Is there evidence for acute air pollution deaths in Southern California?

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The Great Smog of London, 1952, is estimated to have killed thousands of people and alerted all to the hazards of high levels of air pollution. There has been great progress in reducing air pollution and current literature is mixed on if current levels of air pollution are associated with acute deaths. There is a need to assess possible mortality effects of current levels of air pollution in specific regions as it is well-known that there is geographic heterogeneity. Daily deaths and air pollution levels as measured by PM2.5 and ozone were obtained for the years 2007-2010 for eight California air basins. Here we report on findings for a Southern California air basin. Spikes in the levels of PM2.5 and ozone, so called natural experiments, can be use to test for the acute effects of air pollution. People 65 and older were taken to be most sensitive to air pollution. Lung and cardiovascular deaths were taken to be most relevant to air pollution. Seasonal effects were removed using 21-day moving medians to give time-local estimates of deaths and air pollution. Death lags of 0, 1, and 2 days were examined. Analyses were computed for two measures of air pollution, four years, and three lags, looking for a consistent, acute effect of air pollution on mortality. A number of data visualization and statistical analyses support the statement that there were no consistent statistical effects of PM2.5 or ozone on acute deaths. We concluded that there is no evidence of an increase in acute deaths due to PM2.5 or ozone in Southern California for the years 2007-2010.

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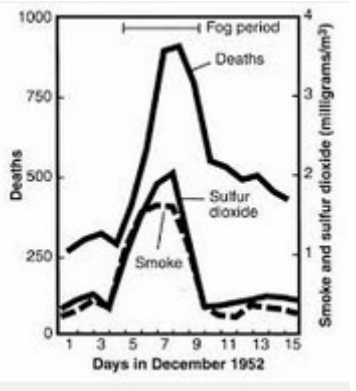
10/13/2014

London Fog, 1952



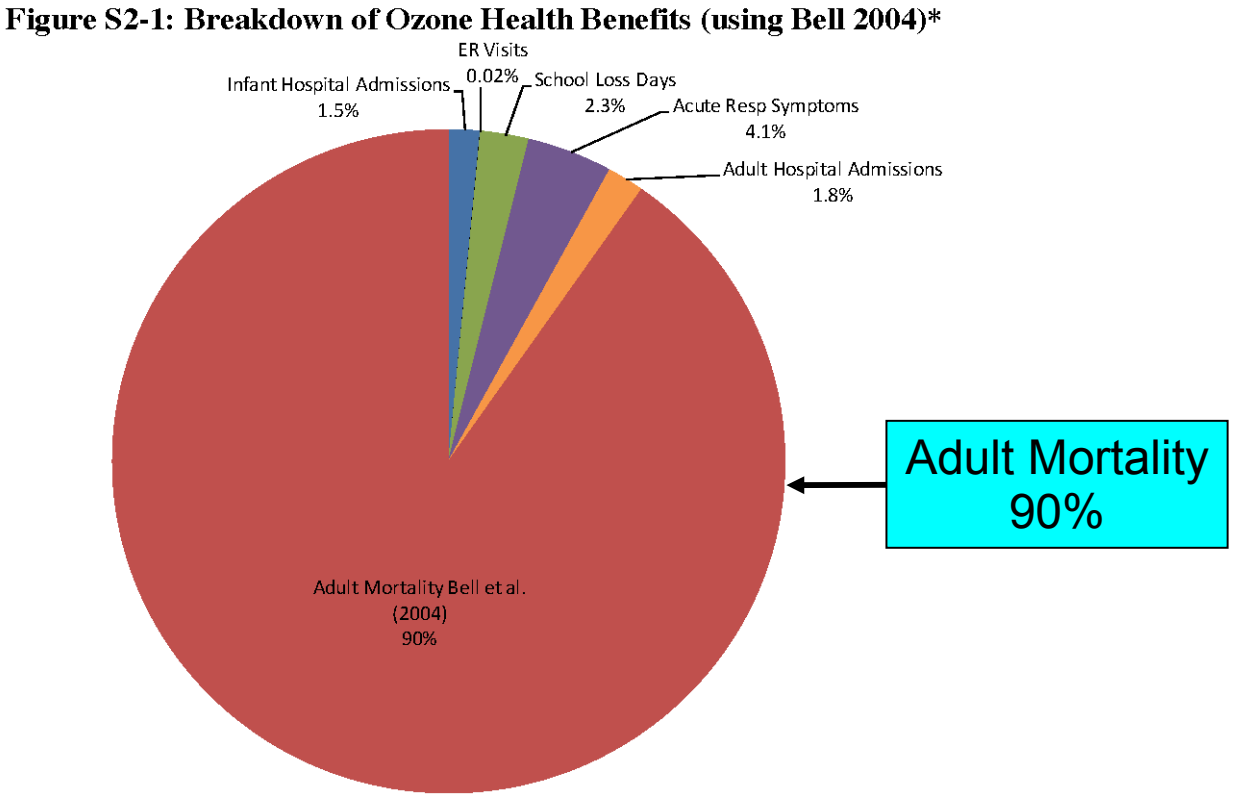
LA 1948

Beijing

Singapore

Mortality Claim Vital to EPA/CARB

- Revised Ozone NAAQS
- Alleged benefits depend heavily on assumed relationships between ozone, PM2.5 & mortality



“Trust me” Science

1. EPA has refused to provide health data used in air quality studies since 1994
2. Efforts to criticize methodology have failed

1. Problem solved: California public use files
   a. All deaths 2000-2012 (2007-2010 analyzed)
   b. Age at death, cause of death, zip code at death

California Data Is the Best Data

1. Most current – even 2013 is available.
2. No cherry picking – all deaths from entire state with the ‘worst’ air in U.S.
3. Data will be made publicly available.
4. Level playing field for air quality science.
5. Opens up EPA/CARB epidemiology to scrutiny.

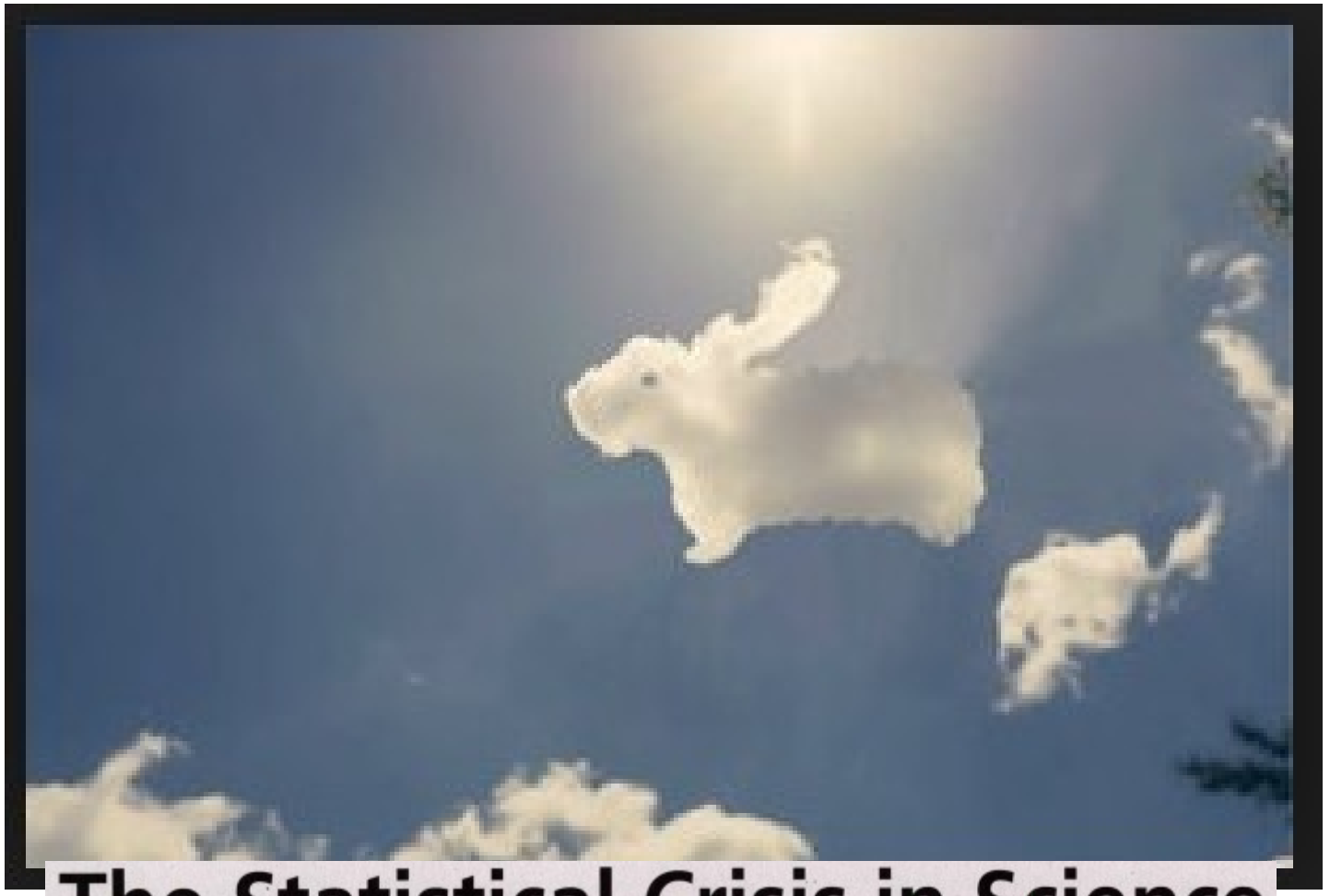
Question/Data/Methods

Do increases in ozone or PM2.5 increase acute mortality?

Data: Mortality for eight air basins in California
Heart/Lung for 65 and older
Years, 2007-2010

Methods: Visualizations: (p-values, p-value plots)
Time series, 21-day moving medians
Deviations of daily values from moving medians
Regression: HL 65+ deaths
versus ozone and PM2.5

Bunnies in the sky



The Statistical Crisis in Science

Data-dependent analysis—a "garden of forking paths"—explains why many statistically significant comparisons don't hold up.

Andrew Gelman and Eric Loken

Moving Median

1. Median: ½ values below and ½ values above.

2. 21-day moving median for time series.

