HOT AS BLUE BLAZES:

The impacts of excessive heat on preterm labor

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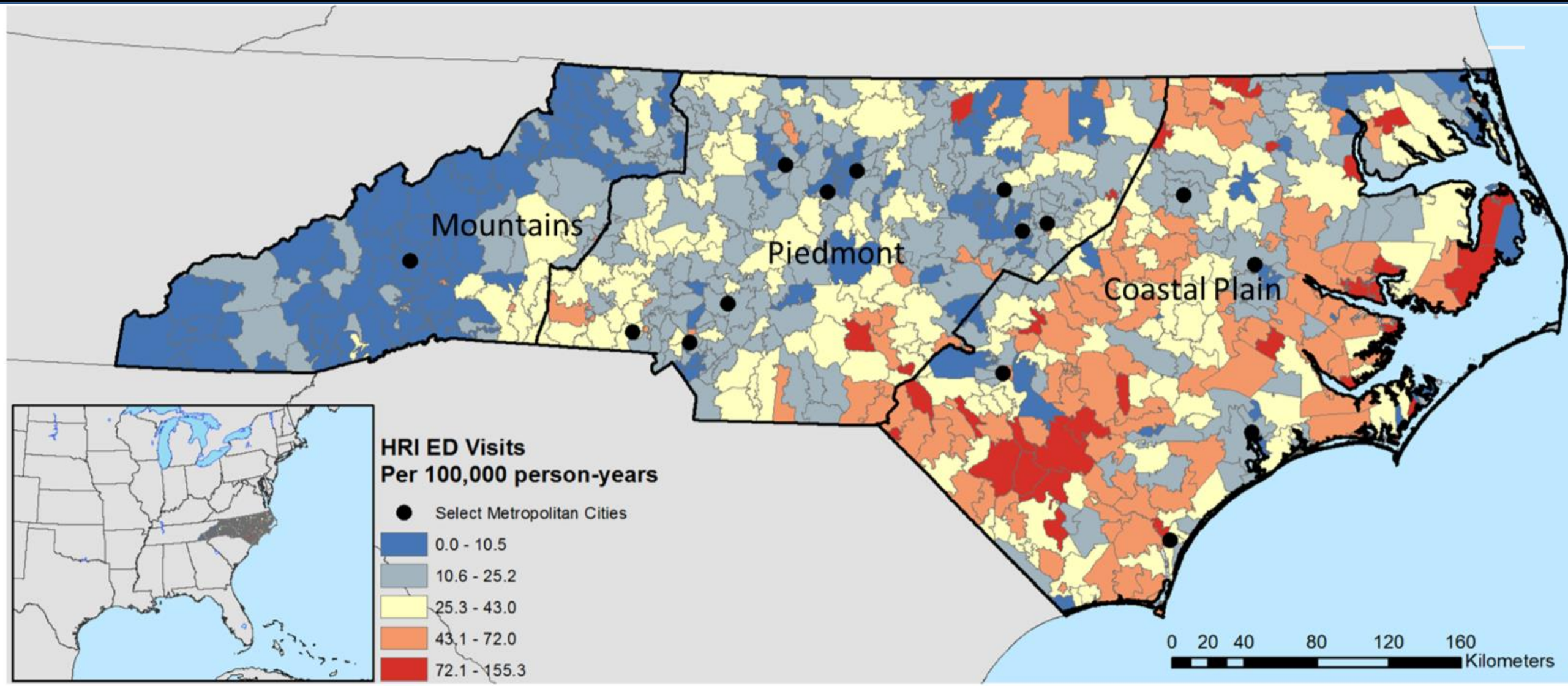
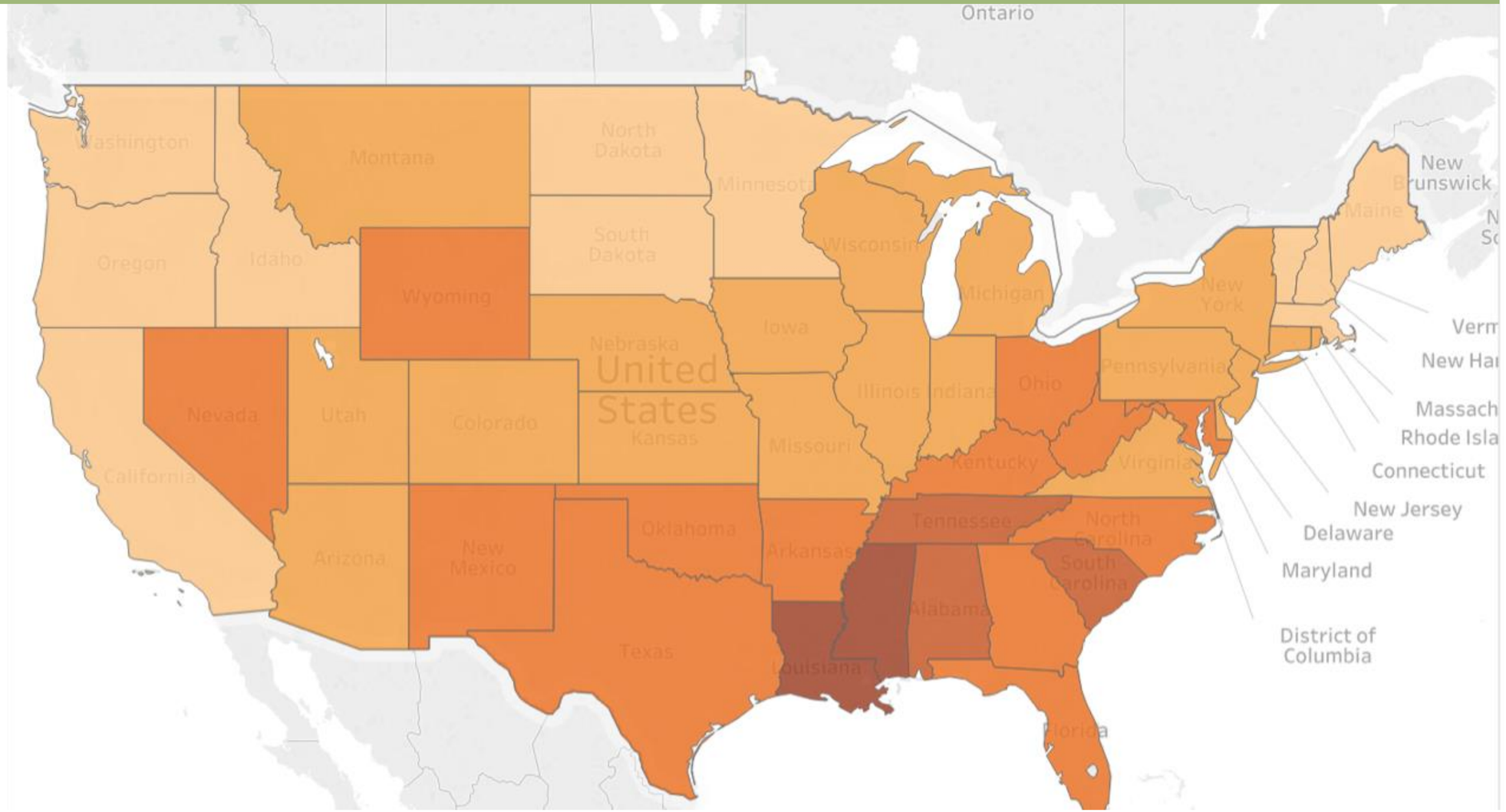
Heat-Related Illness Rates by Zip Code, NC 2007-2012



