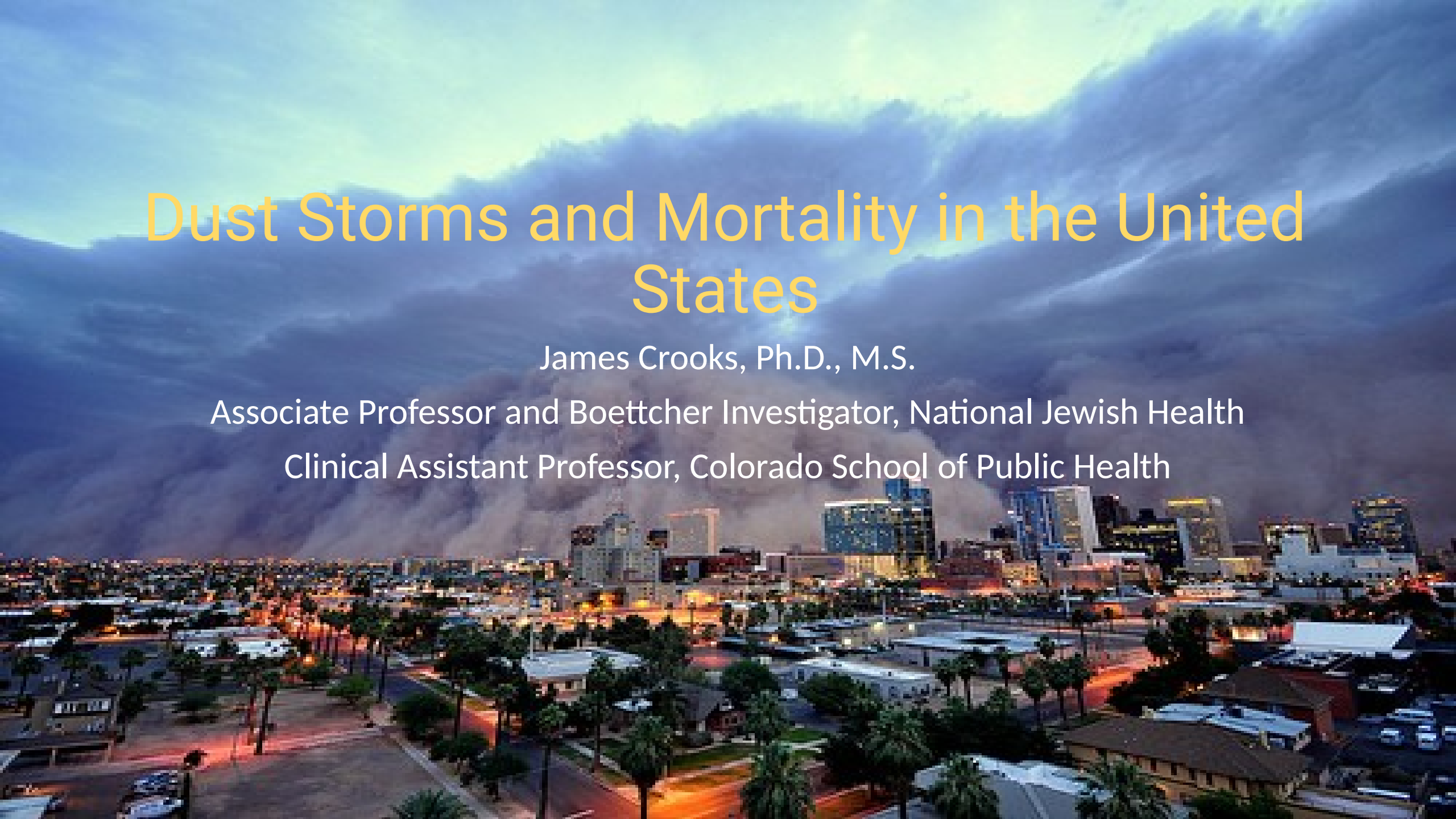

Dust Storms and Mortality in the United States

James Crooks, Ph.D., M.S.

