What does the Harvard COVID-19 study mean for Louisiana?

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“A small increase in long-term exposure to PM 2.5 leads to a large increase in COVID-19 death rate”

1 μg/m^3 PM 2.5 pollution increases COVID-19 death rate by 15%.

Exposure to air pollution and COVID-19 mortality in the United States

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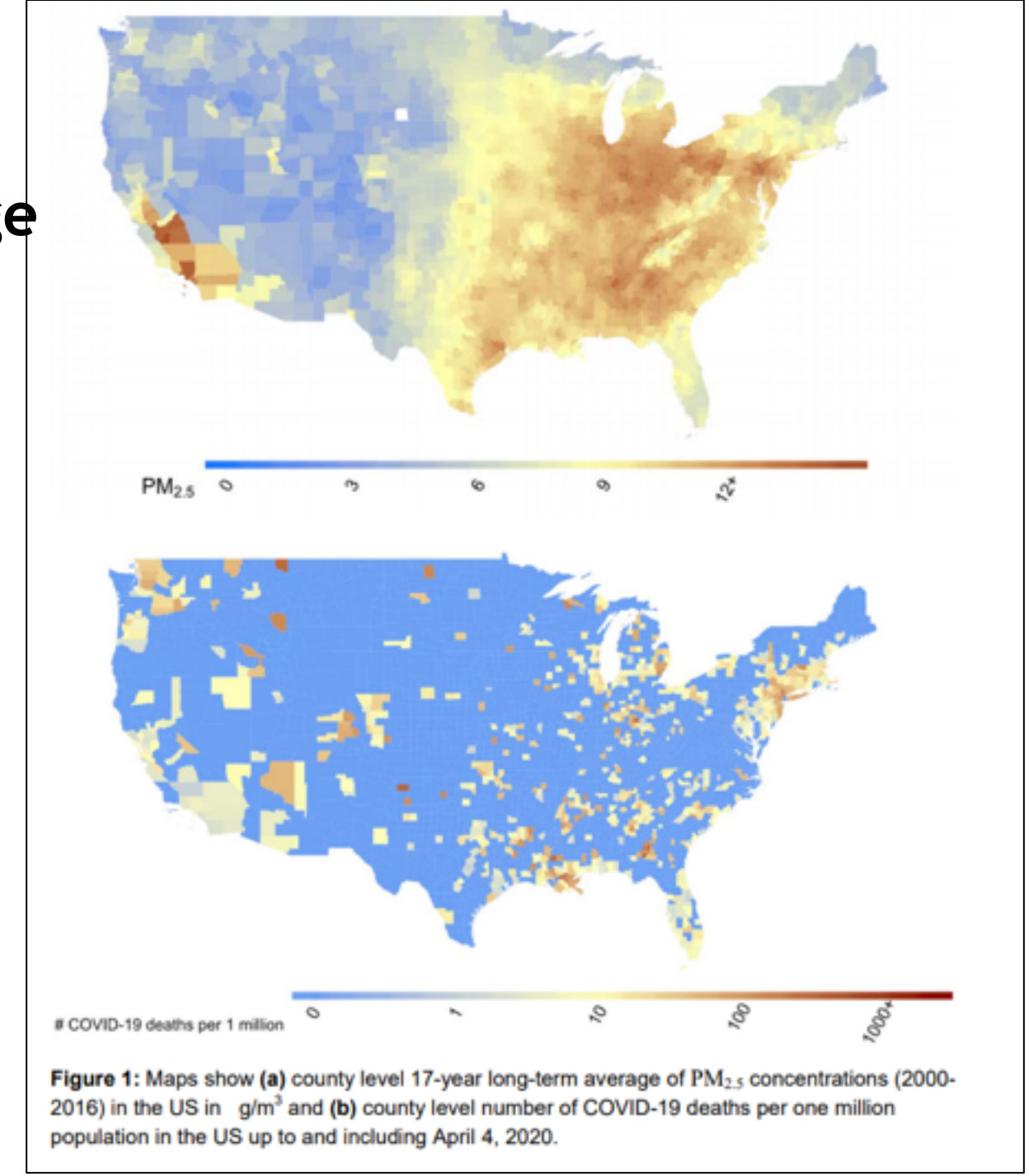


Figure 1: Maps show **(a)** county level 17-year long-term average of $PM_{2.5}$ concentrations (2000-2016) in the US in g/m^3 and **(b)** county level number of COVID-19 deaths per one million population in the US up to and including April 4, 2020.

