

Ozone Pollution and Human Health

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Ozone Transport Commission

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Today's Presentation

- Trends in ozone pollution and scientific evidence
- Air quality policies and health benefits
- Ozone and climate change

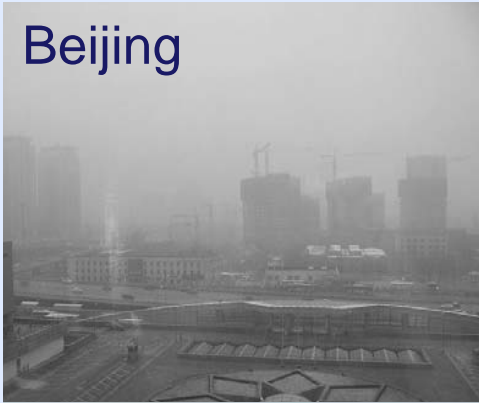
Trends in Ozone Pollution and Scientific Evidence

“London Fog” of 1952



Extreme Levels - Today

Beijing



São Paulo



Mexico City



Cairo



Nepal



Photo: A. Gurung

Ozone Levels in the U.S.

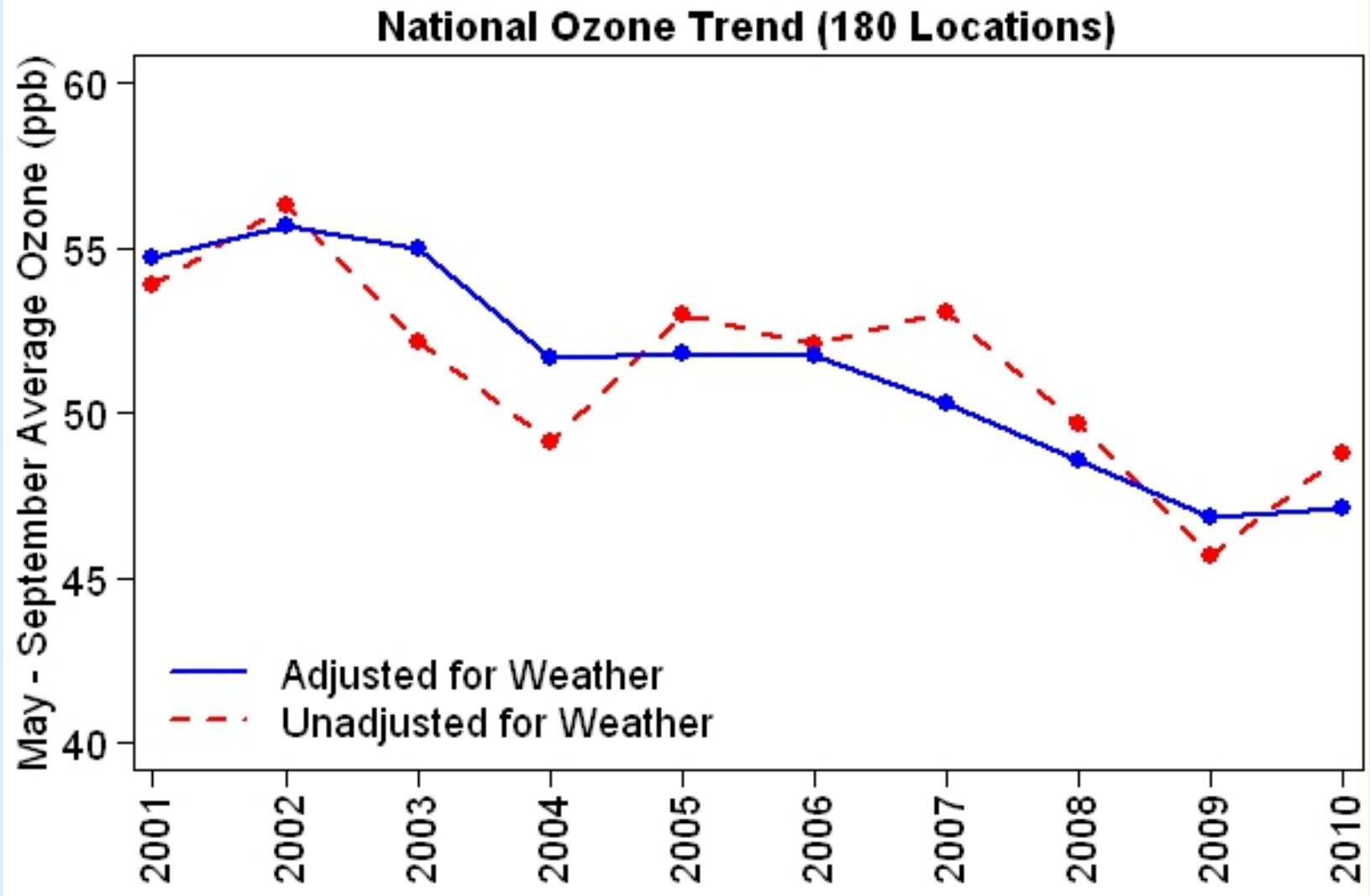
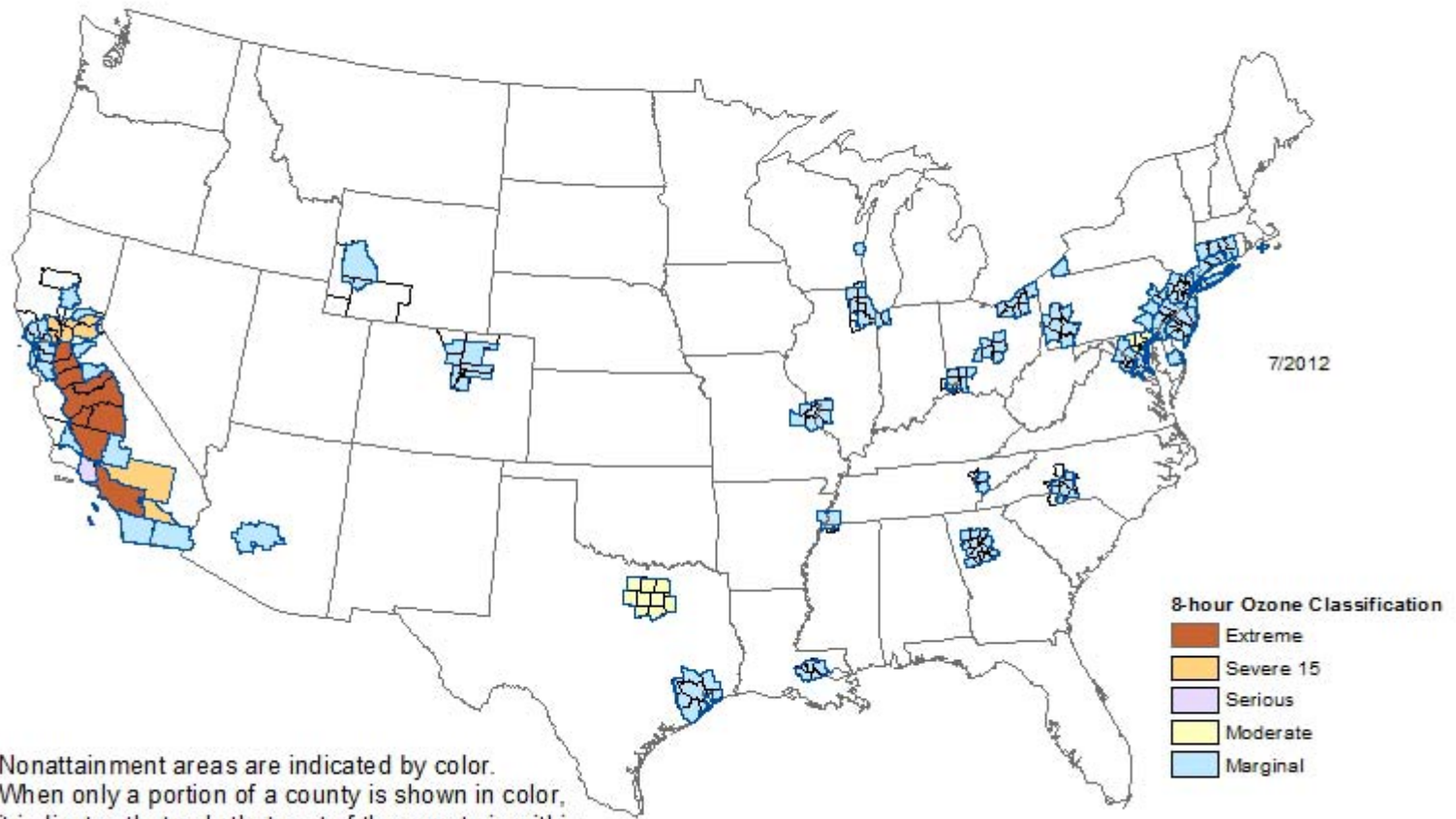