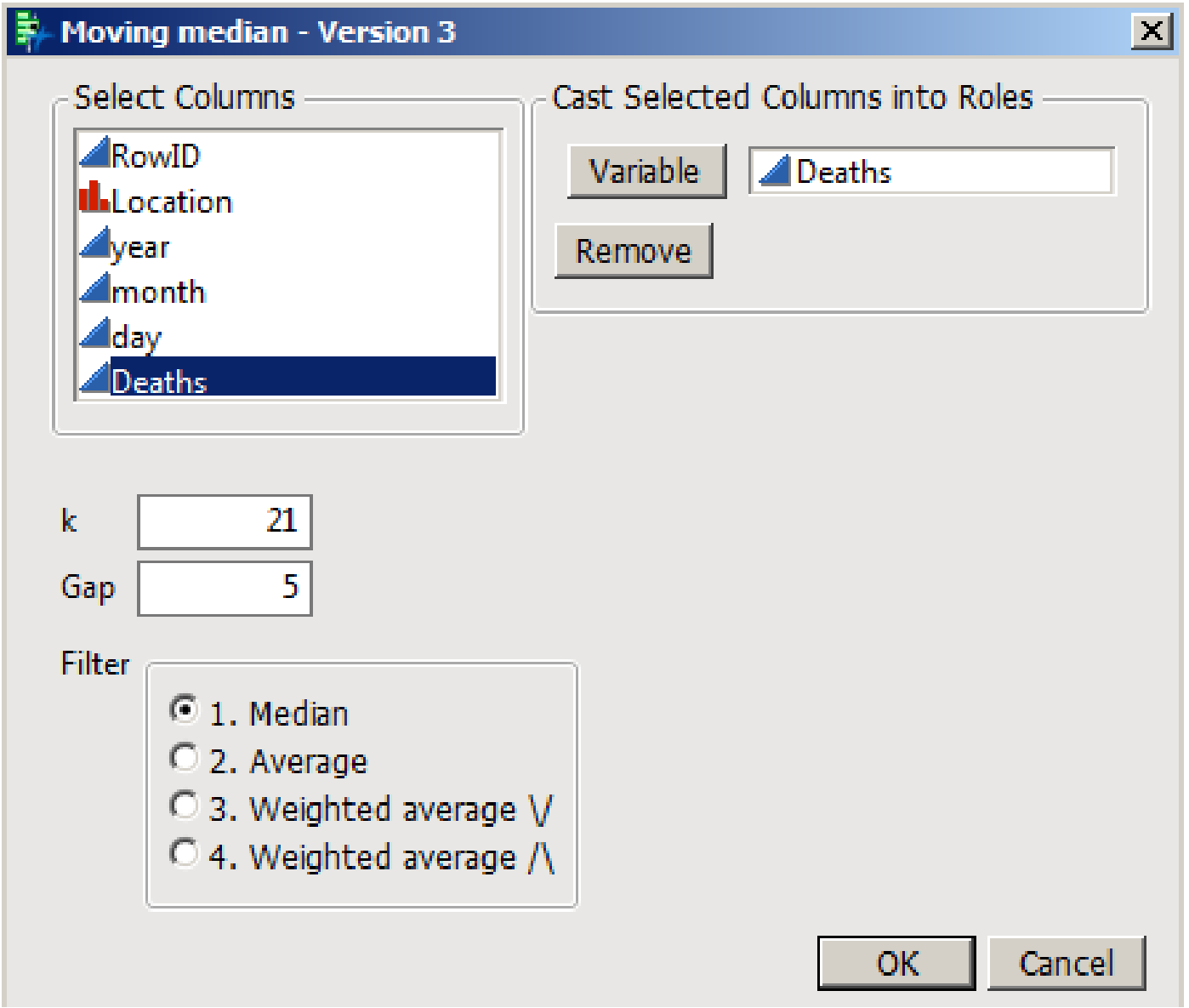
   a. Take 21 consecutive values and compute median, allow for gaps.

   b. Remove 1st value and add 1 value at end.

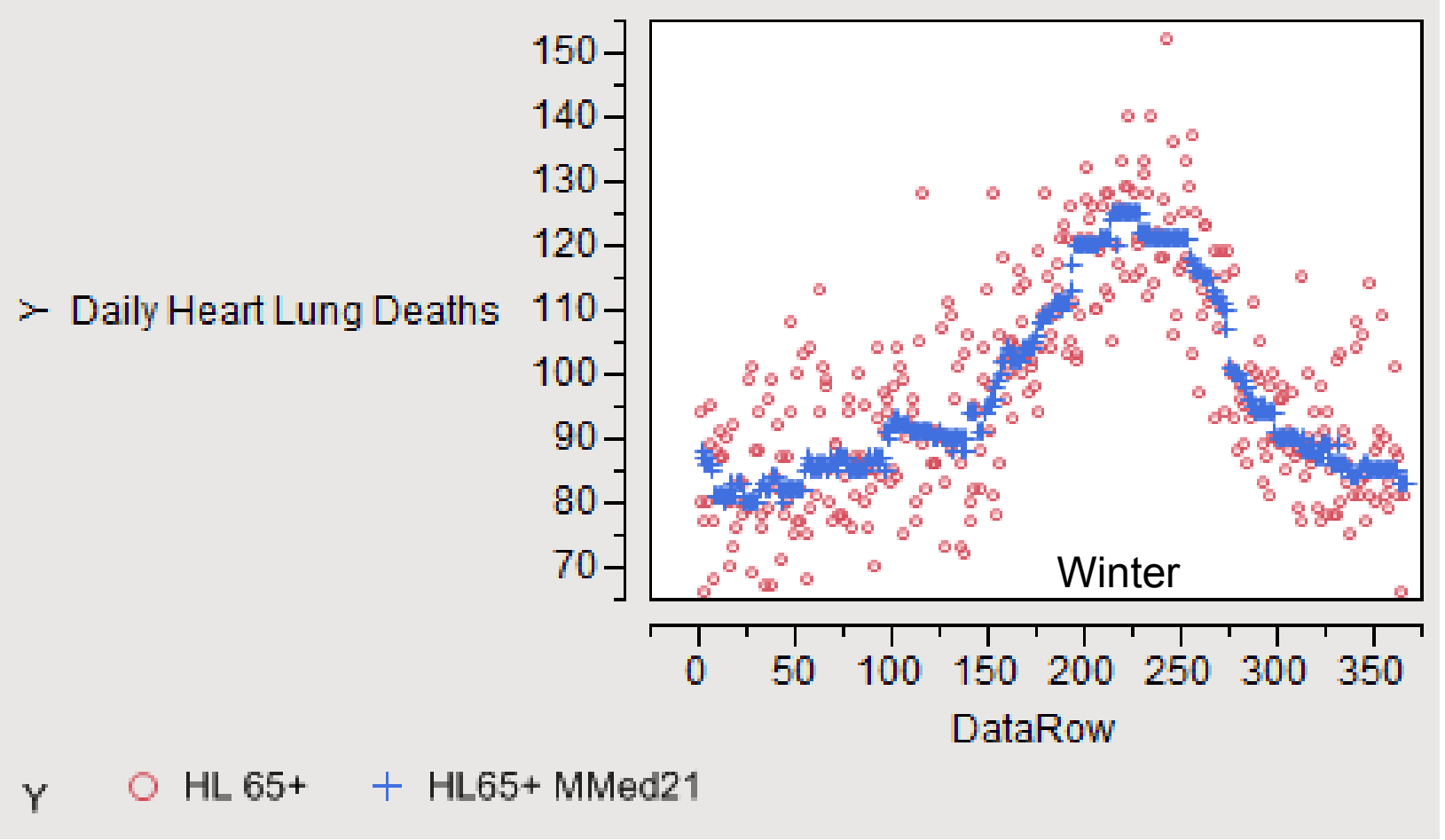
   c. Compute new median.

