

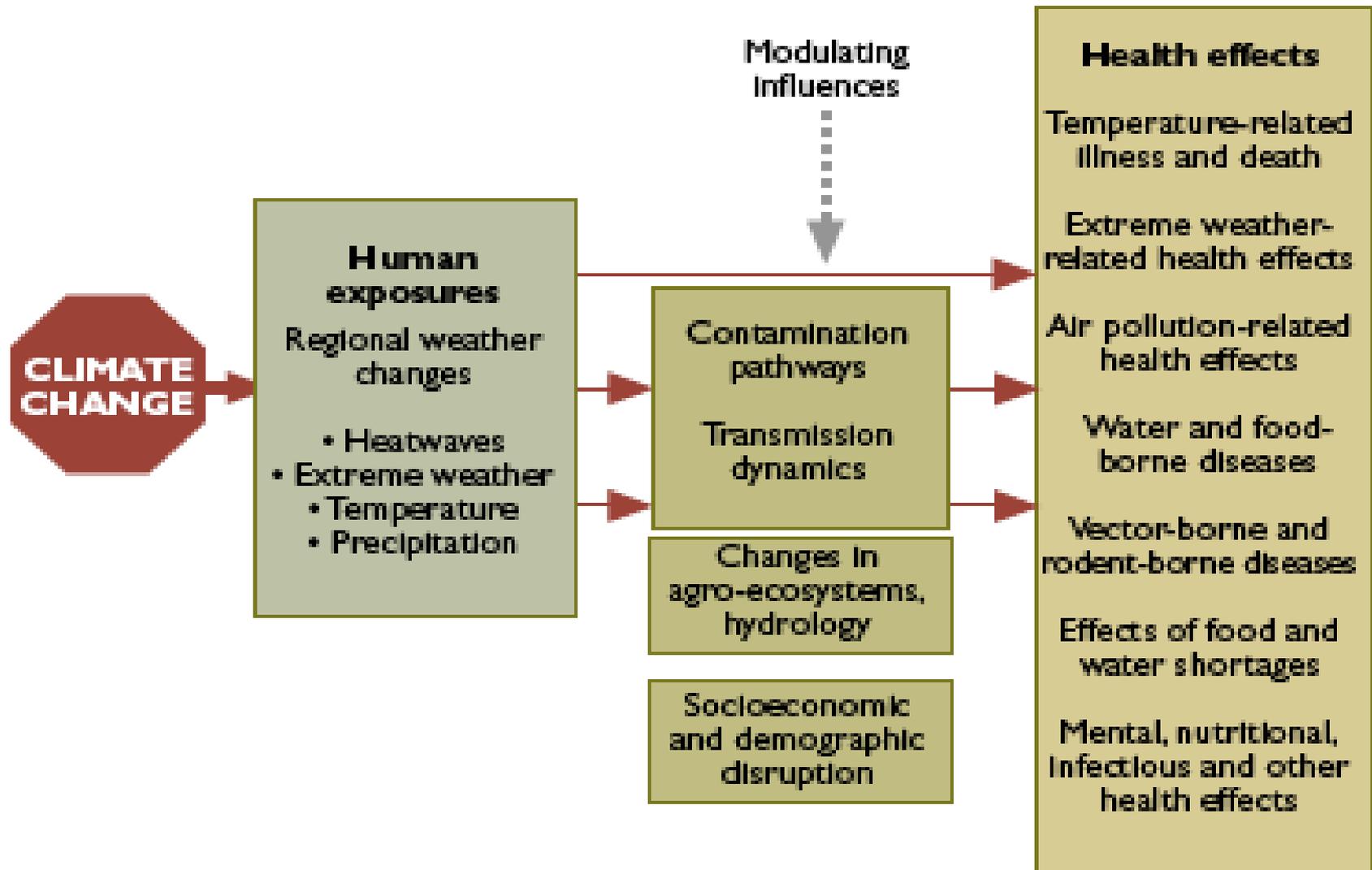


Climate Change, Air Quality and Human Health

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Pathways Linking Climate Change to Human Health



Climate Solutions

Two Strategies:

Mitigation

Actions to reduce emissions (or enhance sinks) of greenhouse gases

Adaptation

Measures to reduce the vulnerability of natural & human systems against actual or expected climate change effects

How can health knowledge inform climate solutions?

