

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 PM<sub>2.5</sub> 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 PM<sub>2.5</sub> 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 PM<sub>2.5</sub> or ozone on acute deaths. We concluded that there is no evidence of an increase in acute deaths due to PM<sub>2.5</sub> or ozone in Southern California for the years 2007-2010.

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

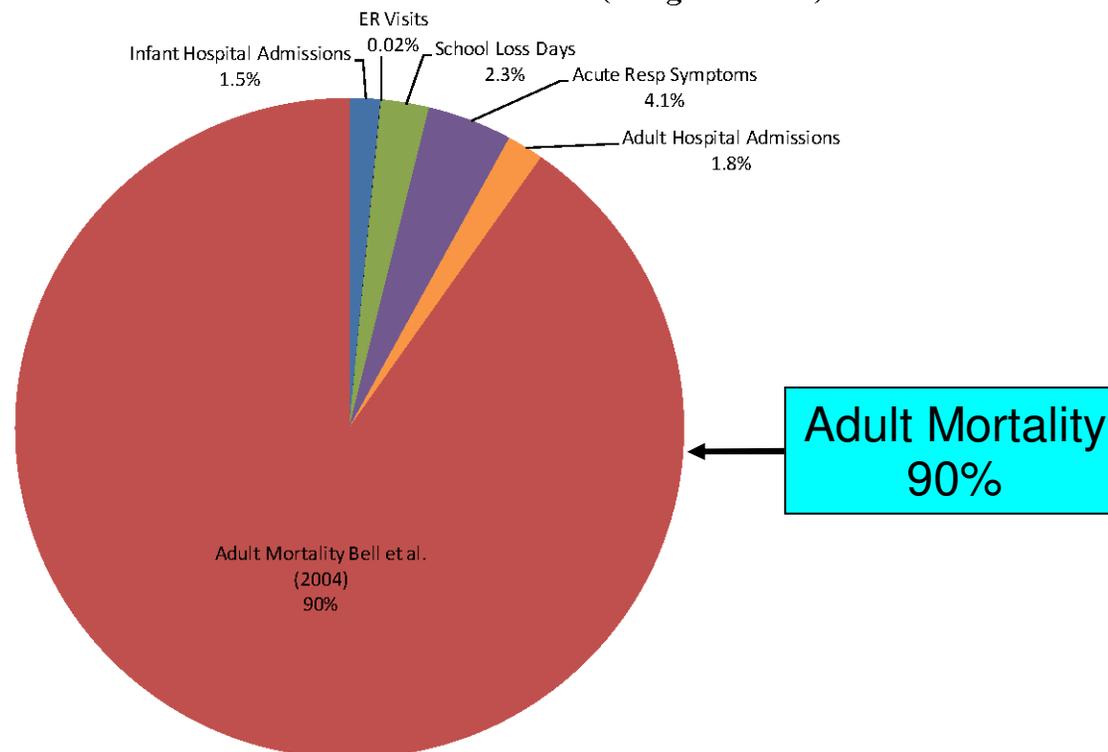
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# Mortality Claim Vital to EPA/CARB

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

Figure S2-1: Breakdown of Ozone Health Benefits (using Bell 2004)\*



# Secret Science

1. EPA has refused to provide health data used in air quality studies since 1994 (trust me science)
2. Efforts to criticize methodology have failed
3. Problem solved in 2013 by obtaining California death certificate data
  - a. All deaths 1998-2010 (2007-2010 analyzed)
  - b. Age at death, cause of death, zip code at death

# California Data Is the Best Data

1. Most current – even 2011 is available
2. No cherry picking – all deaths from entire state with the ‘worst’ air in U.S.
3. 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?

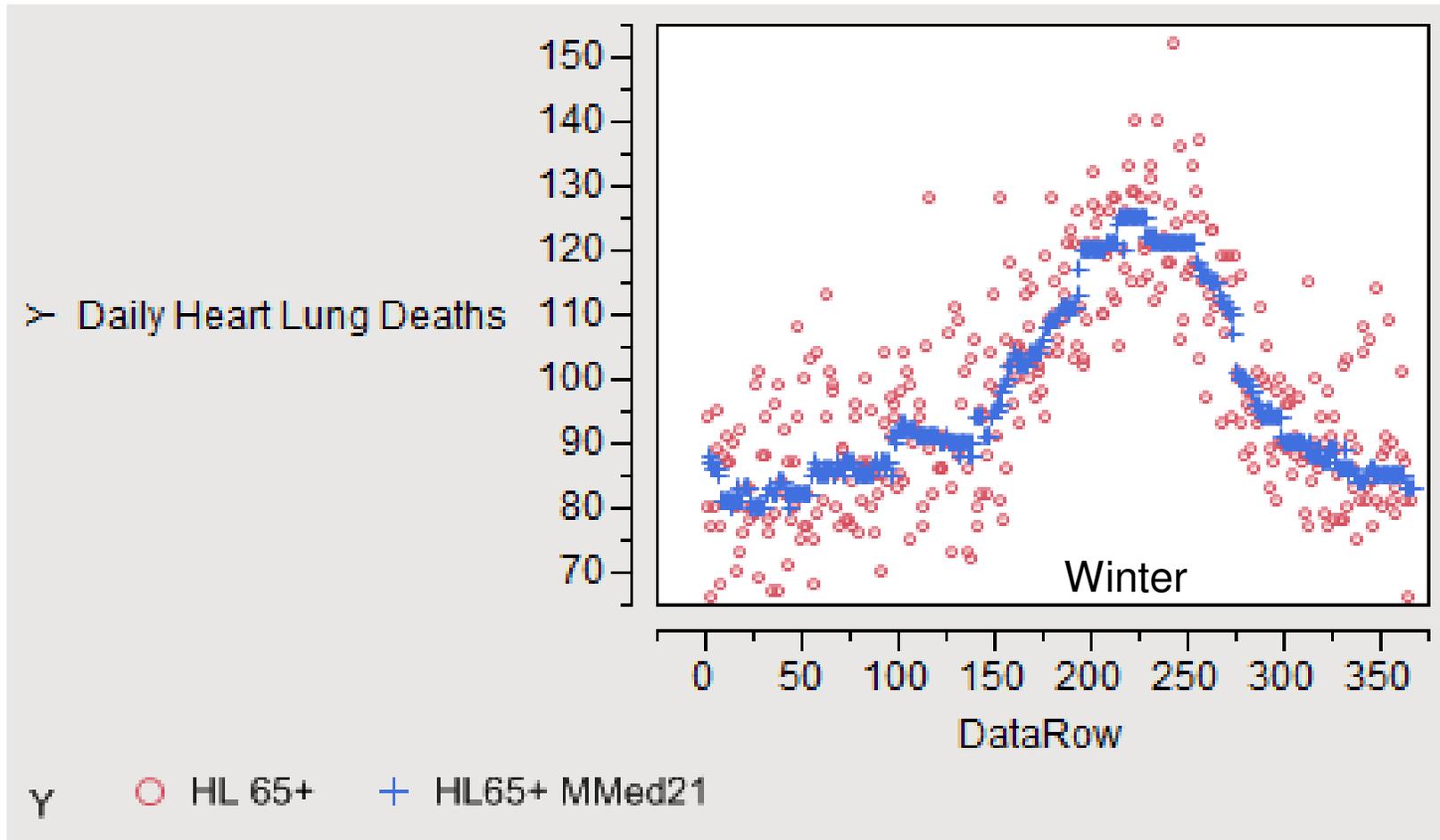
Data: Mortality for eight air basins in California  
Heart/Lung for 65 and older  
Years, 2007-2010