3. The moving 21-day median tracks the time series.

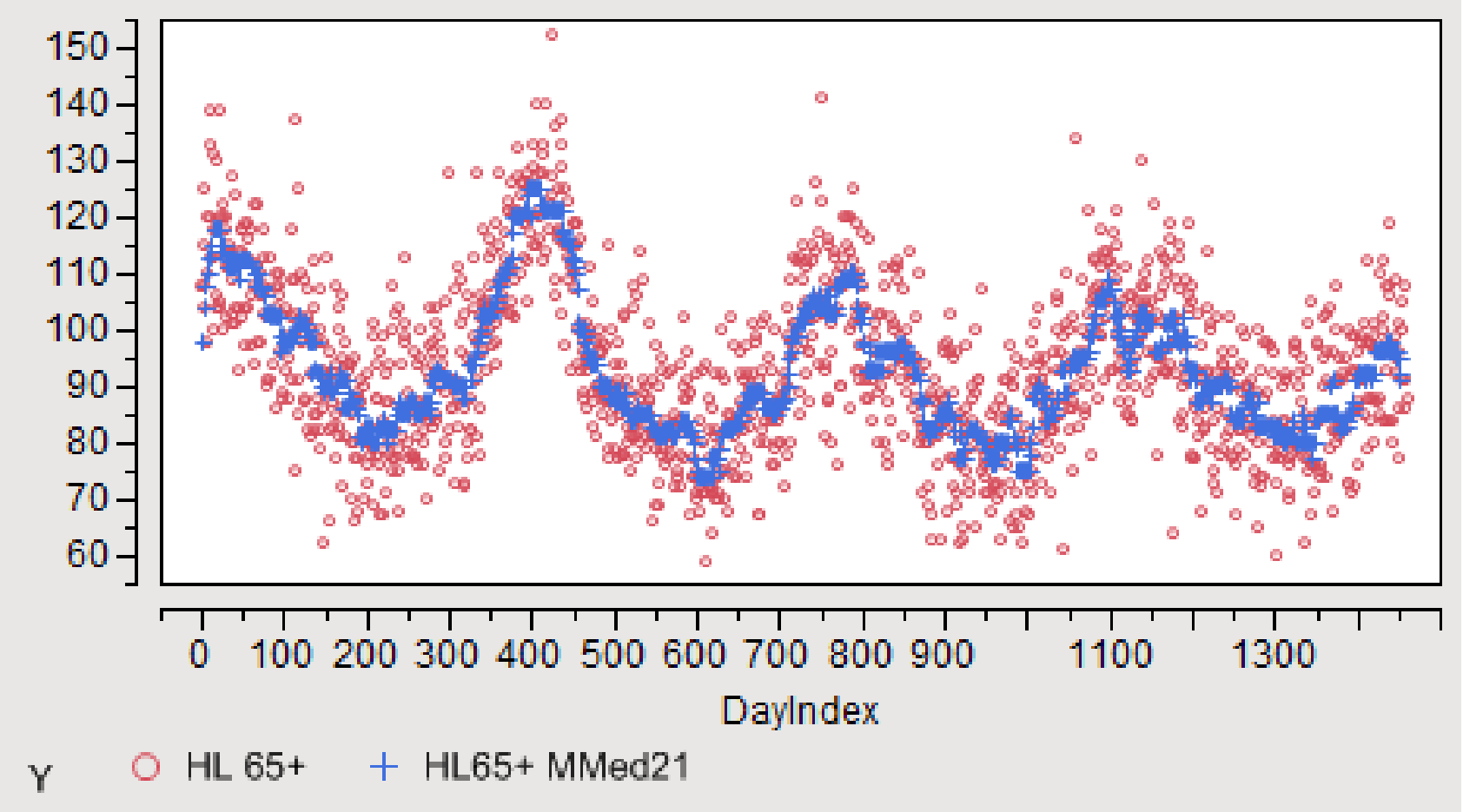
JMP moving median addin



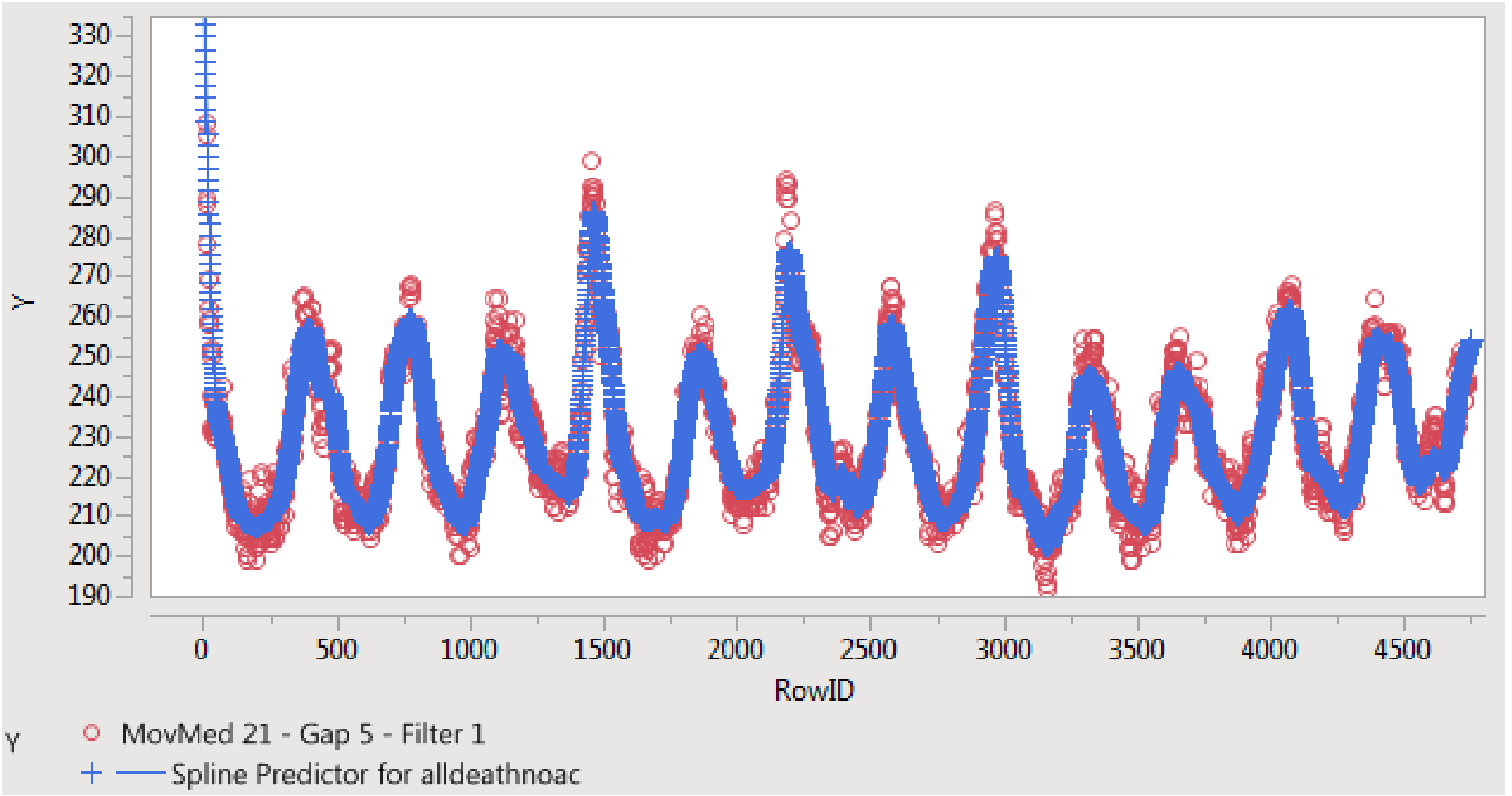
South Coast (LA), 2007-2008



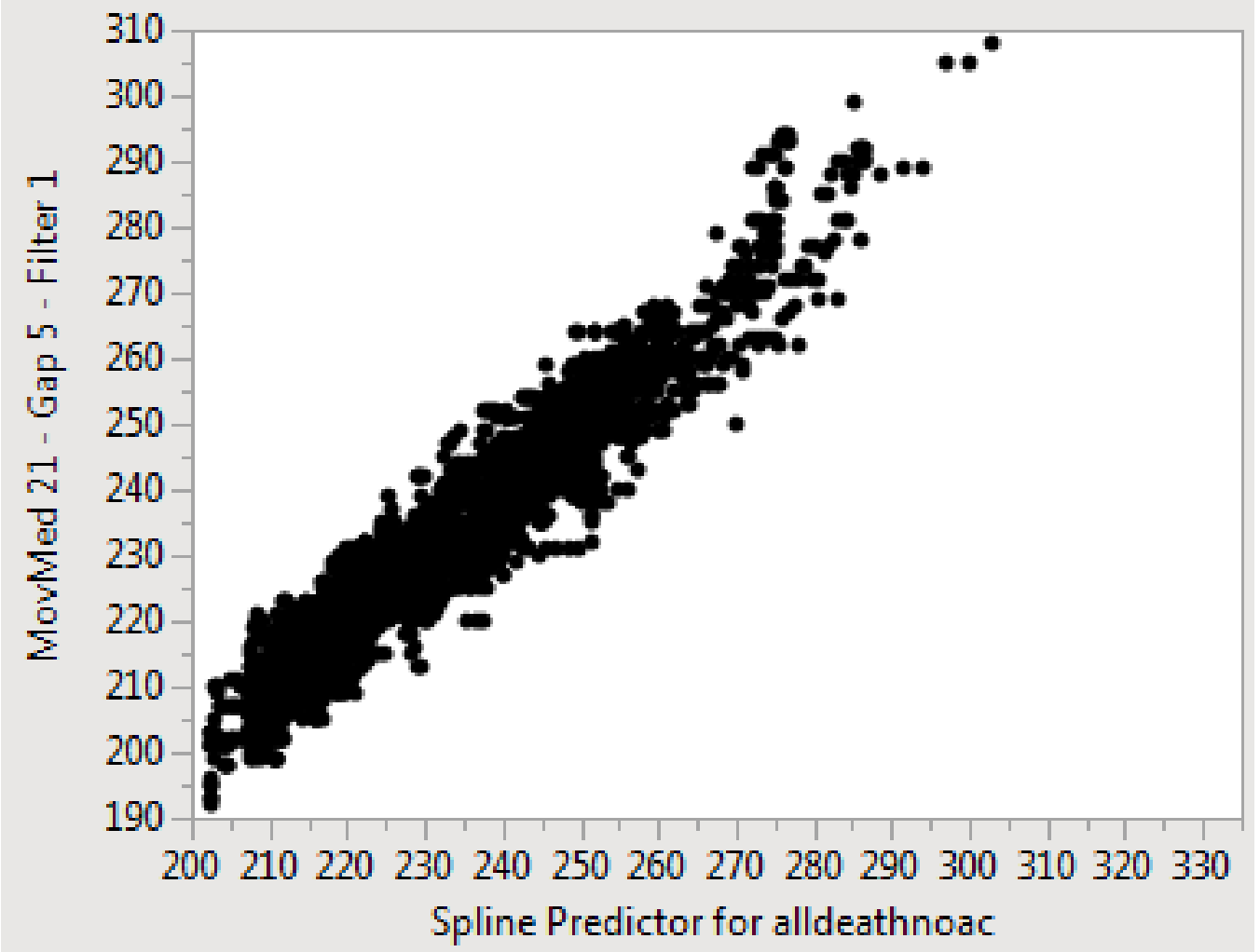
South Coast Deaths, 4 years



Moving Median vs Spline



Moving Median vs Spline



Natural Experiments

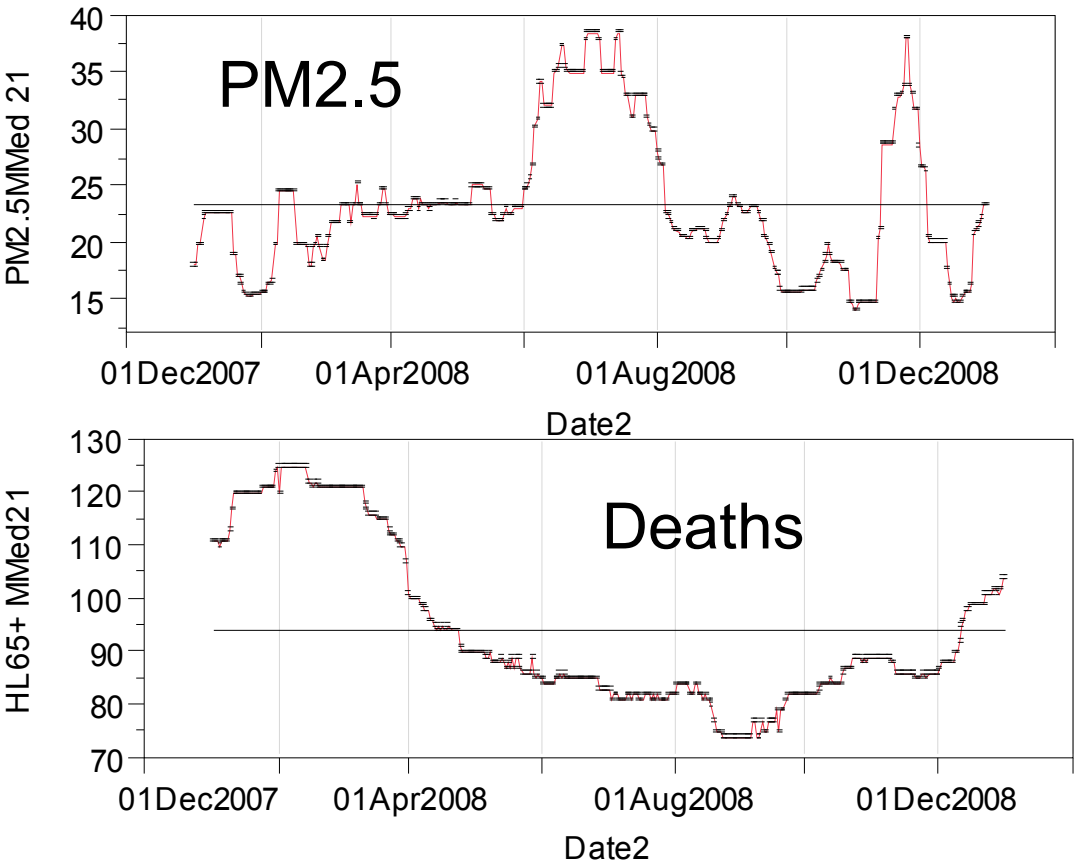
Wildfires

2008 Summer California wildfires

The wildfires as seen from space on July 9, 2008.