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“The Association between Dust Storms and Daily Non-Accidental Mortality in the United States, 1993-2005”

Crooks, Cascio, Percy, Reyes, Neas, and Hilborn

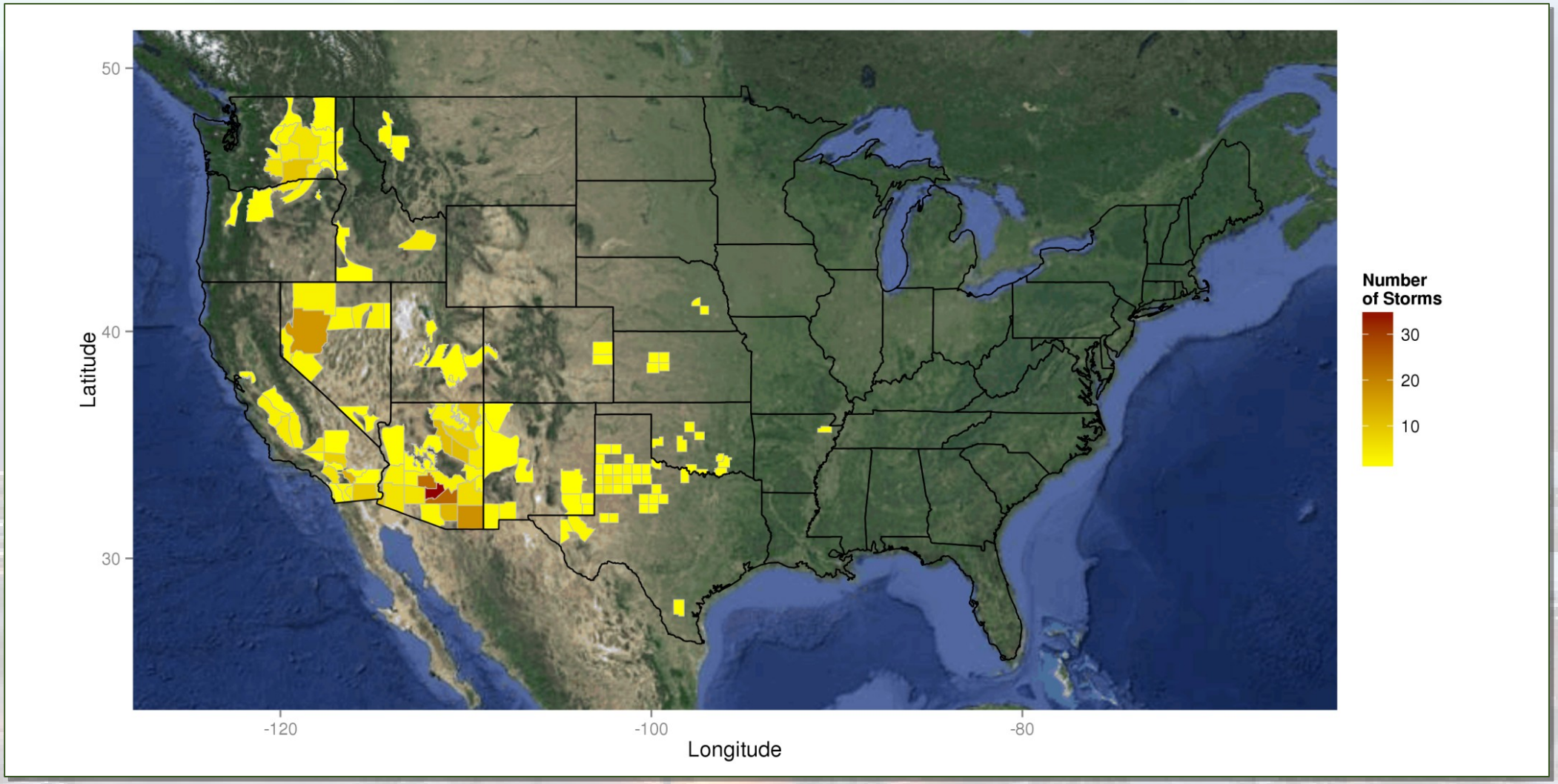
Environmental Health Perspectives 124(11) 2016.

