

Long-Range Fine Particulate Matter from Forest Fires and Mortality in Greater Boston and New York City

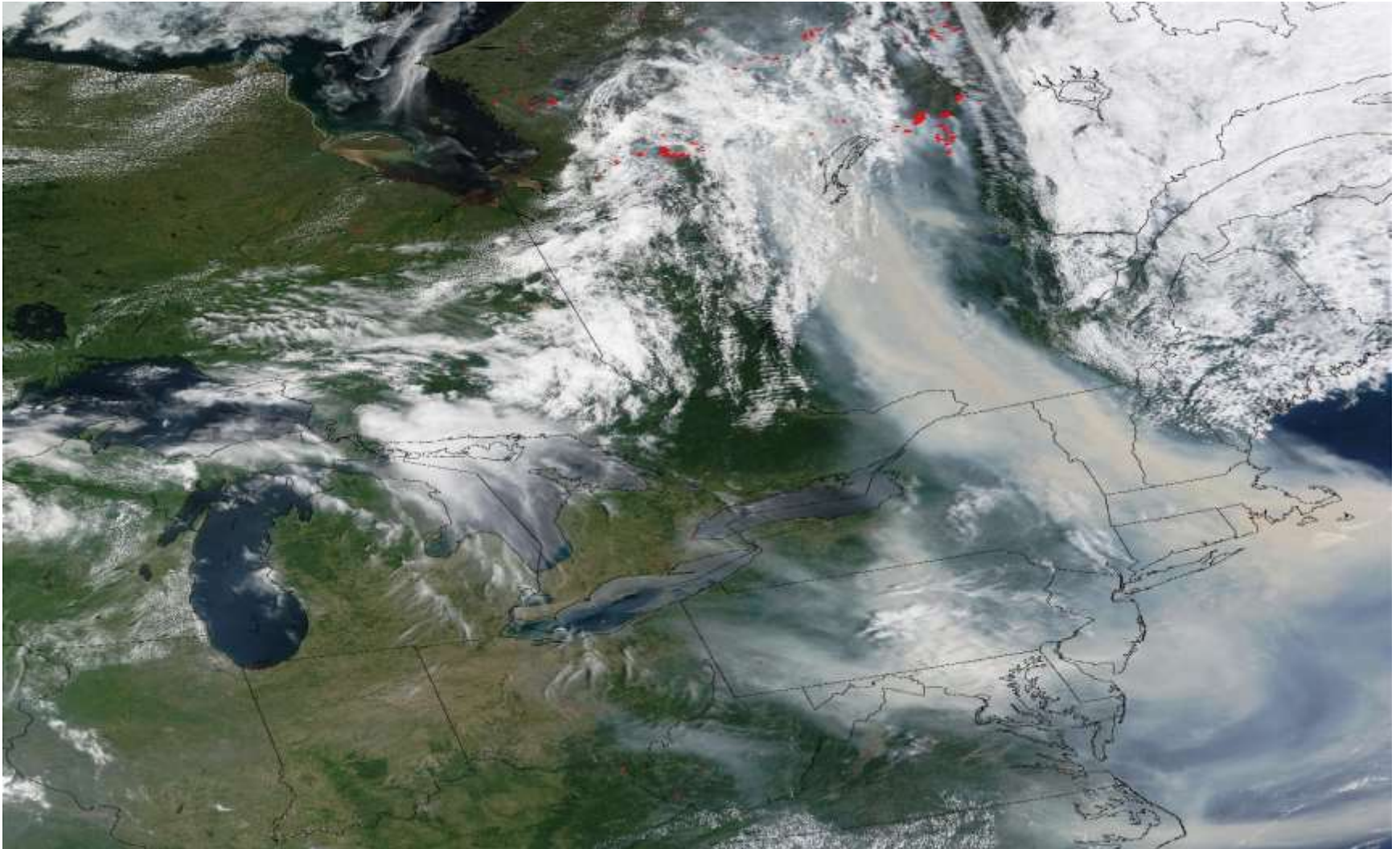
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October 3, 2018