Some key (and somewhat buried) details

- The study accounted for population density, population size, # COVID-19 tests, # hospital beds, smoking, body mass index, poverty, income, education, race, % elderly population, and weather (temperature and humidity).

- Results were similar whether using long-term PM 2.5 exposure (2000 – 2016) or 2016 PM 2.5 exposure. (See Supplemental Materials)

- The mortality risk accumulates as pollution continues to increase. In other words, higher levels of PM 2.5 resulted in an even greater COVID-19 mortality risk (>200% for the highest PM 2.5 category). (See Supplemental Materials)

S.6 Tables

Table S1: Main, secondary and sensitivity analysis results for P-1, i.e., $PM_{2.5}$ exposure measured as the 17-year average concentration 2000-2016 by van Donekelaar et al (2019) (1). Point estimates and 95 % confidence intervals and p-values of the log mortality rate ratios (MRR).

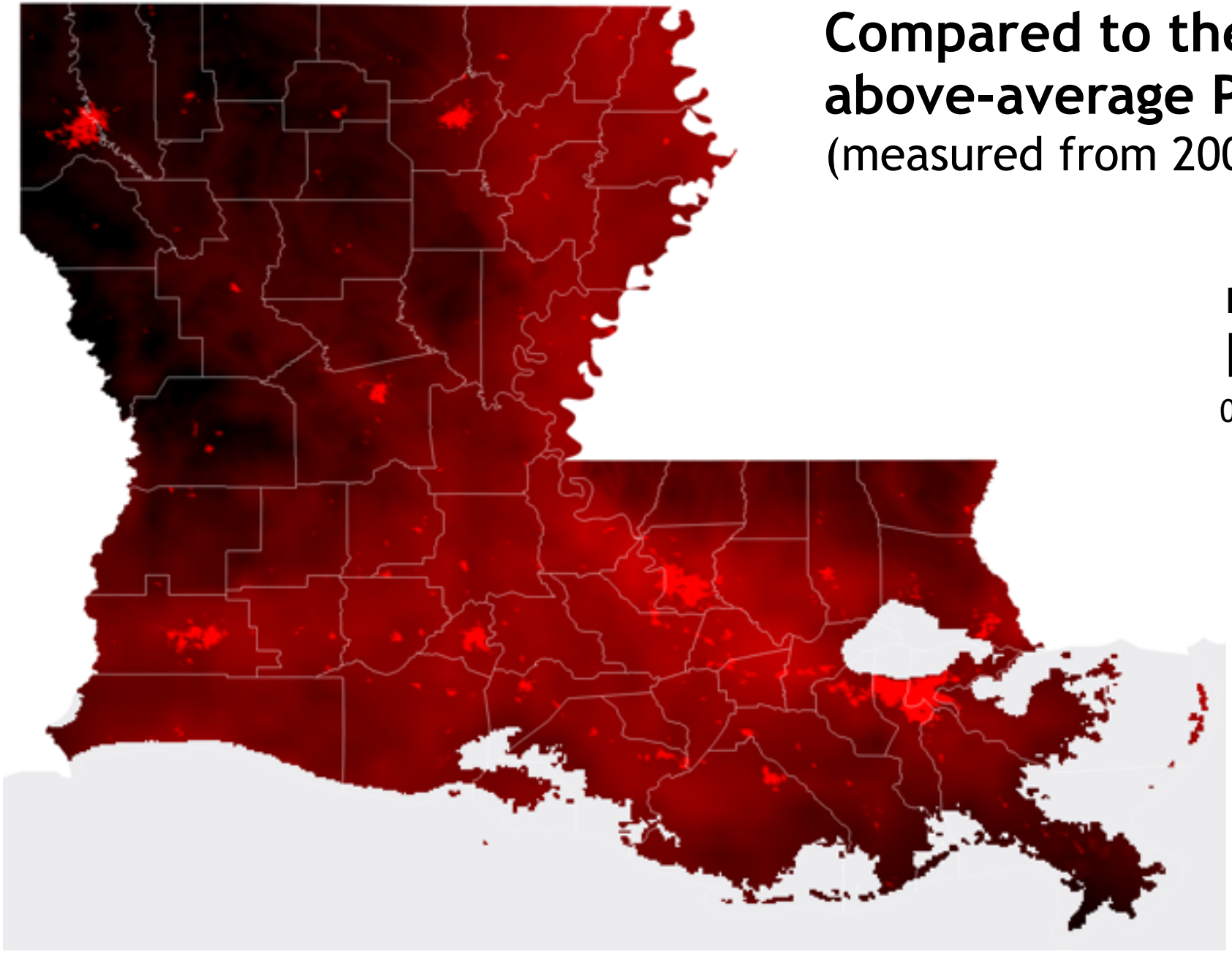
Analysis	N Counties	log(MRR)	P-Value
Main analysis	1783 counties	$0.14(0.05, 0.22)$	< 0.01
Exclude # beds	2214 counties	$0.06(-0.01, 0.13)$	0.09
Exclude # tested	1783 counties	$0.14(0.05, 0.22)$	< 0.01
Exclude BRFSS	2272 counties	$0.12(0.03, 0.20)$	0.01
Exclude weather	1783 counties	$0.10(0.03, 0.18)$	0.01
Exclude counties in New York	1726 counties	$0.12(0.03, 0.20)$	0.01
Exclude counties with < 10 confirmed cases	873 counties	$0.11(0.01, 0.20)$	0.04
Categorize $PM_{2.5}$ into quintiles	1783 counties		
Q1 (0-5.79 $\mu g/m^3$)		0	
Q2 (5.79-8.05 $\mu g/m^3$)		$0.36(-0.13, 0.85)$	0.15
Q3 (8.05-9.53 $\mu g/m^3$)		$0.65(0.11, 1.19)$	0.02
Q4 (9.53-10.74 $\mu g/m^3$)		$0.89(0.31, 1.46)$	< 0.01
Q5 (10.74+ $\mu g/m^3$)		$1.23(0.60, 1.85)$	< 0.01
Categorize population density into quintiles	1783 counties	$0.13(0.03, 0.22)$	0.01
Use standard Negative Binomial model	1783 counties	$0.14(0.05, 0.23)$	< 0.01
Adjust log(population) as covariate	1783 counties	$0.19(0.10, 0.28)$	< 0.01
Adjust population as covariate	1783 counties	$0.37(0.28, 0.46)$	< 0.01