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

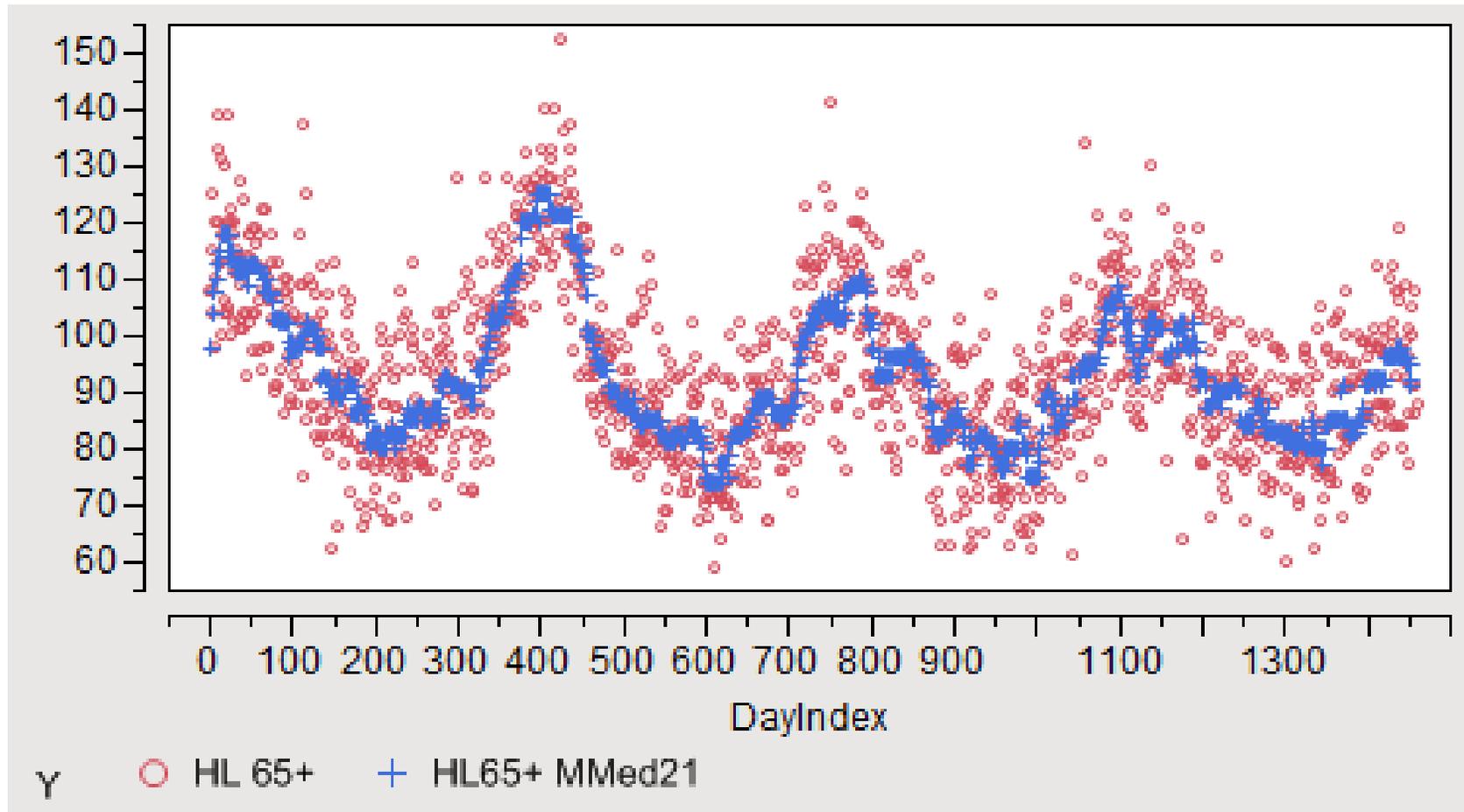
# Moving Median

1. Median:  $\frac{1}{2}$  values below and  $\frac{1}{2}$  values above.
2. 21-day moving median for time series.
  - a. Take 21 consecutive values and compute median.
  - b. Remove 1<sup>st</sup> value and add 1 value at end.
  - c. Compute new median.
3. The moving 21-day median tracks the time series.