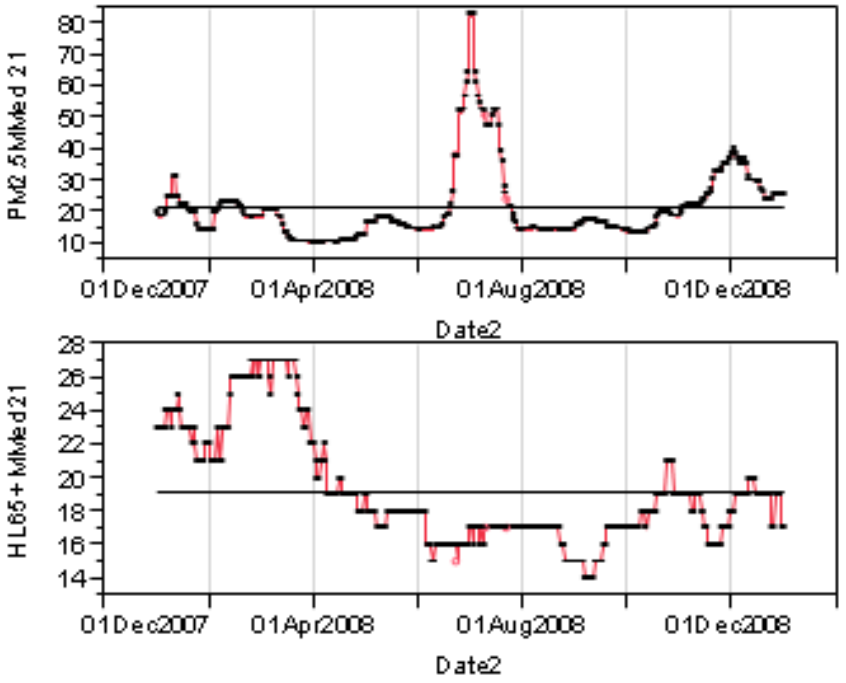
Location	Northern and Central California
Date	May 22, 2008 - August 29, 2008
Burned area	1,157,930 acres (4,686 km^2)[1][2][3]

South Coast, 2008

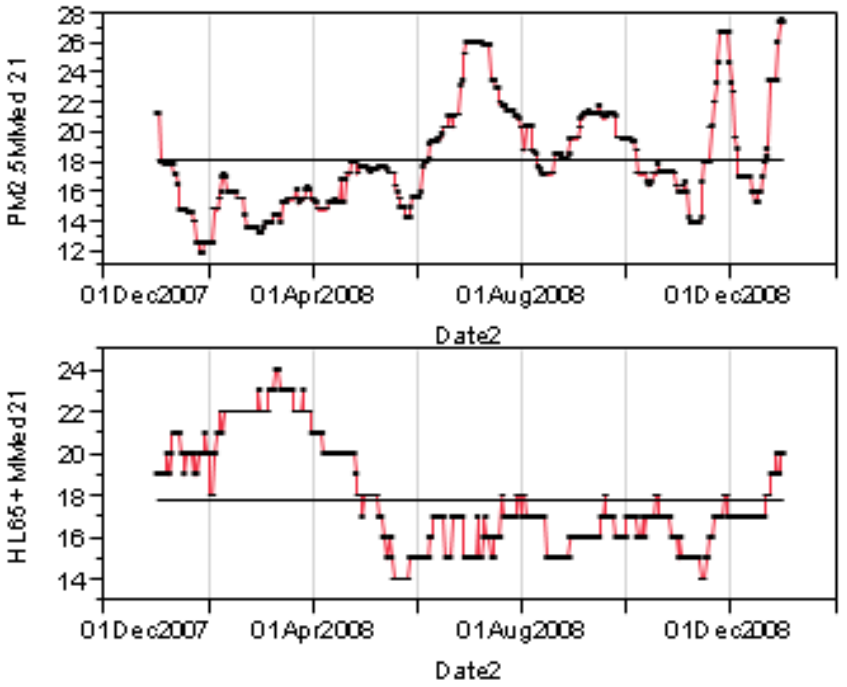


Natural Experiments (2)

Sacramento Valley

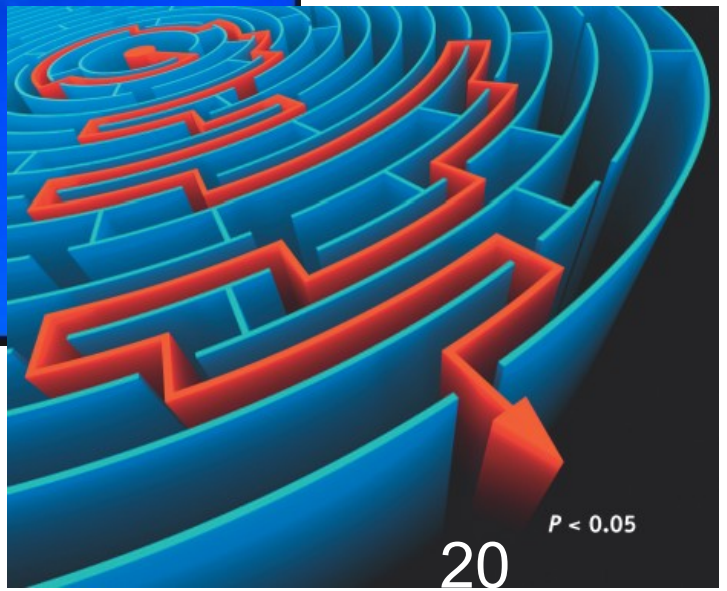


San Diego County

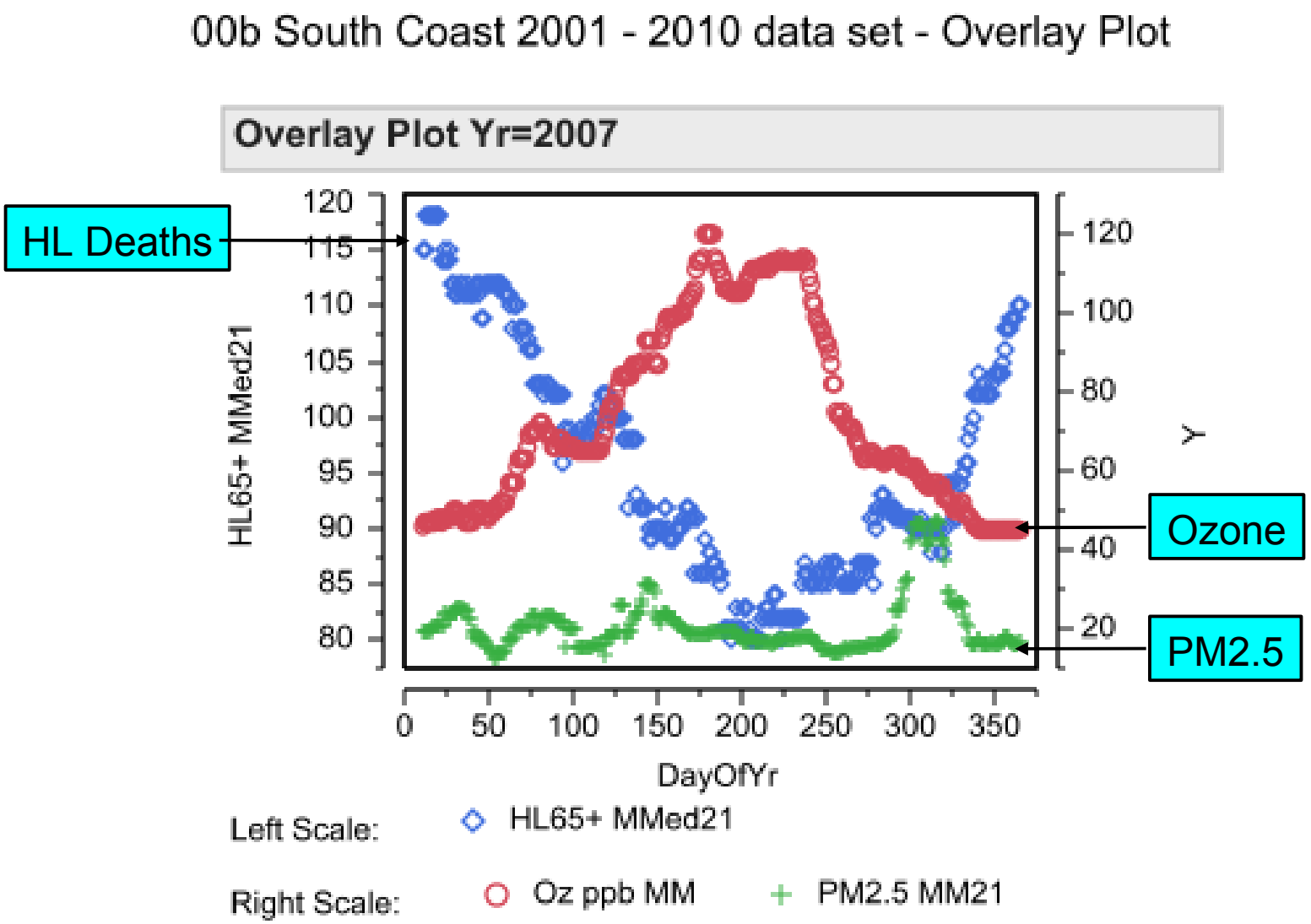


Similar lack of effect for all 8 air basins.