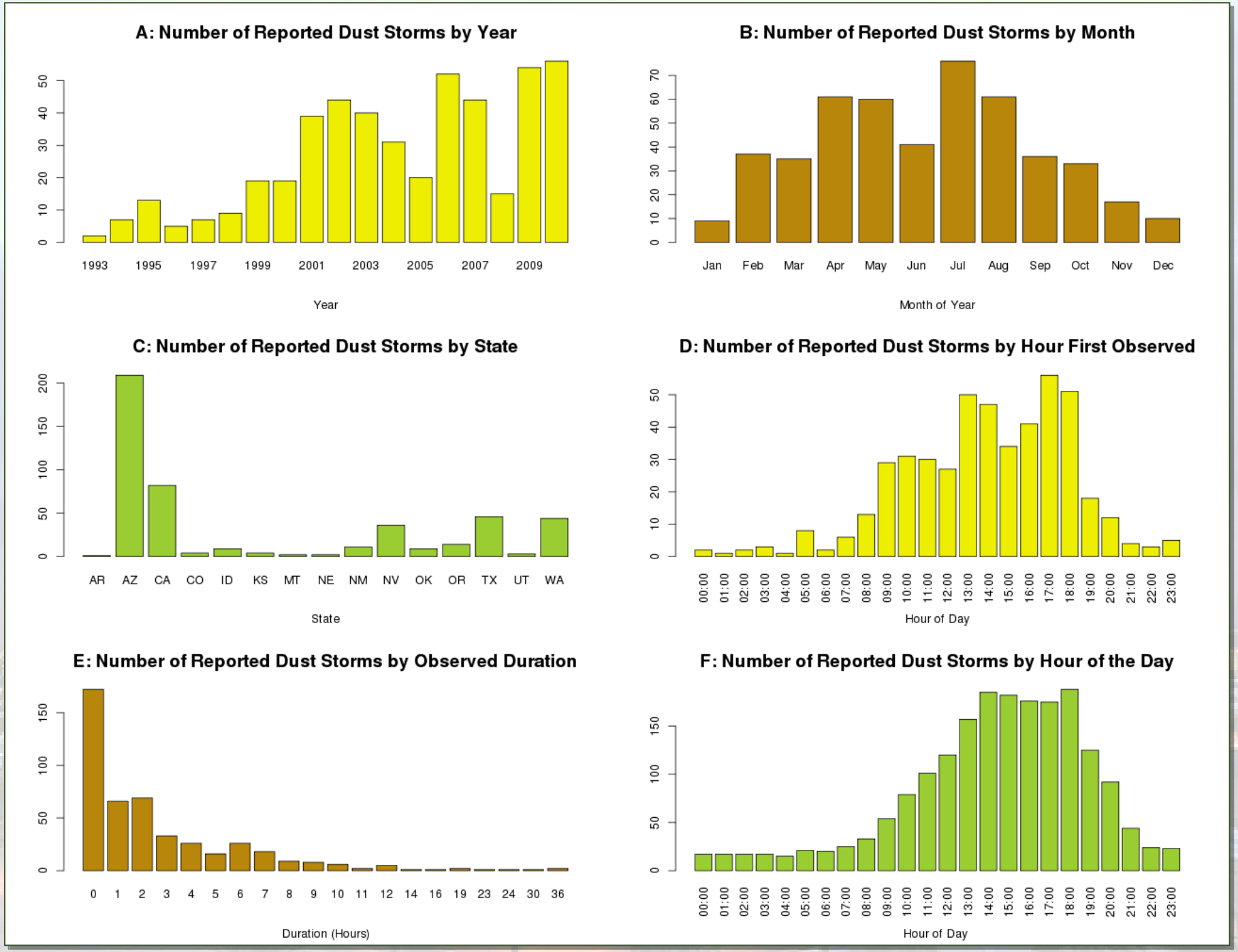
Funding: U.S. EPA Office of Research and Development Air, Climate, and Energy Program (intramural)

Dust Storm Exposure Data

- The U.S. National Weather Service (NWS) maintains a public database of storm events reported by NWS observers, emergency personnel, media reports, and the public, going back to the 1940s.
- We extracted all storm events in the NWS storm database with the words “dust” or "sand" in the event category. Dust and sand storm categories were added in 1993.
- We dropped two Sahara dust incursions to focus on the health impacts of storm events themselves rather than long-range transport of storm dust.
- We dropped two dust storms occurring east of the Mississippi River in order to focus on desert dust.
- This procedure yielded 378 storms between 1993 and 2010, or 209 storms between 1993 and 2005.

