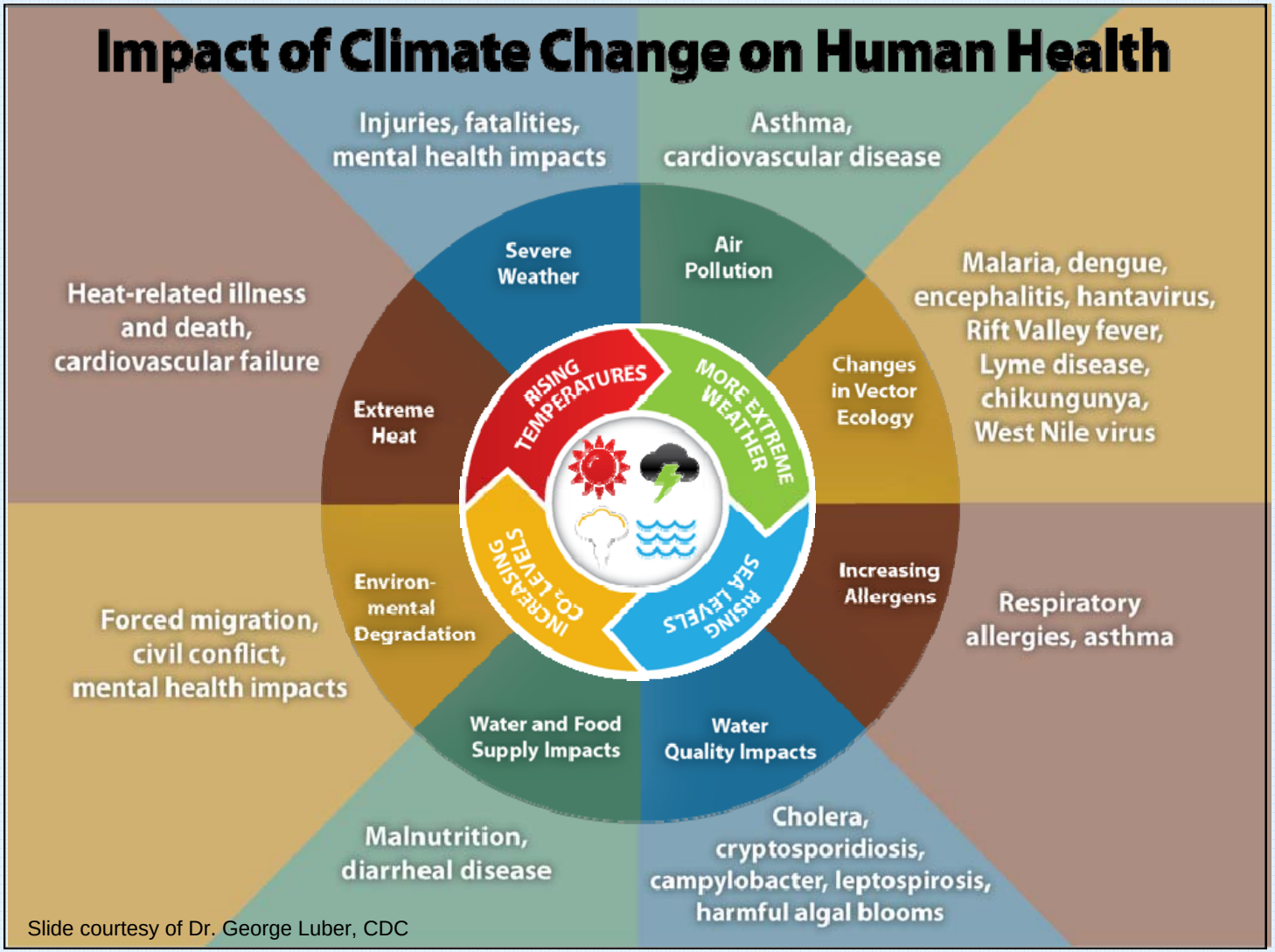
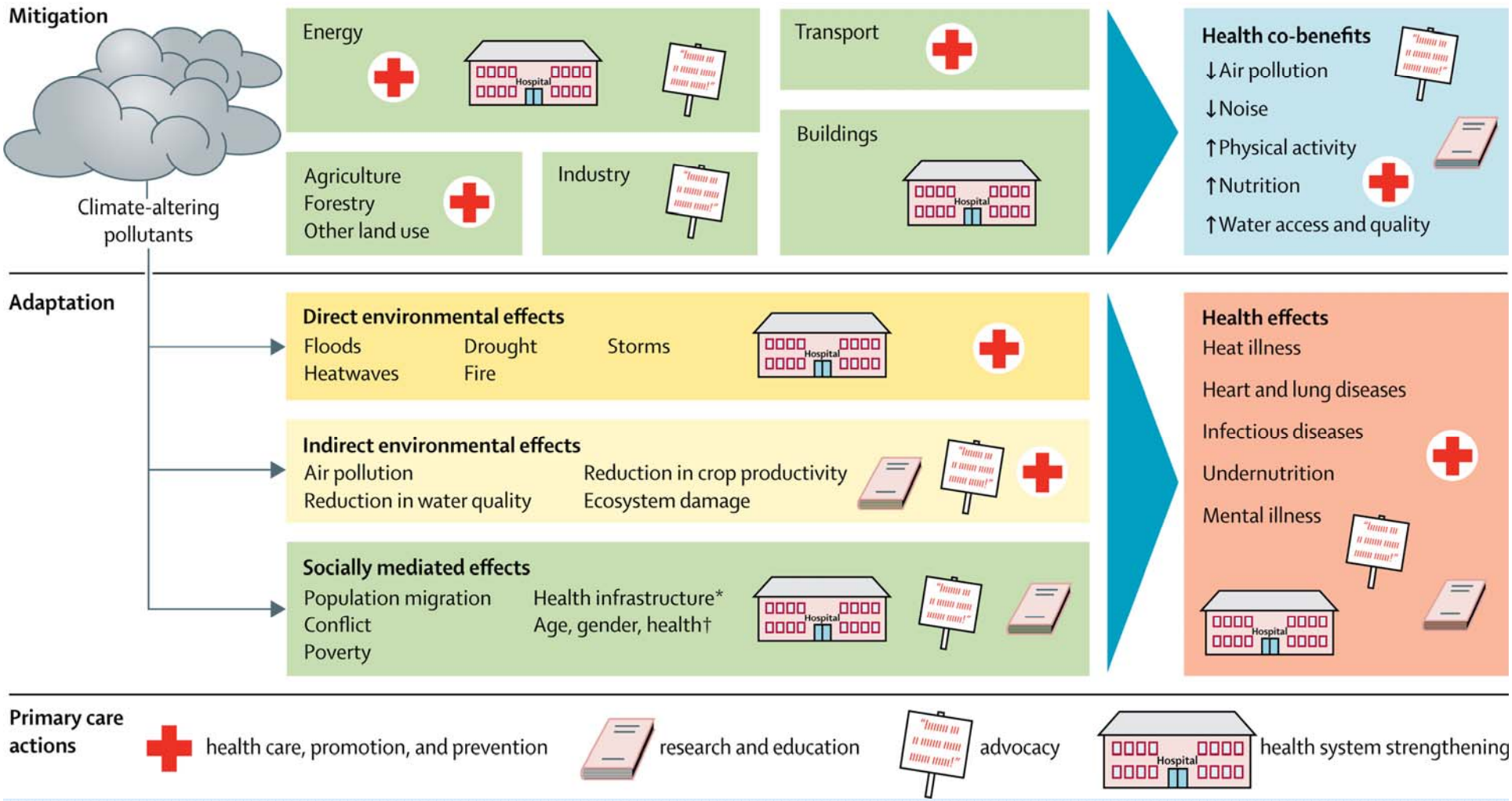
Key Message 1: Climate change affects the health of all Americans