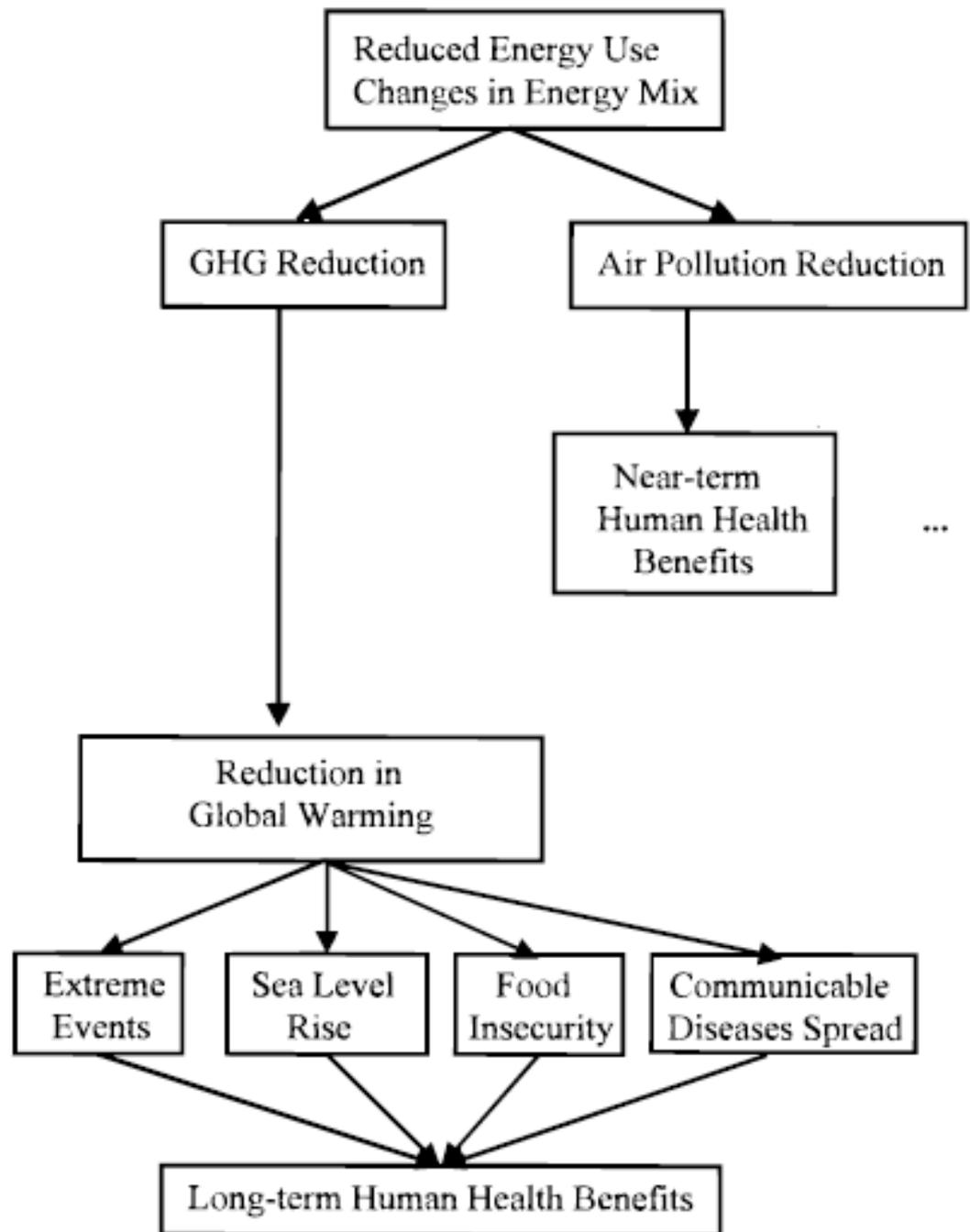
- **We can model the health co-benefits of future climate change mitigation actions**
 - *leading to healthier, more efficient mitigation policies*
- **We can identify and prioritize adaptations based on modeled future health impacts under plausible climate change scenarios**
 - *leading to more cost-effective adaptation plans*

→ *Model the health co-benefits of future climate change mitigation actions...*

- Reducing greenhouse gas emissions can improve health at two time/space scales

- At the global scale, reduced emissions lead to fewer hazards from global warming, mainly in the far future.

