Where should the cancer control interventions target: A geospatial hotspot analysis for major cancer mortality 2018-2022 in the U.S.

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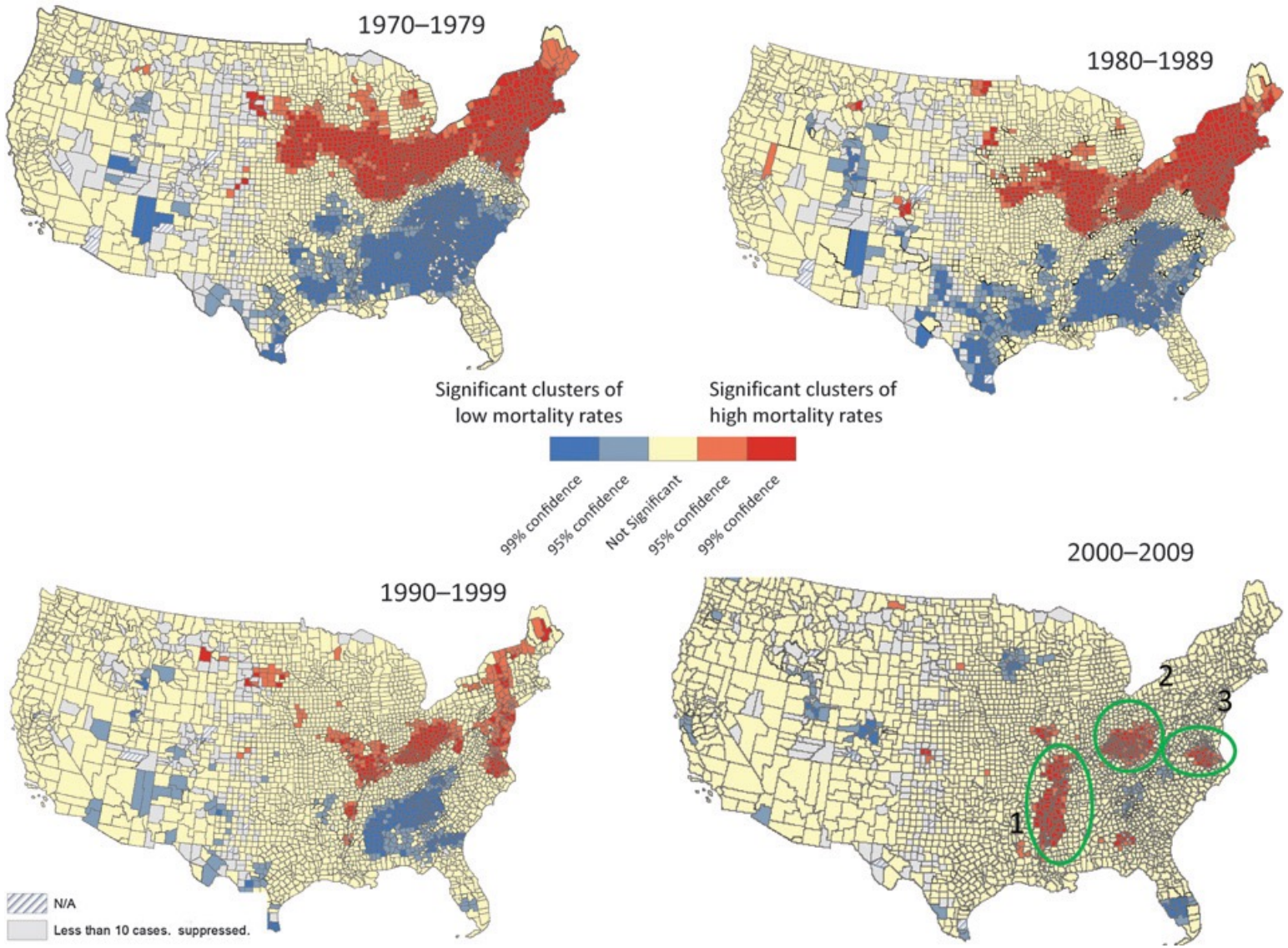
Mortality by cancer type

Estimated Deaths

Males			Females		
Lung & bronchus	83,550	26%	Lung & bronchus	70,500	25%
Prostate	29,430	9%	Breast	40,920	14%
Colon & rectum	27,390	8%	Colon & rectum	23,240	8%
Pancreas	23,020	7%	Pancreas	21,310	7%
Liver & intrahepatic bile duct	20,540	6%	Ovary	14,070	5%
Leukemia	14,270	4%	Uterine corpus	11,350	4%
Esophagus	12,850	4%	Leukemia	10,100	4%
Urinary bladder	12,520	4%	Liver & intrahepatic bile duct	9,660	3%
Non-Hodgkin lymphoma	11,510	4%	Non-Hodgkin lymphoma	8,400	3%
Kidney & renal pelvis	10,010	3%	Brain & other nervous system	7,340	3%
All Sites	**323,630**	**100%**	**All Sites**	**286,010**	**100%**