PM_{2.5} and Mortality

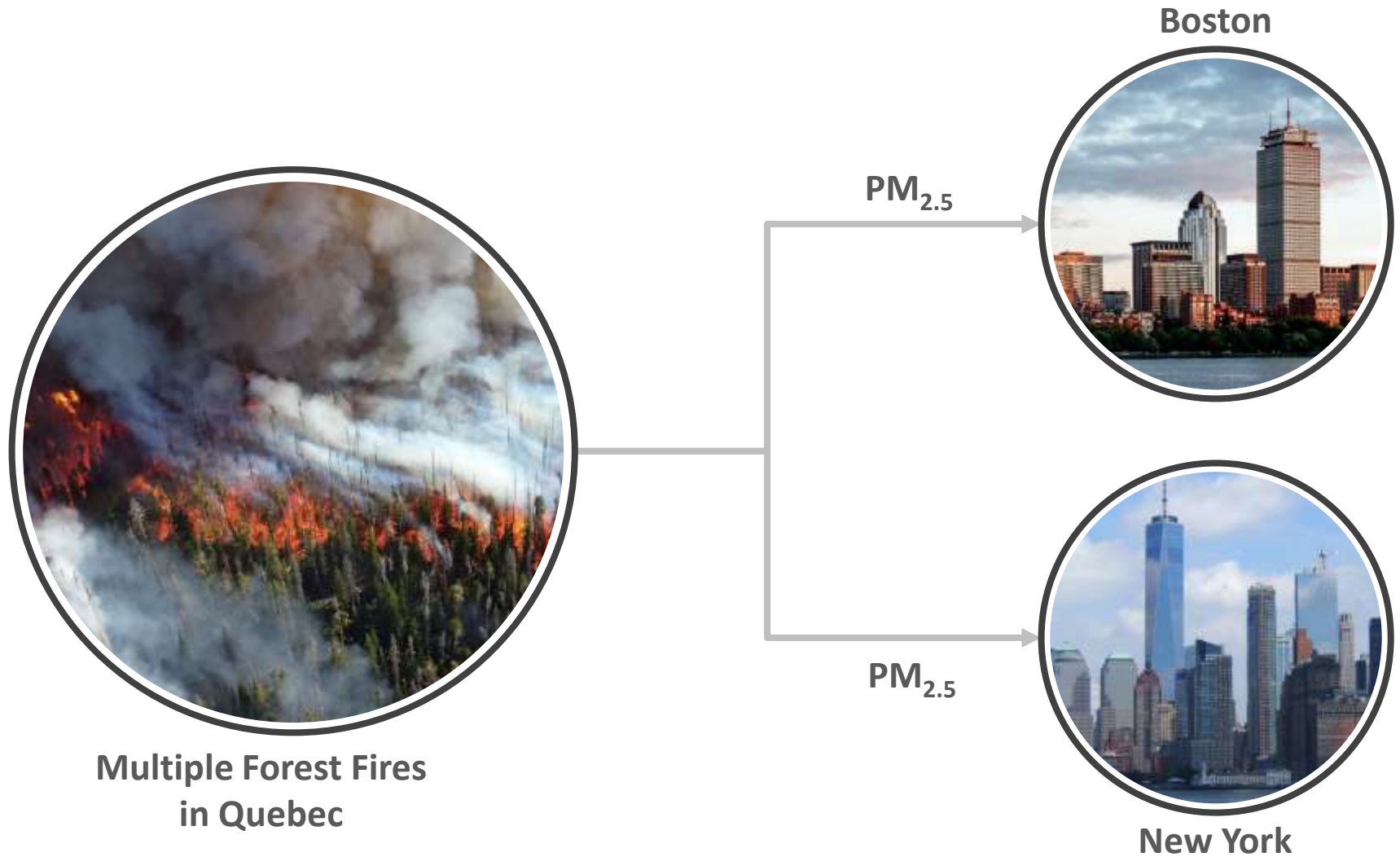
- Geographic variation
 - Positive and negative correlations
 - Some studies, associations in cities with lower PM_{2.5}
- No major PM_{2.5} components are toxic in animal studies at low concentrations
- Co-pollutant confounding
- Inconsistent mortality/morbidity associations
- PM_{2.5} and mortality both correlated with societal activity/stress

Quebec Forest Fires and Smoke over the US



MODIS Photo on July 7, 2002

A Natural Experiment

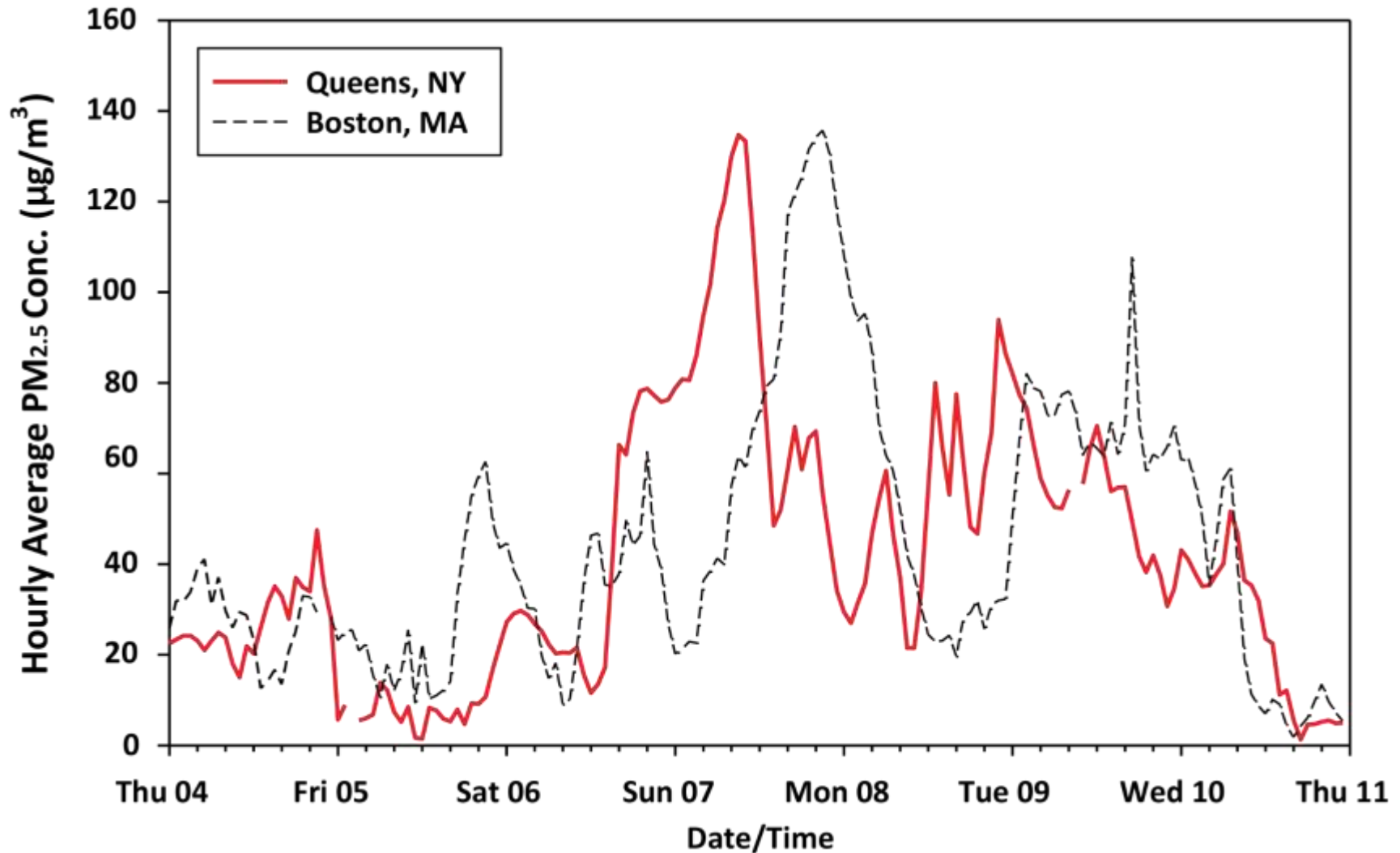


Multiple Forest Fires
in Quebec

Boston

New York

Elevated PM_{2.5} in Boston and NYC



Mortality Data

- Individual-level mortality records
 - The Massachusetts Department of Public Health
 - The New York City Department of Health and Mental Hygiene
- Daily death counts by city
 - Total (by natural causes)
 - Cardiovascular
 - Respiratory