- At local scale, reduced emissions lead to reductions of criteria pollutants, with immediate health benefits.



From: Wang and Smith,
ES&T 1999

W Health and Climate Change 6

Public health benefits of strategies to reduce greenhouse-gas emissions: overview and implications for policy makers

*Andy Haines, Anthony J McMichael, Kirk R Smith, Ian Roberts, James Woodcock, Anil Markandya, Ben G Armstrong, Diarmid Campbell-Lendrum, Alan D Dangour, Michael Davies, Nigel Bruce, Cathryn Tonne, Mark Barrett, Paul Wilkinson**

Lancet 2009; 374: 2104-14

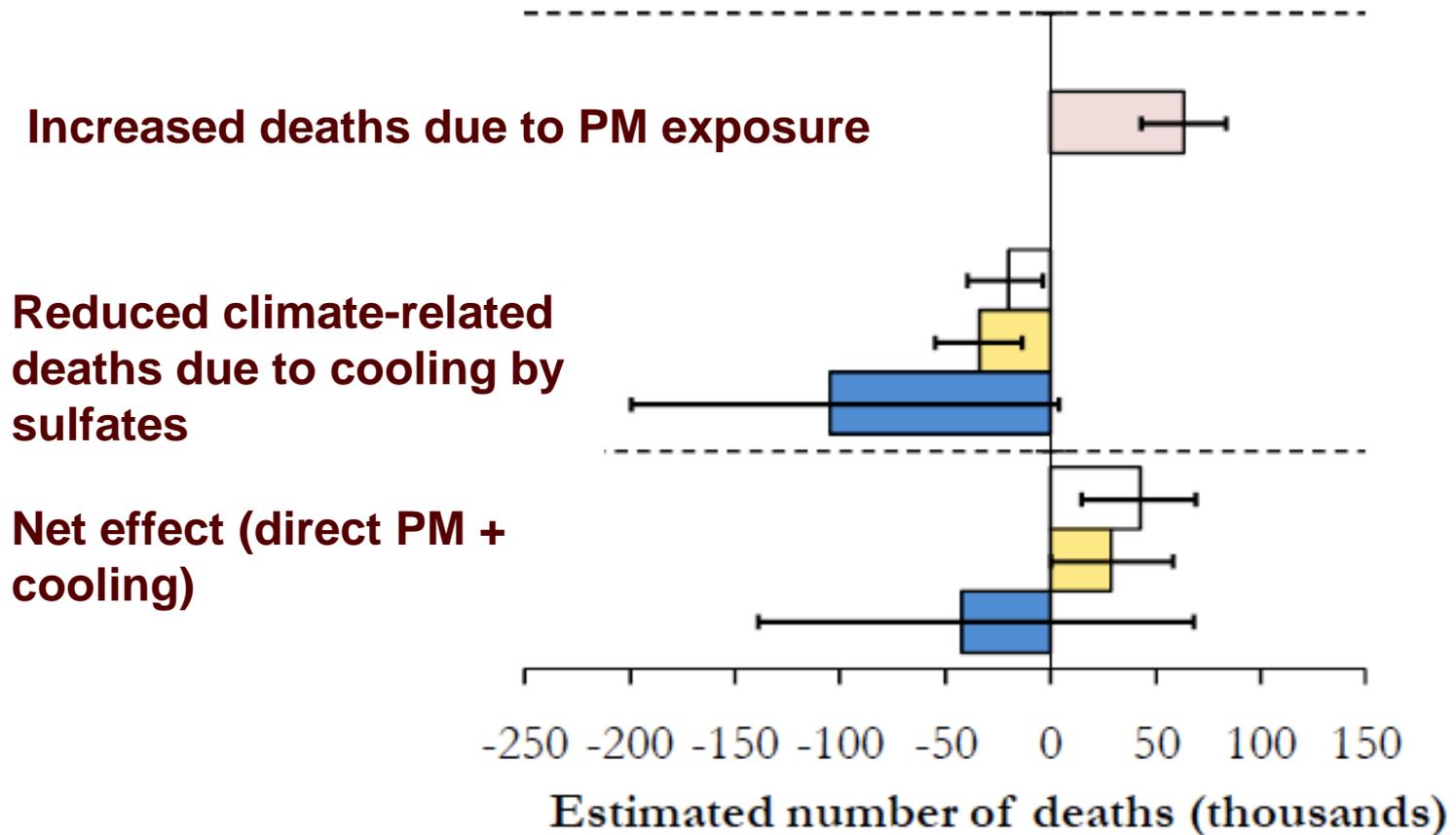
Published Online
November 25, 2009
DOI:10.1016/S0140-
6736(09)61759-1