Kovach, M., Konrad, C., Fuhrmann, C. (2015). Area-level risk factors for heat-related illness in rural and urban locations across North Carolina, USA. Applied Geography. 60, 175-183.

Percent of Preterm Births 2011-2015



9 of top 10

are in the Southeast

All of southeast with exception of Virginia in top 20 & exceed national average for preterm births

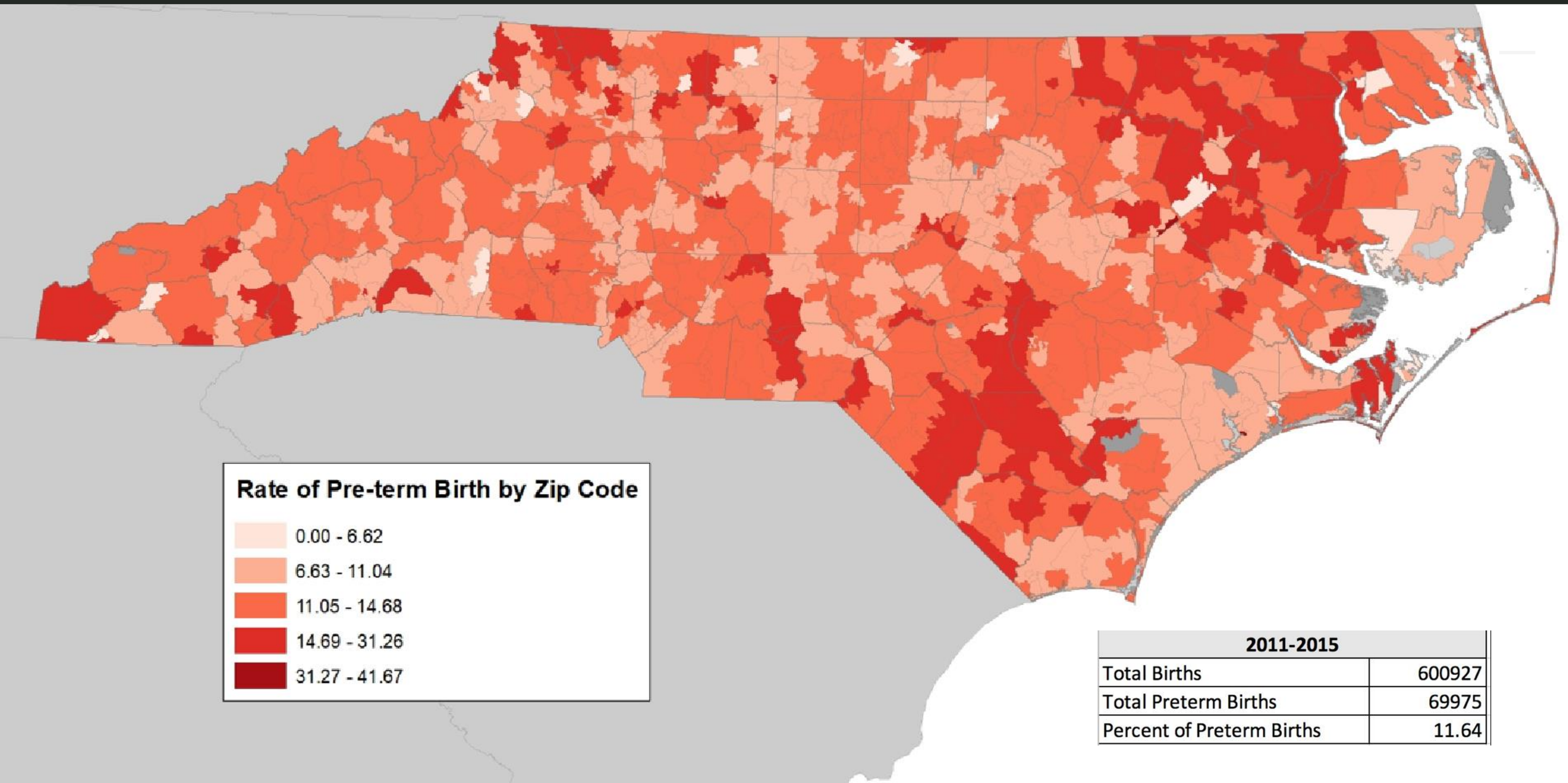
Associations with

Preterm Birth in NC

- History of preterm birth
- Multiple births
- Smoking, alcohol, or drug use
- Late or no prenatal care
- Diabetes or hypertension
- Infection