Bunnies in the sky (2)

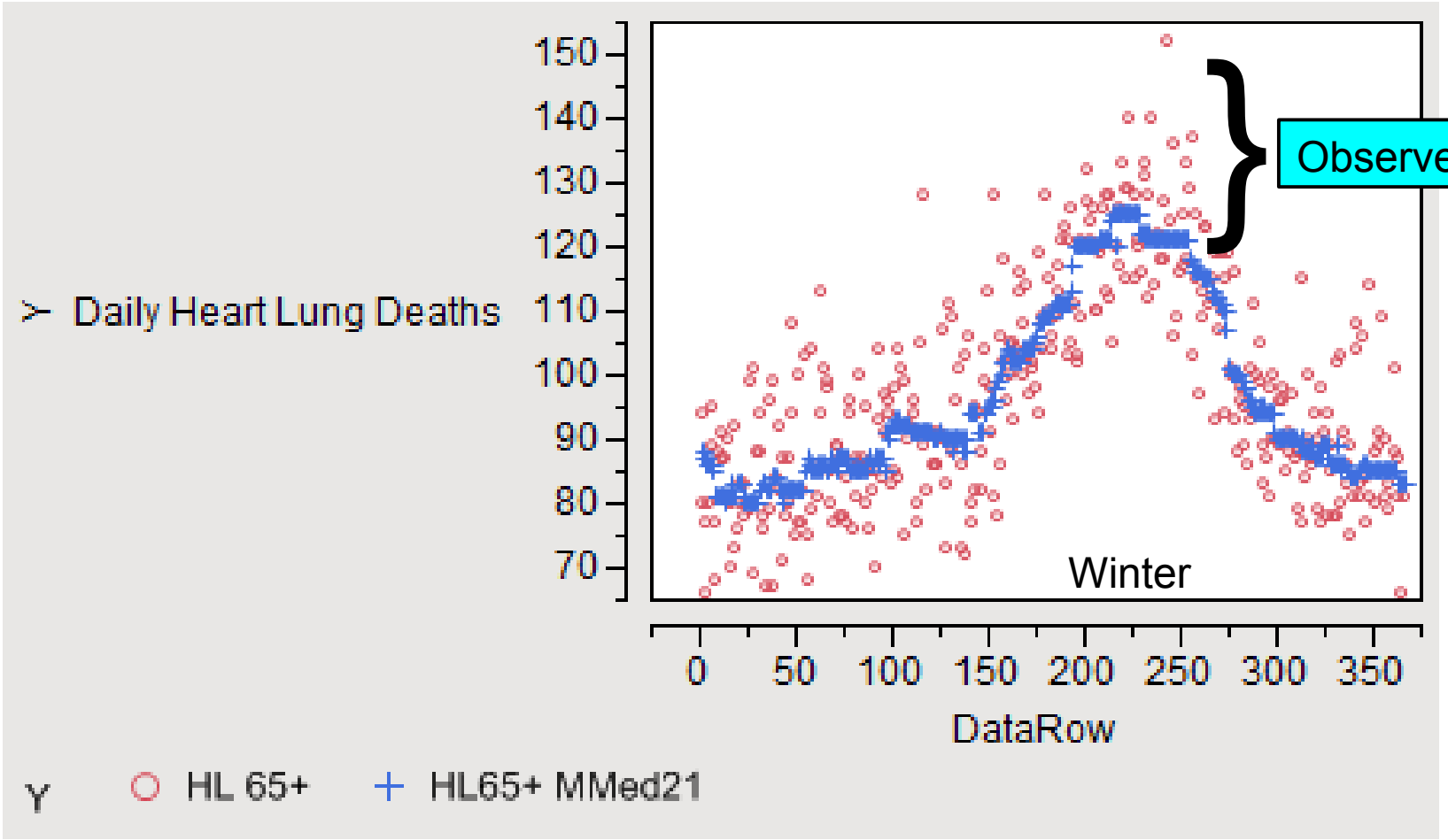


Moving 21-day medians



Compute "local effect"

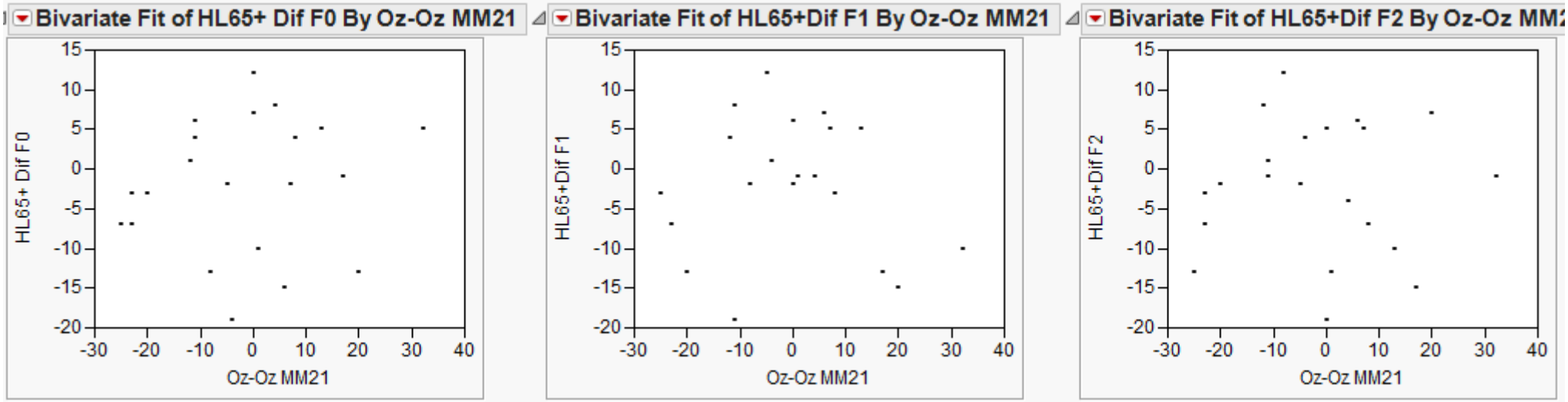
South Coast (LA), 2007-2008



For each day compute the observed value minus the 21-day moving median.

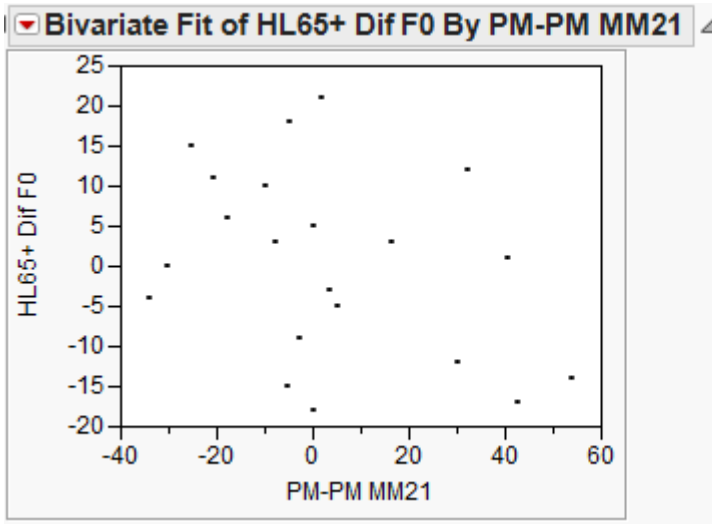
HL 65+ deaths versus Ozone

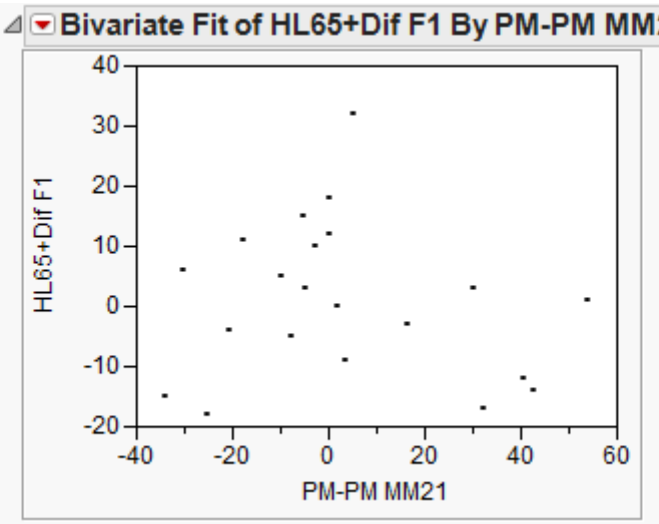
Local effect of HL 65+ deaths, lags of 0, 1, 2 days, versus local effect of ozone.

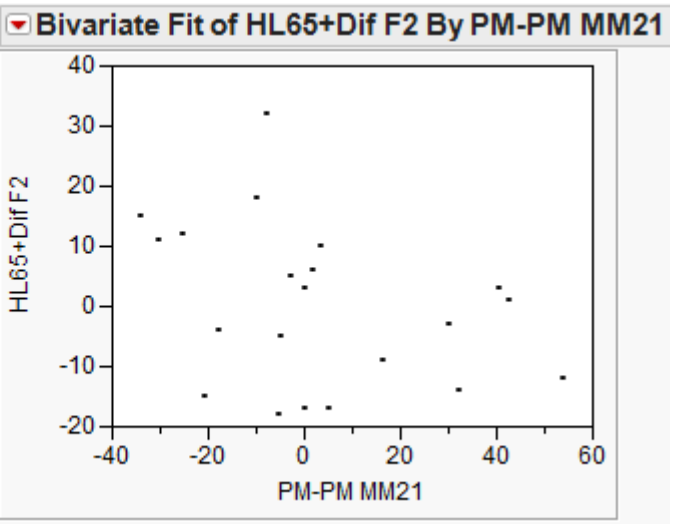


HL 65+ deaths versus PM2.5

Local effect of HL 65+ deaths, lags of 0, 1, 2 days, versus local effect of PM2.5.