# South Coast (LA), 2007-2008



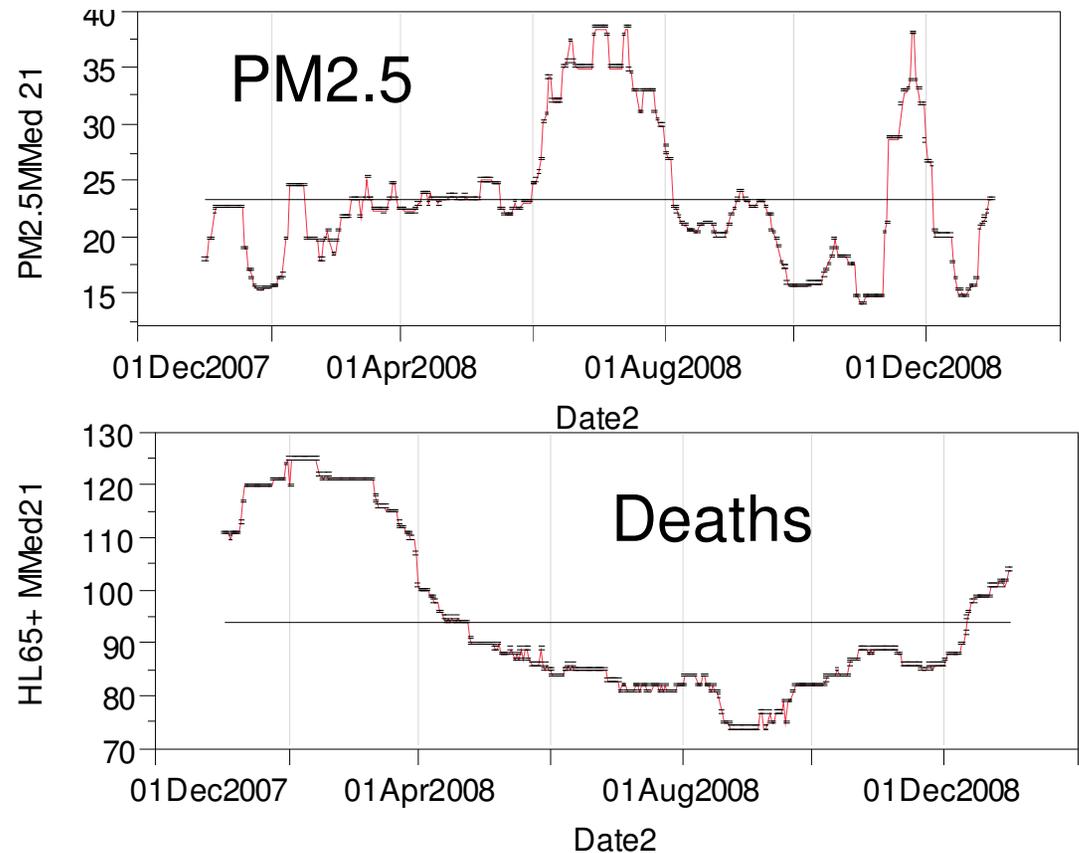
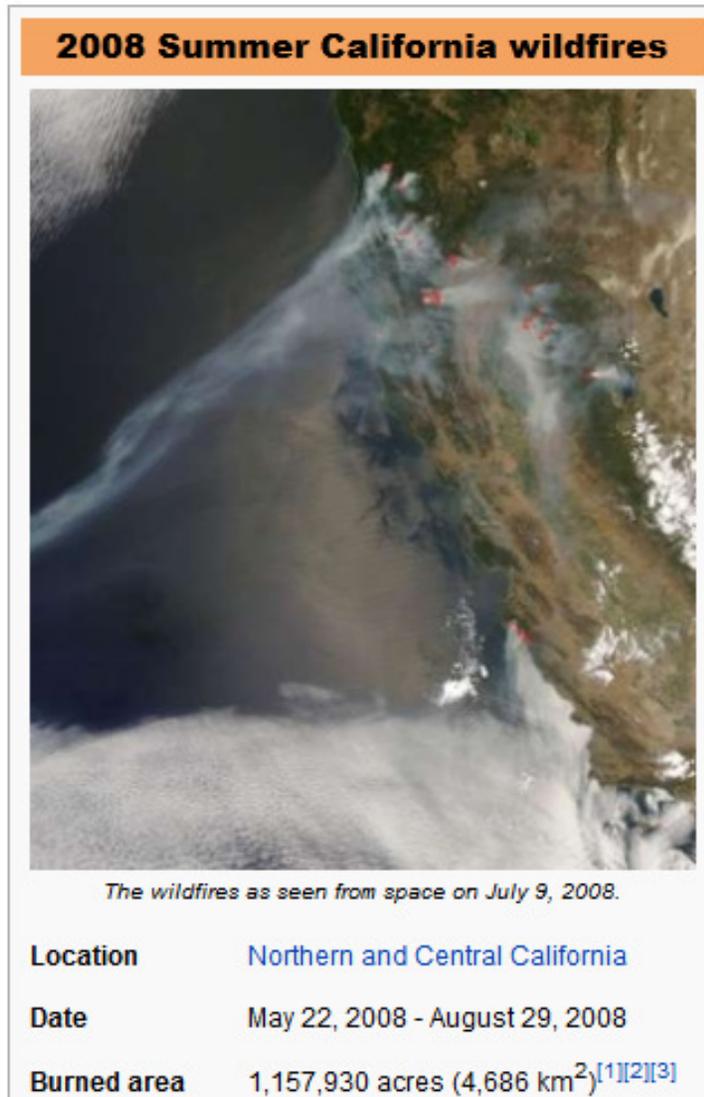
# South Coast Deaths, 4 years