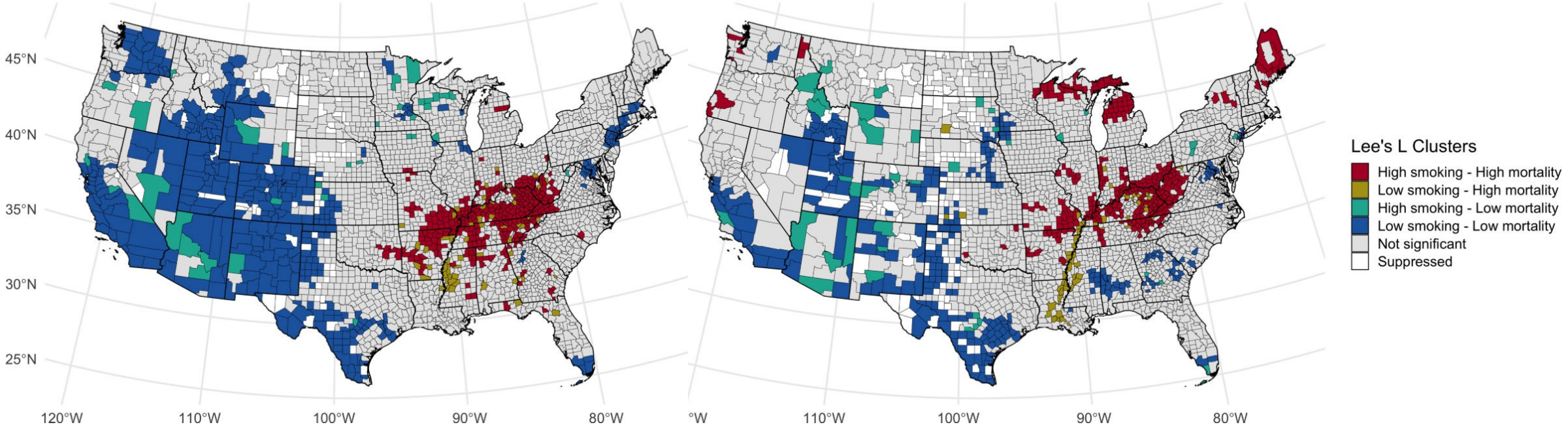
Colorectal cancer mortality hotspots



Siegel et al 2015

1970-2009 data

Lung cancer mortality hotspots



Male

Female

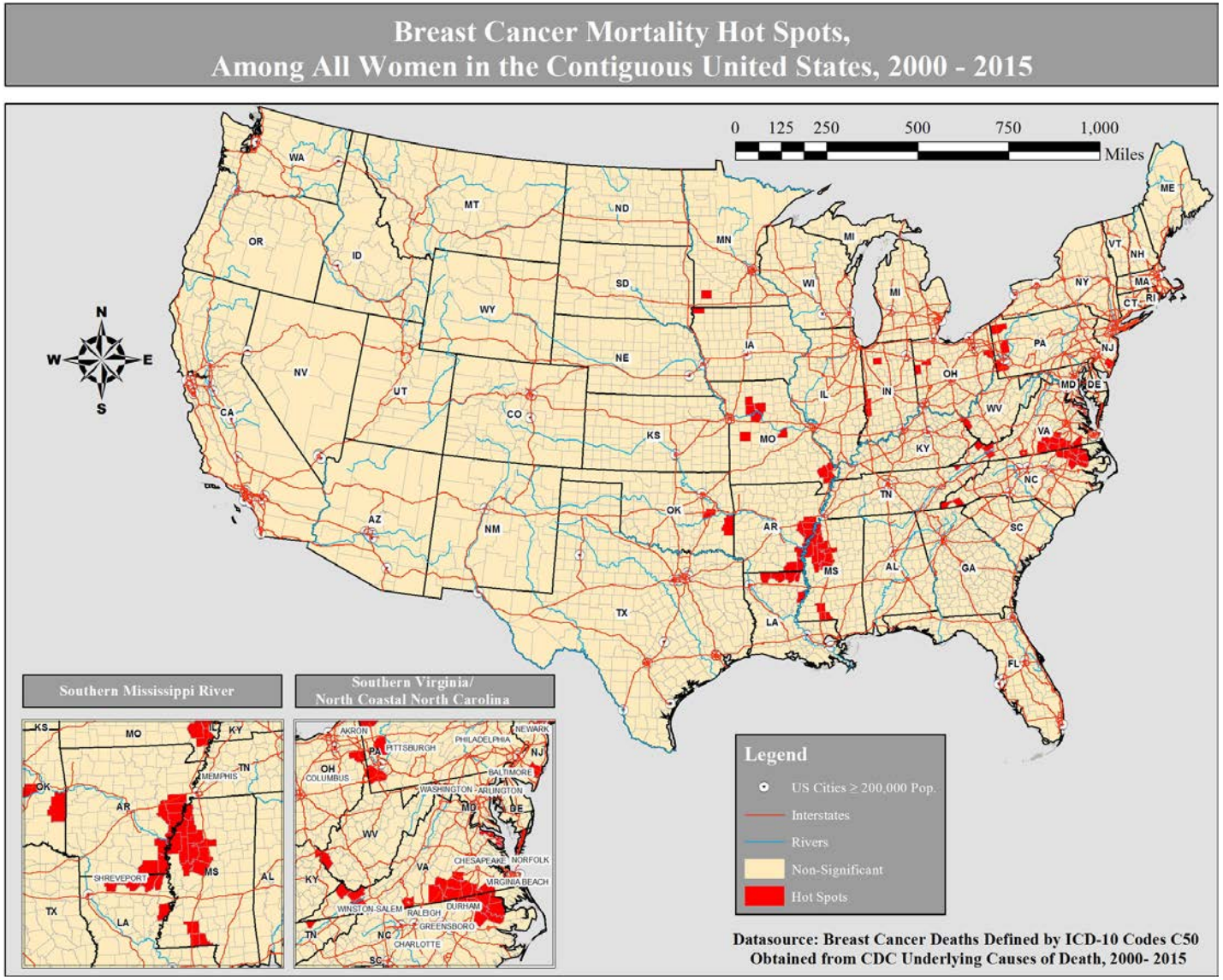
Shreves, et al. 2023

2005–2018 data

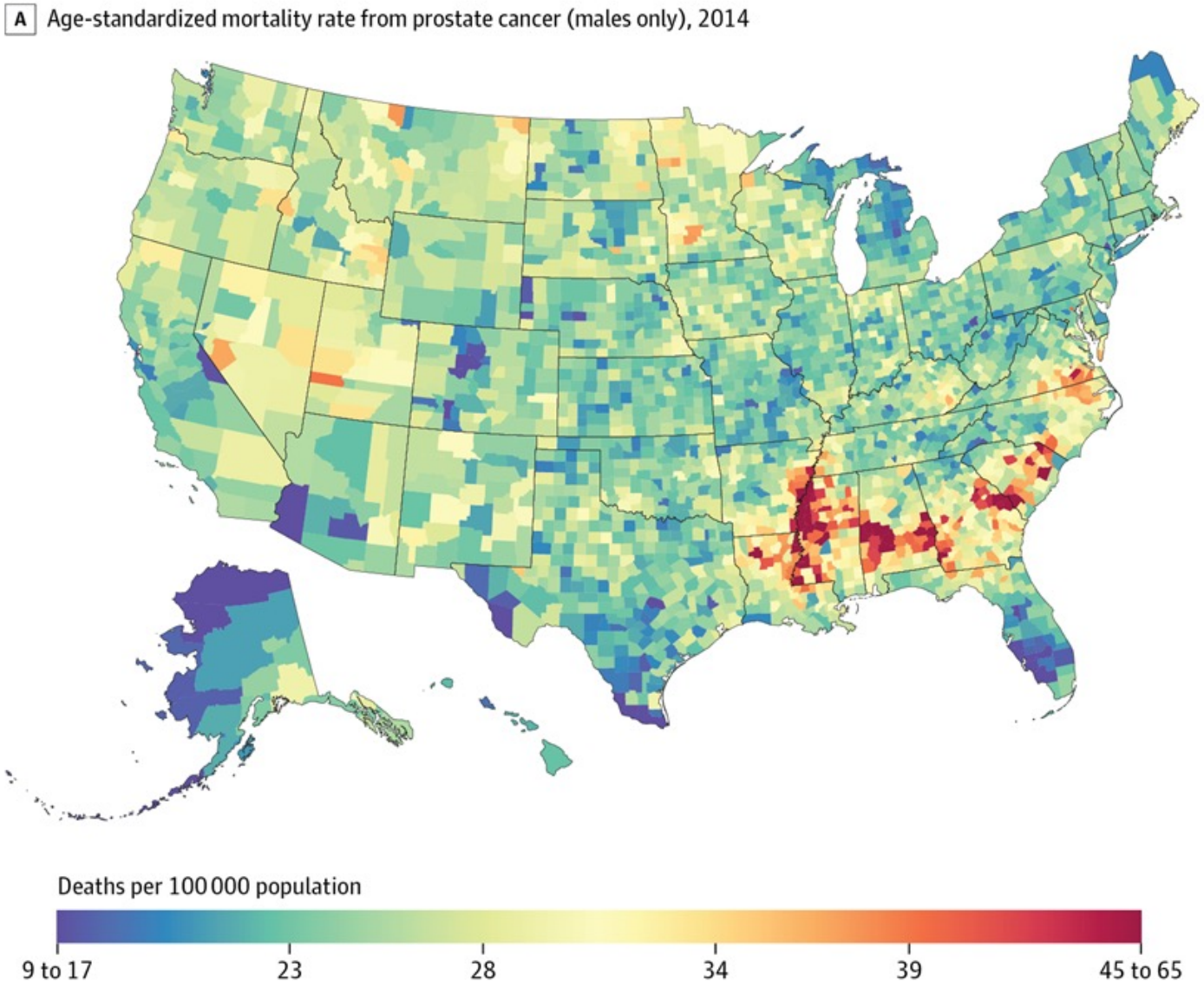
Breast cancer mortality hotspots

Moore, et al. 2018

2000-2015 data



Prostate cancer mortality hotspots



Mokdad, et al. 2017

1980-2014 data

Cancer mortality, 2018-2022

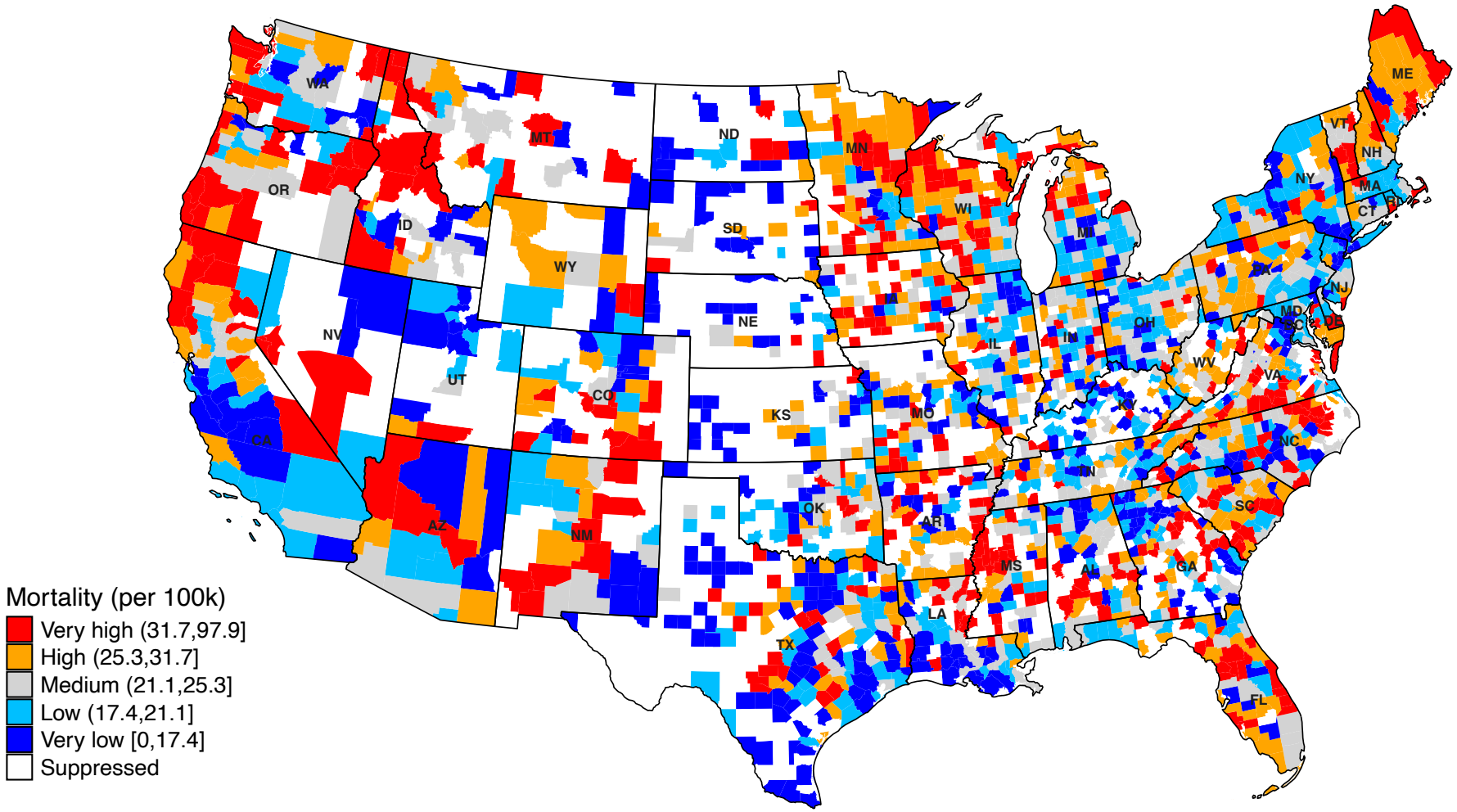
- The CDC Wide-ranging ONline Data for Epidemiologic Research (WONDER) Underlying Cause of Death data.

- US mainland county-level (n=3108), 2018-2022 data.

- Cancer by ICD-10 113 Cause List:
  - Malignant neoplasms of colon, rectum and anus (C18-C21);
  - Malignant neoplasms of trachea, bronchus and lung (C33-C34);
  - Malignant neoplasm of breast (C50); and
  - Malignant neoplasm of prostate (C61).

Data suppression

Direct visualization of prostate cancer mortality (US mainland 2018–2022)



Data suppression

- Death counts (1-9) are suppressed for some counties.
- May affect the clustering of neighbor counties.

Cancer Type	Number of counties with suppression (total N=3108)	National average mortality per 100,000
Lung	211 (6.8%)	42.0
Colorectal	536 (17.2%)	16.4
Breast (female)	849 (26.2%)	25.9
Prostate (male)	974 (31.3%)	20.2

Imputation

- Use cancer-related predictors (n=14):
  - median age, male/female ratio, poverty % in 2018, education, unemployment rate, uninsured %, PCP rate,
  - smoking %, obese %, physically inactive %, excessive drinking %, mammogram screening %,
  - food environment index, and average daily inhalable particulate matter level (PM 2.5).
- Data from the Census and County Health Ranking, 2018.
- Spatial error regression model.
- Impute the suppressed death counts with fitted value (truncated within 1-9).