PM_{2.5} and Meteorology Data

- PM_{2.5} data
 - The US EPA Air Quality System (AQS)
 - Greater Boston and the five New York City boroughs (Manhattan, Brooklyn, Queens, the Bronx, and Staten Island)
 - City-level daily 24-hour average PM_{2.5} concentrations
- Meteorology data
 - The National Climatic Data Center (NCDC)
 - City-level daily apparent temperatures calculated from average and dew point temperatures

Statistical Analysis

July 2002

	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28						

July 2001

	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29						

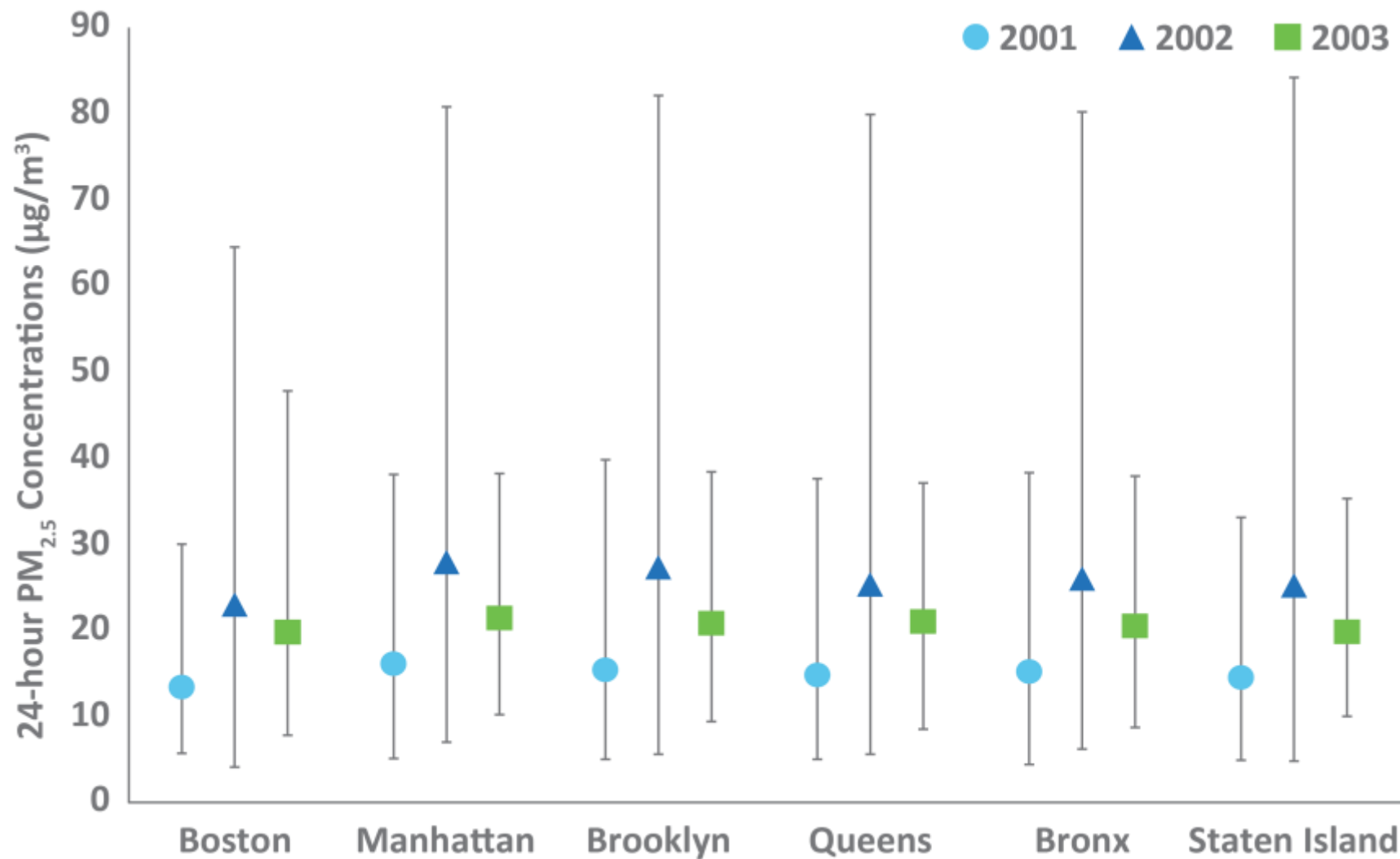
June-July 2003

	30	1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27						

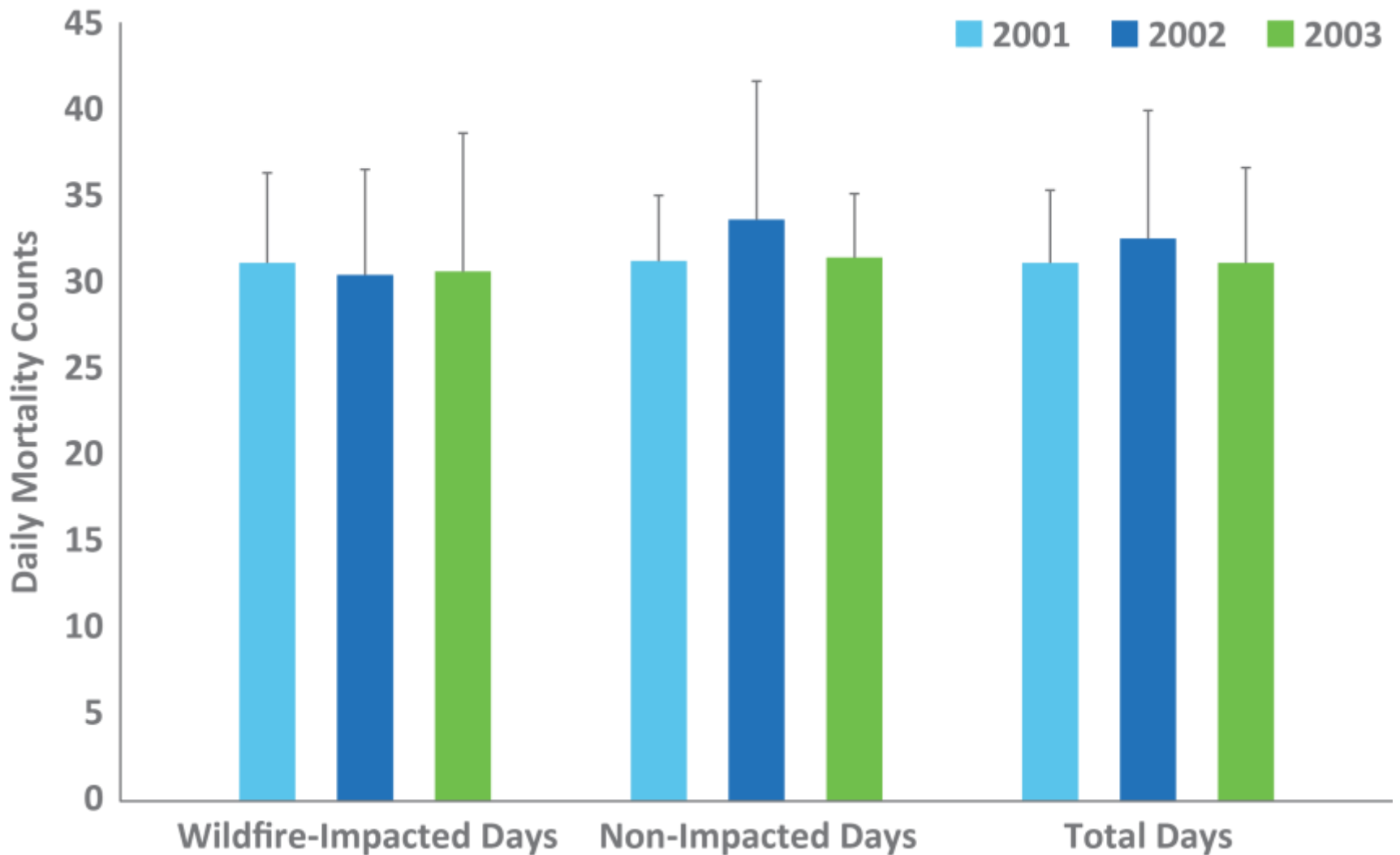
 Forest fire smoke-impacted days

 Non-impacted days

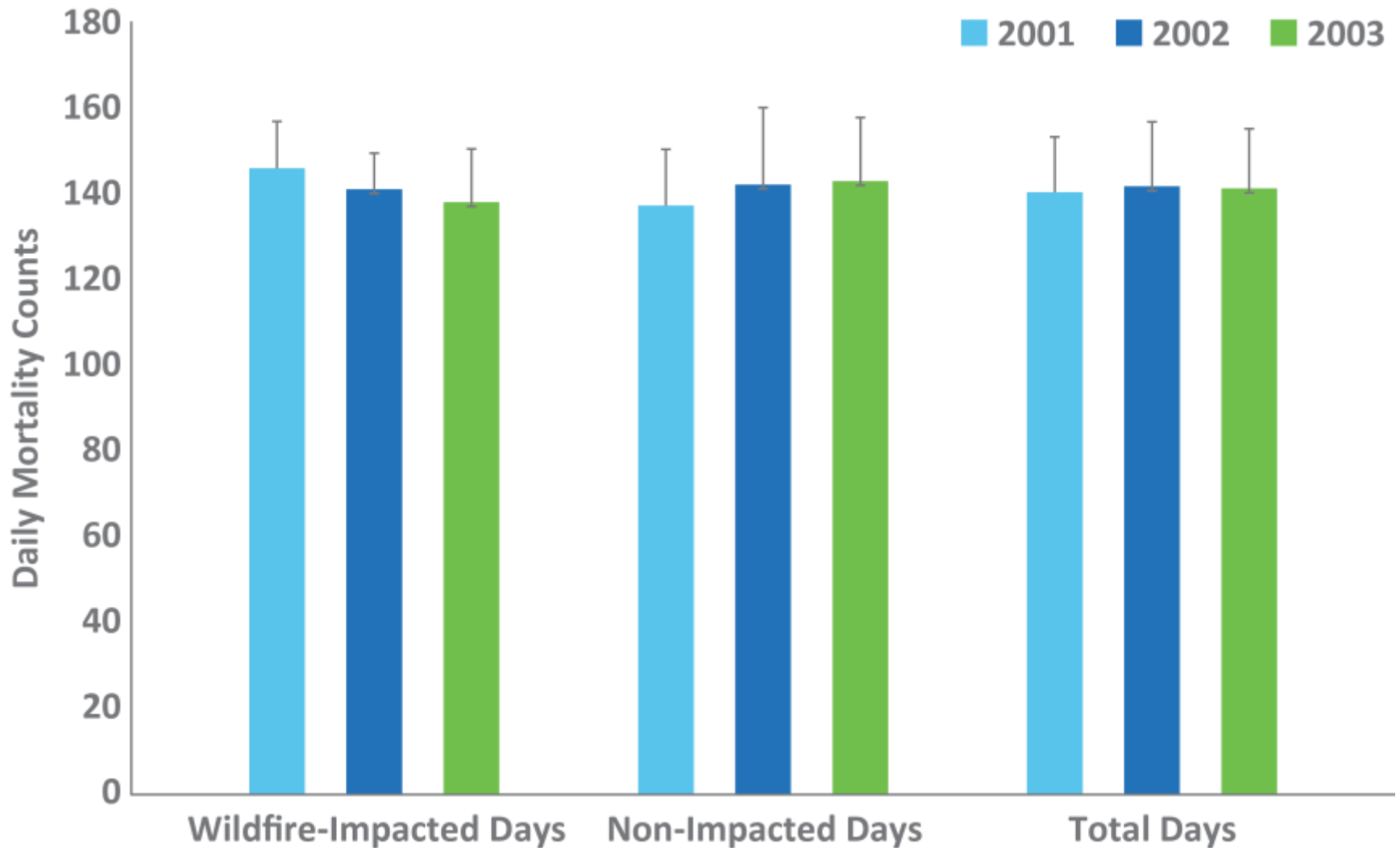