# Natural Experiments

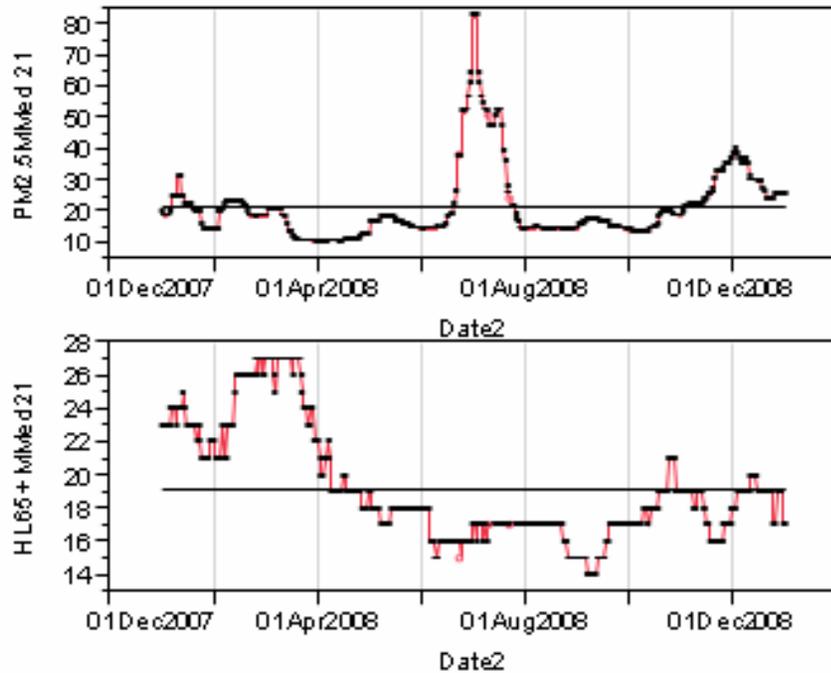
## Wildfires

## South Coast, 2008

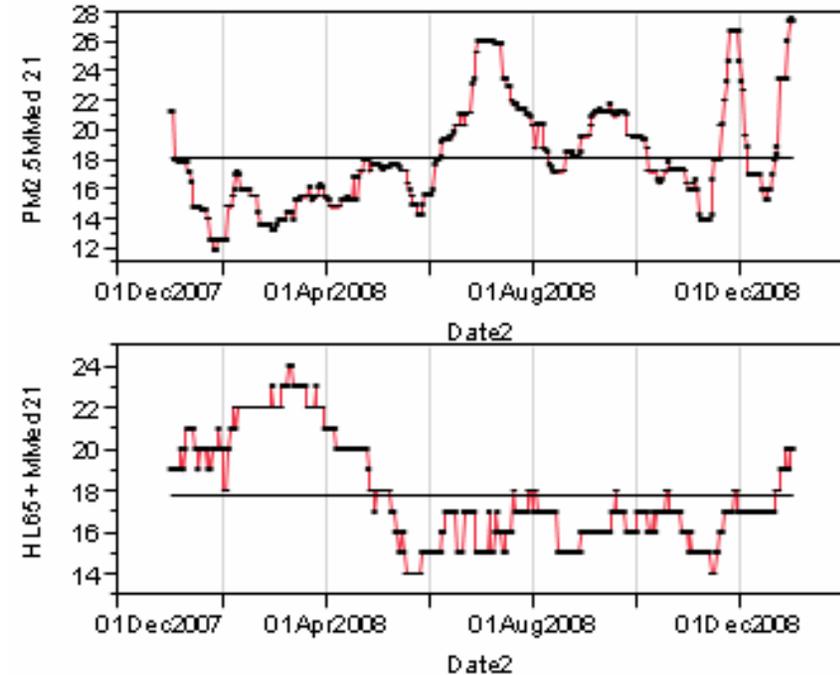


# Natural Experiments (2)

## Sacramento Valley



## San Diego County