Figure: U.S. EPA

Nonattainment Areas

8-Hour Ozone Nonattainment Areas (2008 Standard)



Nonattainment areas are indicated by color. When only a portion of a county is shown in color, it indicates that only that part of the county is within a nonattainment area boundary.

EPA's Recent Scientific Assessment of Health Effects

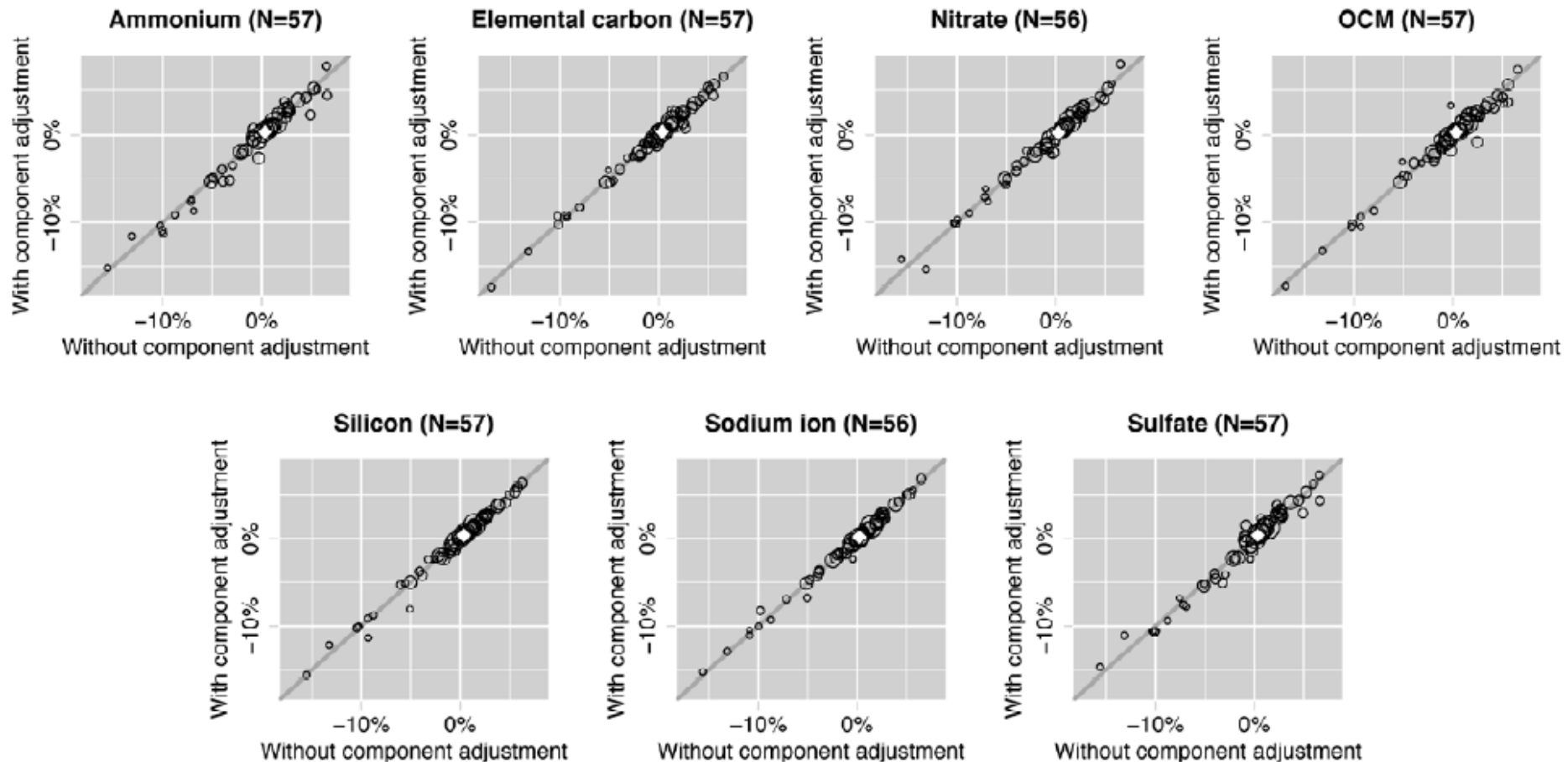
Level of evidence	Short-term exposure	Long-term exposure
<i>Causal</i>	Respiratory effects	
<i>Likely causal</i>	CVD effects, total mortality	Respiratory effects
<i>Suggestive of causal relationship</i>	Central nervous systems	CVD effects, reproductive and developmental effects, central nervous effects, total mortality
<i>Inadequate information</i>		Cancer

Scientific Evidence for Ozone and Human Health

- Impacts from respiratory symptoms to premature mortality.
- Growing evidence for other outcomes.
- No evidence of a “safe” threshold.
- Strong evidence that the effects are *not* an artifact of temperature or particulate matter total mass (PM_{2.5}).

