Community-Engaged Research in Urban and Rural Settings to Identify Health Risks from Extreme Heat Events

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Rationale for community-engaged research in the Deep South

- Previously identified vulnerability factor rates high.
- Health disparities--historically based mistrust of government and medical authorities.
- Disaster-prone region.
- Currently, no state or local government adaptation planning.

Rural Health Challenges

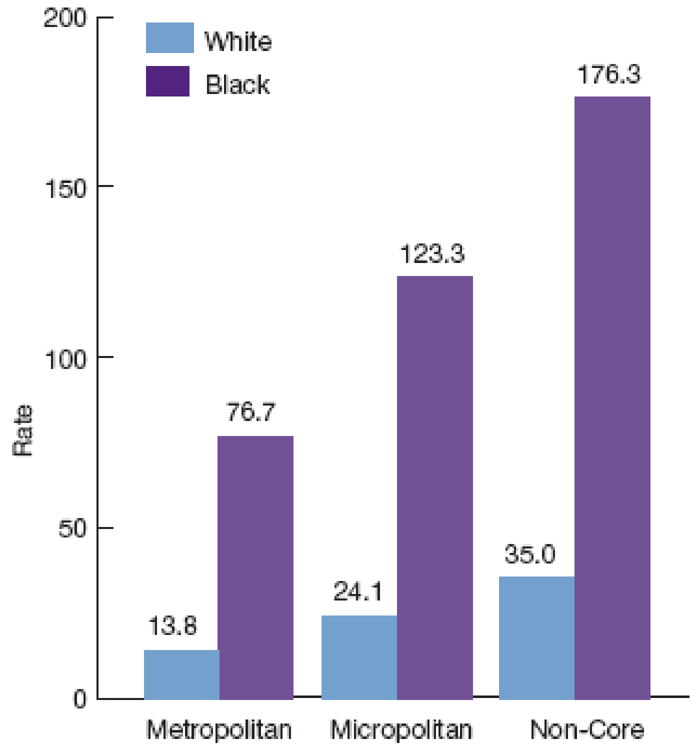
Compared with their urban counterparts, residents of rural areas:

- Report fair or poor health.
- More often have chronic conditions such as diabetes.
- Die from heart disease.

Rural residents have fewer visits to health care providers and are less likely to receive recommended preventive services.

Rural minorities appear to be particularly disadvantaged, and differences are observed in cancer screening, management of cardiovascular disease and diabetes, and mental health.

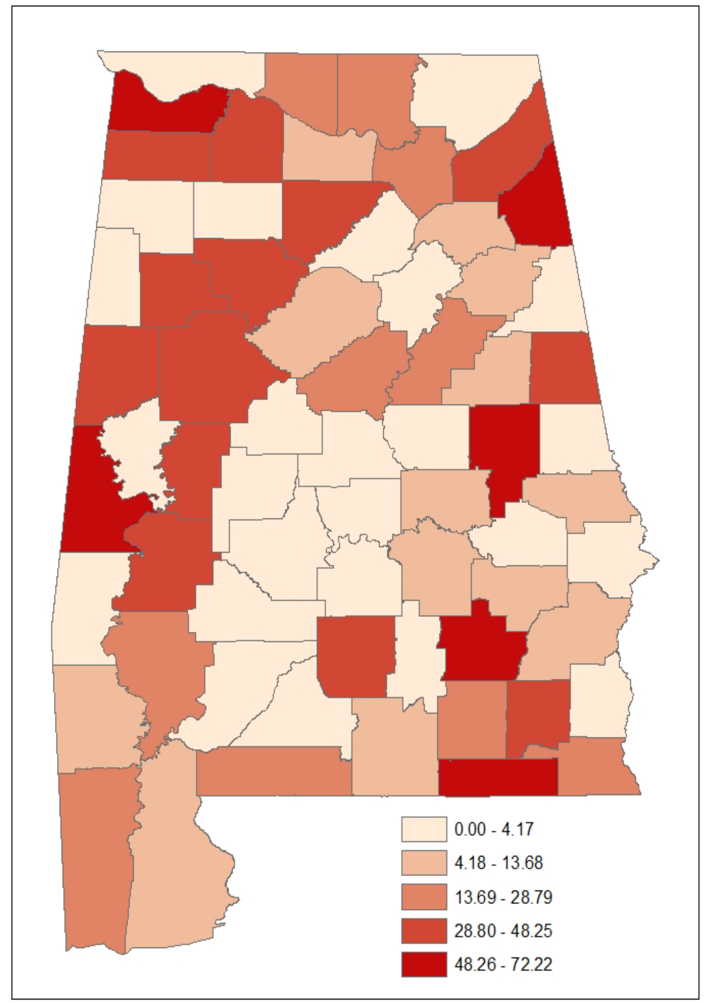
Adult Admissions for Uncontrolled Diabetes Without Complications per 100,000 Population, by Race



Source: Healthcare Cost and Utilization Project, State Inpatient Databases disparities analysis file, 2001.