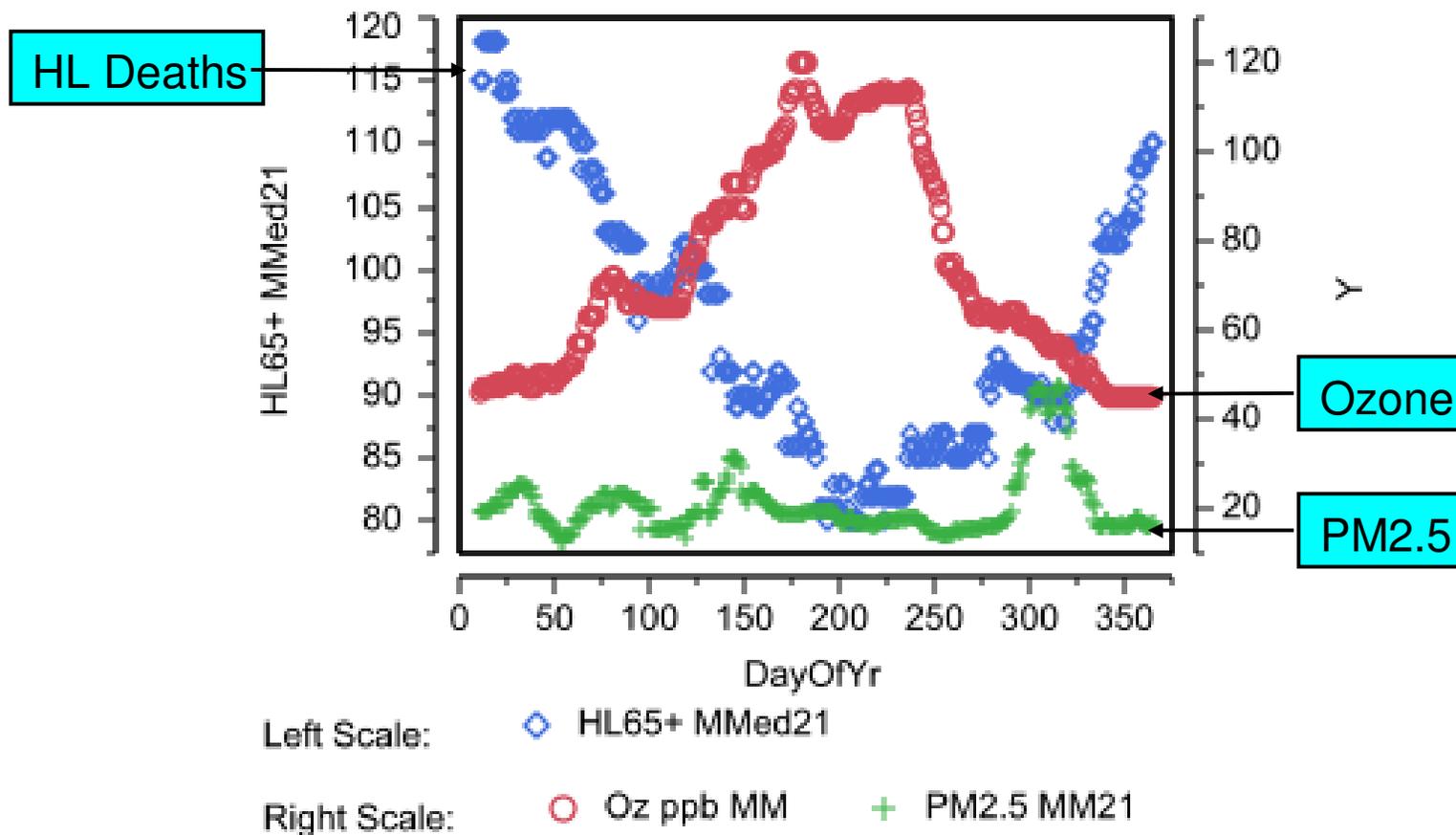


Similar lack of effect for all 8 air basins.

# Moving 21-day medians

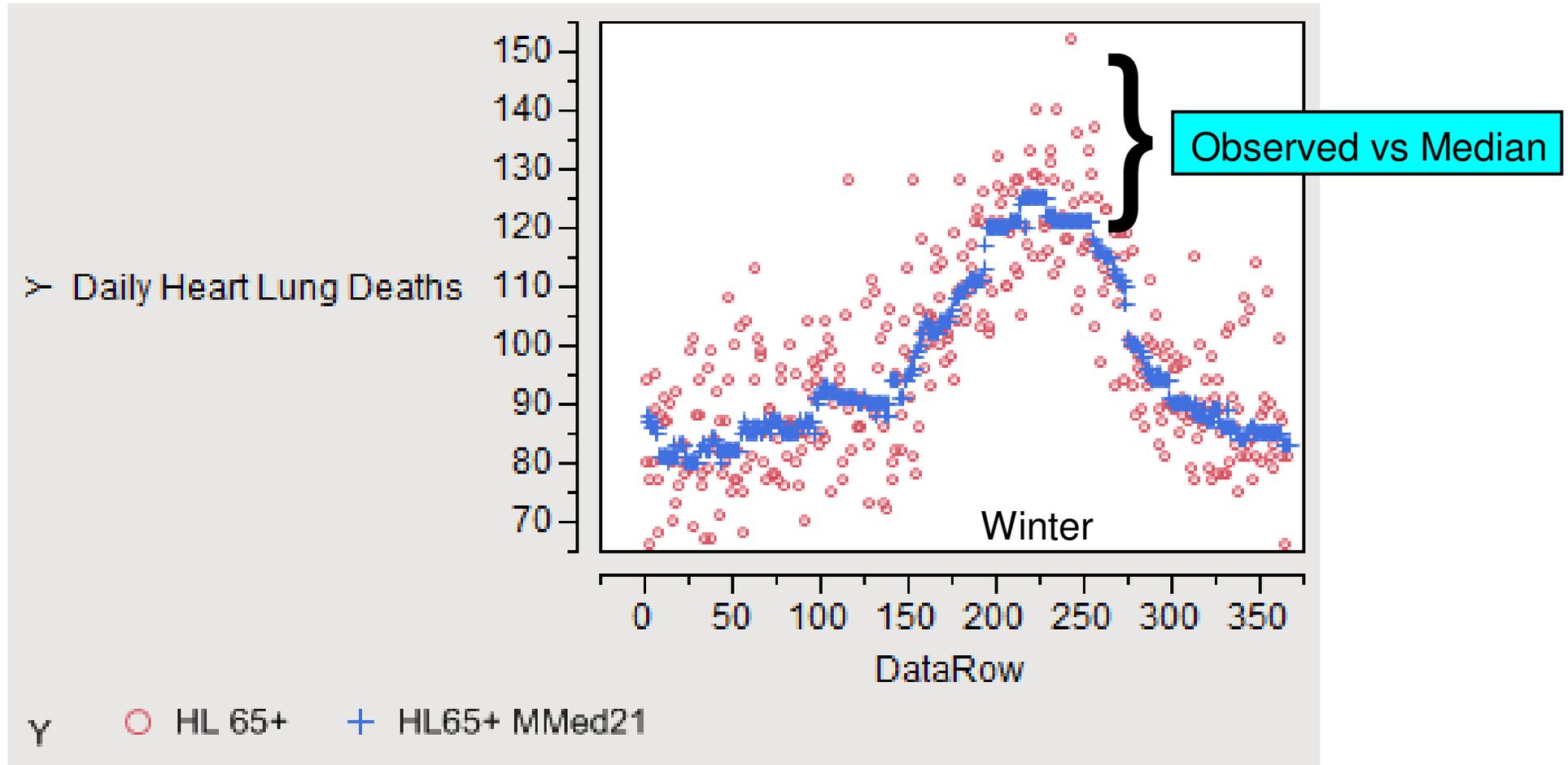
00b South Coast 2001 - 2010 data set - Overlay Plot