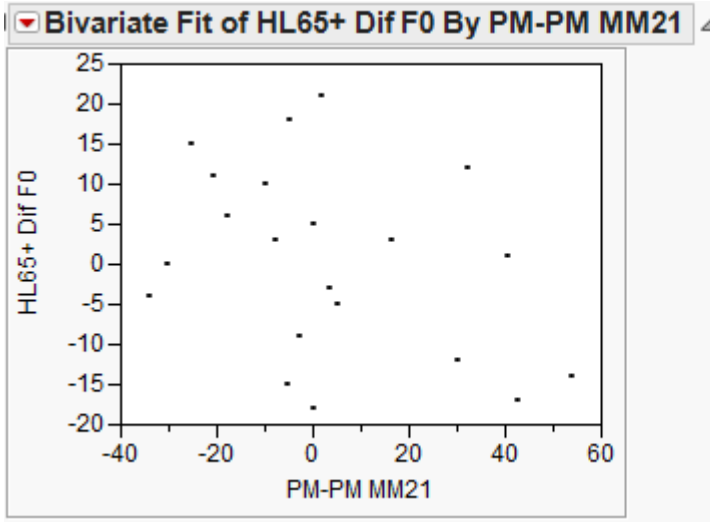


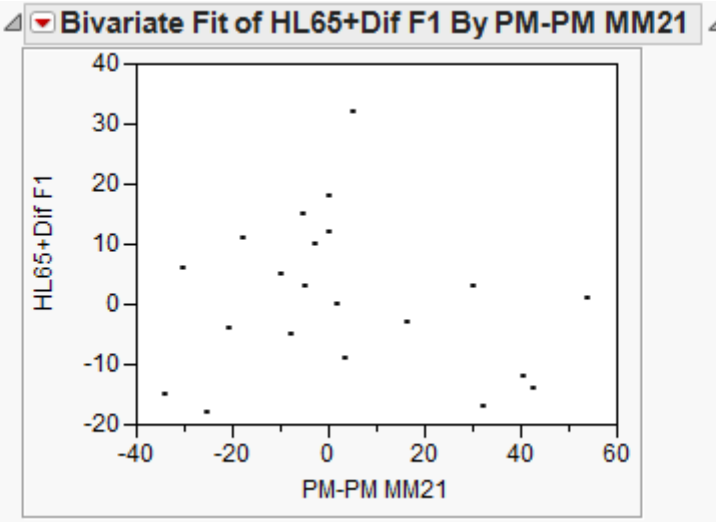


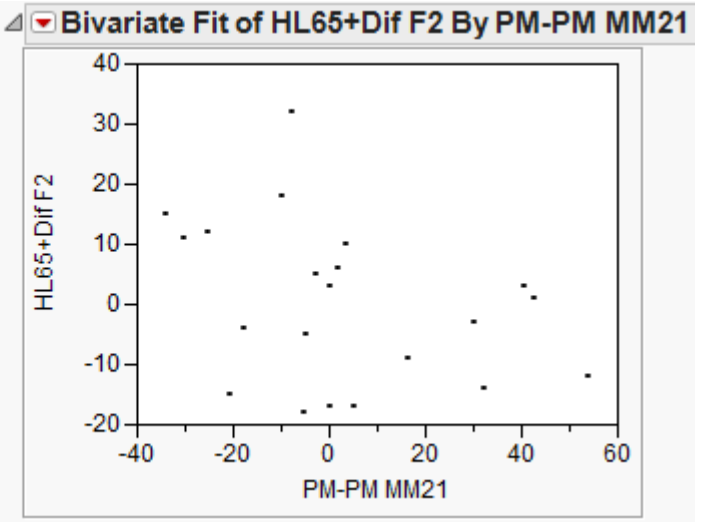


HL 65+ deaths versus PM2.5

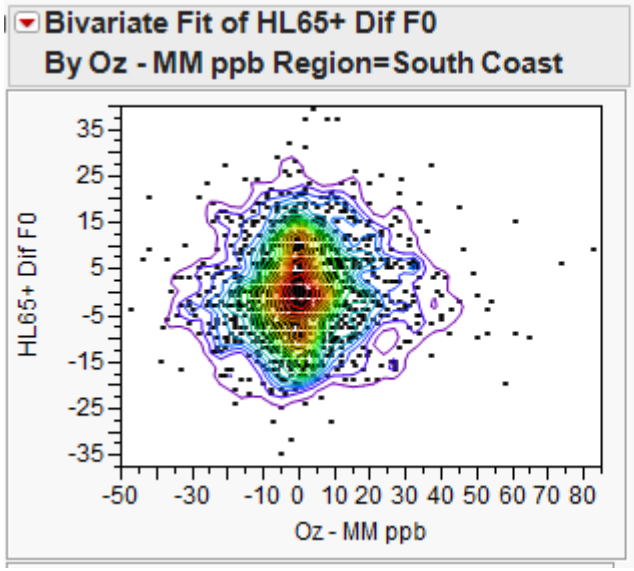
Local effect of HL 65+ deaths, lags of 0, 1, 2 days, versus local effect of PM2.5.