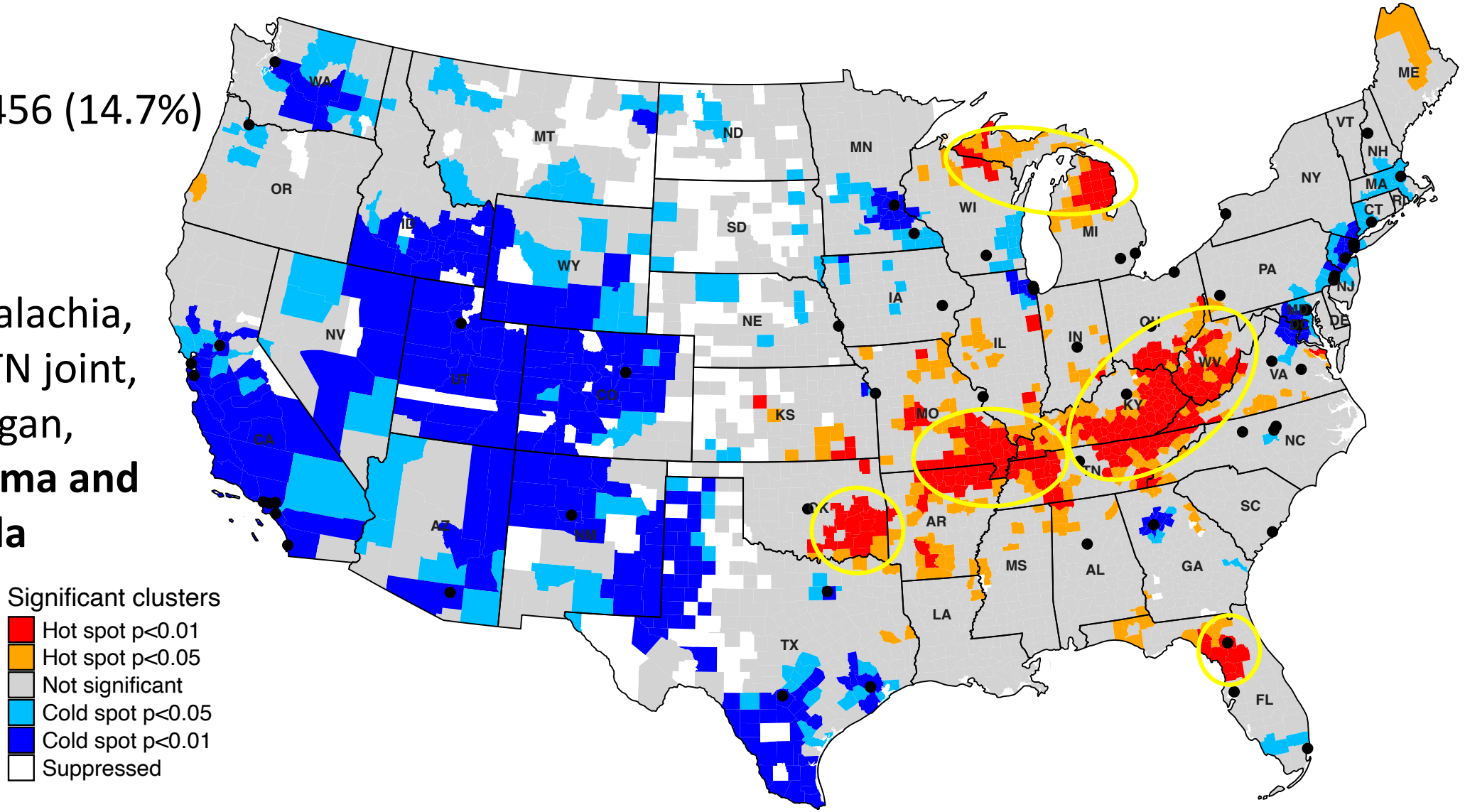
Hotspot analysis

- Mortality hotspots: counties with high mortality rates based on their neighborhood counties.
- The Getis-Ord Gi* statistics are used to identify hotspots.
- Statistical significance based on permutation testing: a larger global G test statistic (and smaller p-value) indicates more spatial clustering.
- The counties with imputed mortality rates were used to evaluate their neighboring counties' spatial clustering but their own clustering was not calculated.

Lung cancer mortality, 2018-2022

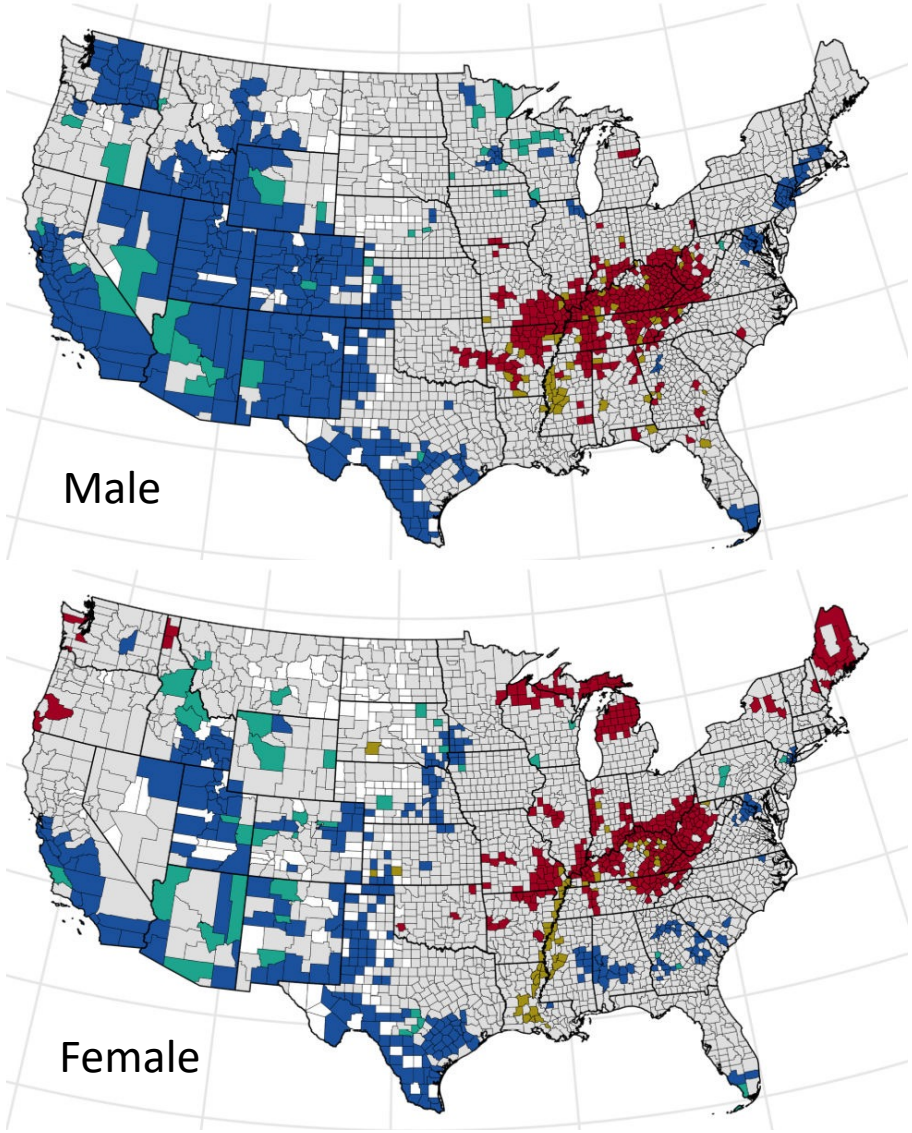
Hotspot n=456 (14.7%)

Central Appalachia,
MO-KY-AR-TN joint,
North Michigan,
East Oklahoma and
North Florida



Lung cancer mortality, 2018-2022

- Compare to previous hotspots:
  - Central Appalachia, MO-KY-AR-TN joint and north Michigan remain.
  - East Oklahoma and north Florida are the new hotspots.