Overlay Plot Yr=2007



# Compute "local effect"

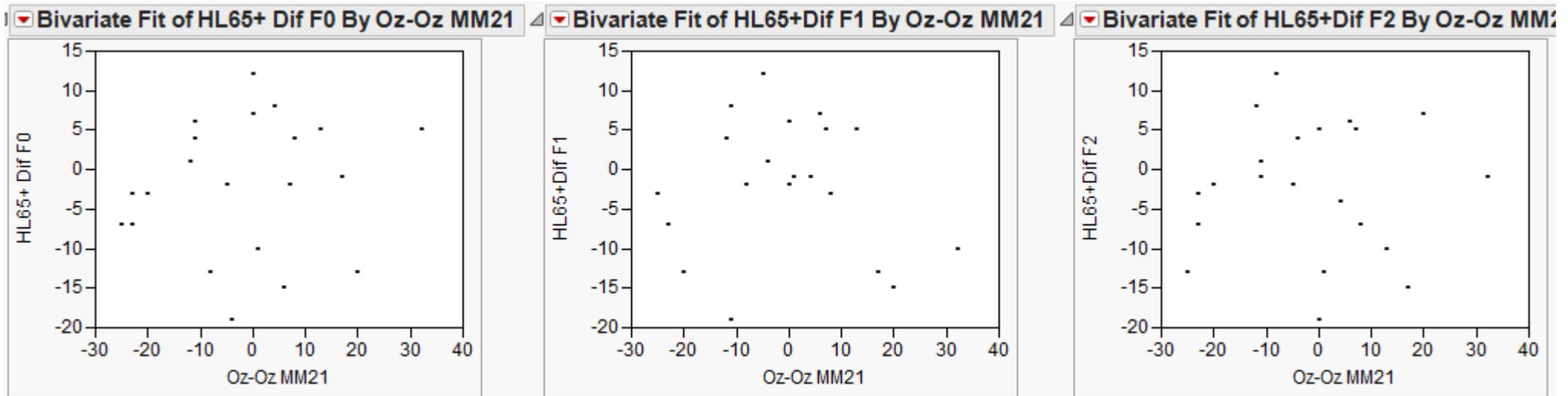
## South Coast (LA), 2007-2008



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

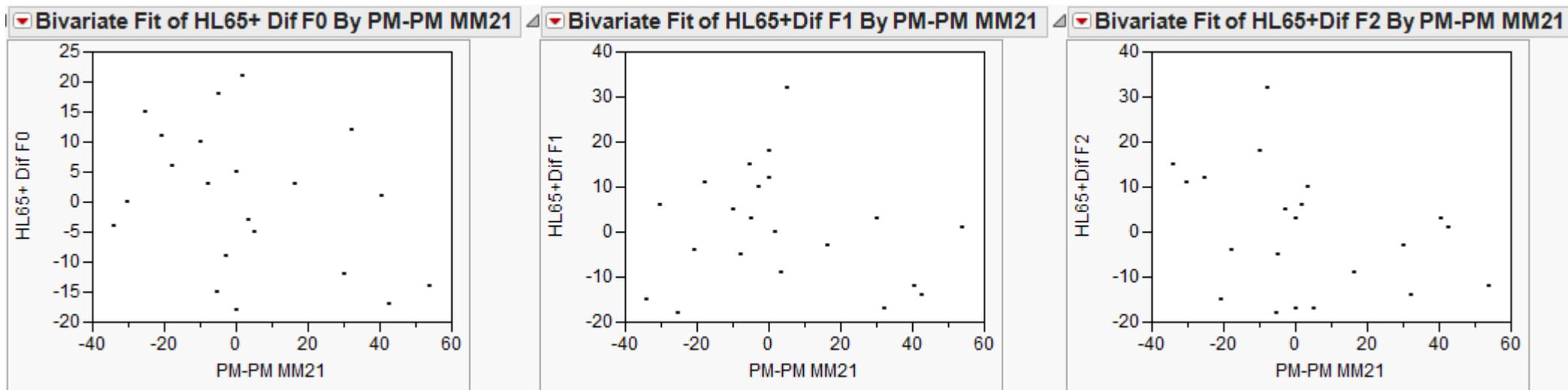
# HL 65+ deaths versus Ozone

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



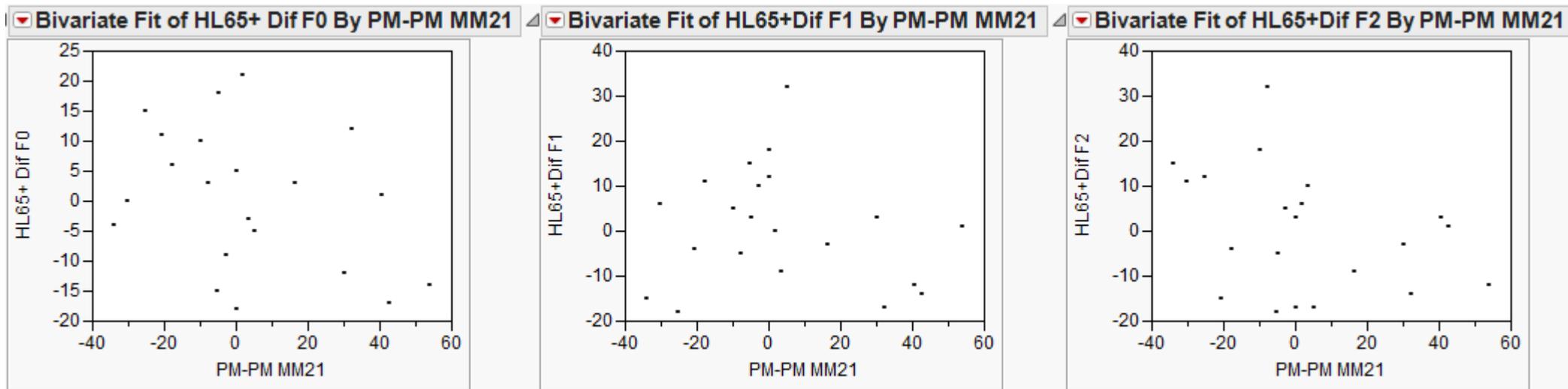