Key: Metropolitan = 50,000 or more inhabitants; micropolitan = 10,000 to 50,000 inhabitants; noncore = not metropolitan or micropolitan.

Heat-related illnesses and rurality



ADPH, 2012

Are urban and rural communities different?

Establish environmental health priorities in underserved urban and rural communities

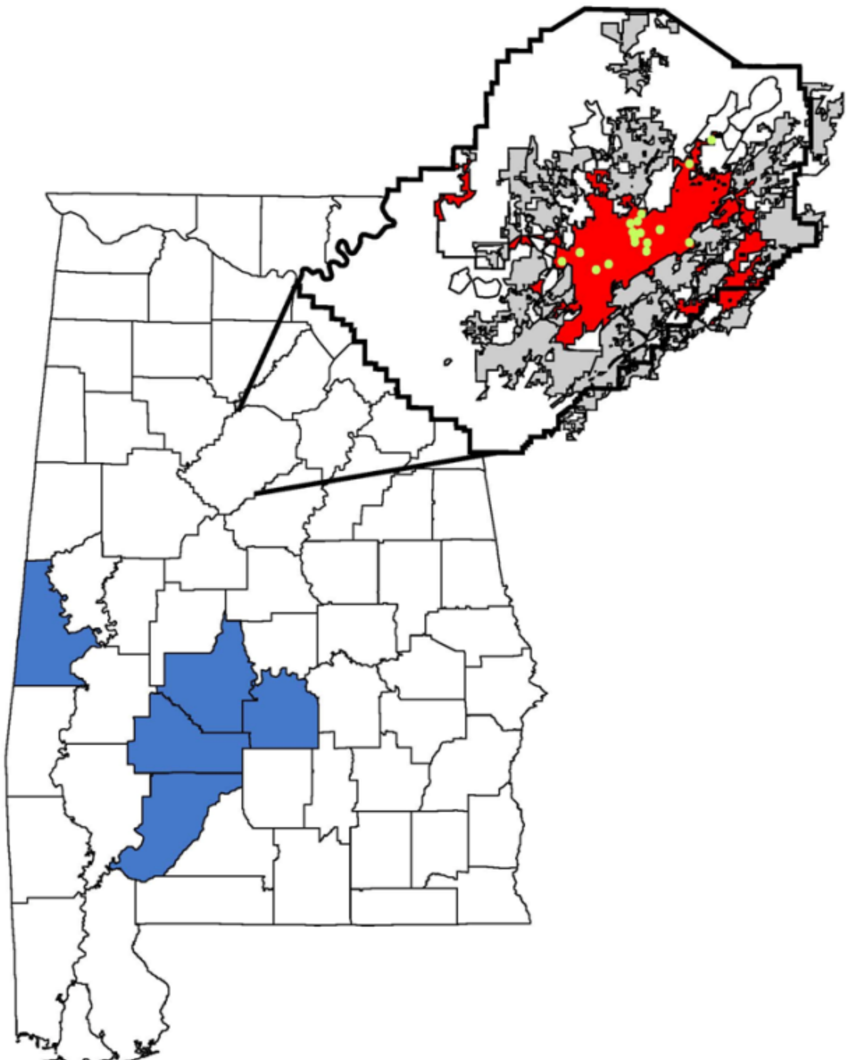
Health outcomes associated with extreme heat events

1990-2010 birth/death records analysis

Pilot community research

Individual level exposures

Determining environmental health priorities in urban and rural communities



Sheila Tyson, Friends of West End, Birmingham AL

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Sheryl Threadgill and Ethel Johnson, West Central Alabama Community Health Improvement League