"…We found the magnitude of MRRs [mortality rate ratios] increase dramatically and monotonically as the quintile of PM2.5 exposures increases for P-1…"

(page 9, Supplemental material).

Compared to the U.S., Louisiana has above-average PM 2.5 pollution

(measured from 2000 – 2016).



PM 2.5 Pollution ($\mu g/m^3$)

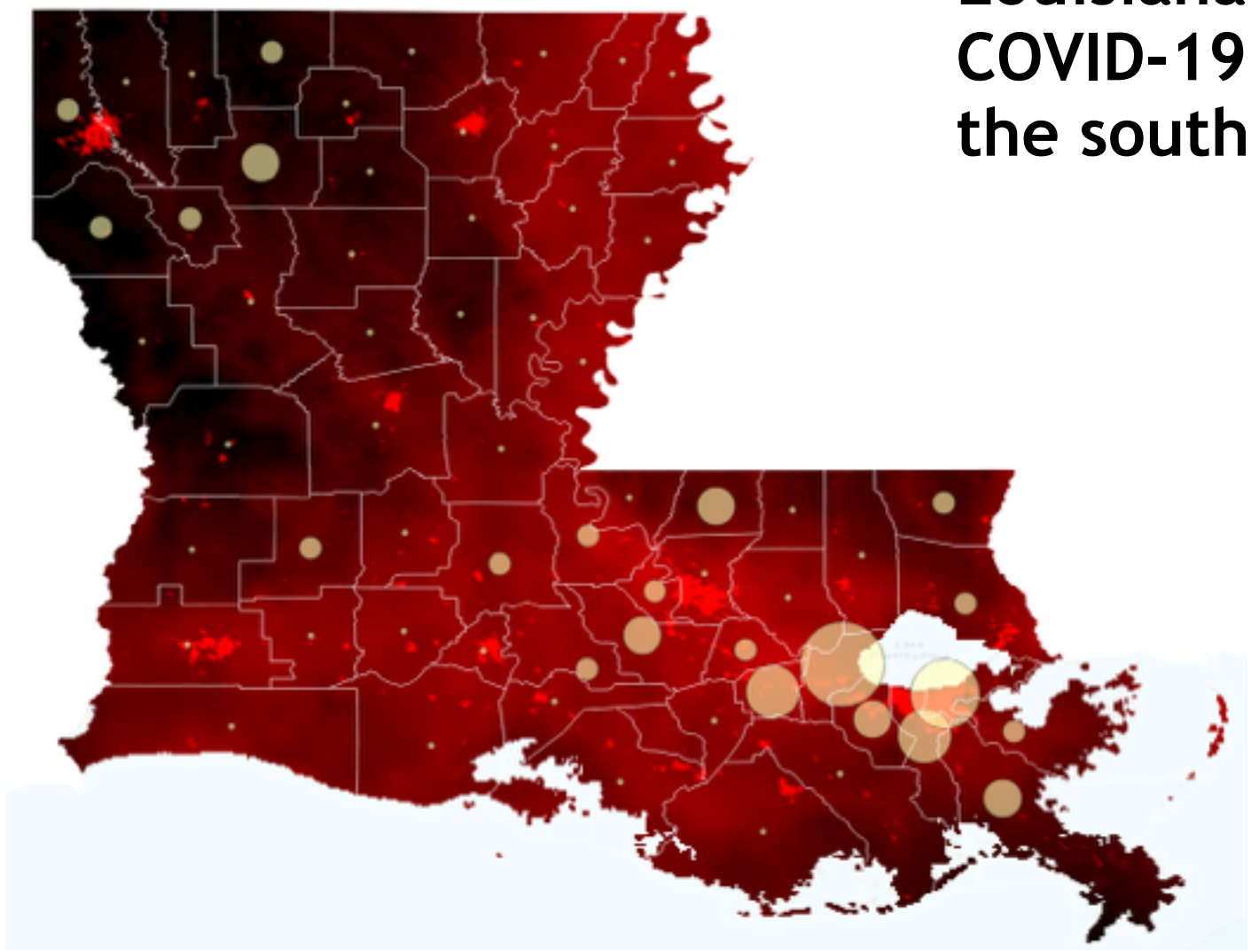
0 — 8.40 (U.S. Average) — 11.03

DATA SOURCE

17-Year average PM 2.5 concentrations (2000 – 2016), presented relative to the overall U.S. mean (8.4 $\mu g/m^3$). From: van Donkelaar, A., R. V. Martin, et al. (2019). Regional Estimates of Chemical Composition of Fine Particulate Matter using a Combined Geoscience-Statistical Method with Information from Satellites, Models, and Monitors. Environmental Science & Technology, 2019, doi:10.1021/acs.est.8b06392.

http://fizz.phys.dal.ca/~atmos/martin/?

Louisiana has above-average COVID-19 death rates, particularly in the southeast industrial region.



COVID-19 Deaths by Parish

(# deaths per 10,000 people, as of 4/15/20)

- 0.0 – 1.8 ----U.S. average (0.75)*
- 1.8 – 3.7
- 3.7 – 5.5
- 5.5 – 7.3
- 7.3 – 9.1
- 9.1 – 11.0

*Based on CDC data, as of Apr 15, 2020 (24,582 deaths) and ACS 2018 U.S. population estimate (327,167,439).