Dust Storms by Forecast Zone, 1993-2010




A: Number of Reported Dust Storms by Year
0 10 20 30 40 50
1993 1995 1997 1999 2001 2003 2005 2007 2009
Year
B: Number of Reported Dust Storms by Month
0 10 20 30 40 50 60 70
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Month of Year
C: Number of Reported Dust Storms by State
0 50 100 150 200
AR AZ CA CO ID KS MT NE NM NV OK OR TX UT WA
State
D: Number of Reported Dust Storms by Hour First Observed
0 10 20 30 40 50
00:00 01:00 02:00 03:00 04:00 05:00 06:00 07:00 08:00 09:00 10:00 11:00 12:00 13:00 14:00 15:00 16:00 17:00 18:00 19:00 20:00 21:00 22:00 23:00
Hour of Day
E: Number of Reported Dust Storms by Observed Duration
0 50 100 150
0 1 2 3 4 5 6 7 8 9 10 11 12 14 16 19 23 24 30 36
Duration (Hours)
F: Number of Reported Dust Storms by Hour of the Day
0 50 100 150
00:00 01:00 02:00 03:00 04:00 05:00 06:00 07:00 08:00 09:00 10:00 11:00 12:00 13:00 14:00 15:00 16:00 17:00 18:00 19:00 20:00 21:00 22:00 23:00
Hour of Day

Associations between Individual Monitor PM_{10} 24-hr Concentrations and Dust Storms

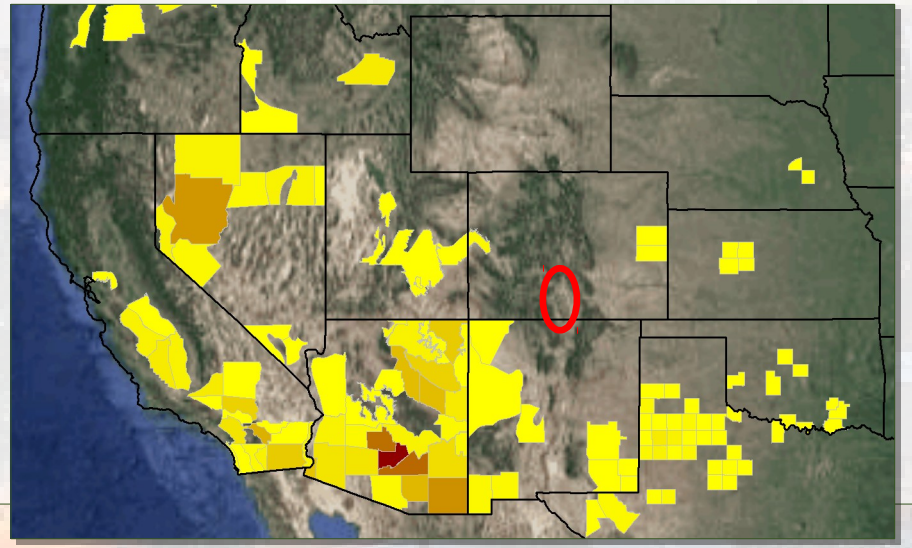
Location	Rural Only?	Coefficient (μg/m³)	CI: 2.5%	CI: 97.5%	p-value
All U.S.	No	77.6	59.8	95.4	$<10^{-16}$
	Yes	75.8	35.3	116.3	0.0003
Arizona	No	74.8	54.8	94.7	$<10^{-16}$
	Yes	70.5	19.8	121.2	0.0067
California	No	82.5	53.2	111.8	$<10^{-16}$
	Yes	130.1	25.3	234.8	0.0169

Recall that the current U.S. EPA PM_{10} standard is 150 μg/m³, to be exceeded no more than three times in any three year period.