# HL 65+ deaths versus PM2.5

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

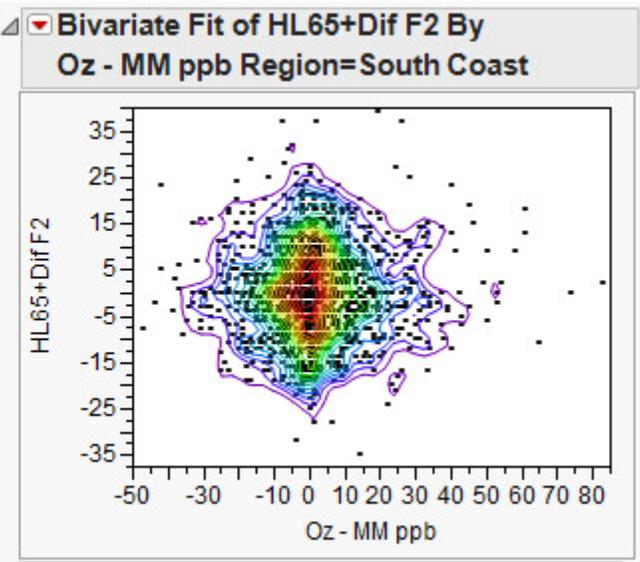
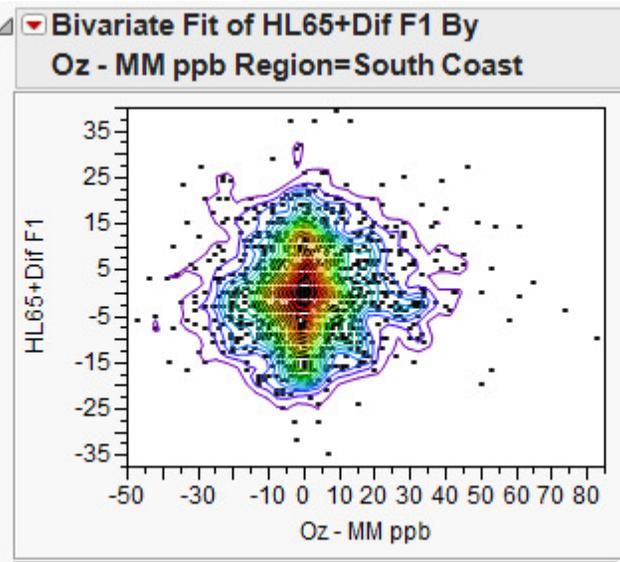
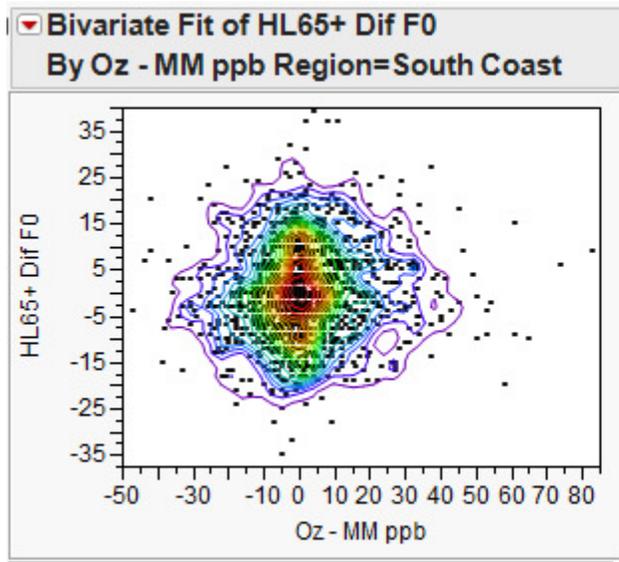


# HL 65+ deaths versus PM2.5

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



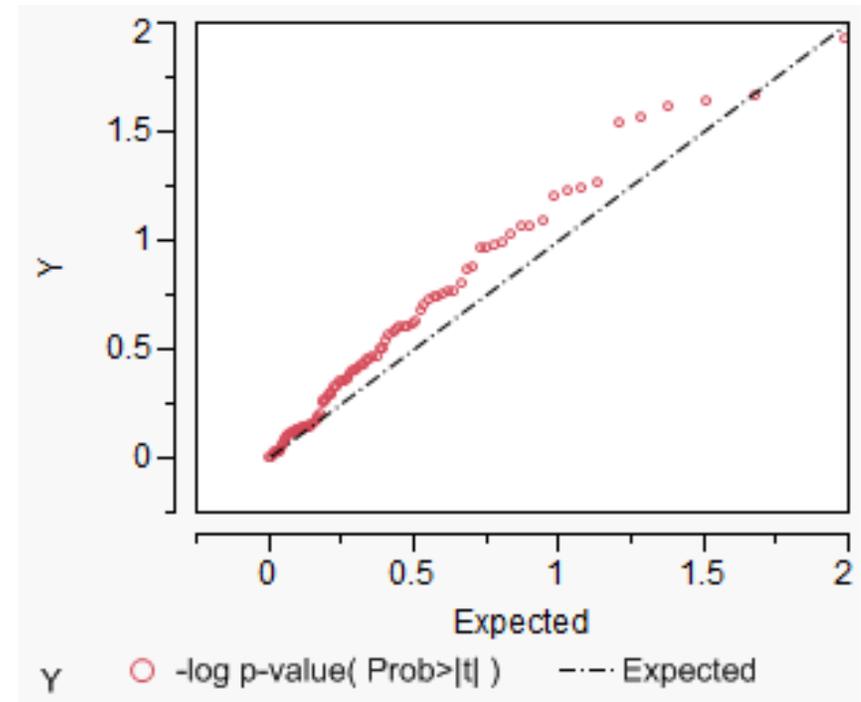
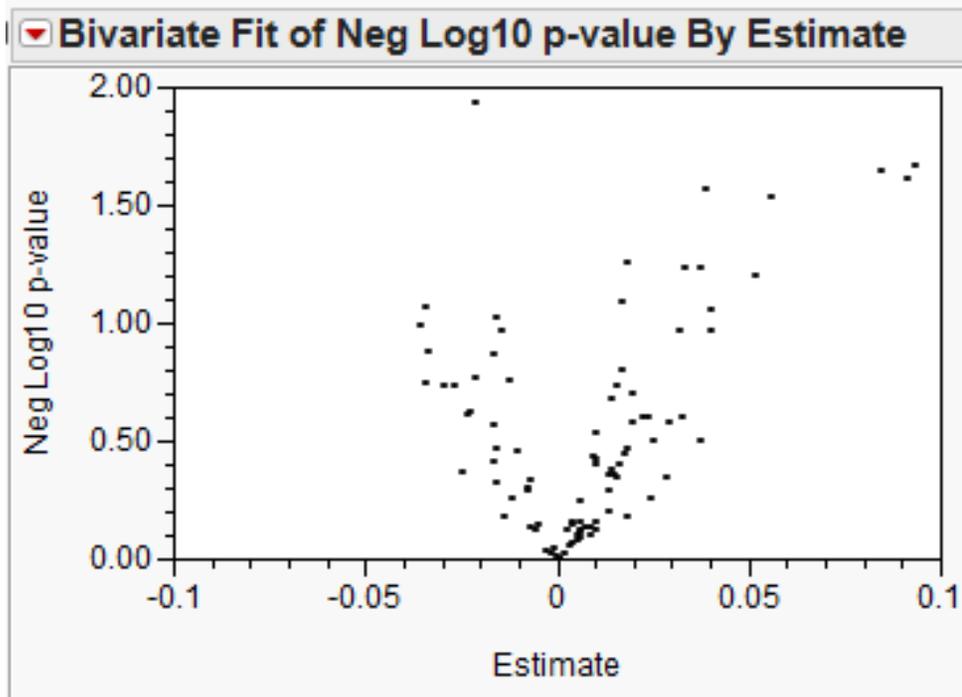
# Density plots South Coast