24-hour PM_{2.5} Concentrations



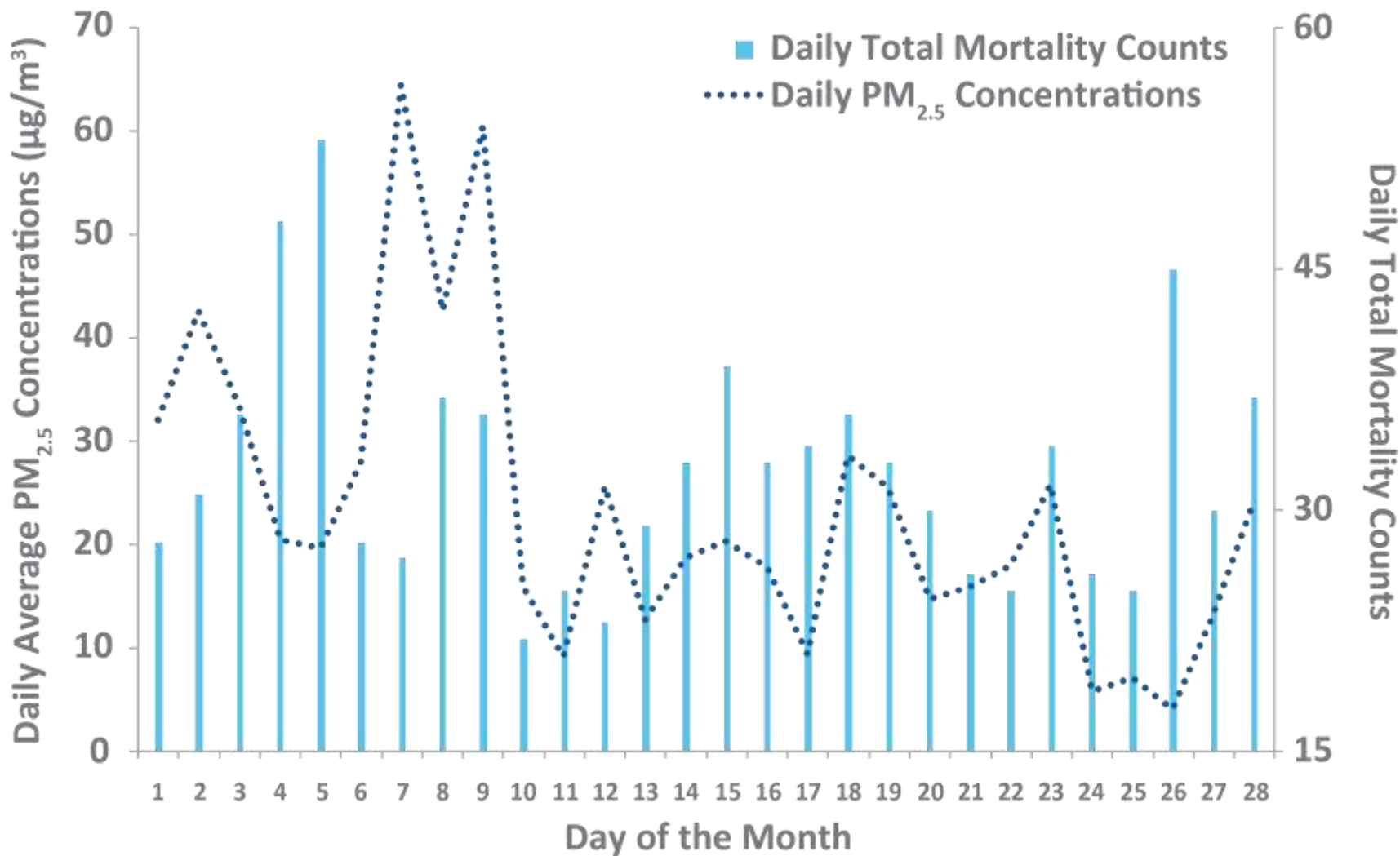
Mortality in Greater Boston



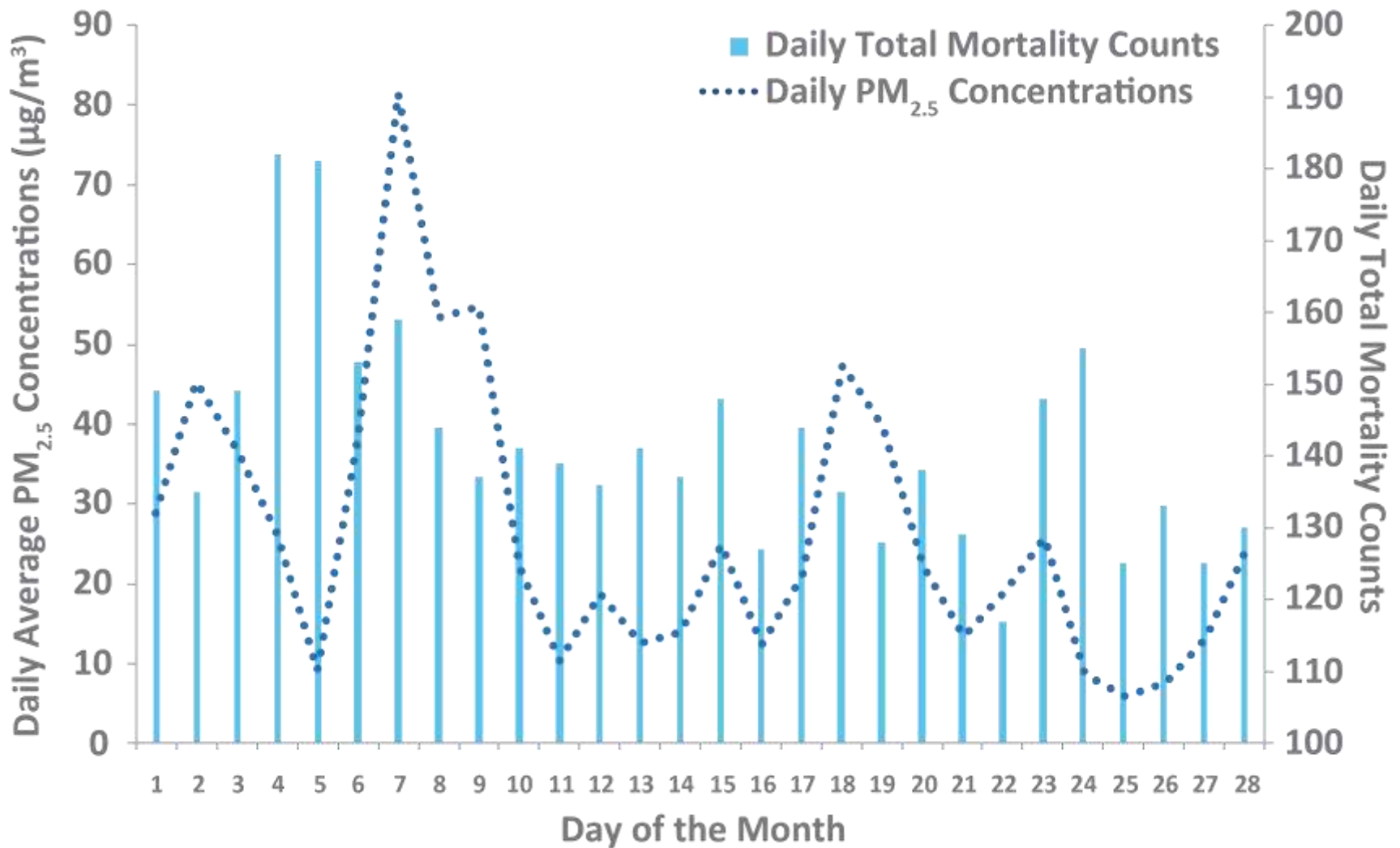
Mortality in New York City



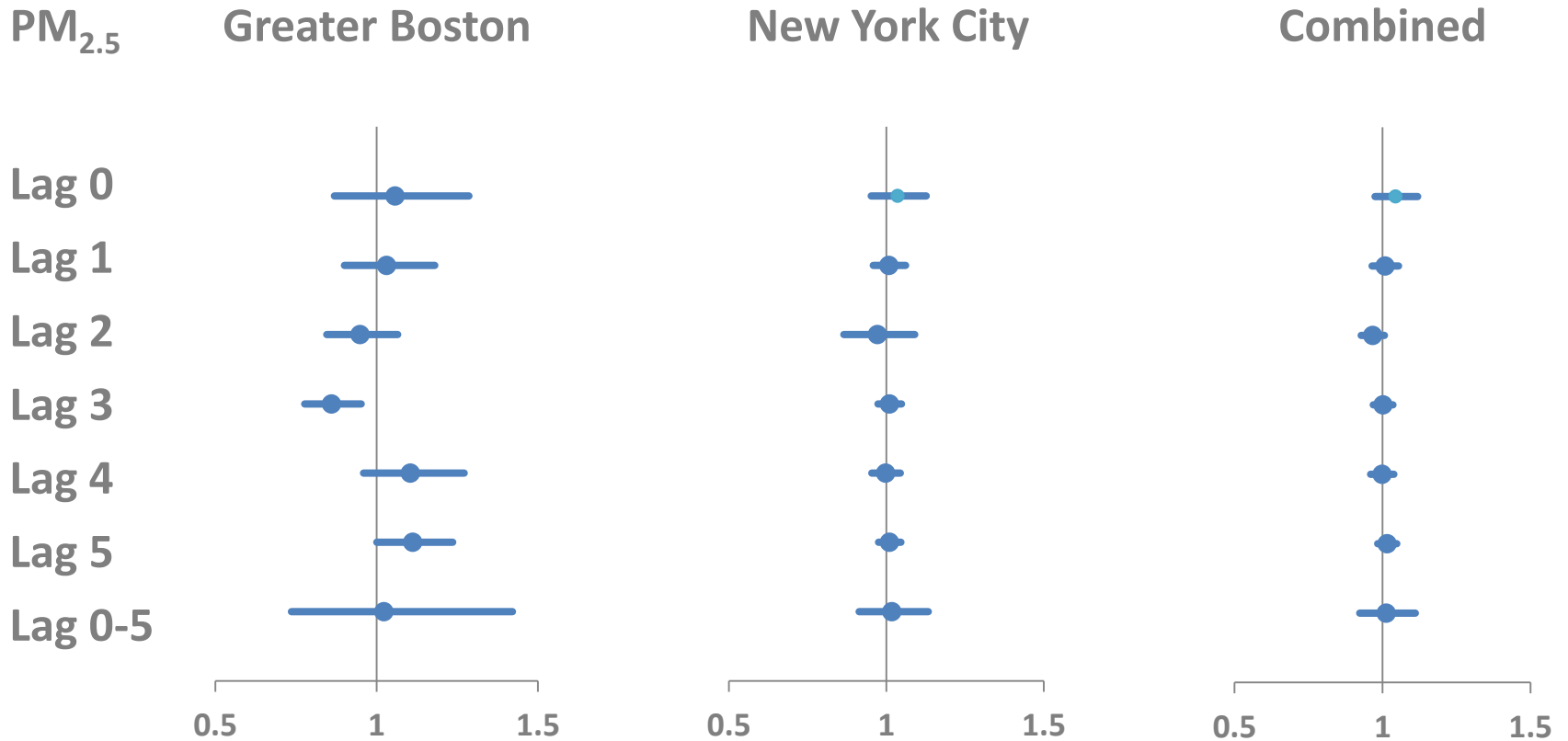
PM_{2.5} and Mortality in Greater Boston, 2002