WCACHIL
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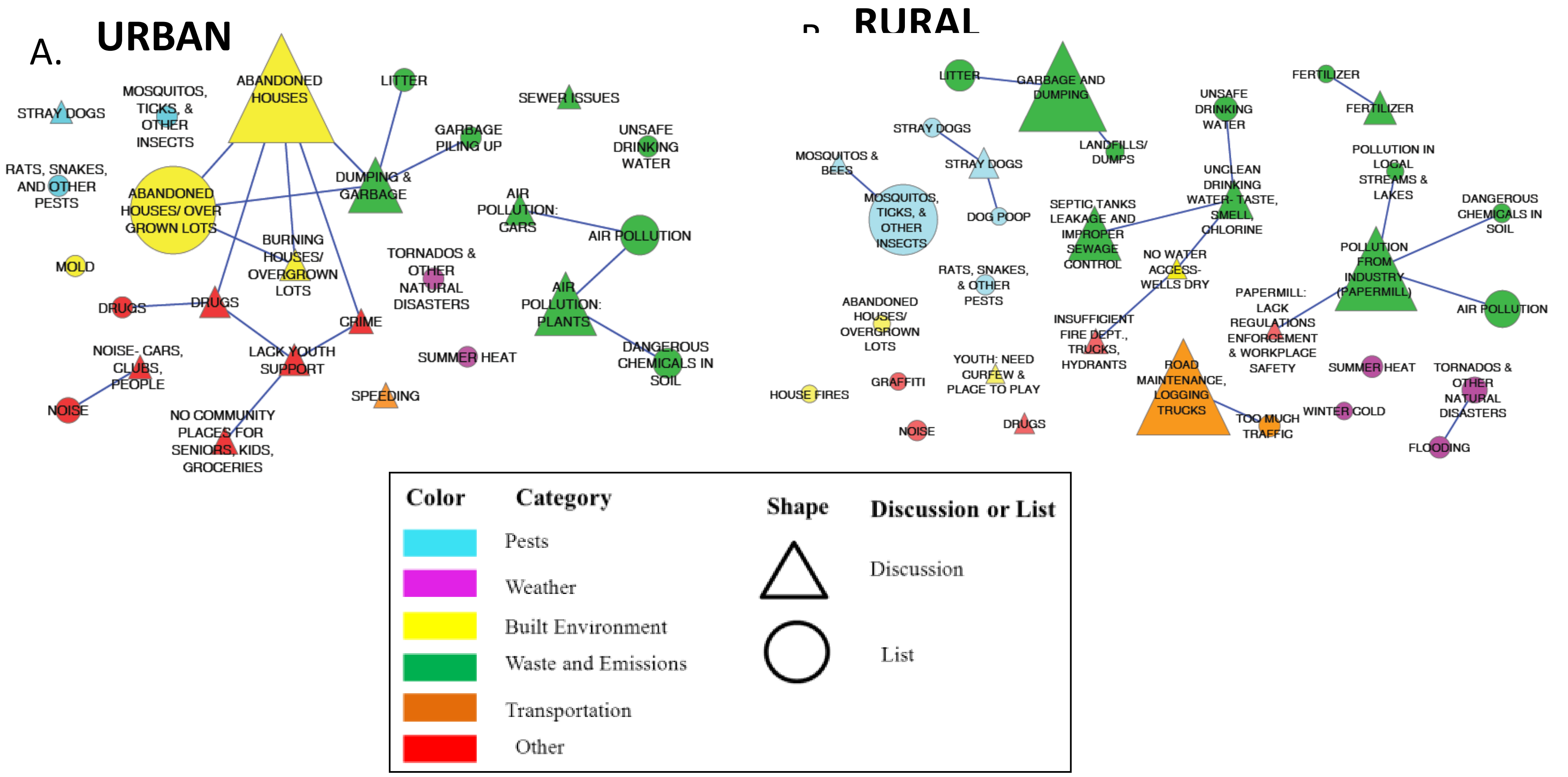
Built environment and industrial pollution are identified as priorities



Bernhard et al. submitted

Alabama birth and death record analysis (1990-2010)

Time-stratified case-crossover design

Responses:

- Non-accidental mortality (N=298,879)
- Preterm Birth (N=281,546)

Exposure metric?