The health and well-being of Americans are already affected by climate change, with the adverse health consequences projected to worsen with additional climate change.



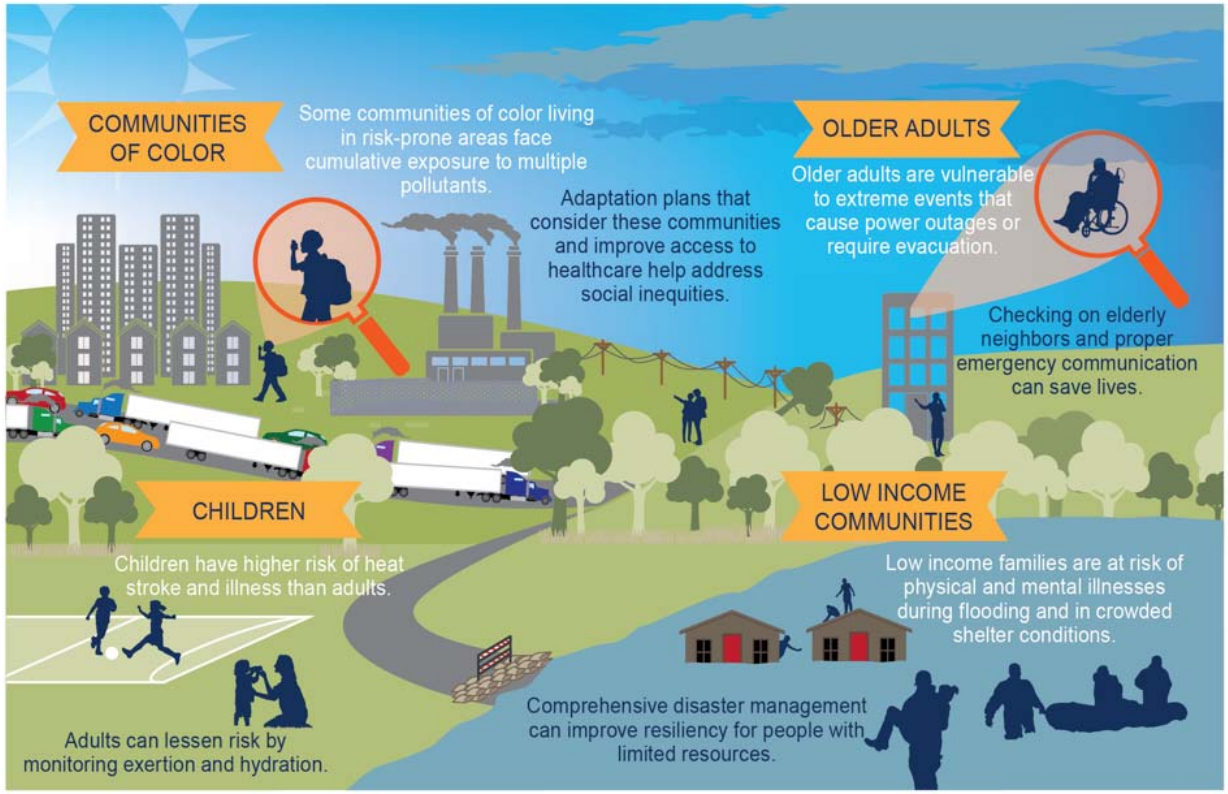