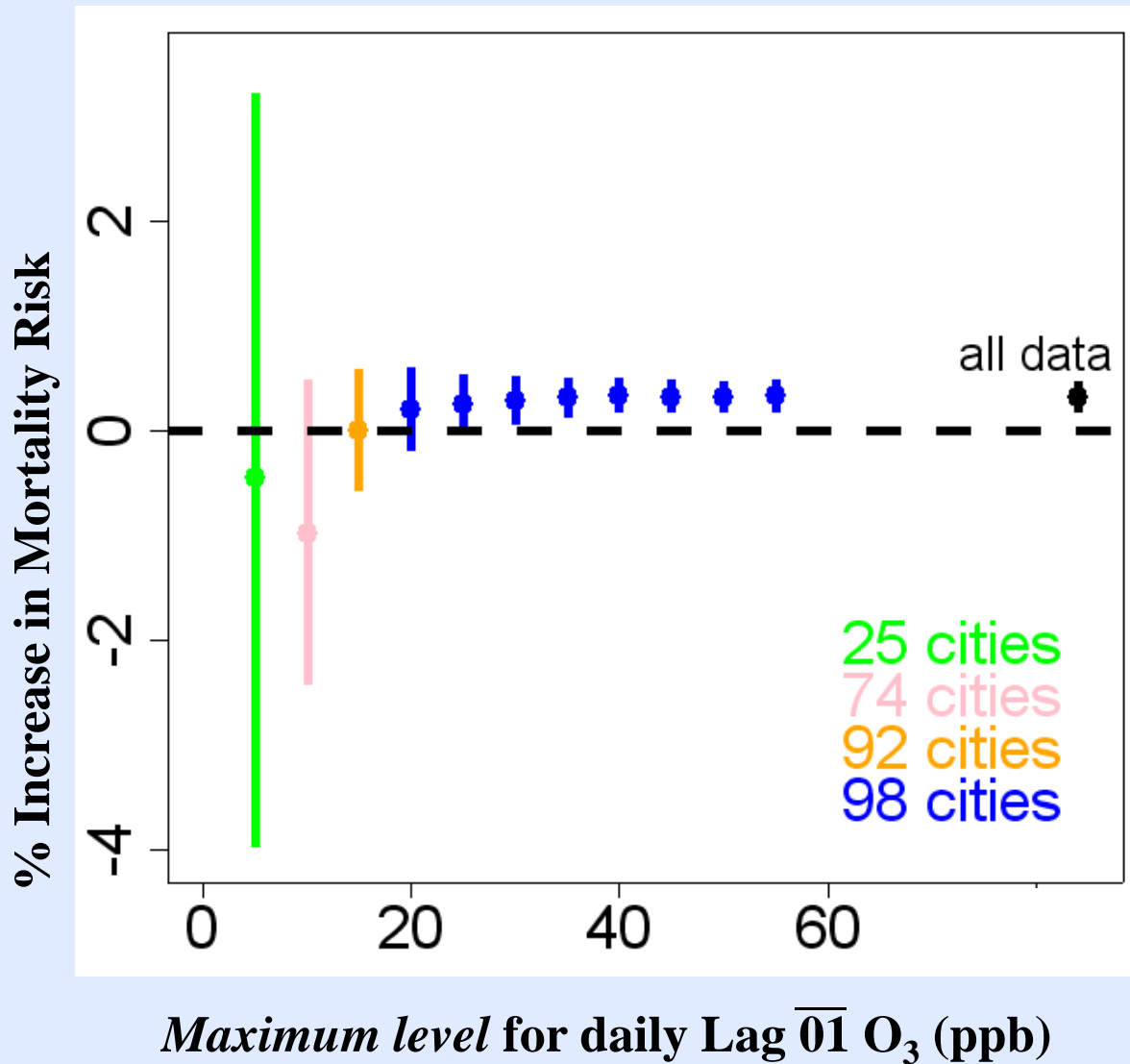
New Findings

Strong evidence that the effects are *not* confounded by chemical components of PM_{2.5}.



Air Quality
Policies and Health
Benefits

Effects at Low Levels



Health Impacts Can Occur at Low Levels (below NAAQS)

8-Hour Ozone Nonattainment Areas (2008 Standard)



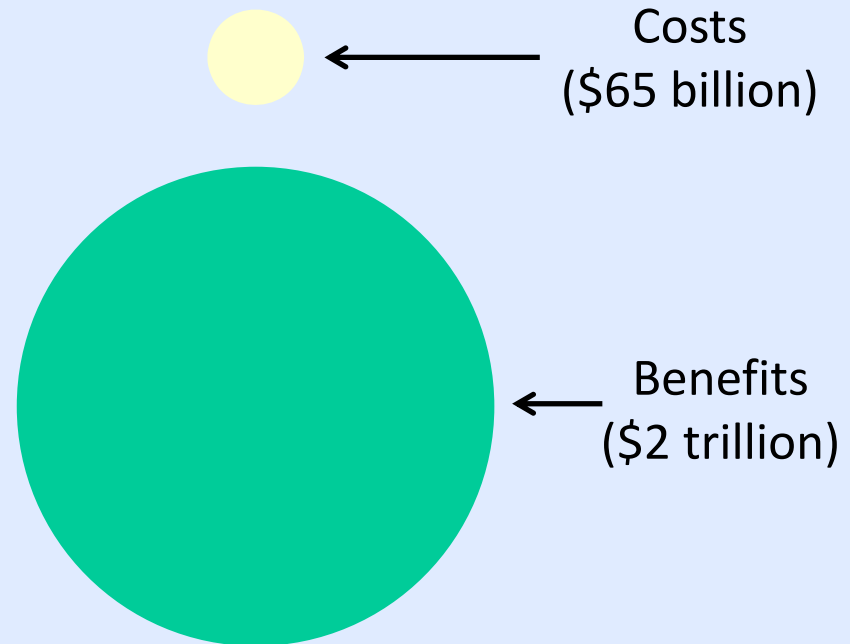
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Cost Effectiveness of Policies

- How do the benefits compare to the costs of air pollution policy?

U.S. EPA's analysis of the Clean Air Act:

- Benefits more than 30 times that of costs.
- Key benefits from averted mortality