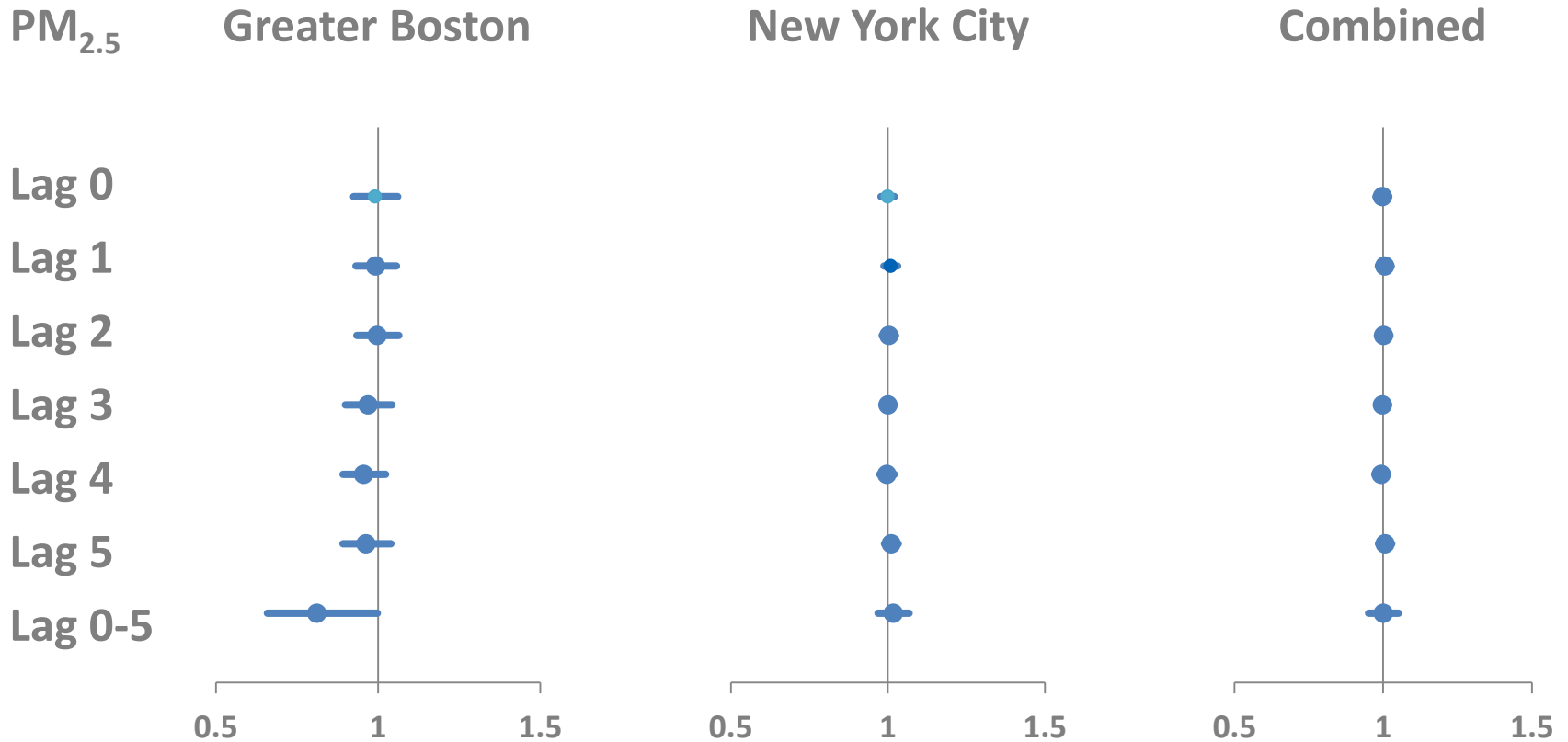
PM_{2.5} and Mortality in New York City, 2002