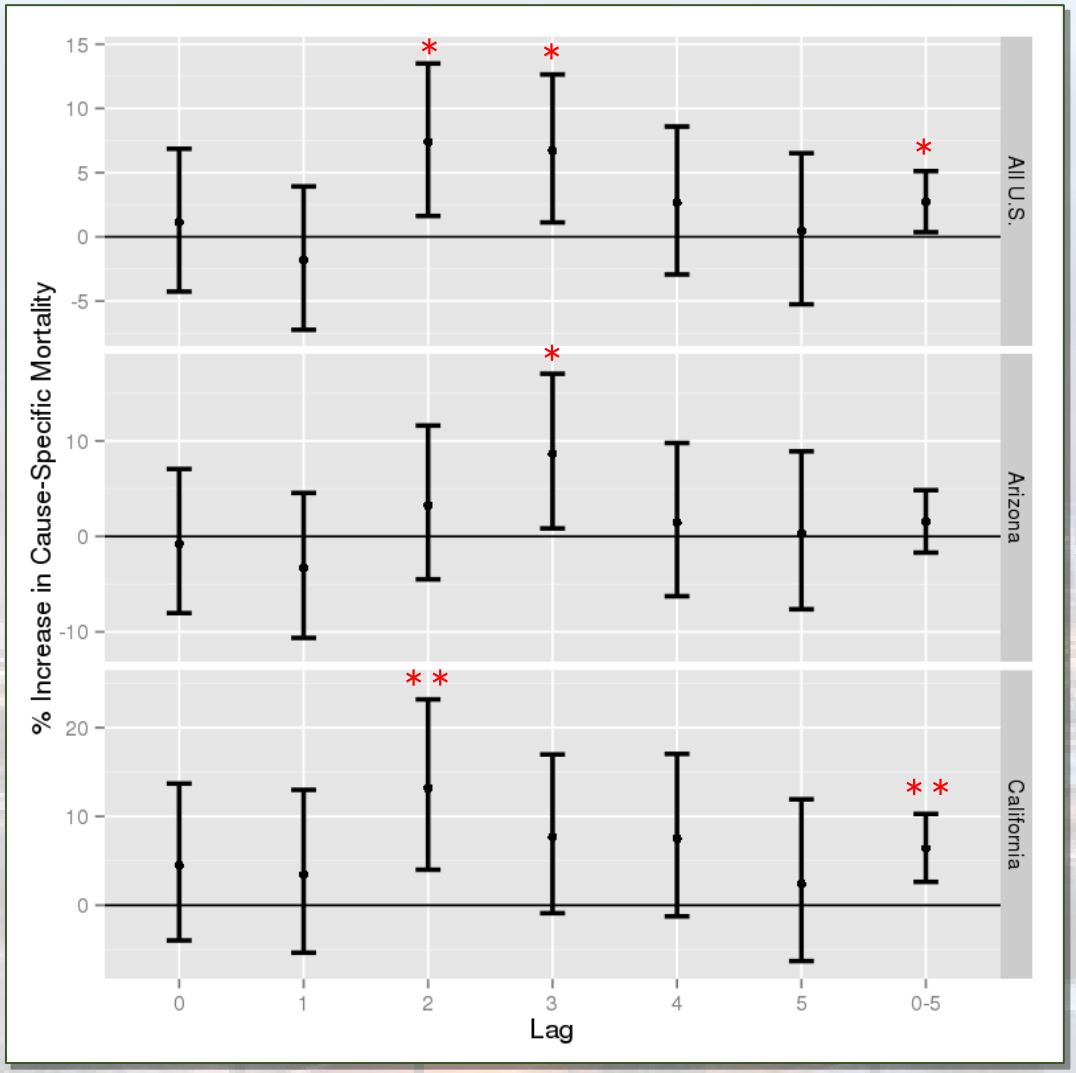
The corresponding associations with PM2.5 were all null.