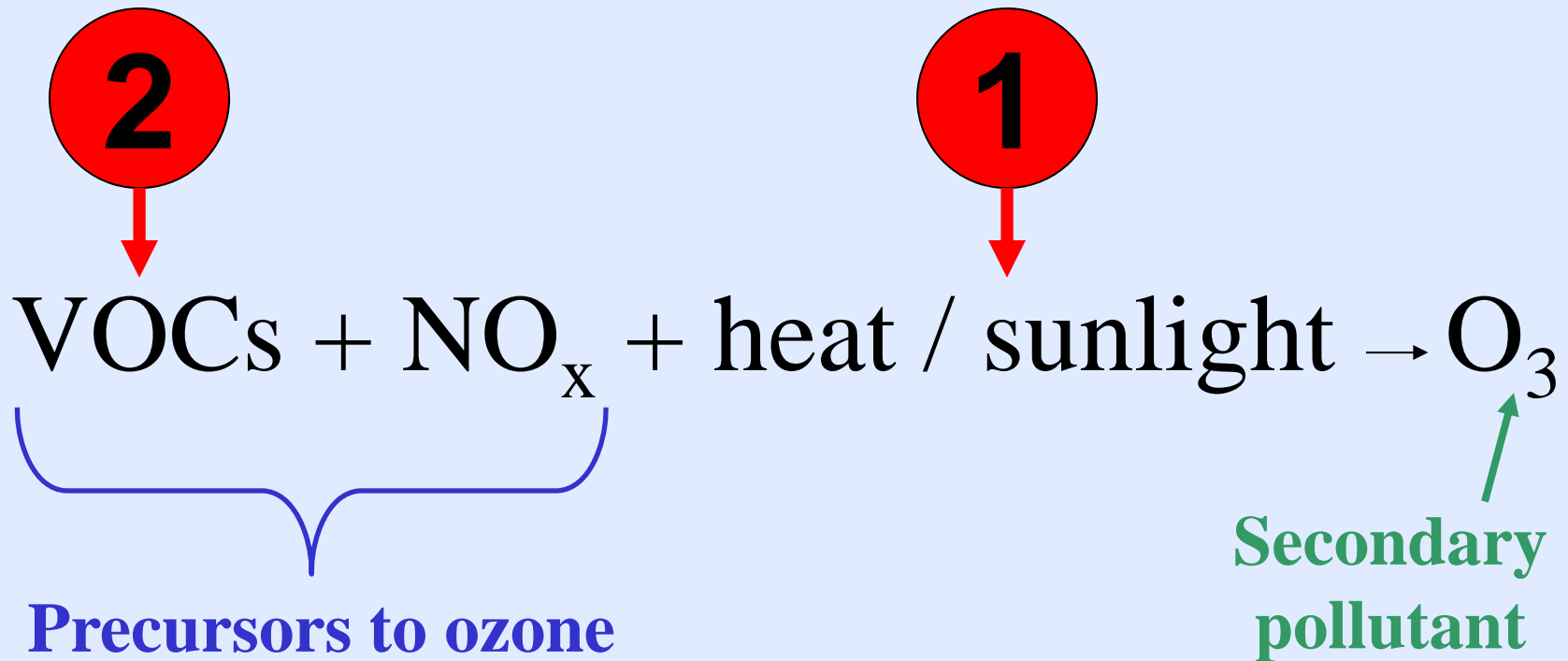


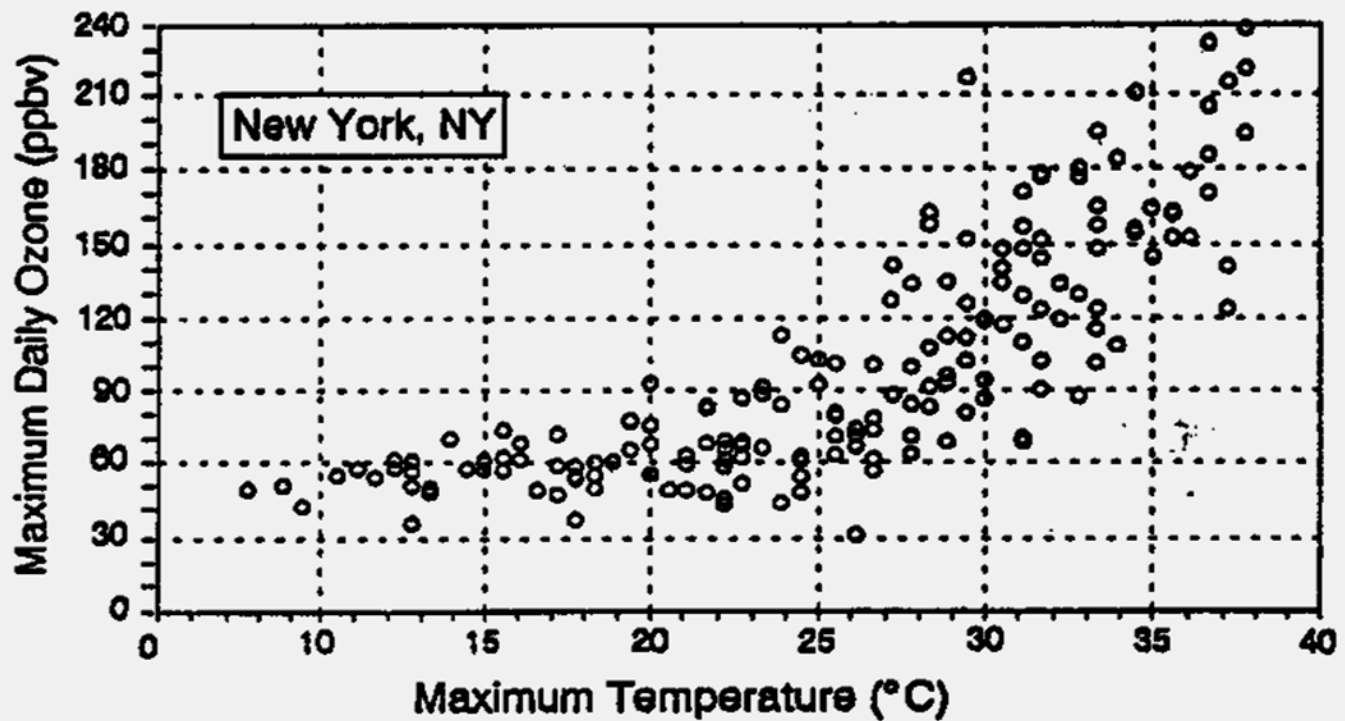