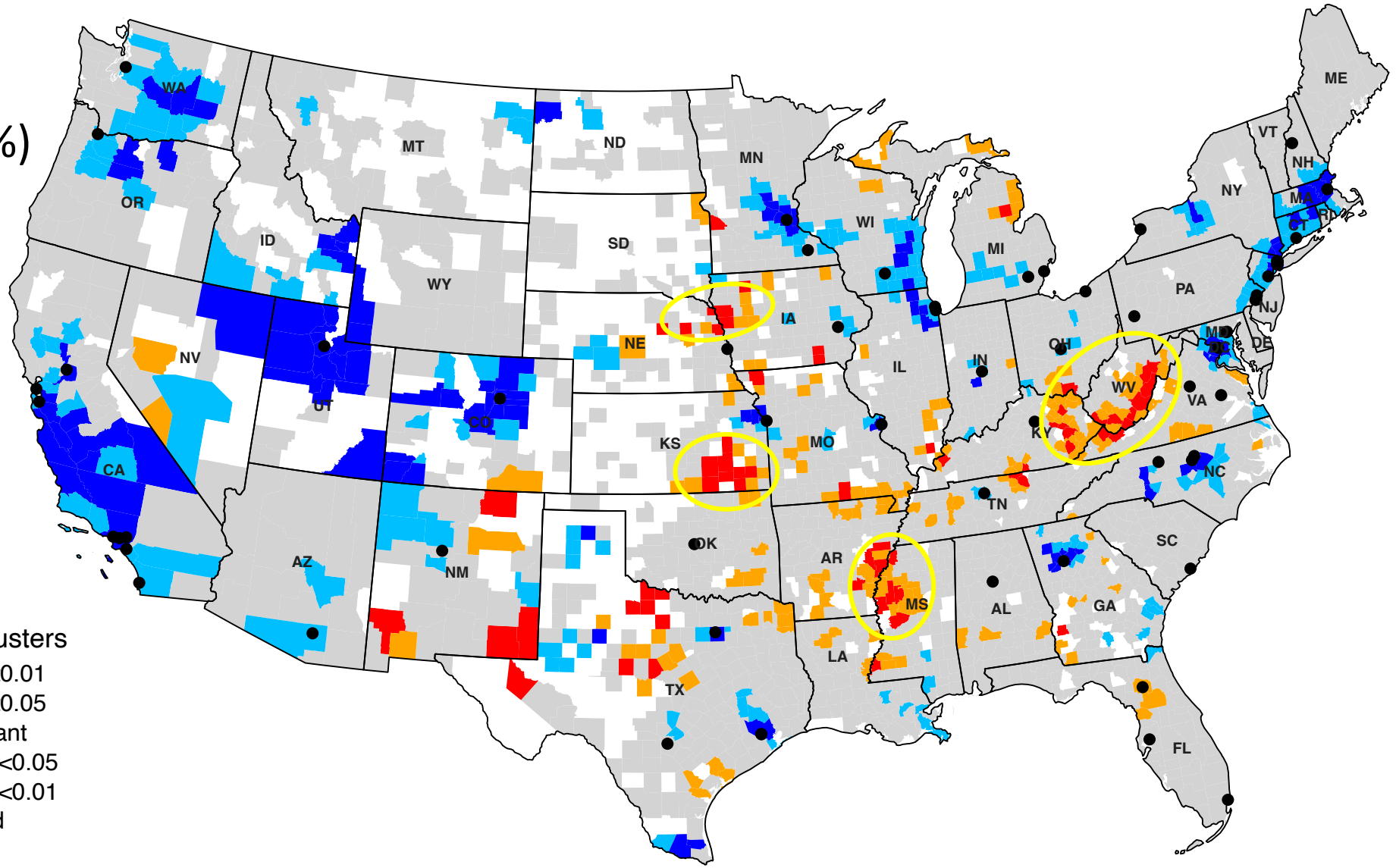
Lung hotspots, 2005–2018

Shreves, et al. 2023

Colorectal cancer mortality, 2018-2022

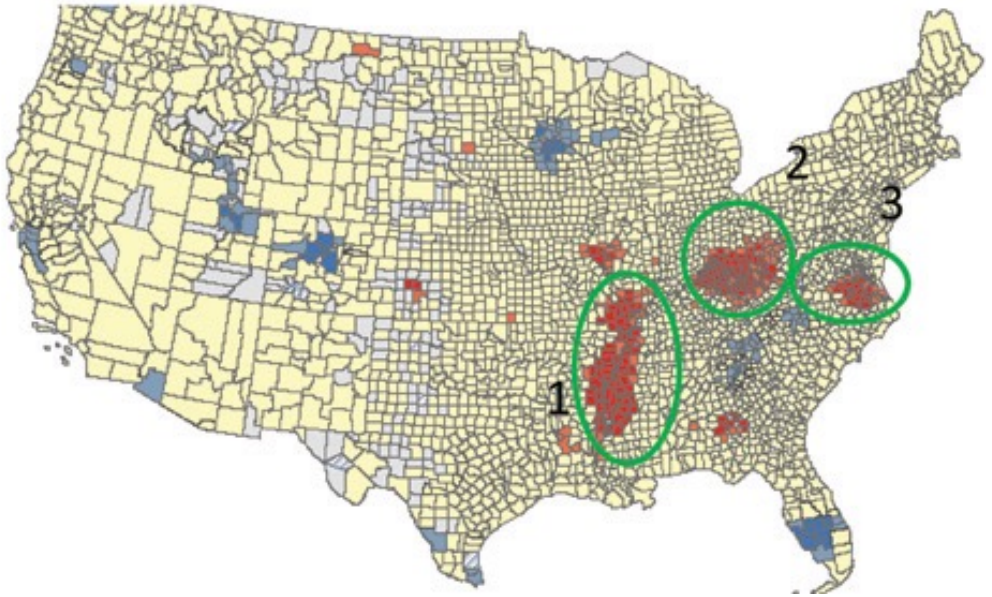
Hotspot n=244 (7.9%)

Central Appalachia (KY, WV), LMD (MS, AR), and **Midwest (KS, IA)**



Colorectal cancer mortality, 2018-2022

- Compare to previous hotspots:
  - Central Appalachia and Lower Mississippi Delta remain,
  - Eastern North Carolina/Virginia hotspots shrank, and
  - Small areas in the Midwest (IA, KS) emerged as the new hotspots.