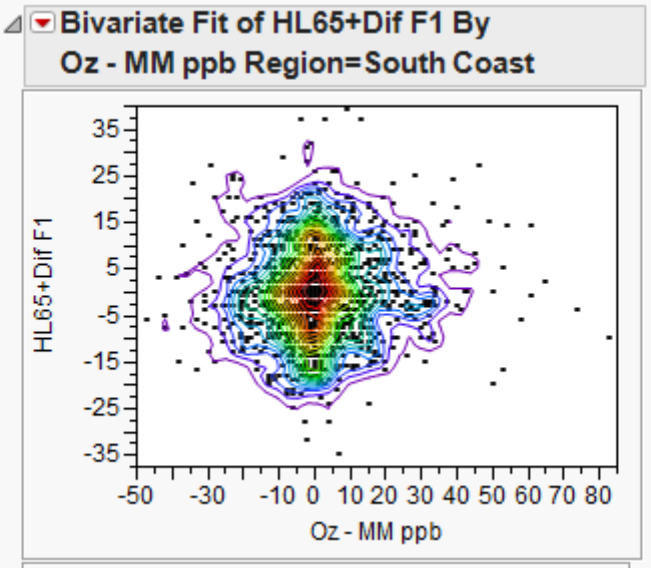


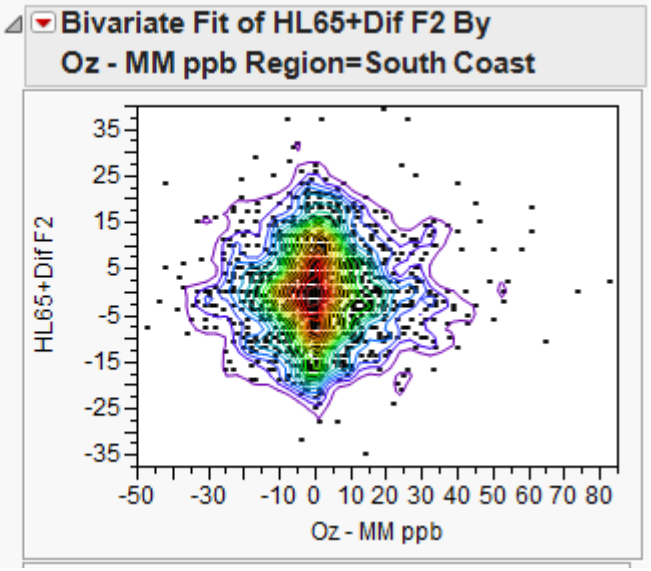




Density plots South Coast, Ozone

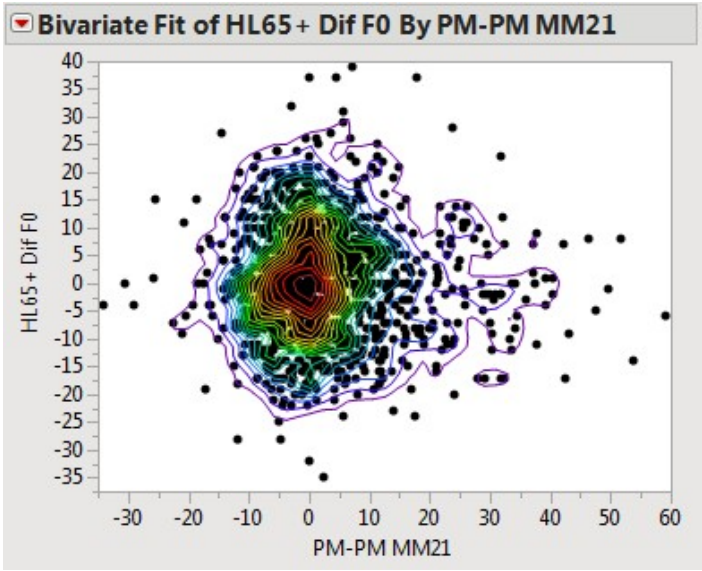


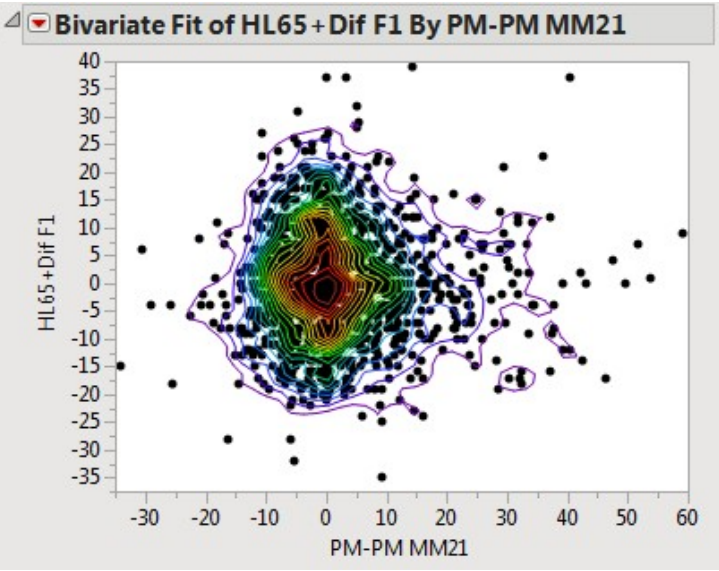


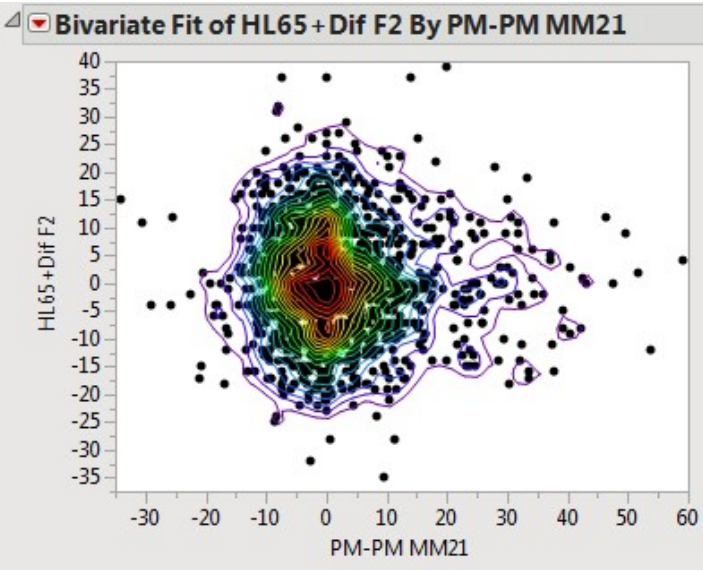


Comments
South Coast
Three lags

Density plots South Coast, PM2.5

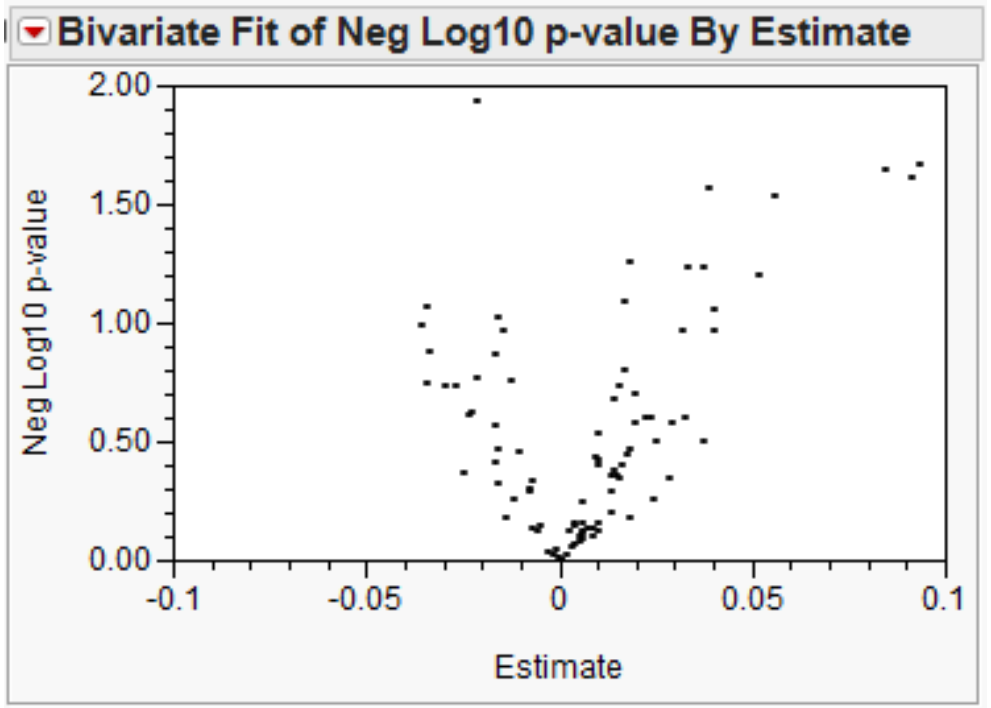


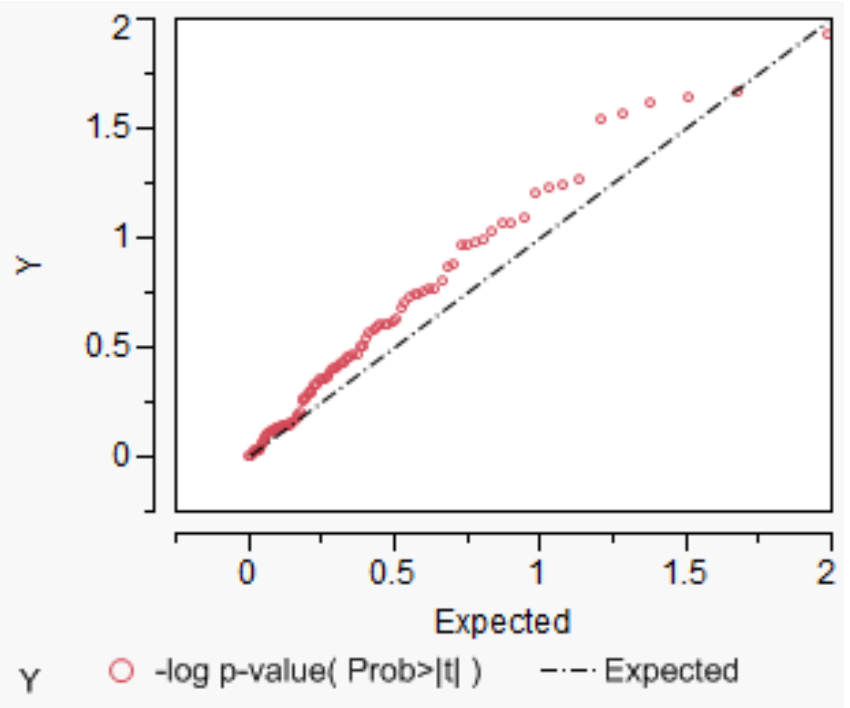




Ozone regression analysis results

1. 96 regressions were computed, local HL deaths vs local ozone.
2. Regression slope of 0 implies no effect.
3. Larger neg Log10 p-values are more significant.

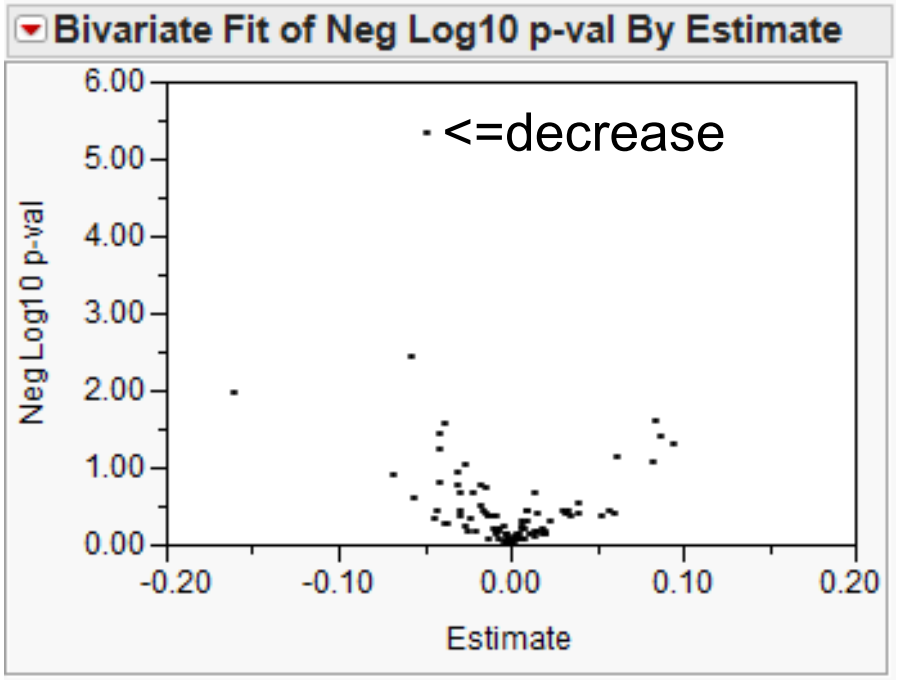


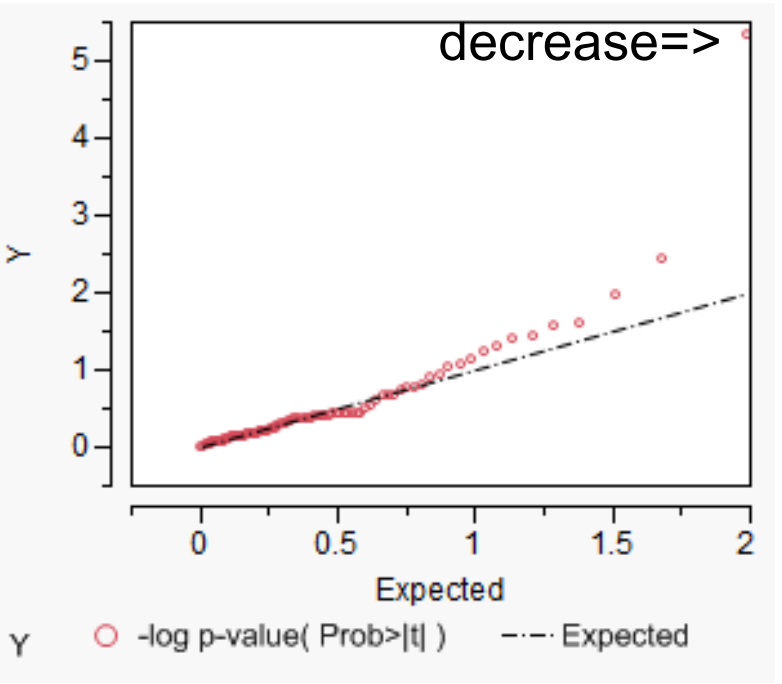


1. The regression coefficients center at 0 implying no overall effect.
2. The p-values are close to 45 degree line implying no effect.

PM2.5 regression analysis results

1. 96 regressions were computed, local HL deaths vs local ozone.
2. Regression slope of 0 implies no effect.
3. Larger neg Log10 p-values are more significant.





1. The regression coefficients center at 0 implying no overall effect.
2. The very small p-values is for a decrease in HL deaths.
3. The p-values are close to 45 degree line for most coefficients implying no effect.

Bunnies in the sky (3)

It is not the statistical test.
It is everything around the statistical test.

Table

1	Design of experiments
2	Data construction, moving from raw data to an analysis file
3	Simple data-handling mistakes
4	Multiple testing
5	Multiple modeling
6	Bias in observational studies due to imbalanced covariates
7	A p-value of <0.05 is not strong enough
8	Publication bias
9	Fraud
10	Inadequate scientific oversight
11	Perverse incentives

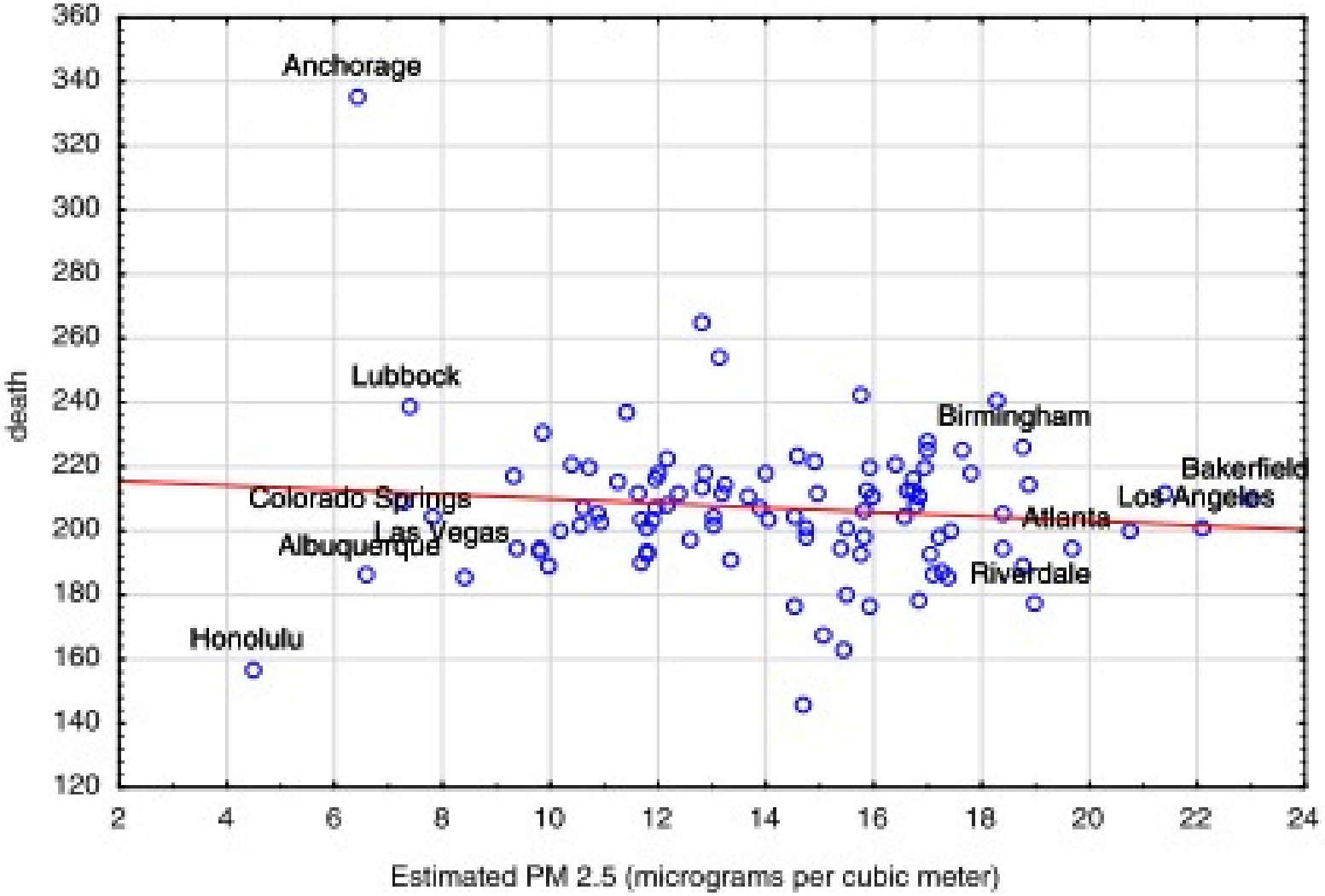
Cox “causal analysis”