Sources: 1) “Born too soon and too small in North Carolina.” March of Dimes Foundation, March 2015; 2) Berkowitz, GS, Papiernick E. 1993. Epidemiology of preterm birth. Epidemiological Review 15(2): 414-443

Preterm Birth Rates by Zip Code, NC 2011-2015



2011-2015	
Total Births	600927
Total Preterm Births	69975
Percent of Preterm Births	11.64

Previous work on excessive heat impacts to pregnant women

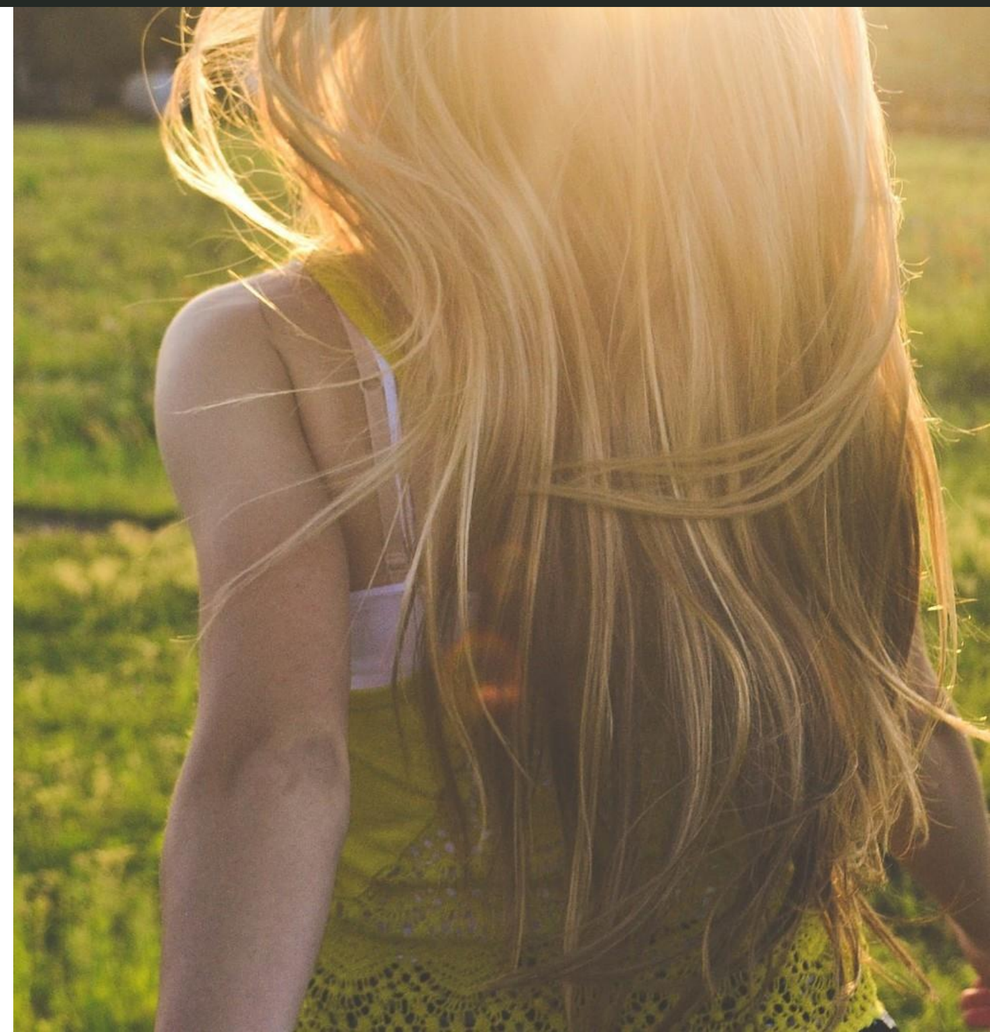
- Focuses on single events
- Examines impact of all temperature extremes
- Western United States or overseas