Limitations of our Exposure Metric

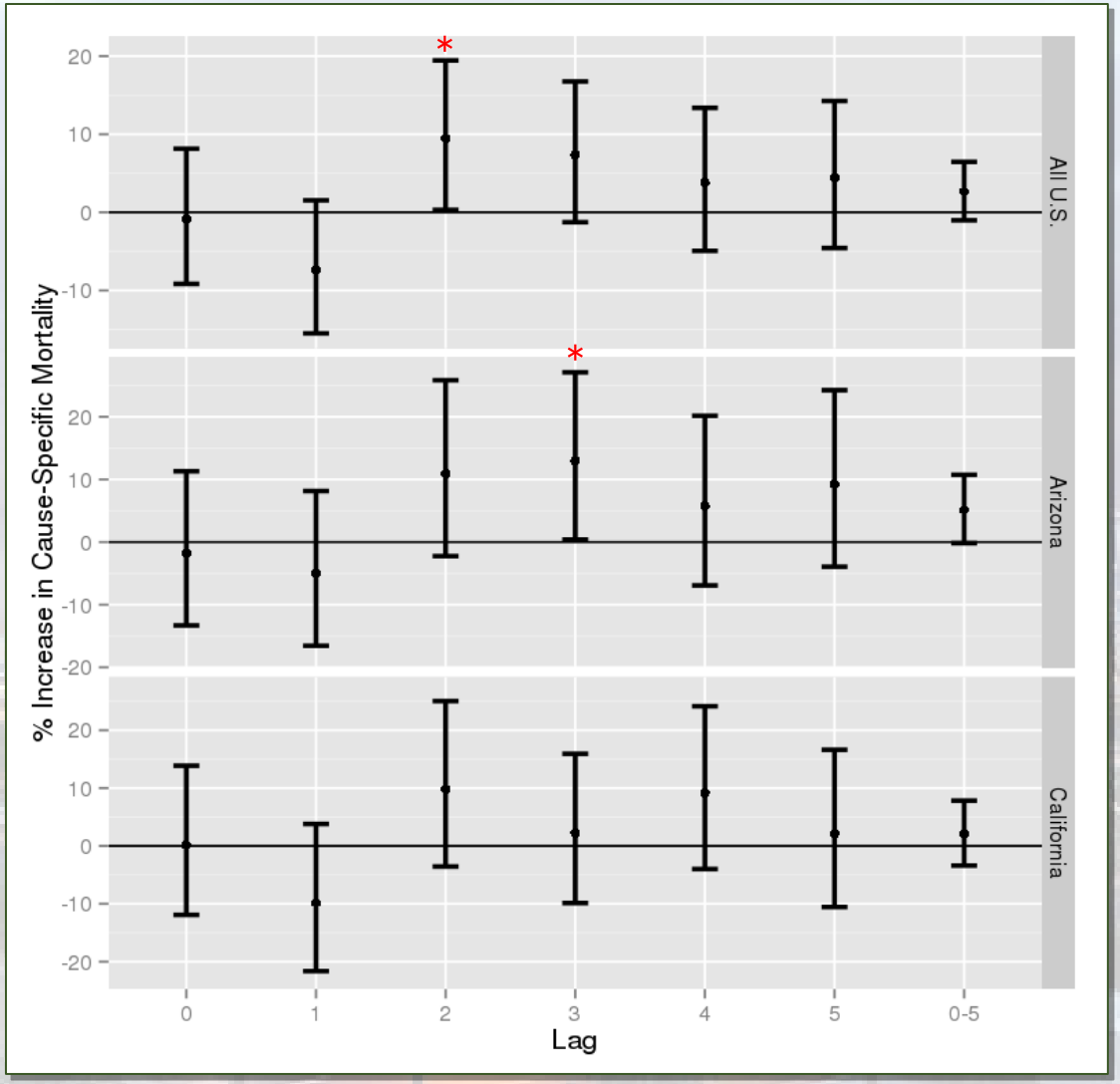
- No consistent quality control of storm event records.
- Only indirect, limited evidence for particle size distribution and none for particle composition.
- Some areas of the U.S. (e.g., southern Colorado) where we know dust storms occur do not have any recorded events.
- Limited spatial resolution



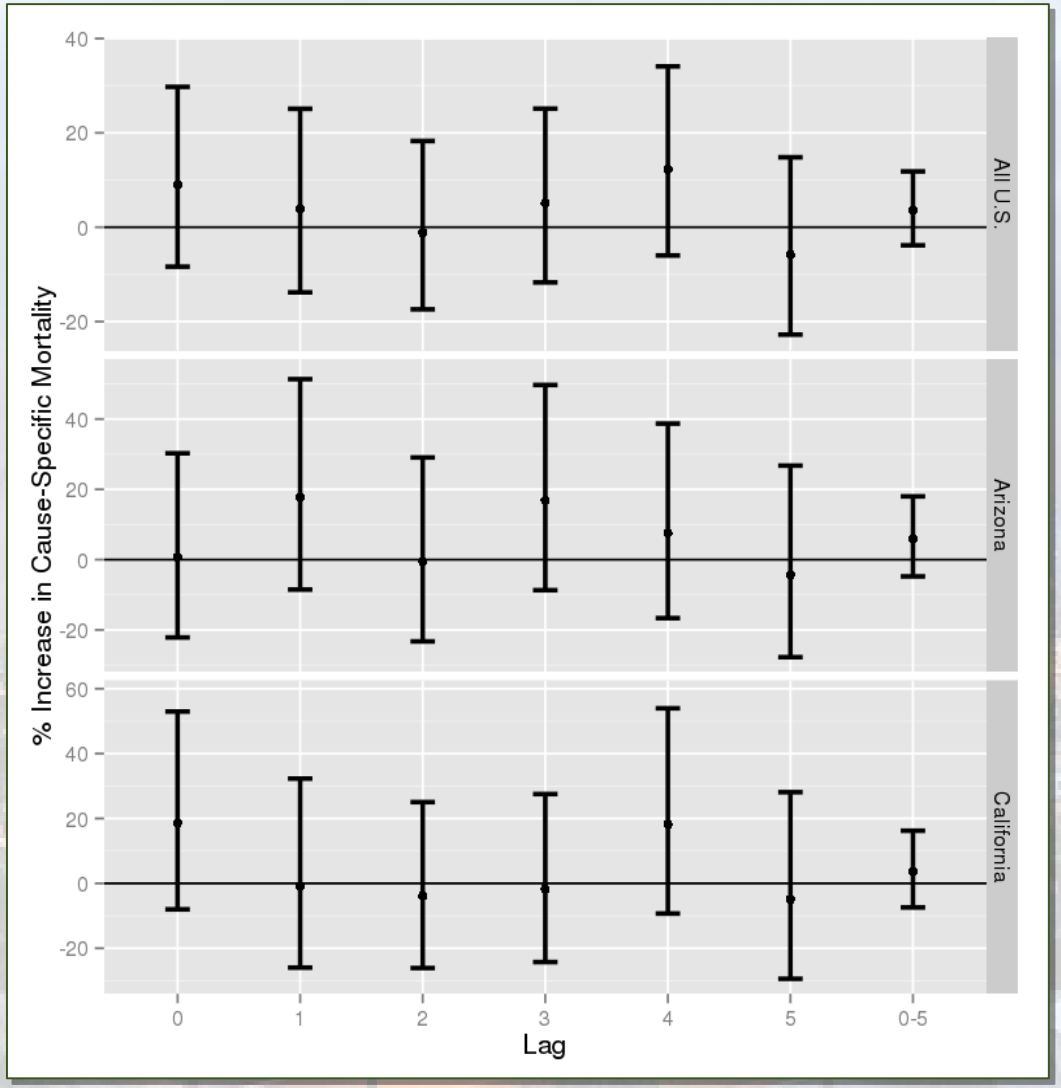
Percent Increase in Total Non-Accidental Mortality Associated with Dust Storms