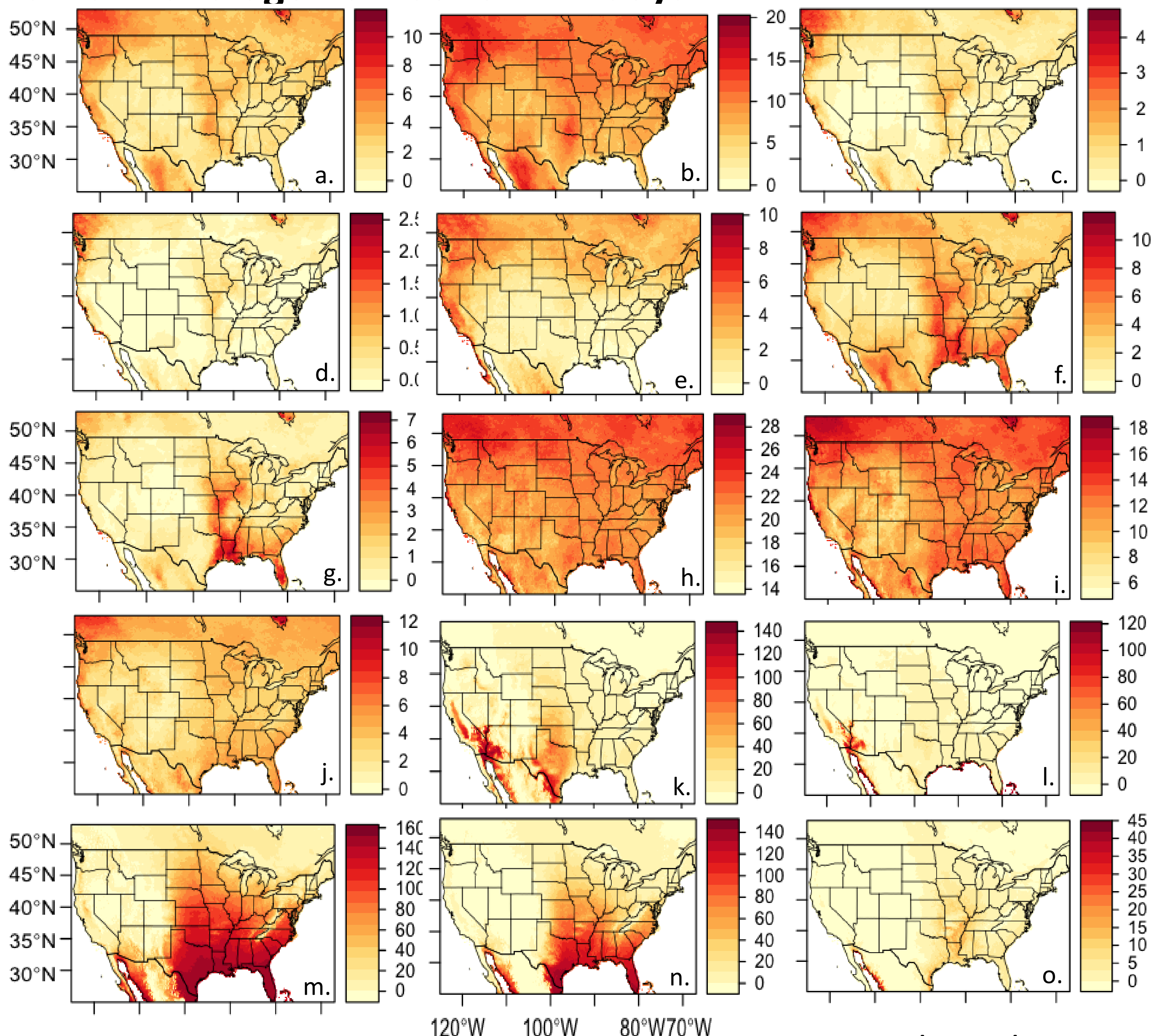
Heat wave definitions

Heat Wave Indices (HI)	Temperature Metric	Threshold	Duration	HI Type	Reference(s)
HI01	Mean daily temperature	>95th percentile	2+ consecutive days	Relative	Anderson and Bell (2011)
HI02	Mean daily temperature	>90th percentile	2+ consecutive days	Relative	Anderson and Bell (2011)
HI03	Mean daily temperature	>98th percentile	2+ consecutive days	Relative	Anderson and Bell (2011)
HI04	Mean daily temperature	>99th percentile	2+ consecutive days	Relative	Anderson and Bell (2011)
HI05	Minimum daily temperature	>95th percentile	2+ consecutive days	Relative	Anderson and Bell (2011)
HI06	Maximum daily temperature	>95th percentile	2+ consecutive days	Relative	Anderson and Bell (2011)
HI07	Maximum daily temperature	T1: >81st percentile T2: >97.5th percentile	Everyday, >T1; 3+ consecutive days, >T2; Avg T_{max}>T1 for whole time period	Relative	Peng et al. (2011); Meehl and Tebaldi (2004)
HI08	Maximum daily apparent temperature	>85th percentile	1 day	Relative	Steadman (1984)
HI09	Maximum daily apparent temperature	>90th percentile	1 day	Relative	Steadman (1984)