DATA SOURCES

- Deaths per 10,000 people calculated from 2018 ACS population data (https://www.census.gov/data/datasets/time-series/demo/popest/2010s-counties-total.html) and Louisiana Department of Health. Coronavirus (COVID-19). Data accessed 4/15/2020. http://ldh.la.gov/Coronavirus/.
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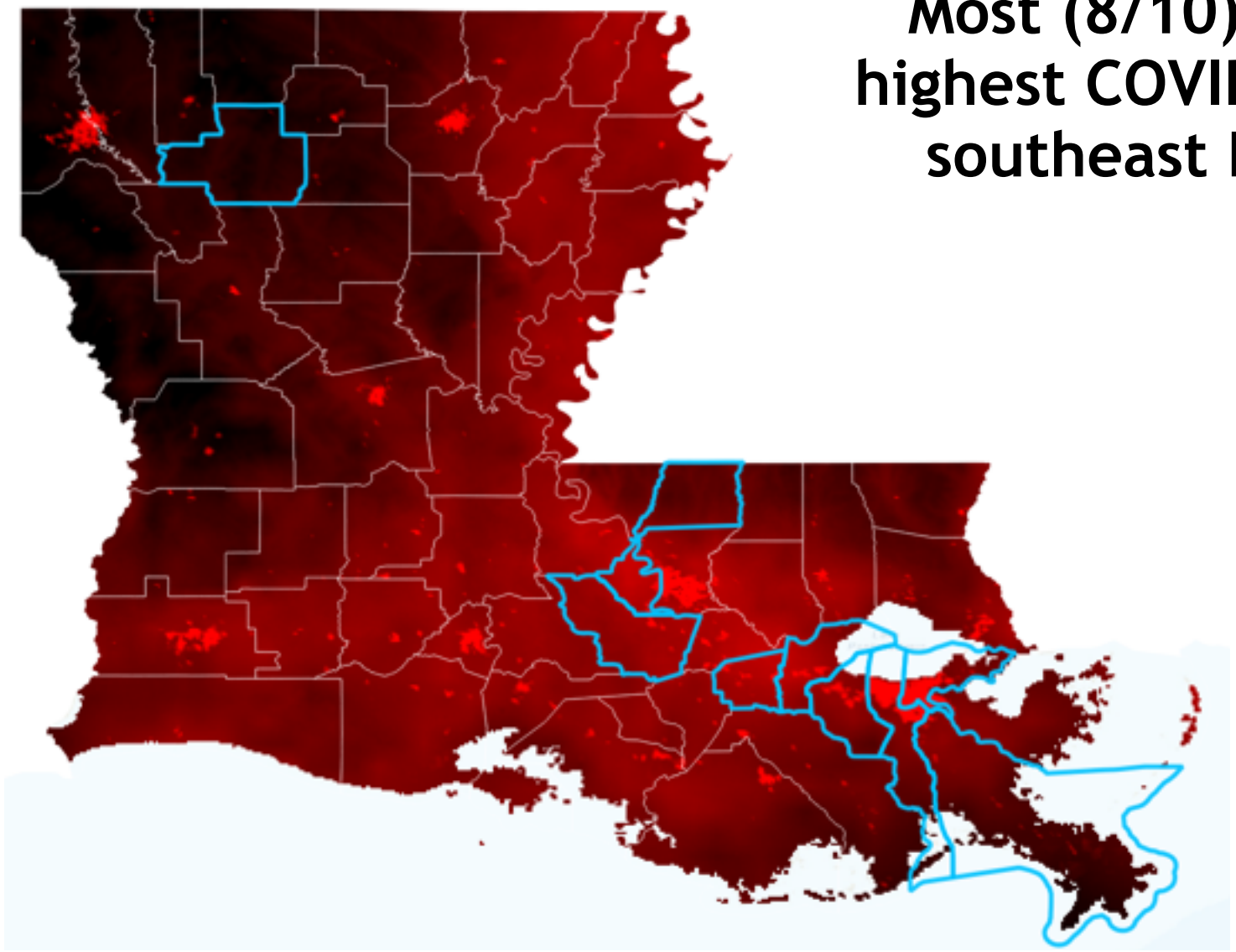

Most (8/10) of the parishes with the highest COVID-19 death rates are in the southeast Louisiana $PM_{2.5}$ Pollution Corridor.

COVID-19 Deaths by Parish

(# deaths per 10,000 people, as of 4/15/20)

PARISH	DEATH RATE
St. John the Baptist	10.97
Orleans	7.36
St. James	6.16
Jefferson	5.71
Bienville	5.29
Iberville	5.23
St. Charles	4.90
Plaquemines	4.74
East Feliciana	3.66
West Baton Rouge	3.40