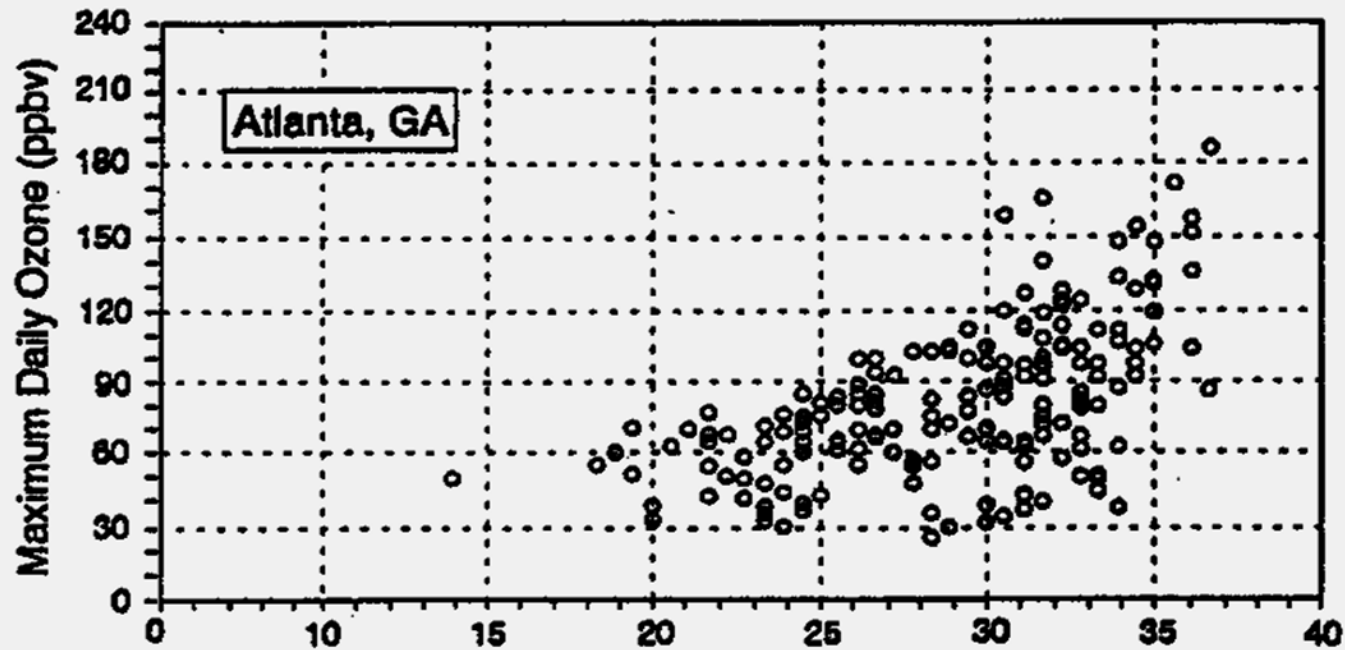
Ozone and Climate Change