HI10	Maximum daily apparent temperature	>95th percentile	1 day	Relative	Steadman (1984)
HI11	Maximum daily temperature	>35 °C	1 day	Absolute	Tan et al. (2007)
HI12	Minimum & maximum daily temperature	T_{min}>26.7 °C T_{max}>40.6 °C	≥1 threshold for 2+ consecutive days	Absolute	Robinson (2001)
HI13	Maximum daily heat index	>80 °F	1 day	Absolute	National Weather Service, Rothfusz and Scientific Services Division (1990); Steadman (1979)
HI14	Maximum daily heat index	>90 °F	1 day	Absolute	National Weather Service, Rothfusz and Scientific Services Division (1990); Steadman (1979)
HI15	Maximum daily heat index	>105 °F	1 day	Absolute	National Weather Service, Rothfusz and Scientific Services Division (1990); Steadman (1979)
HI16*	Maximum daily heat index	>130 °F	1 day	Absolute	National Weather Service, Rothfusz and Scientific Services Division (1990); Steadman (1979)

Smith et al. 2012 *Climatic Change*

Average number of hw days

- **1979-2011 average number of HW days**



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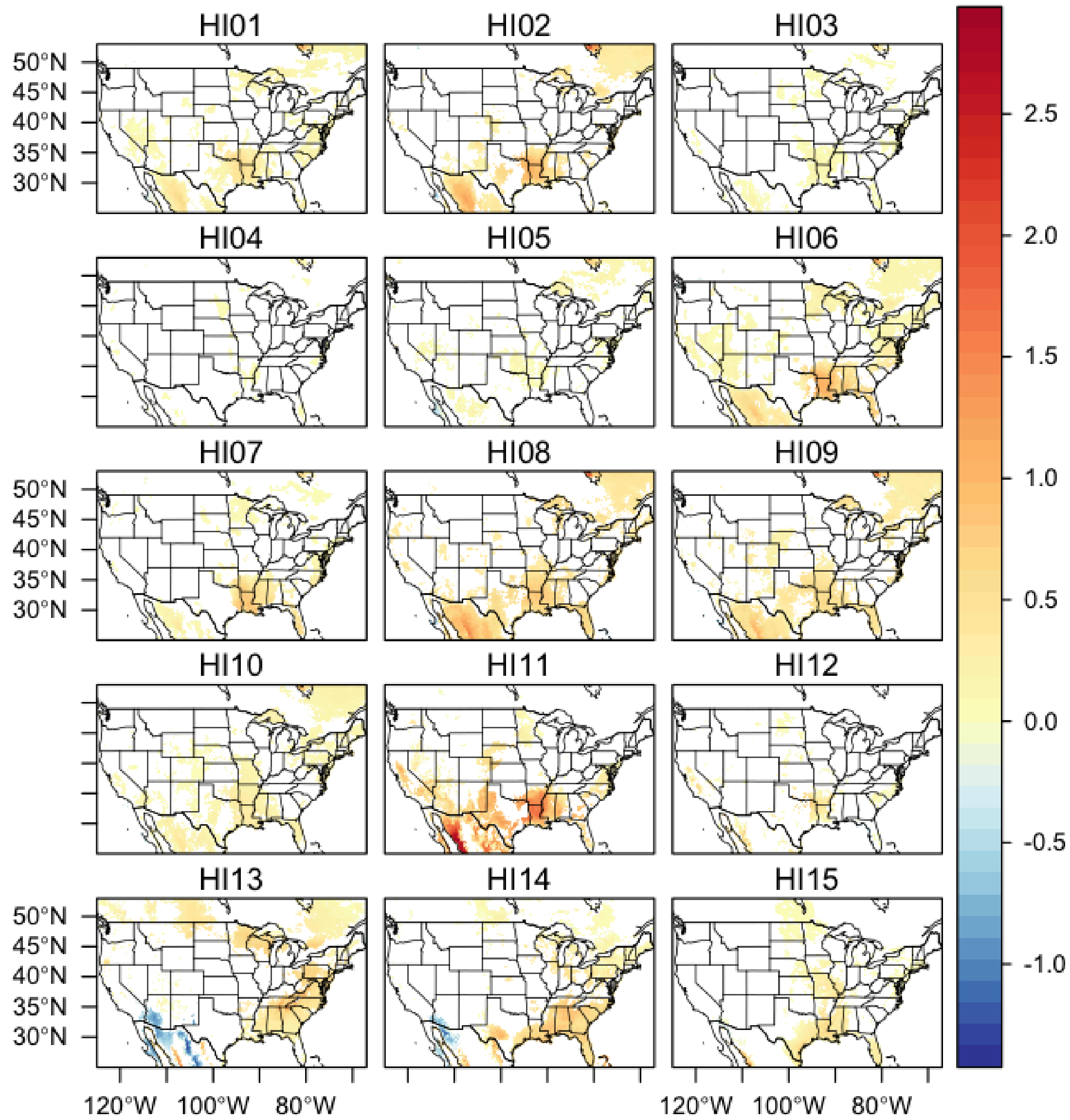
Temporal Trends: HWs in the SE have increased at 2X the rate of HWs in the NE