Warmer is healthier: Effects on mortality rates of changes in average fine particulate matter (PM2.5) concentrations and temperatures in 100 U.S. cities

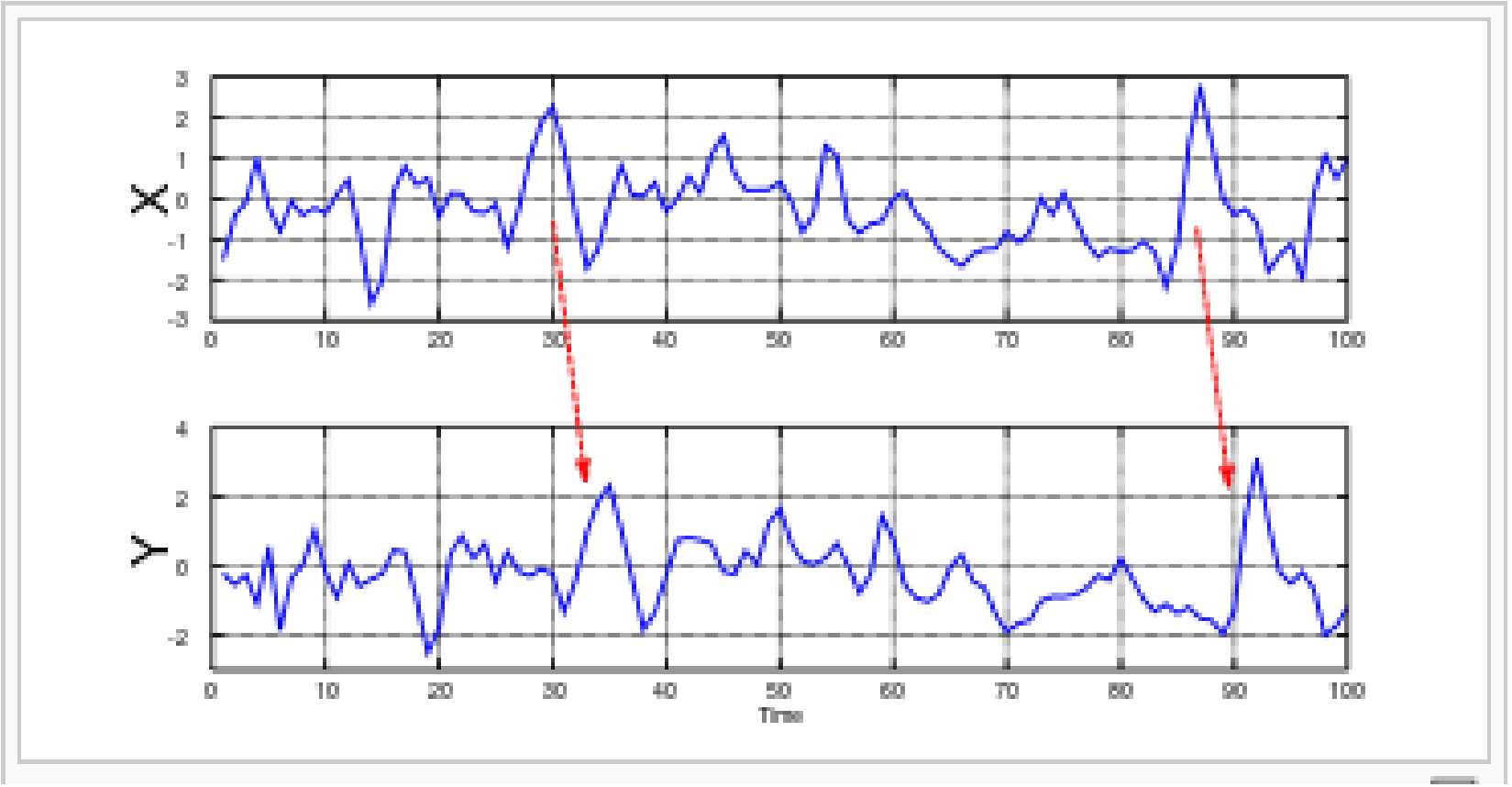
Louis A. Cox Jr., Douglas A. Popken, Paolo F. Ricci *

1. Johns Hopkins data set, NMMAPS
2. Age >75
3. Nominally 100 locations
4. Mostly 1999 vs 2000
5. Temp, min Max, PM2.5(?)
6. 8 death endpoints
7. Granger “causal” analysis

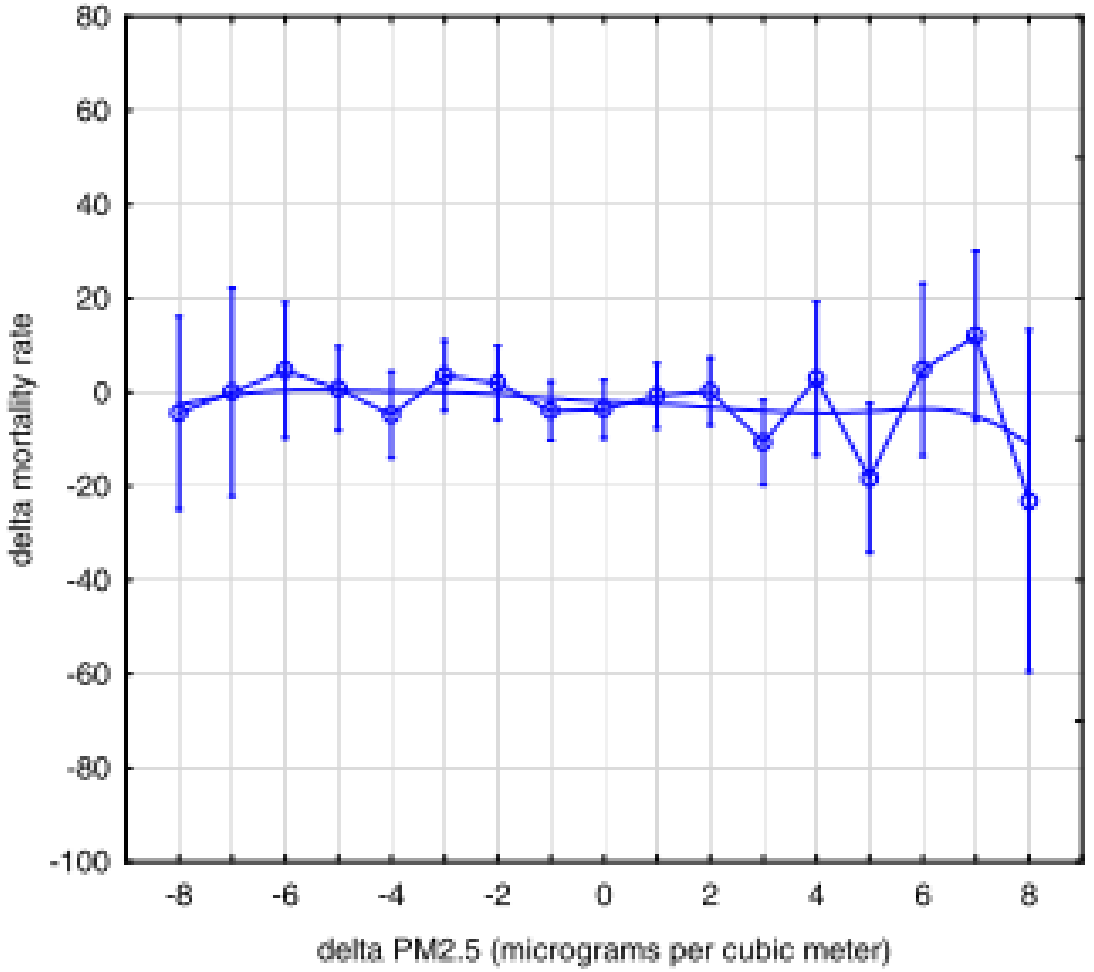
Surprise/Mystery



Granger Causality



Cox et al. Claim



"... we find no evidence that reductions in PM2.5 concentrations cause reductions in mortality rates."

Summary

1. A large California data set was assembled.
2. Natural experiments were examine.
3. Local effects for HL 65+ deaths, ozone and PM2.5 were computed.
4. Lags of 0, 1, and 2 days were examined.
5. There is no indication that ozone or PM2.5 are associated with acute deaths.

Bottom Line

Young/Milloy analysis finds no effects of ozone or PM2.5.

EPA/CARB should make data sets publicly available.

California Legislature and US Congress

should require CARB/EPA to

a. Name papers used in support of regulations

b. Make data used in papers public

What can you do?

You have “skin in the game”

as new ozone regs projected cost $270B/yr

$900/yr for every man, woman and child.

Make your own data sets public.

Support US House Bill 4012.

$PM_{2.5}$ & Total Mortality in California: RR (95% CI)

(http://www.scientificintegrityinstitute.org/ASAS092812.pdf)

McDonnell 2000 (9 air sheds)	AHSMOG	RR ~ 1.03 (0.95-1.12)	1976-1992
Krewski 2000 (4 MSAs, reported in 2010)	CA CPS II	RR = 0.87 (0.81-0.94)	1982-1989
Enstrom 2005 (11 cos & 25 cos)	CA CPS I	RR = 1.00 (0.98-1.02)	1983-2002
Zeger 2008 (CA + OR + WA)	MCAPS "West"	RR = 0.99 (0.97-1.01)	2000-2005
Krewski 2010 (4 MSAs)	CA CPS II	RR = 0.96 (0.92-1.00)	1982-2000
Jerrett 2010-11 (Nine Model Average)	CA CPS II	RR = 1.00 (0.99-1.01)	1982-2000
Lipsett 2011	CA Teachers	RR = 1.01 (0.95-1.09)	2000-2005
Jerrett 2013 (Conurbation LUR Model Only)	CA CPS II	RR = 1.06 (1.00-1.12)	1982-2000
Enstrom Unp	CA NIH AARP	RR ~ 1.03 (1.00-1.06)	1997-2010

Air Pollution Epidemiology Issues Relevant to USC Preventive Medicine

1) Examine 2000, 2005, 2009, 2013 Papers of former USC PM Prof Michael Jerrett re PM2.5 & Total Mortality in CA

2) Ask ACS Alpa Patel (USC Epi Ph.D.) About ACS CPS II Confidentiality & Analysis of 1992 CPS II Nutrition Cohort

3) Ask USC PM Chair Jonathan Samet About Zeger 2008 & New EPA Ozone NAAQS Based on Jerrett 2009 (CPS II)

4) Follow "Secret Science Reform Act" (H.R. 4012) re Reform of EPA Regulations & "Secret Science" Data Use

5) Follow CARB & SCAQMD Regulations That are Based on EPA "Secret Science" and Not on Actual Evidence in CA