Pathways for Climate Change's Impact on Air Pollution Levels


- Multiple pathways
 - Precipitation, wind speed and direction, temperature
 - Higher temperature means
 - Faster chemical reaction rates for formation of tropospheric ozone
 - More emissions of natural ozone precursors

Tropospheric Ozone Chemistry (simplified)





Source:
EPA
1996



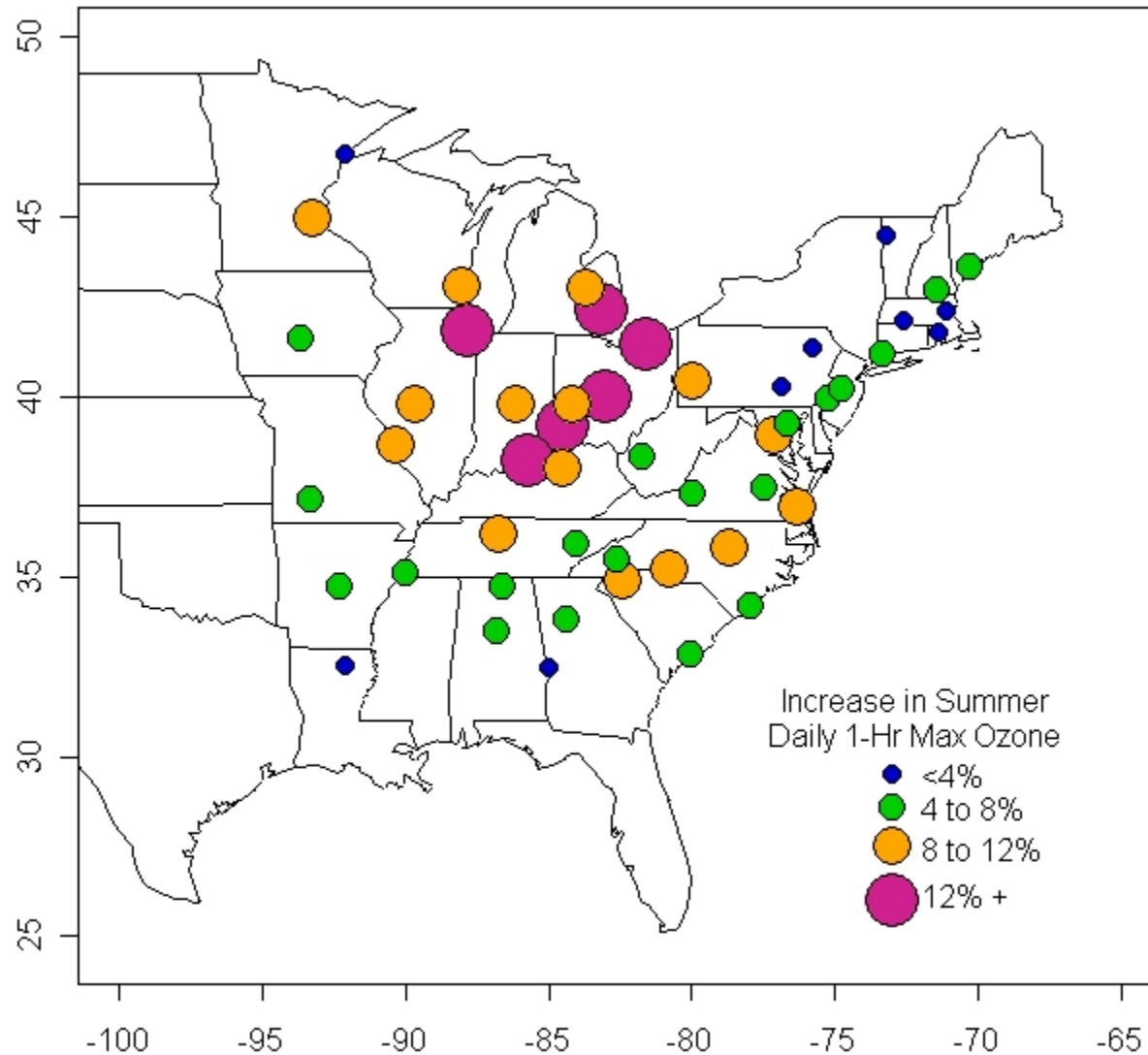
Climate Change Impact on Biogenic Emissions