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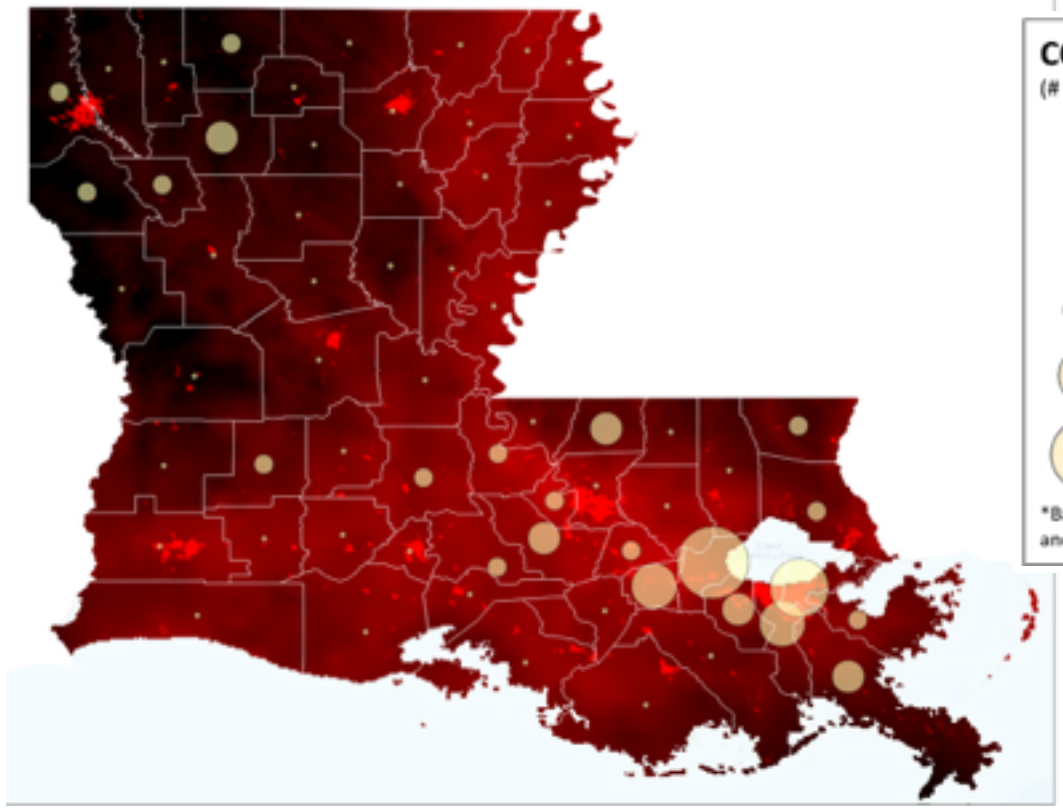
COVID-19 Death Rates and PM 2.5 Air Pollution in Louisiana



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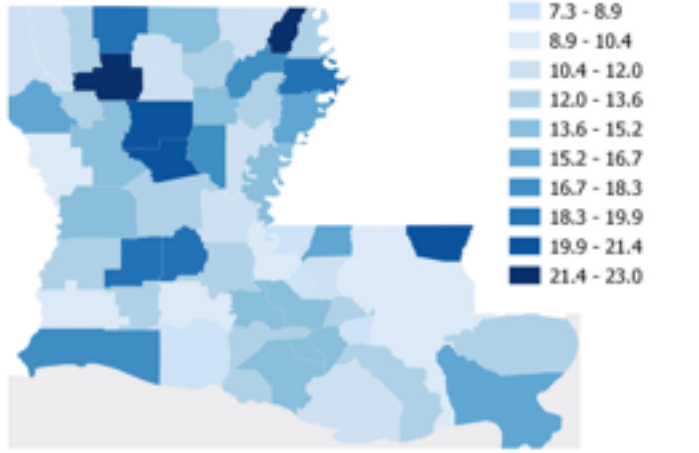
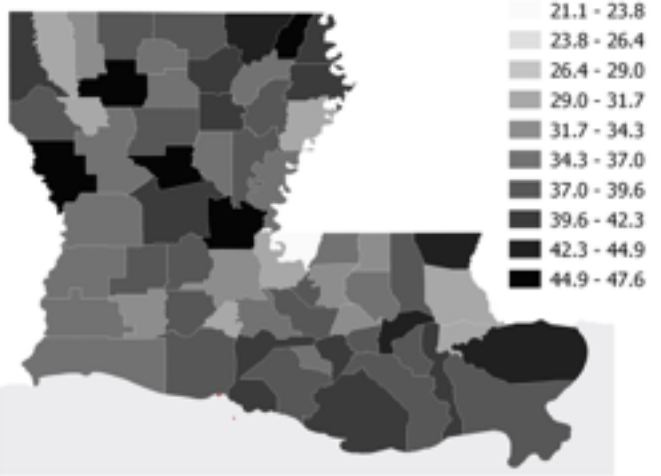
Diabetes