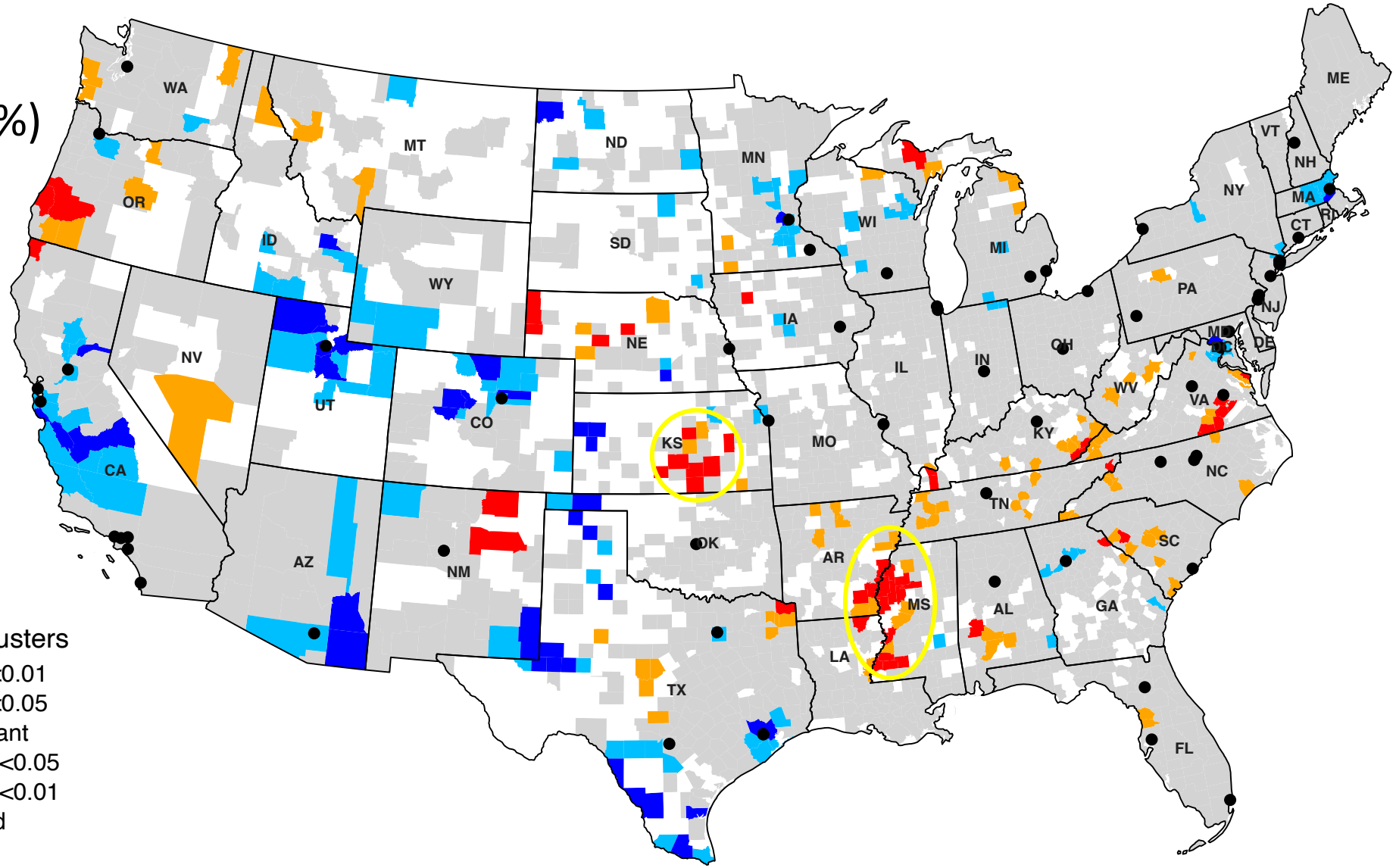
Colorectal hotspots, 2000-2009

Siegel, et al. 2015

Breast cancer mortality, 2018-2022

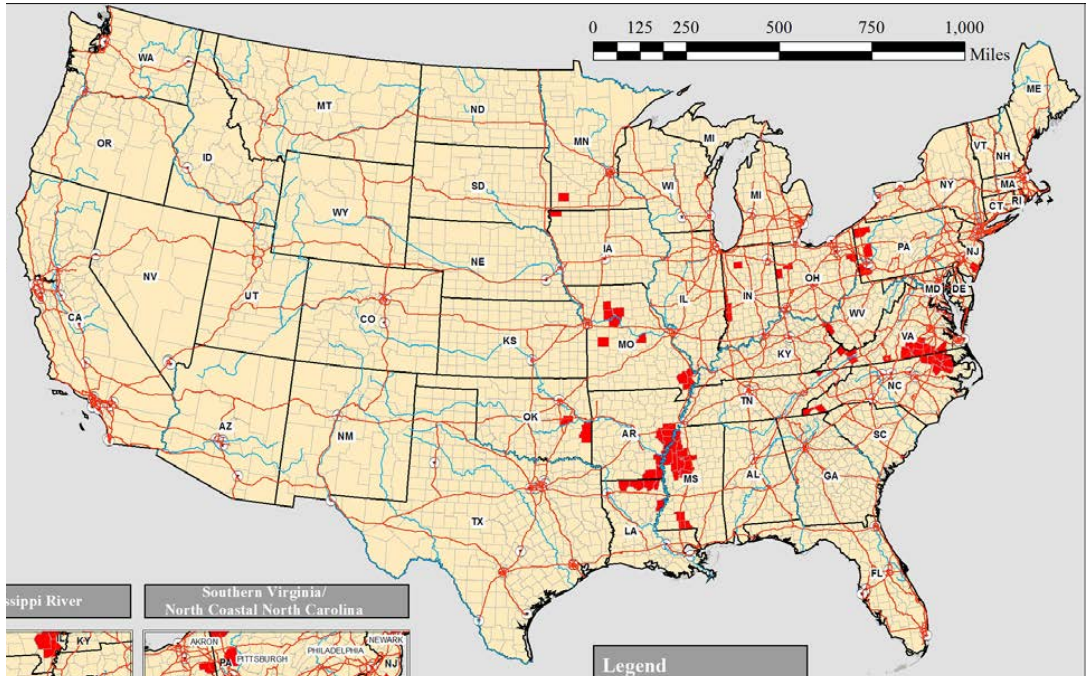
Hotspot n=147 (4.7%)

LMD (MS, AR), and
Southeast Kansas



Breast cancer mortality, 2018-2022

- Compare to previous hotspots:
  - Lower Mississippi Delta remains,
  - Eastern North Carolina/Virginia hotspots shrank, and
  - southeast Kansas emerged as the new hotspot.