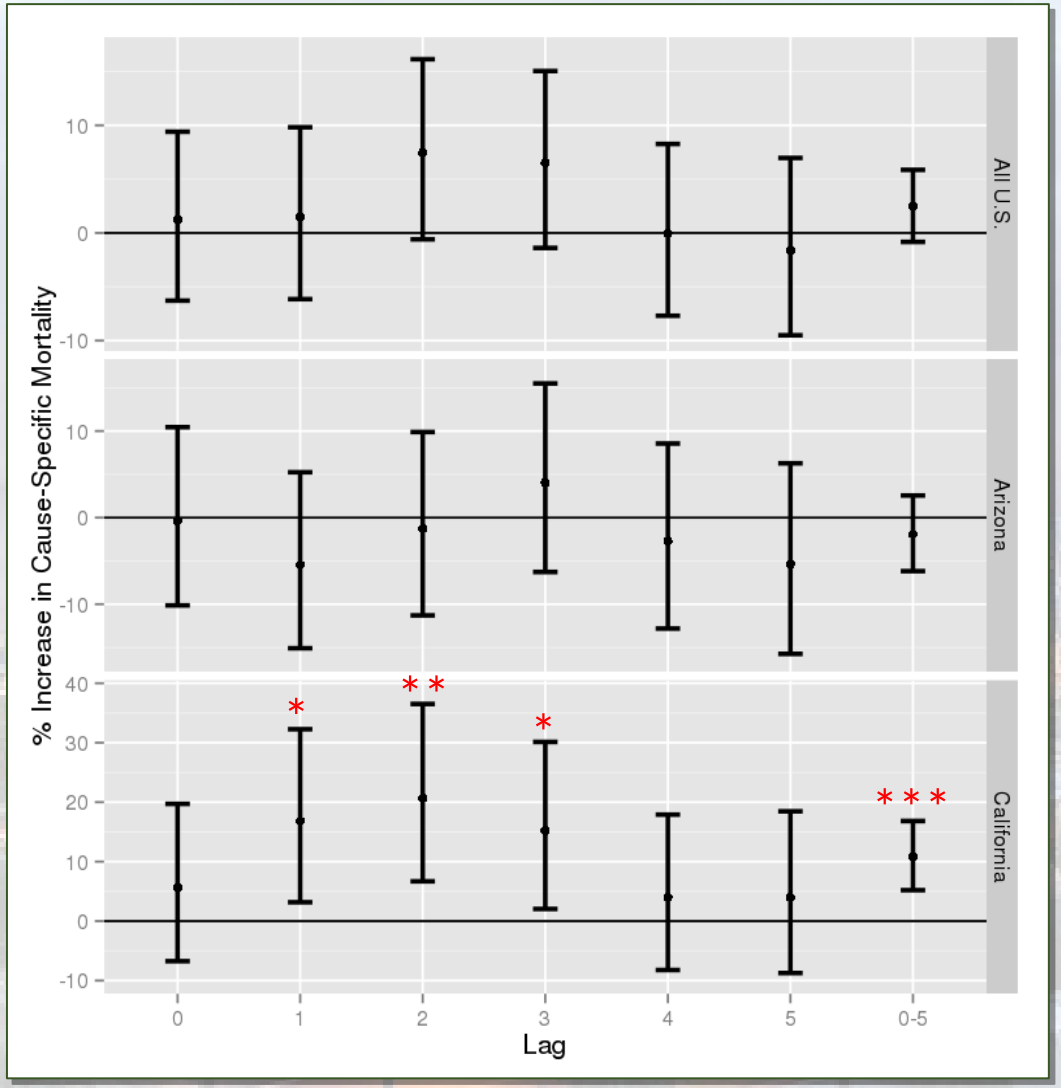
Percent Increase in Cardiovascular Mortality Associated with Dust Storms