This is the sixth in a *Series* of six papers about health and climate change

*Based on the work of the Task Force on Climate Change Mitigation and Public Health, which is described in the preceding papers of this *Series*.

This Series has examined the health implications of policies aimed at tackling climate change. Assessments of mitigation strategies in four domains—household energy, transport, food and agriculture, and electricity generation—suggest an important message: that actions to reduce greenhouse-gas emissions often, although not always, entail net benefits for health. In some cases, the potential benefits seem to be substantial. This evidence provides an additional and immediate rationale for reductions in greenhouse-gas emissions beyond that of climate change mitigation alone. Climate change is an increasing and evolving threat to the health of populations worldwide. At the same time, major public health burdens remain in many regions. Climate change therefore adds further urgency to the task of addressing international health priorities, such as the UN Millennium Development Goals. Recognition that mitigation strategies can have substantial benefits for both health and climate protection offers the possibility of policy choices that are potentially both more cost effective and socially attractive than are those that address these priorities independently.

But, beware opposing impacts: e.g., Global health impacts of shipping emissions



Londahl et al., Atmos Chem Phys 10, 9441, 2010

→ ***identify and prioritize adaptations based on modeled future health impacts under plausible climate change scenarios...***

For example...

- **Study historical health response functions for heat, air quality, and human mortality, and then examine future scenarios of impacts at the local scale**

Health Impact Assessment



However, sufficient information to perform HIA exists for only a subset of climate-health pathways (*e.g., heat and air quality*) and even for those, there are major challenges and uncertainties