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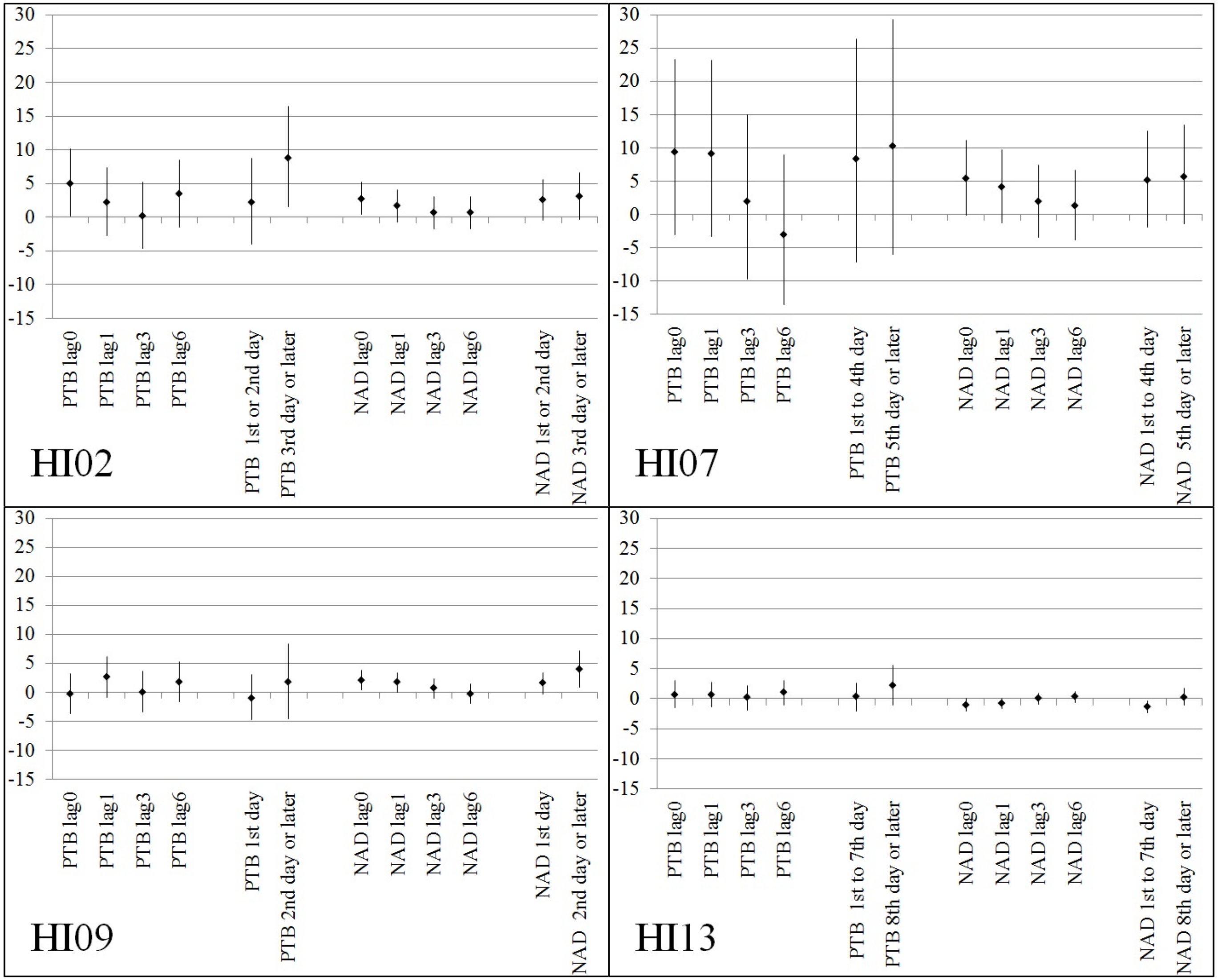
	Preterm Birth	**Non-accidental mortality**
HI	% odds increase (95% CI)	% odds increase (95% CI)
1	7.0 (-1.6, 16.3)	2.4 (-1.5, 6.5)
2	**5.0 (0.1, 10.2)**	**2.8 (0.4, 5.2)**
3	24.6 (-0.6, 56.1)	-0.2 (-10.6, 11.3)
4	-58.5 (-85.4, 18.2)	-24.9 (-52.5, 18.5)
5	13.4 (-22.4, 65.8)	4.5 (-15.9, 29.9)
6	0.0 (-6.9, 6.2)	2.2 (-0.7, 5.2)
7	9.3 (-3.1, 23.3)	5.4 (-0.1, 11.2)
8	1.3 (-1.4, 4.2)	**1.5 (0.2, 2.8)**
9	-0.3 (-3.7, 3.2)	**2.1 (0.5, 3.8)**
10	-2.3 (-7.8, 3.5)	2.4 (-0.4, 5.2)
11	0.8 (-4.9, 6.8)	0.8 (-2.0, 3.6)
12	-0.5 (-9,0, 8.7)	-1.0 (-5.3, 3.5)
13	0.7 (-1.5, 3.0)	**-1.0 (-2.0, 0.0)**
14	1.8 (-1.0, 4.7)	0.9 (-0.3, 2.1)