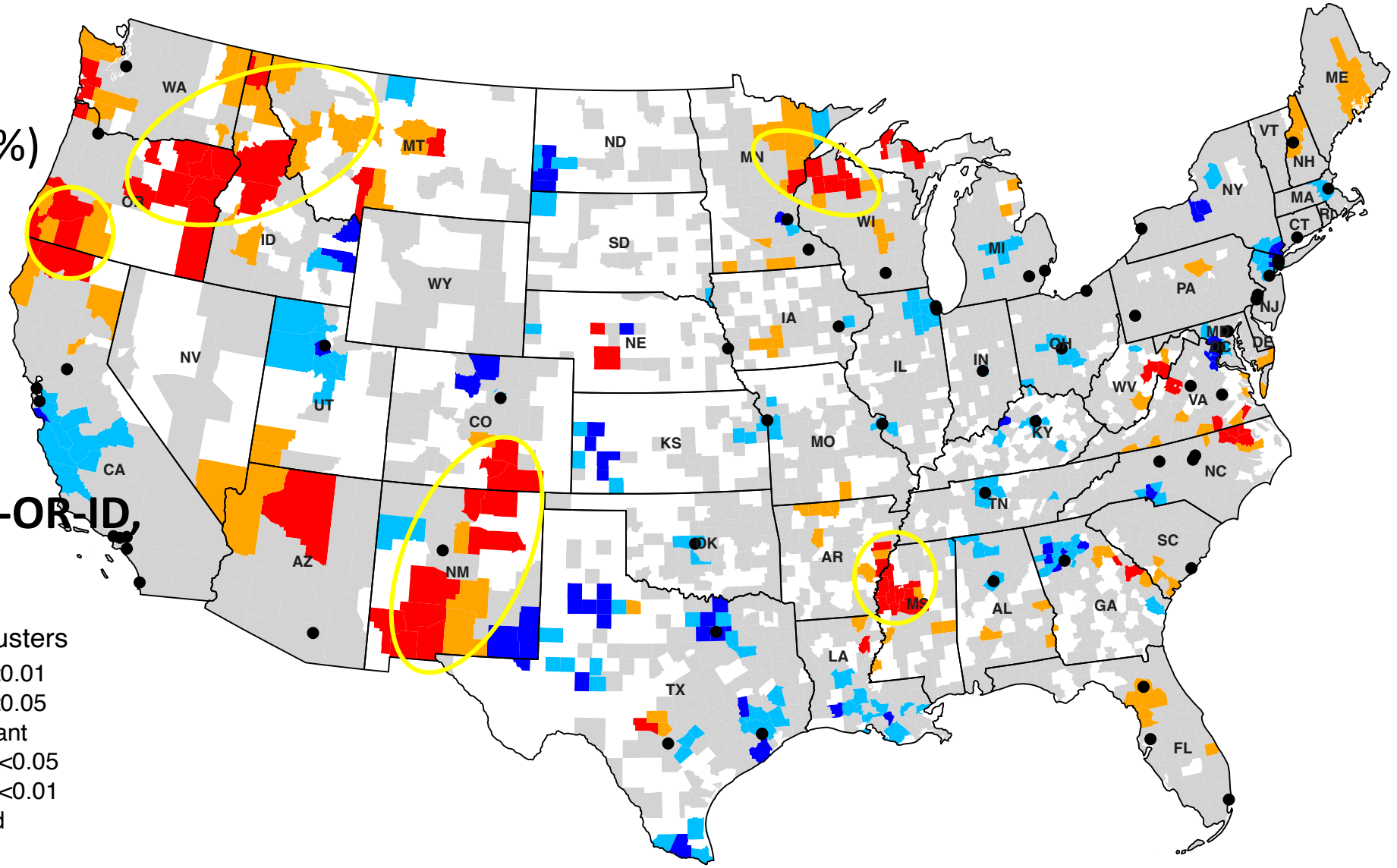
Breast hotspots, 2000-2015

Moore, et al. 2018

Prostate cancer mortality, 2018-2022

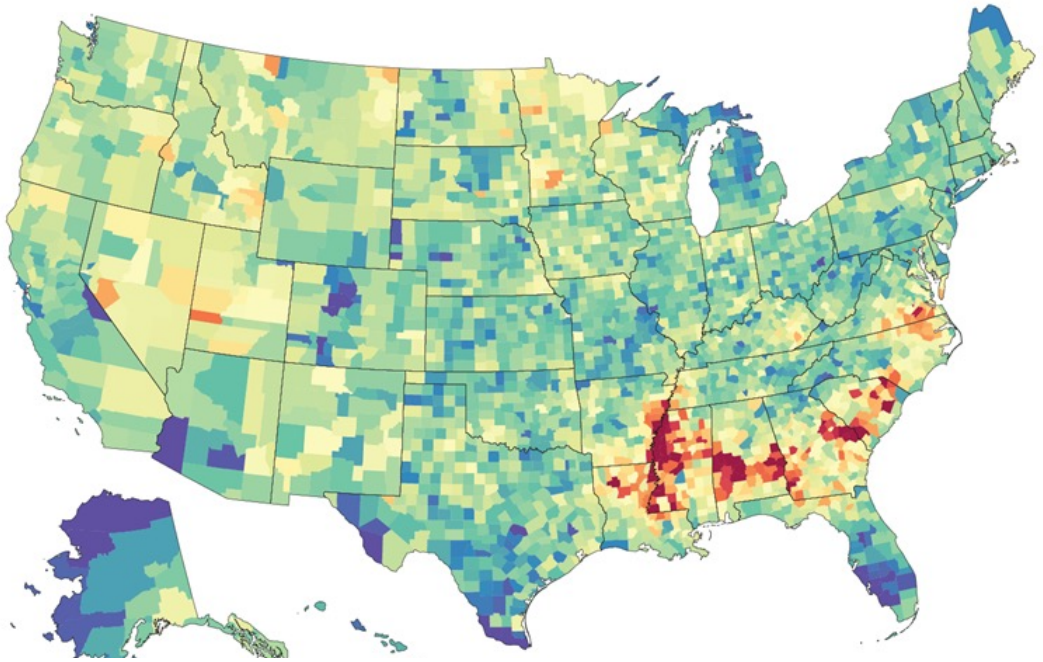
Hotspot n=180 (5.8%)

LMD (MS, AR),
North WI and
The West (north CA-OR-ID, north AZ, and NM)



Prostate cancer mortality, 2018-2022

- Compare to previous hotspots:
  - Lower Mississippi Delta remains,
  - SouthEast (AL-GA-SC) shrinks, and
  - new hotspots in the West (north CA-OH-ID, north AZ, and NM).