Obesity



DATA SOURCE

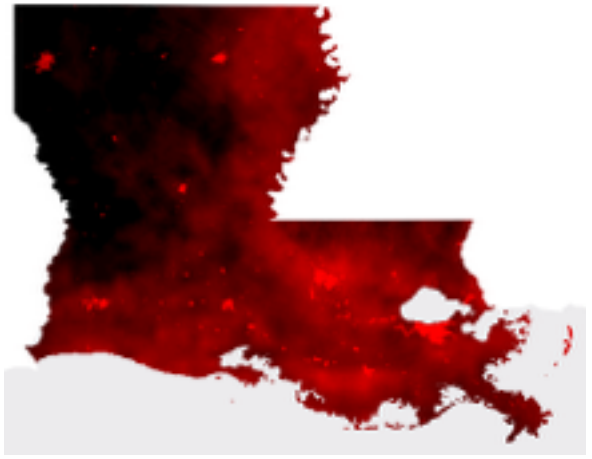
2016 Crude rates of diabetes and obesity among adults (aged, 20+ yrs) in Louisiana. US Diabetes Surveillance System; www.cdc.gov/diabetes/data; Division of Diabetes Translation - Centers for Disease Control and Prevention. 2016. Data accessed 4/13/20. https://gis.cdc.gov/grasp/diabetes/DiabetesAtlas.html

Louisiana improved air quality from 2000-2015, but is now losing ground.

2000

2005

2010

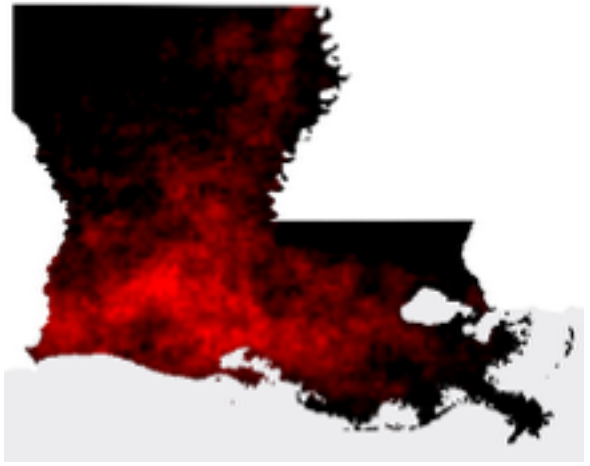


2015

2016

2017

2018



PM 2.5 Pollution ($\mu g/m^3$)

0

11.03 +

8.40
(U.S. Average)