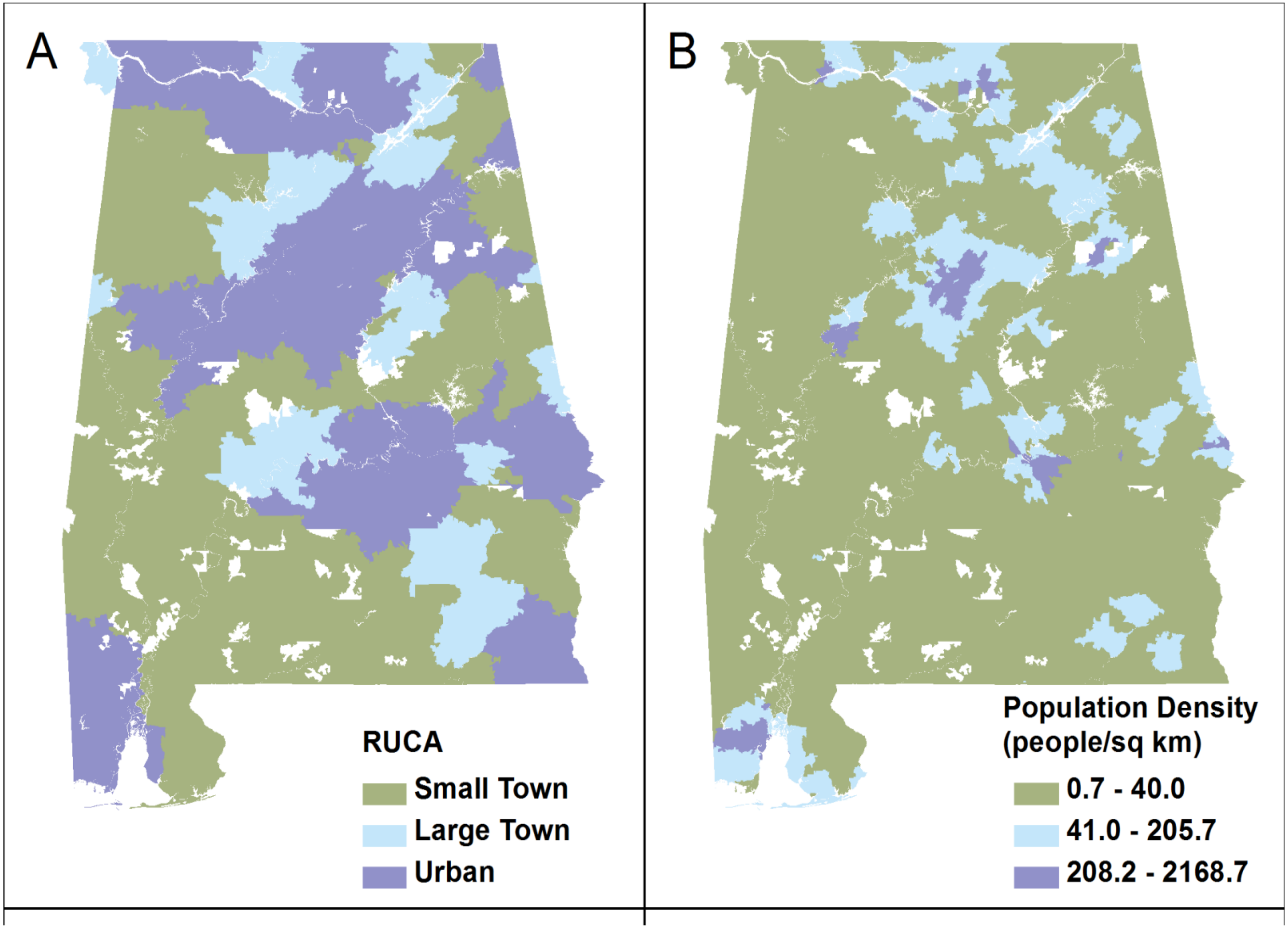
Stuff and

Lag and duration models



Kent et al. in preparation

Rurality Definitions



Rurality-stratified percent increase in odds of preterm birth on a heat wave day, by Heat Wave Indices (HIs)

Rurality category	N	HI02	HI07	HI09	HI13
RUCA					
Small Town	9725	7.6 (-4.9, 21.7)	-5.1 (-30.9, 30.5)	1.3 (-7.1, 10.5)	-1.4 (-6.8, 4.3)
Large Town	9300	4.7 (-9.1, 20.6)	-6.0 (-31.4, 28.9)	-7.5 (-16.7, 2.6)	1.6 (-4.9, 8.4)
Urban	43452	4.6 (-1.2, 10.6)	**16.2 (0.7, 34.2)**	0.5 (-3.5, 4.7)	1.0 (-1.6, 3.7)
Population Density					
1st Tertile	20020	3.1 (-5.3, 12.2)	-2.8 (-20.9, 19.4)	-2.7 (-8.4, 3.4)	2.4 (-1.4, 6.5)
2nd Tertile	20015	**9.1 (0.5, 18.5)**	**28.6 (4.6, 57.9)**	2.0 (-3.9, 8.3)	-0.2 (-4.0, 3.8)
3rd Tertile	20242	2.9 (-5.4, 11.9)	4.4 (-16.1, 29.8)	-0.3 (-6.1, 6.0)	-0.1 (-3.9, 3.8)

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Rurality-stratified percent increase in odds of non-accidental death on a heat wave day, by Heat Wave Indices (HIs)

Rurality category	N	HI02	HI07	HI09	HI13
RUCA					
Small Town	59677	0.2 (-5.1, 5.8)	-3.9 (-15.4, 9.1)	-0.1 (-3.7, 3.6)	**-2.5 (-4.7, -0.3)**
Large Town	41095	-0.8 (-6.9, 5.7)	4.8 (-8.6, 20.1)	1.4 (-3.0, 6.0)	1.9 (-0.8, 4.6)