- Higher temperatures cause increased VOC emissions from trees
 - Increase of 10°C can double biogenic emissions
- Biogenic emissions can be on the same order of magnitude as anthropogenic emissions

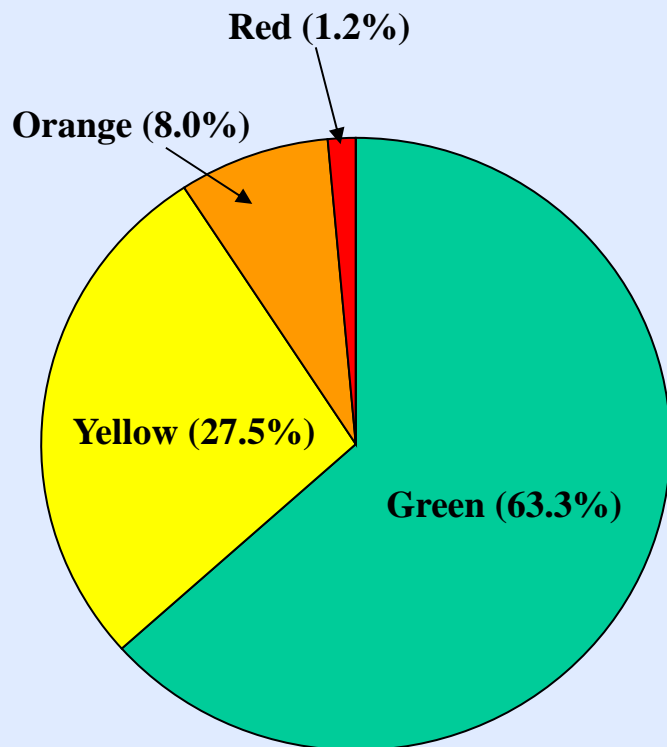
Study of Ozone, Climate Change, and Health

- 50 Eastern U.S. Cities
- Used global climate, air quality, and meteorological modeling to estimate how climate change could effect ozone levels
- Compares summers in the 1990s to the 2050s

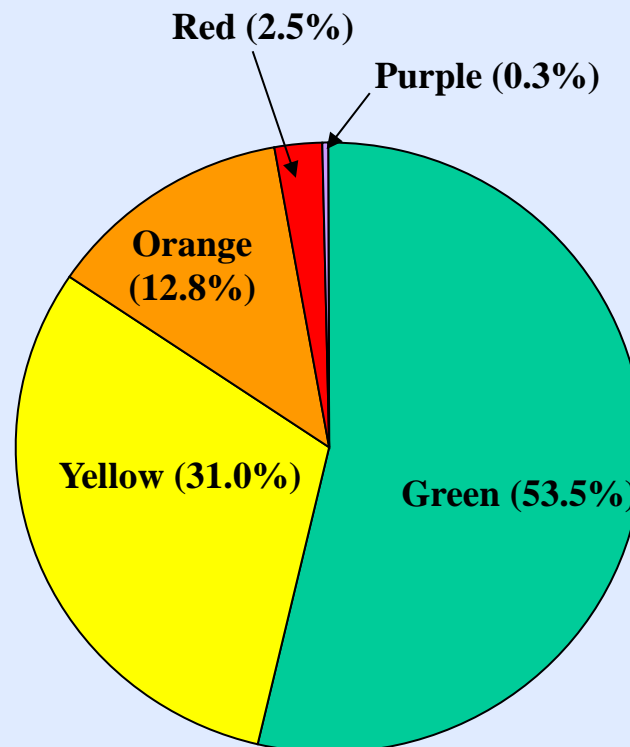
Increase in Ozone (1990s to the 2050s)



% of Summer Days in Each O₃ Air Quality Index Category (Average Across 50 U.S. Eastern Cities)