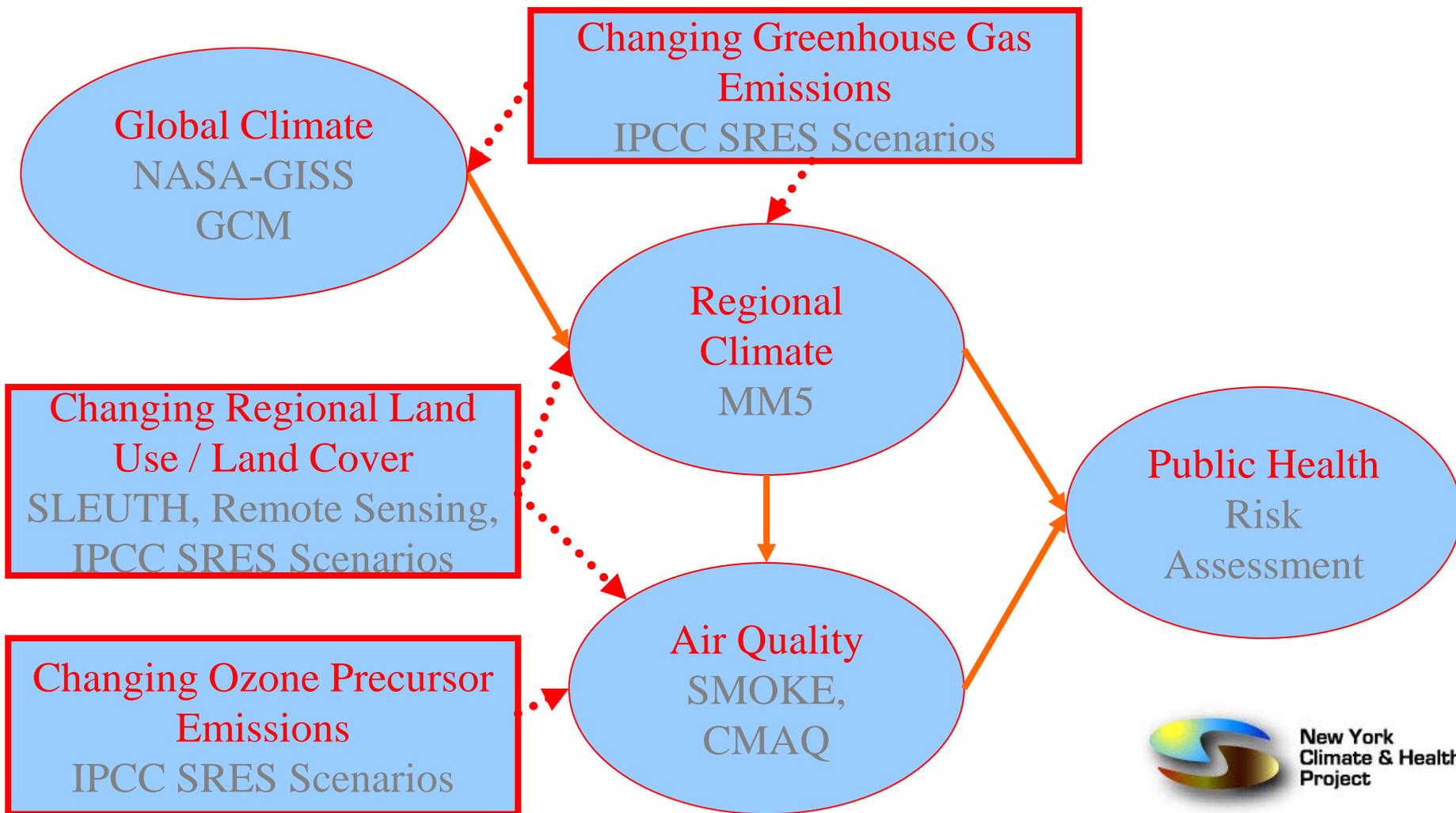
Size of exposed population

- **Well documented in US; gridded estimates available for other countries**
- **Future projections don't extend far**
 - **Important to consider harmonizing future population projections with emissions scenarios**
 - **Changes in age distribution are important for climate-health vulnerability**

Baseline rates of health outcomes, in the absence of a climate-induced change

- **# cases per N people per year, taken from observations during some “baseline” period in the past**
- **Extensive data on cause-specific mortality; other outcomes more spotty**
- **Standard approach assumes no change in baseline rates in future**
 - **Is this plausible?**

Modeled Changes in Environmental Concentration



Down-scaling often a key objective

Global climate (400x500 km)

**Regional Air Quality
(36x36 km)**

Climate Impact on Change in Ozone (ppb) from 1990s

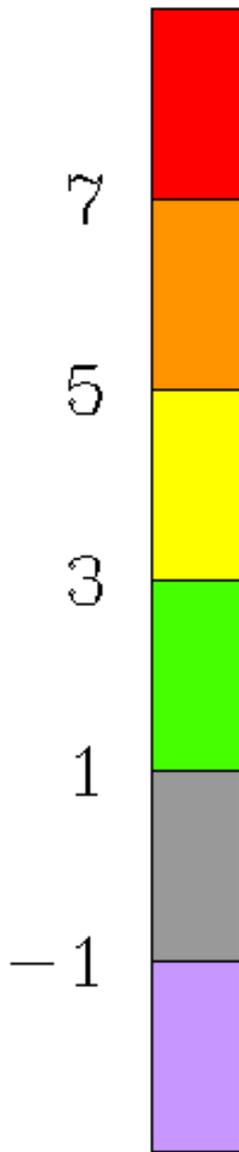
to

2020s

2050s

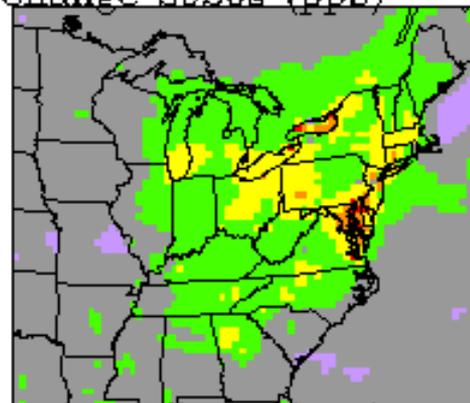
2080s

(summer avg 8-hr daily max)