Percent Increase in Respiratory Mortality Associated with Dust Storms

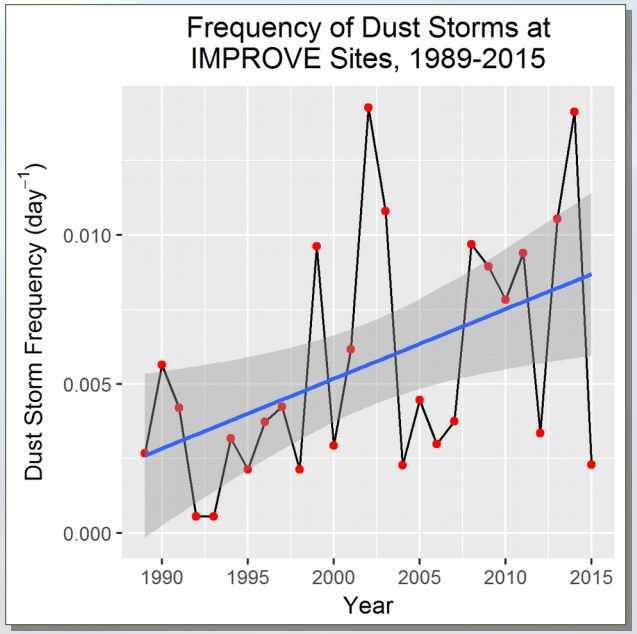


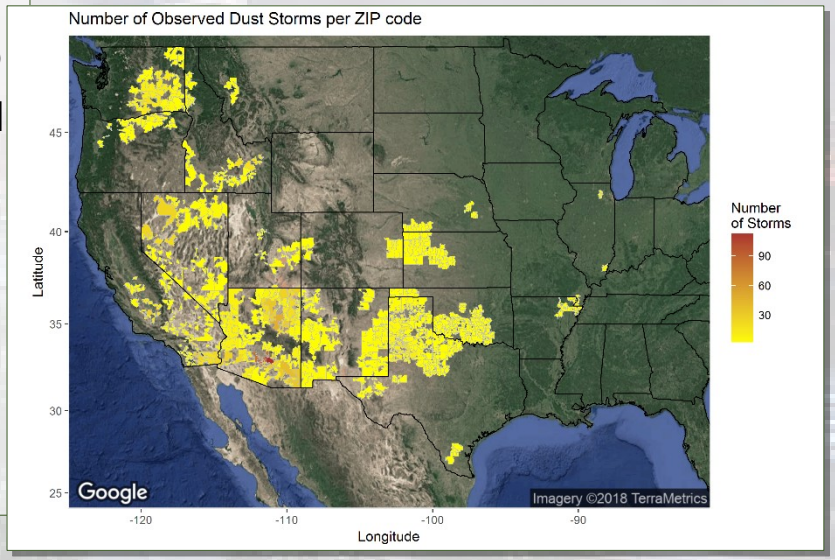
Percent Increase in Other Non-Accidental Mortality Associated with Dust Storms



Ongoing Work

- Recently my collaborators and I have attempted to cross-reference the NWS storm events with dust storms identified at IMPROVE network sites by Daniel Tong (GMU) and colleagues.
- We could not find any agreement between the data sources (Though Dr. Tong's study did also find an increase in storm frequency over time).
- However, storm events identified by Dr. Tong are of limited use for epi studies due to the monitor locations and sampling schedule (every 3rd day, and only at U.S. National Parks and Wildlife Areas).
- Currently I have a small contract from the U.S. EPA for a follow-on study of postal code-level Intensive Care Unit admissions, 1995-2017 using the NWS storm event database again.






Thanks!