Prostate hotspots, 1980-2014

Mokdad, et al. 2017

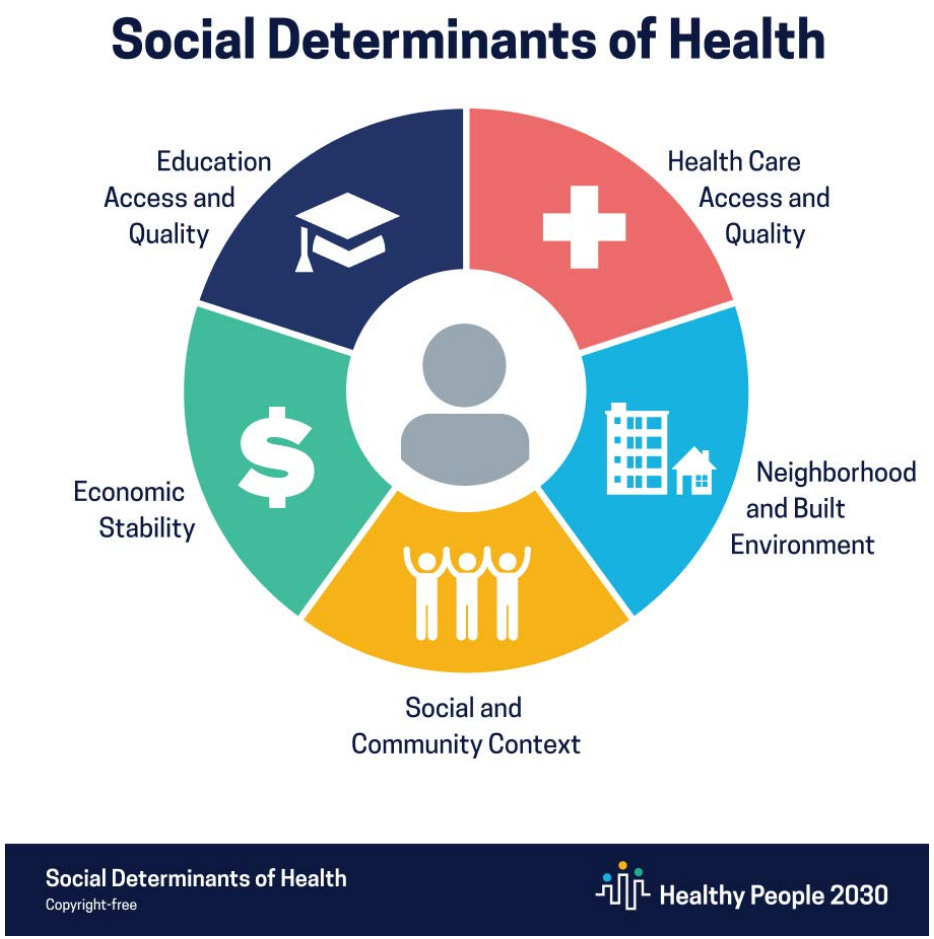
Prostate cancer mortality history

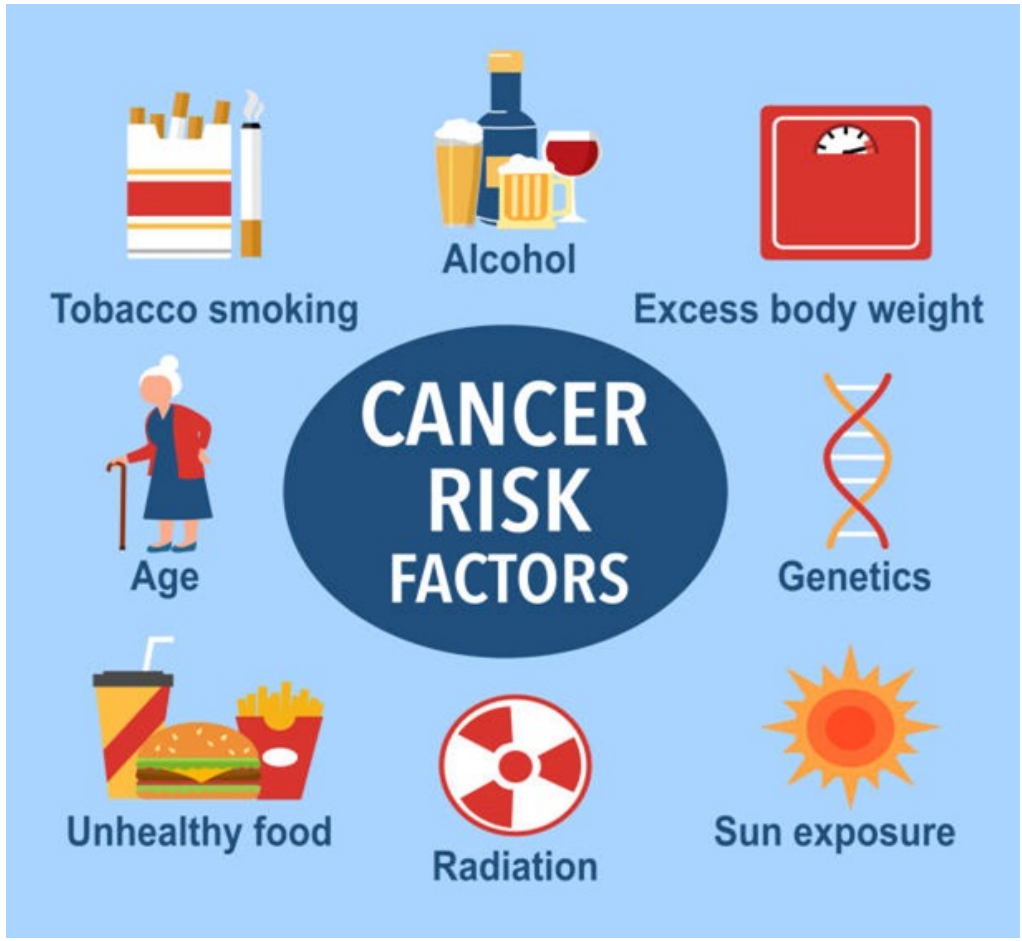
- Studies in recent decades reported prostate cancer mortality shifted from the **North** to the **South** and **West** regions. Our analysis is the first to show that **hotspots have emerged in the West**.

- The underlying factor contributing to this shift was suggested to have changed from **lower UV radiation-related vitamin D synthesis** in earlier studies (1970-1994, Schwartz, et al. 2006) to **lack of access to medical care** (1995-2000, Jemal, et al 2005).

- However, it remains unclear why mortality rates in recent decades are higher in the West region. One possible reason is that men in the West had the **highest rate of active surveillance for low-risk prostate cancer** (Al Awamlh, et al. 2021).

Why geographical disparity exist?





https://www.wellahealth.com/blog/10-cancer-risk-factors-africans-shouldnt-ignore/

Summary

- Updated hotspot analysis for major cancer mortality using the most recent data.
- Developed a novel method to impute the suppressed death counts.
- New hotspots: Midwest for colorectal and breast, East Oklahoma and North Florida for lung cancer, and several hotspots emerged in the West for prostate cancer.
- The geographical disparity is driven by various SDOH, environmental and behavioral factors. Cancer prevention and control efforts should target the under-resourced areas.

Data & code

- Chongliang (Jason) Luo, PhD.
- Email: chongliang@wustl.edu

- https://github.com/chongliang-luo/NationalCancerHotspot


thank you
danke
謝謝
рахмат
ngiyabonga
teşekkür ederim
Баярлалаа
спасибо
faafetai lava
dank je
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