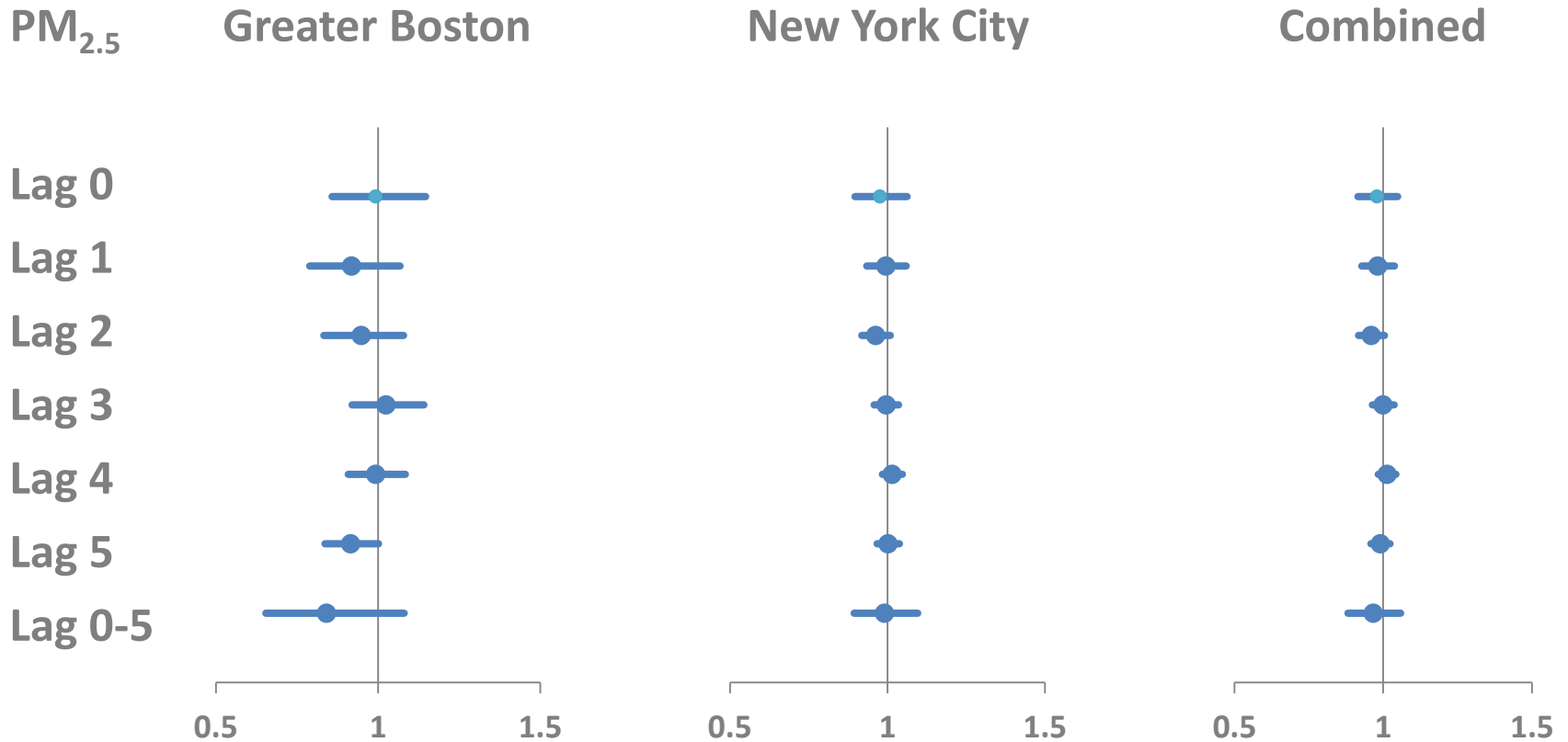
PM_{2.5} and Mortality in 2001



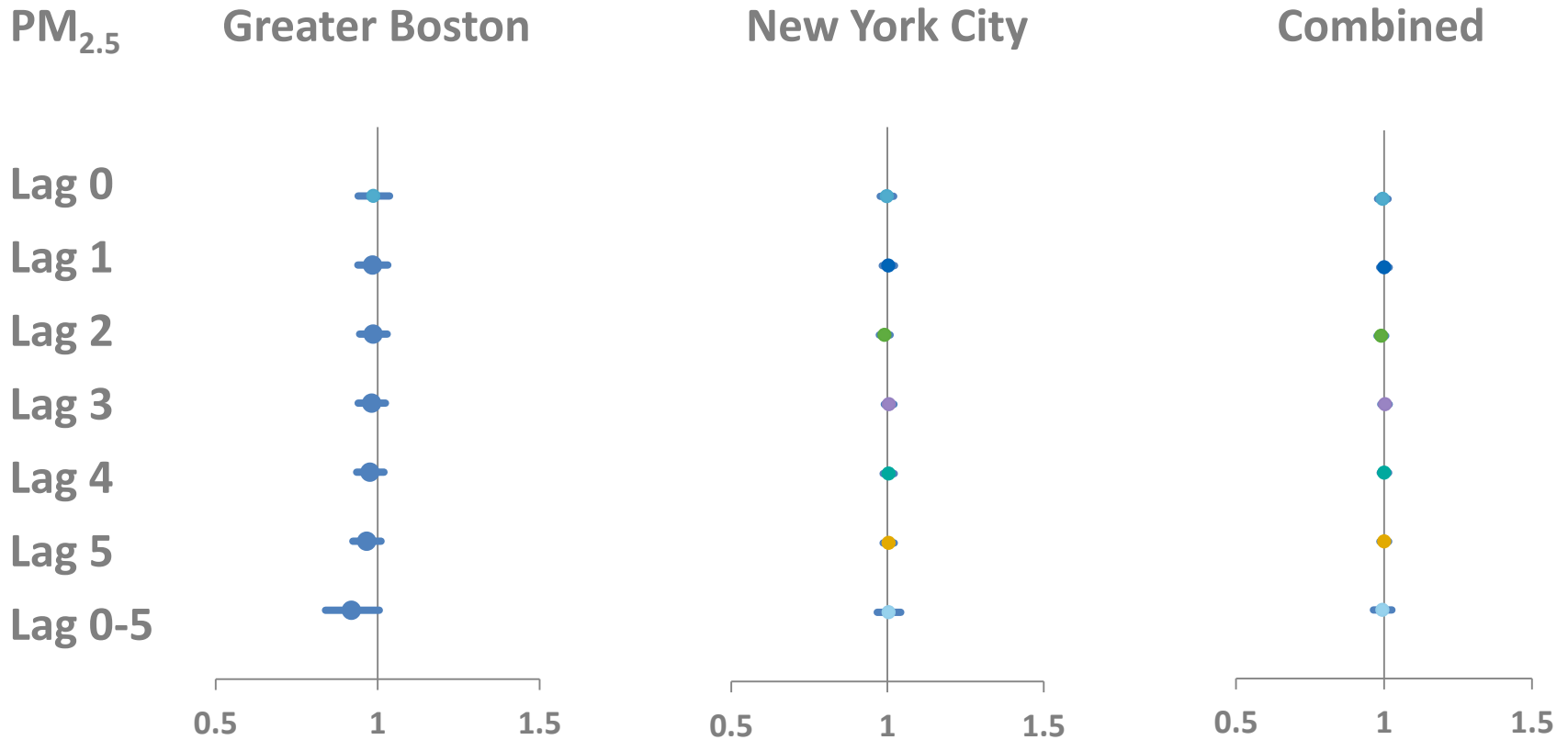
PM_{2.5} and Mortality in 2002



PM_{2.5} and Mortality in 2003



PM_{2.5} and Mortality in 2001-2003



Wood Smoke Particulates

- Relative toxicity uncertain
- Phoenix and Washington DC
 - No association with wood smoke or biomass/wood combustion factors
 - Association with coal combustion primary PM_{2.5}, secondary sulfates, traffic-related PM
- Atlanta
 - Biomass burning or wood smoke similar to diesel source for cardiovascular disease ED visits
- *In vitro*
 - Greater biological activity of wood smoke particles
- Variability of different types of wood smoke

Potential Study Limitations

- Short study period
- Centrally located air monitors
- Visible haze
- Ecological study design

Conclusions

- Natural experiment allowed evaluation of relatively large differences in $PM_{2.5}$
- Substantial short-term elevation in $PM_{2.5}$ from forest fire smoke was not followed by increased daily mortality in Greater Boston or New York City

This work was funded by the Texas Commission on Environmental Quality