Slide courtesy of Dr. George Luber, CDC



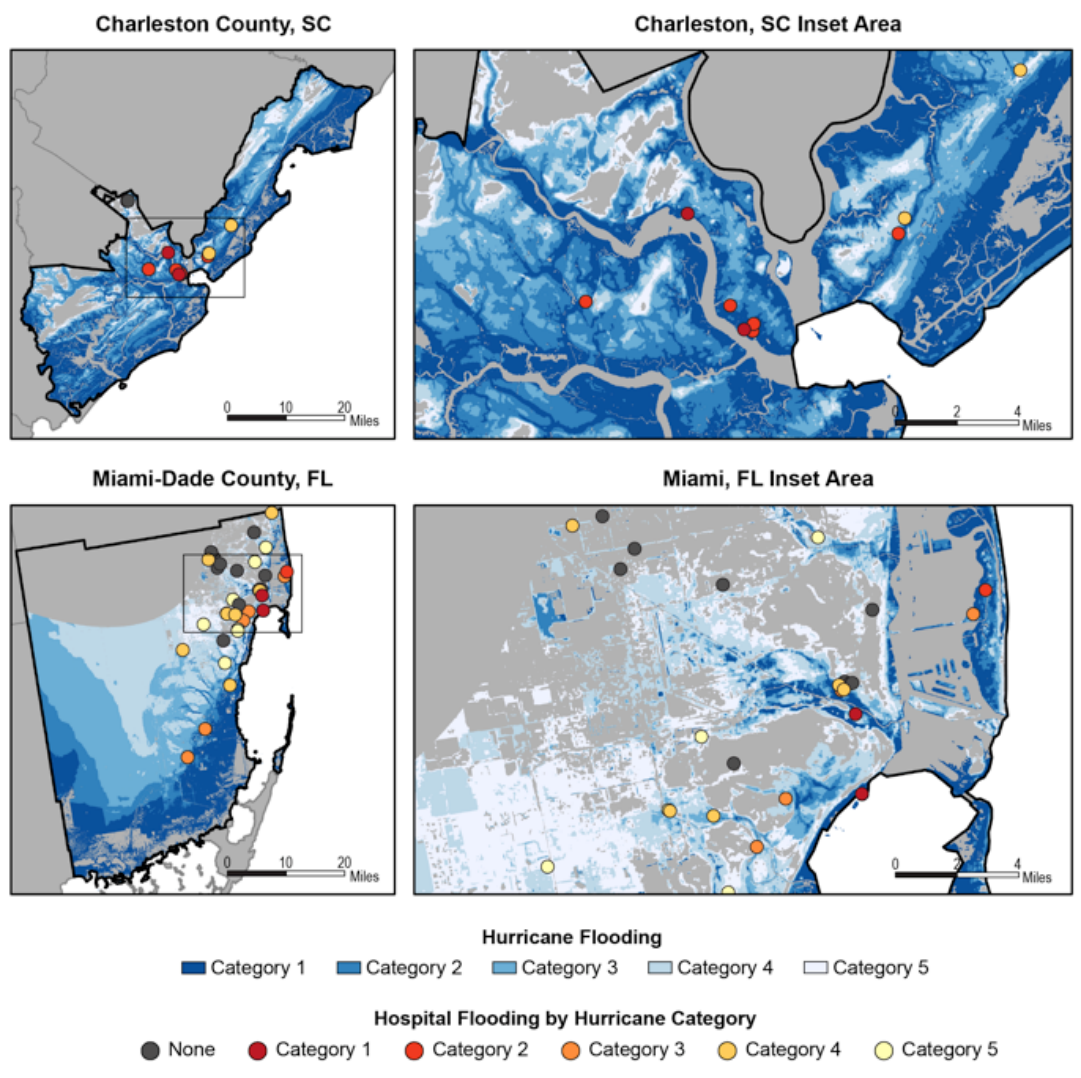
Xie et al. 2018

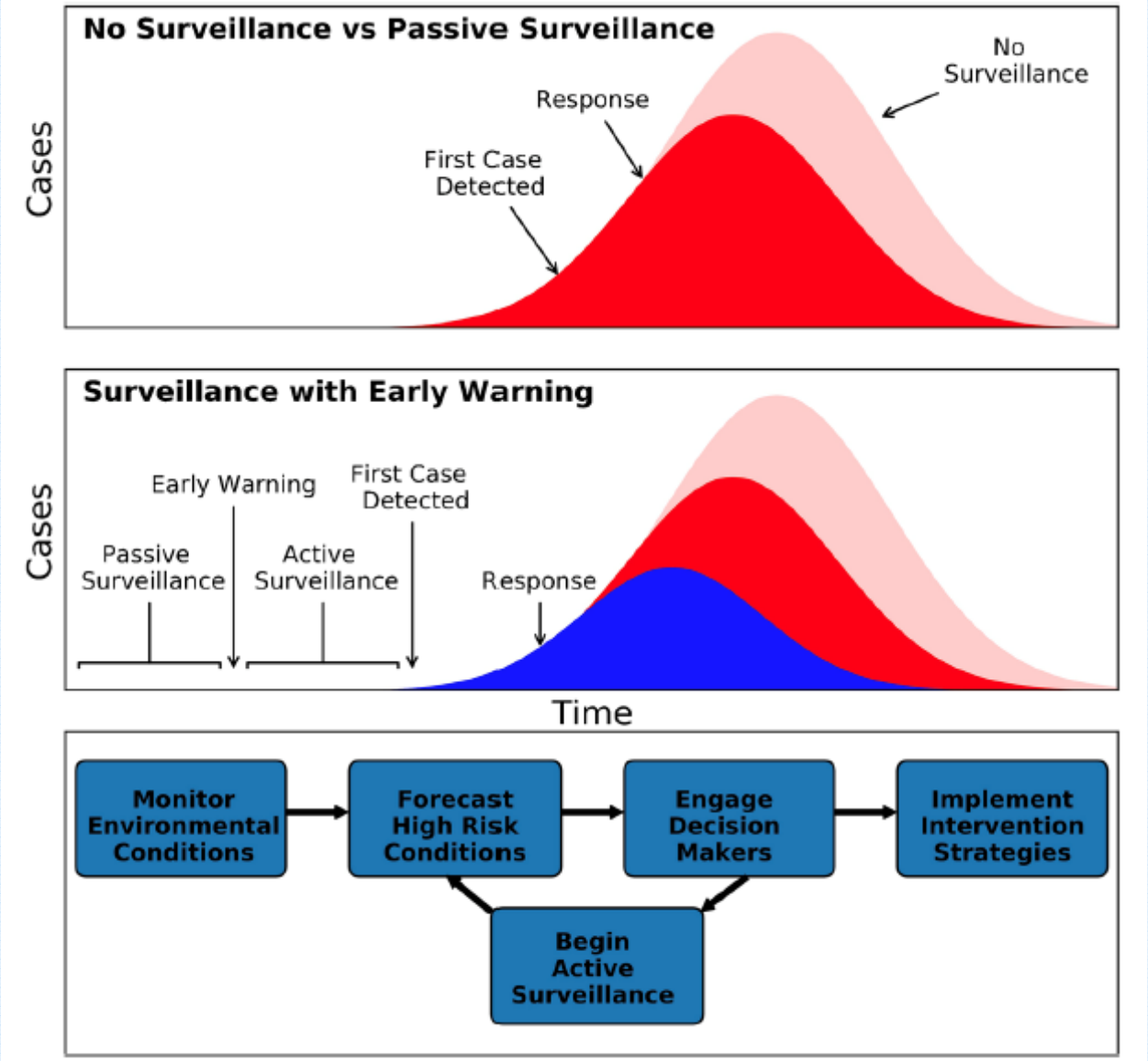
Key Message 2: Exposure and resilience vary across populations and communities