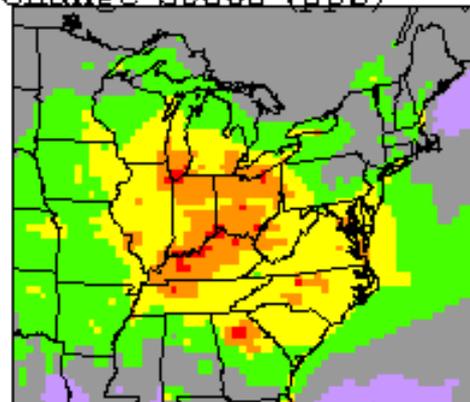
Absolute Change 2020s (ppb)

2020s



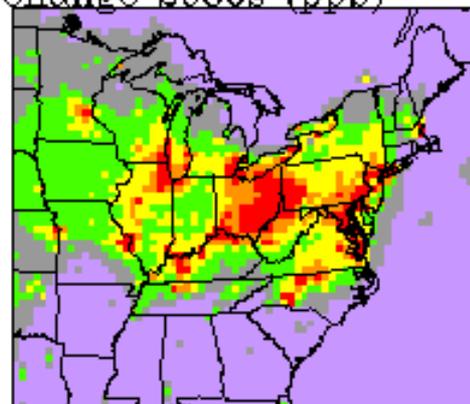
Absolute Change 2050s (ppb)

2050s



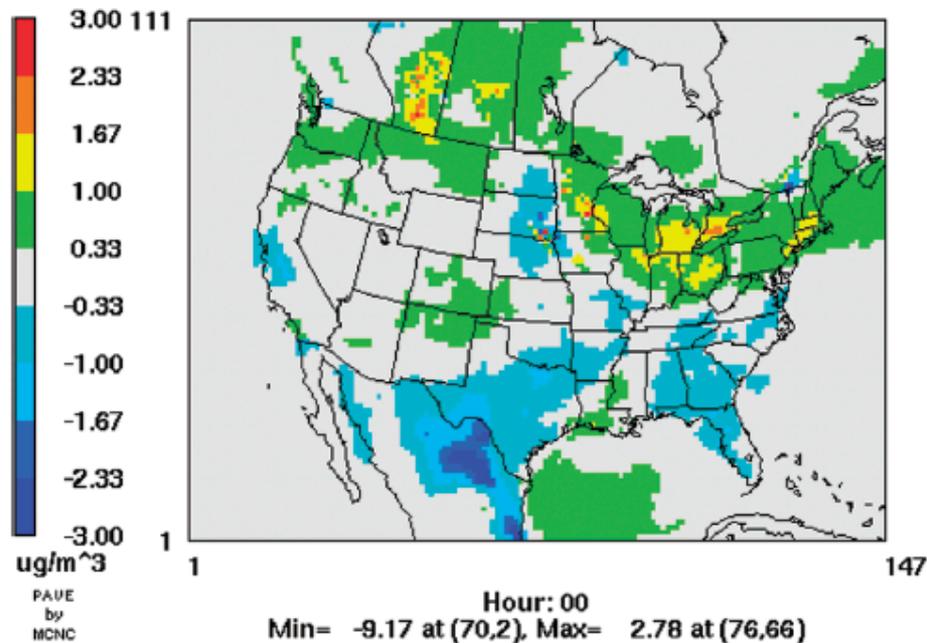
Absolute Change 2080s (ppb)