Comments  
South Coast  
Three lags

# Ozone regression analysis results

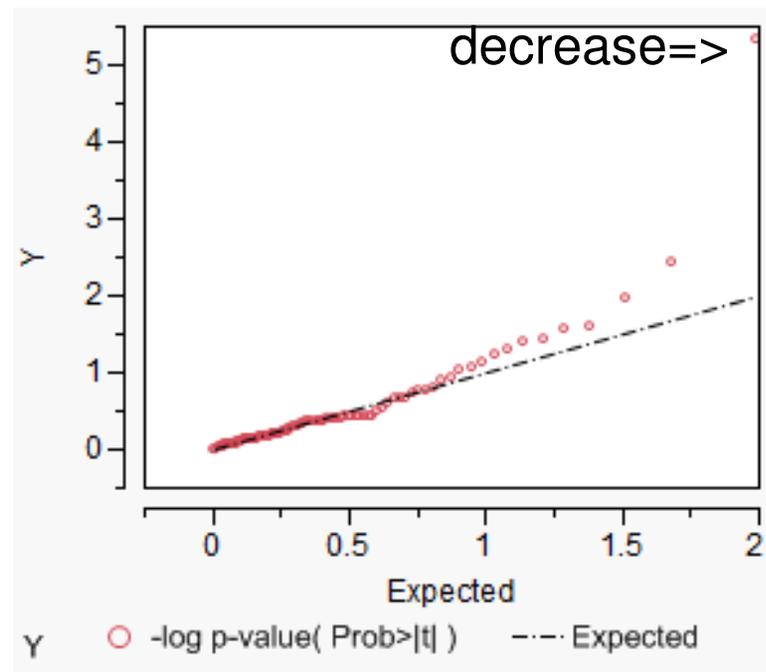
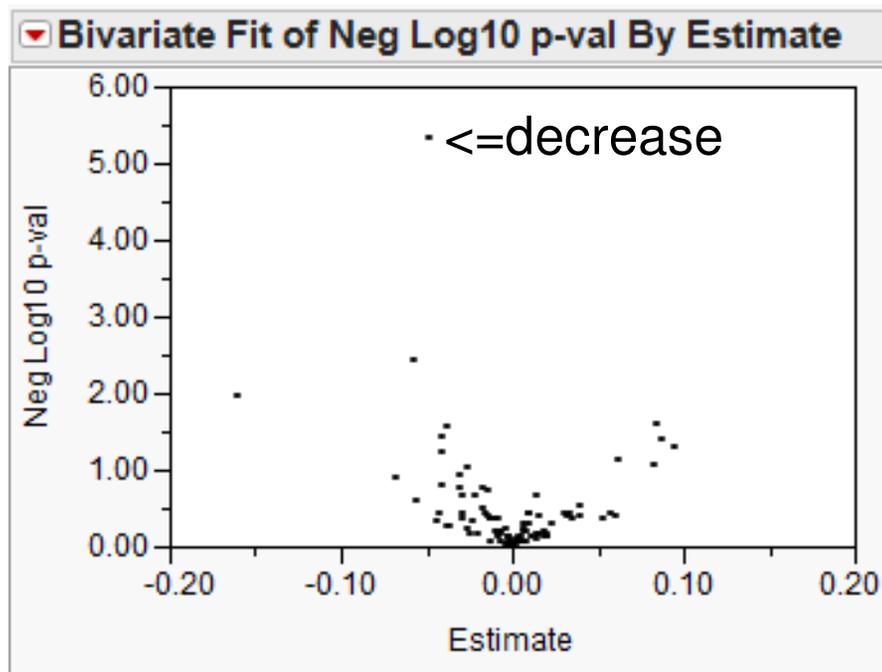
1. 96 regressions were computed, local HL deaths vs local ozone.
2. Regression slope of 0 implies no effect.
3. Larger neg Log10 p-values are more significant.



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.

# Summary

- A large California data set was assembled
- Natural experiments were examine.
- Local effects for HL 65+ deaths, ozone and PM2.5 were computed.
- Lags of 0, 1, and 2 days were examined.
- 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 should require CARB to

- a. Name papers used in support of legislation
- b. Make data used in papers public