Urban	198107	**4.3 (1.3, 7.3)**	**8.2 (1.3, 15.5)**	**3.0 (0.9, 5.1)**	-1.1 (-2.3, 0.1)
Population Density					
1st Tertile	96186	2.9 (-1.3, 7.3)	-3.0 (-11.9, 6.9)	1.7 (-1.2, 4.7)	-1.0 (-2.7, 0.8)
2nd Tertile	102129	3.3 (-0.7, 7.5)	7.2 (-2.0, 17.2)	2.2 (-0.6, 5.1)	-0.2 (-1.9, 1.5)
3rd Tertile	100564	2.1 (-1.9, 6.3)	**11.8 (1.9, 22.6)**	2.4 (-0.5, 5.4)	**-1.8 (-3.5, -0.1)**

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Conclusions

- Tangible adaptation strategies that also address community priorities may be most effective.
- Heatwave definitions—daily mean works as well as apparent temperature.
- Birth records analysis suggests premature births are higher during heat waves.
- Stronger NAM relationships in urban areas.
- Personal monitors may be useful for identifying vulnerable populations or behaviors.
- Individual level exposures may be different across urban and rural areas and are highly dependent on occupation.

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NIEHS National Institute of Environmental Health Sciences

DSC OHS THE DEEP SOUTH CENTER for Occupational Health & Safety
The University of Alabama at Birmingham & Auburn University

PRC Prevention Research Centers

Nutrition Obesity Research Center