**Current Climate
(1990s)**

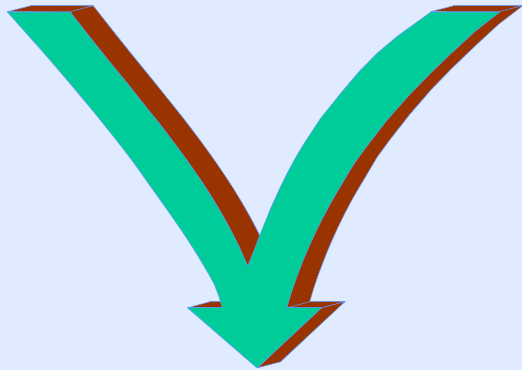


**Future A2 Climate
(2050s)**

Co-Benefits (and Co-Costs) of Climate Change and Air Quality Policies

Air
Quality
Policies

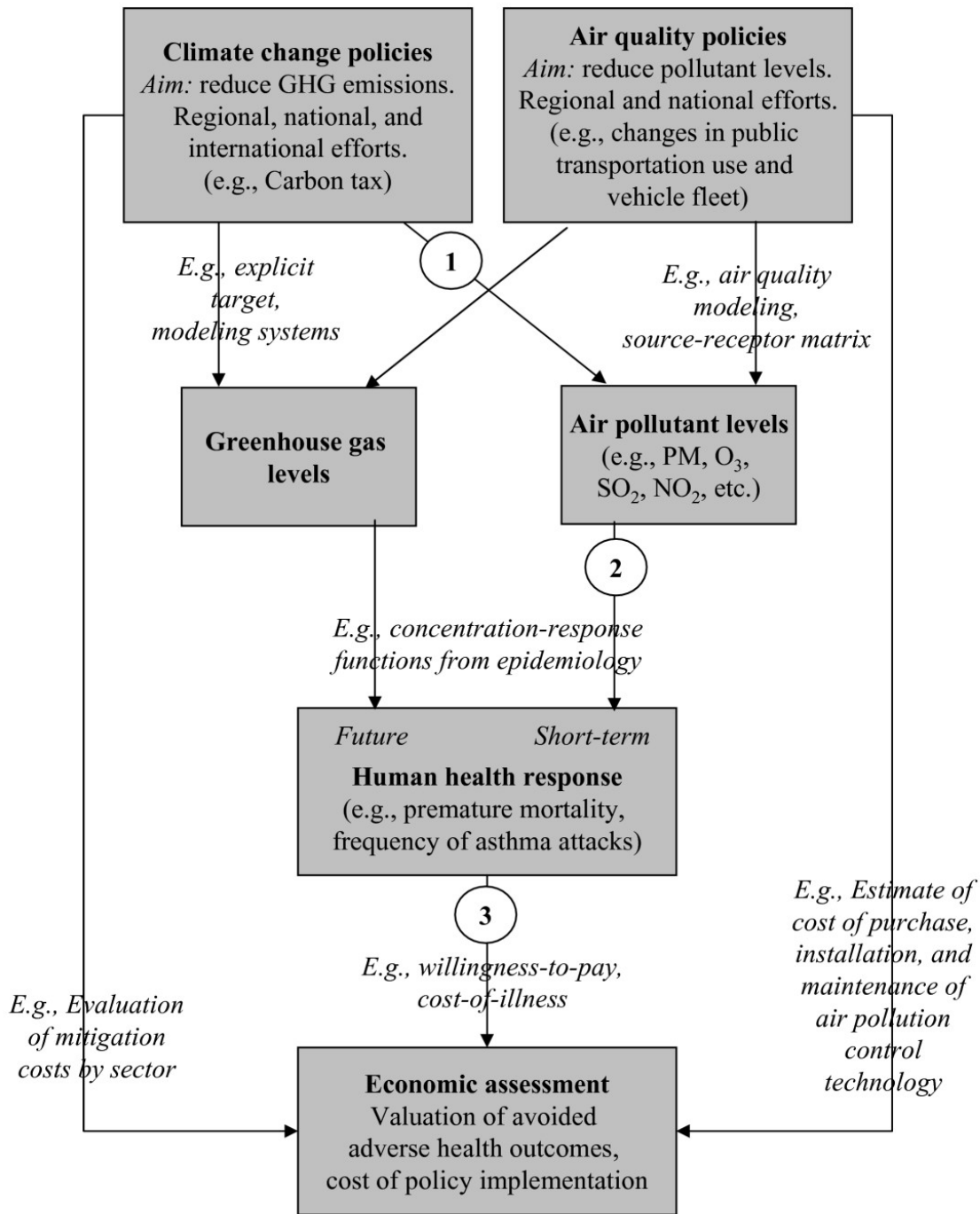
Climate
Change
Policies



Human
Health

- **Many policies to improve air quality would lower GHG emissions.**
- **Many policies to avoid/mitigate climate change would improve air quality in the short-term.**

Relationship between Climate Change and Air Quality Policies



Concluding Thoughts

- Trends in O₃ pollution and science
 - Substantial progress, still a concern
 - Growing evidence for more health outcomes
- Air quality policies and health benefits
 - Benefits at lower levels (including below NAAQS)
 - Policies can be highly cost effective
- Ozone and climate change
 - Health impacts under a changing climate
 - Policy opportunities: co-benefits

Thank you!

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