2080s



PM_{2.5} (left) and ozone changes in 2050 vs. 2001 due to climate alone

Annual average PM_{2.5} change if 2050 climate had occurred in 2001



Annual average O₃ change if 2050 climate had occurred in 2001

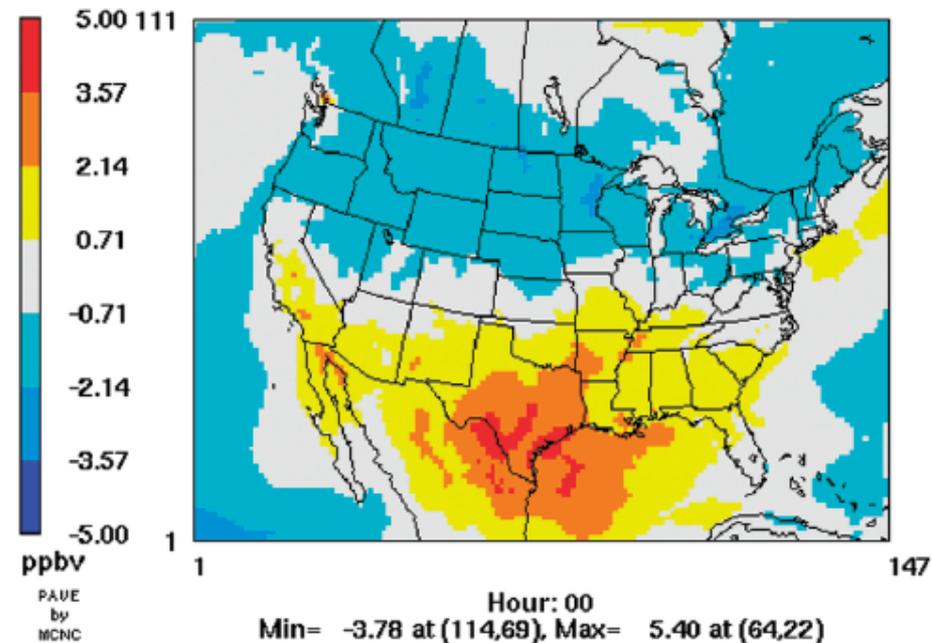


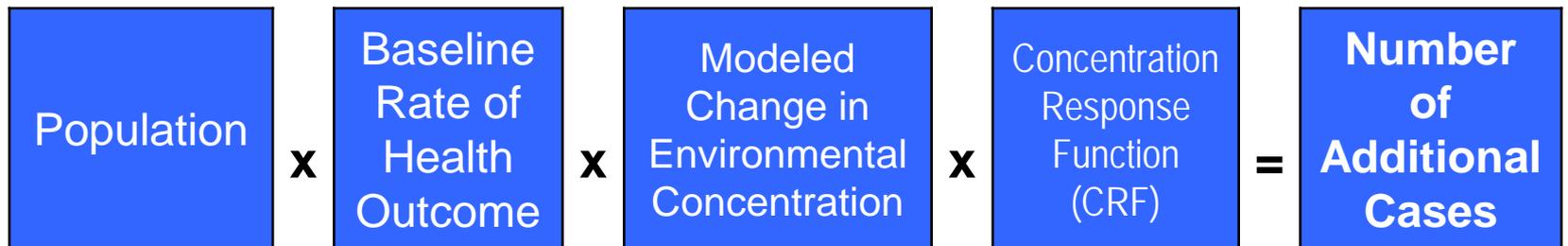
FIGURE 1. Annual PM_{2.5} and ozone concentrations changes in future climate (i.e., 2050) compared to 2001 climate.

Concentration-response

- These are obtained from published epidemiology studies that report health responses in relation to temperature, PM, ozone, etc
- These document the historical CRF, but...
- Will the response function change in the future?
 - Adaptation would tend to decrease CRF
 - Aging might increase it
 - How to model?
 - This is largely untouched territory

Exposure-Response Function for Daily Mortality and Temperature in Manhattan, 1982-1999

Health Impact Assessment



Annual Temperature-Related Deaths in Manhattan, projected from five climate models and two emissions scenarios



Taking Stock of Where we Are

- The climate is changing and will continue to do so regardless of actions taken now
- Weather can have a range of impacts on human health, some of which will likely be worsened under a warming climate
- Both adaptation and mitigation actions are needed to address the challenge of climate change
- Health assessment can potentially inform both greenhouse gas mitigation and societal adaptation strategies
- However, further improvements in the HIA toolbox are needed in order for full potential to be realized

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