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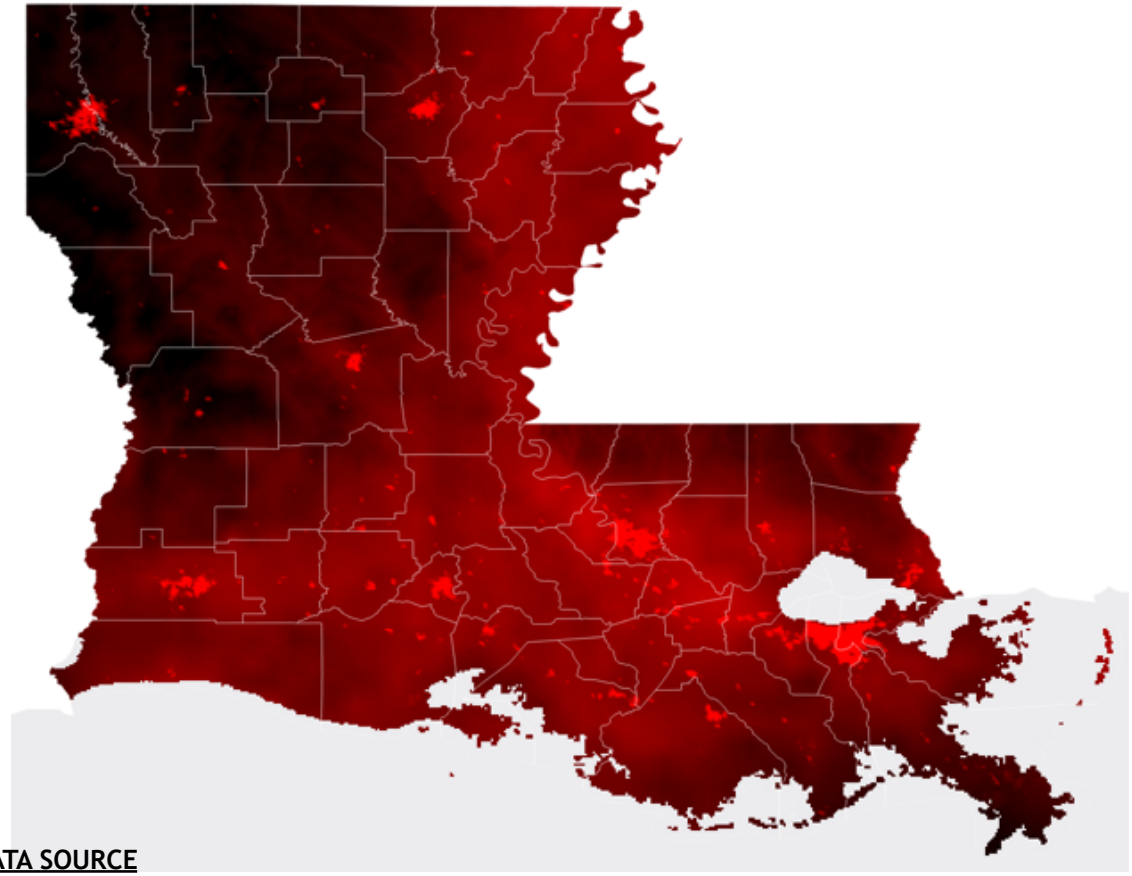
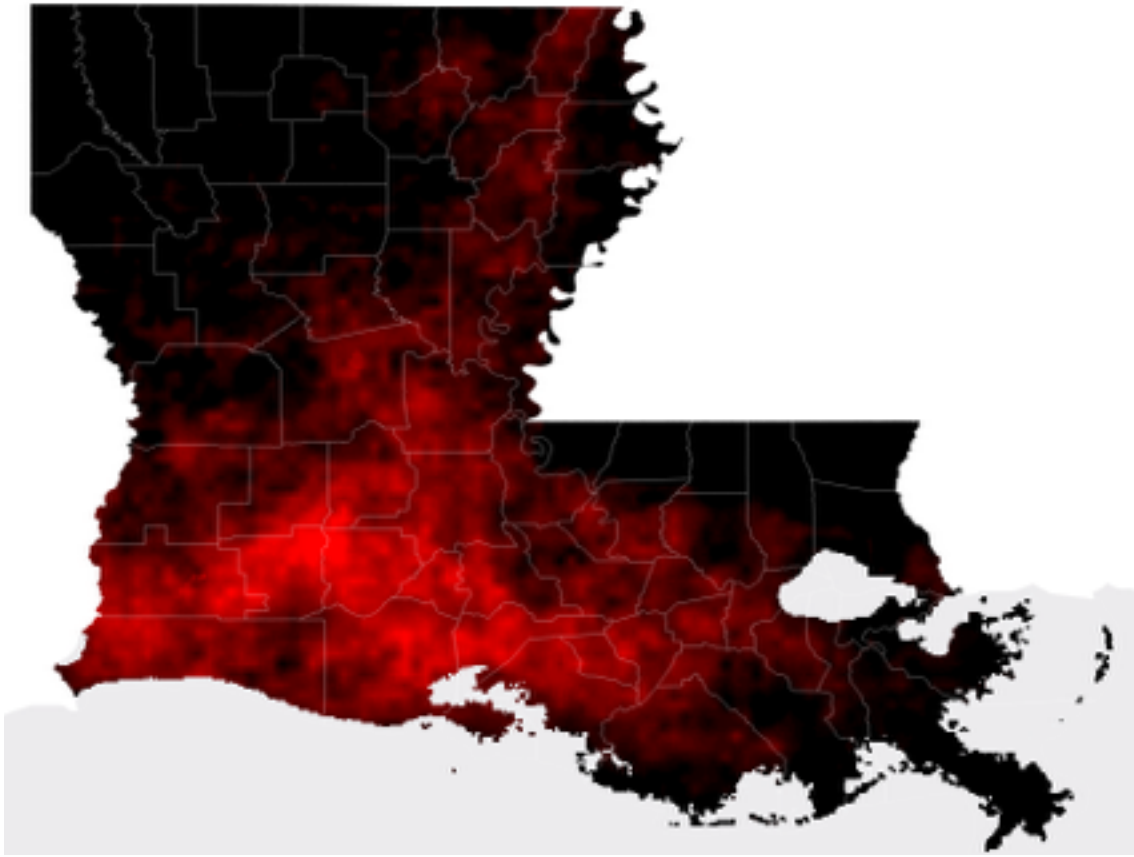
Industrialized communities in south Louisiana are overburdened by pollution and the resulting health risks, including COVID-19 mortality. Based on recent pollution trends, this disparity will continue and likely worsen.

2000 - 2016



2018



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