Key Message 3: Adaptation reduces risks and improves health

Proactive adaptation policies and programs reduce the risks and impacts from climate-sensitive health outcomes and from disruptions in healthcare services. Additional benefits to health arise from explicitly accounting for climate change risks in infrastructure planning and urban design.

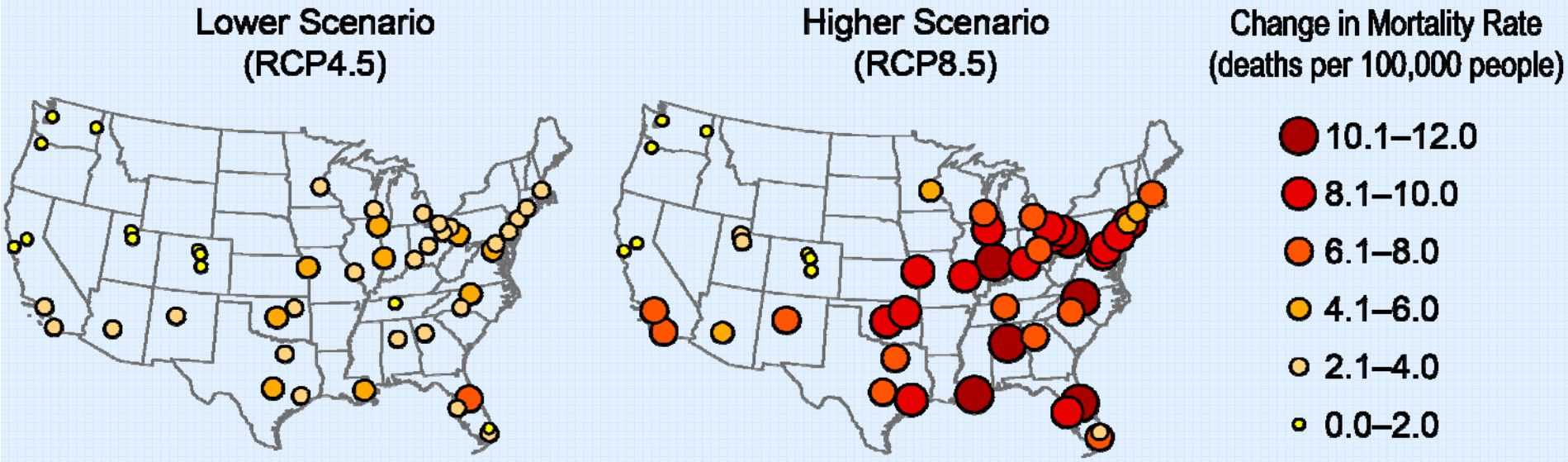




Morin et al. 2018

Key Message 4: Reducing GHG Emissions Results in Health and Economic Benefits

Projected change in annual extreme temperature mortality 2080-2099



3,900 additional deaths

9,300 additional deaths

14 Acknowledgments

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