Findings:

1.Heat waves associated with pre-term birth but how much depends upon strength and length of exposure

2. Impacts range from <1% – 2% increase in risk for each increase in degree interval (most common association with heat index)

3. Heat Index highly correlated



Aims

1. Describe the relationship between excessive heat days and preterm delivery (<37 weeks) in NC, 2011-2015

- Max temp
- Min temp
- Mean temp
- Heat index
- 1-5 day lags for each
- 3 day cumulative for each
- departure from normal

2. Determine thresholds at which health impacts occur for each meteorological variable

Methods

1. Population: all live, singleton births in NC during 2011–2015 heat seasons (May-September)

2. Exposure: PRISM data was provided for each available variable; other variables calculated from these provided variables (heat index, mean temperature, lags, and cumulative variables)

3. Outcome classification: birth certificate data from NC Vital Records was obtained

4. Other variables: maternal age, maternal race, maternal ethnicity, principal source of payment, access to OB/ midwife, birth weight, region, urban access (determined from Census)

Methods

Statistical Analysis:

- Case-crossover study with time-stratified referent selection
- Cox Proportional Hazards

Descriptive Statistics:

- Individual and county-level summaries of pre-term birth

Binomial Generalized Additive Model:

- To establish thresholds at which impacts are experienced

Summary Statistics:

Preterm birth, NC

Region		West	Piedmont	East
No of Preterm Birth		3392	16739	9723
Maternal Age	<20	13.19	13.99	13.61
	20-24	11.19	11.60	11.46
	25-34	10.58	10.46	11.56
	35 and above	13.45	13.19	16.04
Maternal Race	African American	17.30	15.61	16.74
	American Indian	17.17	12.73	13.38
	Asian	10.25	10.24	11.02
	Non-White	10.42	10.93	11.05
	White	10.83	9.69	10.04
Maternal Ethnicity	Hispanic	10.16	10.75	10.85
	Non-Hispanic	11.48	11.51	12.37
Method of Payment	Medicaid	12.64	13.21	14.23
	Private Insurance	9.51	9.91	10.07
	Self-Pay	10.78	11.49	12.59
	Other	8.02	11.13	9.86
	Unknown	9.76	10.42	18.24

Region	Threshold	Odds Ratio	Percentile
Mountains	73 - 74	1.01 (1.01,1.02)	84 - 86
	74 - 75	1.04 (1.03,1.04)	86 - 88
	75 - 76	1.06 (1.05,1.07)	88 - 90
	76 - 77	1.08 (1.05,1.11)	90 - 92
	77 - 78	1.10 (1.05,1.14)	92 - 94
	78 - 79	1.11 (1.04,1.17)	94 - 96
	79 - 80	1.12 (1.04,1.19)	96 - 98
Piedmont	74 - 75	1.01 (1.00,1.01)	86 - 88
	75 - 76	1.01 (1.01,1.02)	88 - 90
	76 - 77	1.02 (1.00,1.05)	90 - 92
	77 - 78	1.03 (0.98,1.07)	92 - 94
	78 - 79	1.03 (0.97,1.09)	94 - 96
	79 - 80	1.04 (0.97,1.11)	96 - 98
	80 - 81	1.04 (0.96,1.11)	98 - 100
Eastern	72 - 73	1.01 (1.01,1.01)	84 - 86
	73 - 74	1.02 (1.02,1.02)	86 - 88
	74 - 75	1.03 (1.03,1.03)	88 - 90
	75 - 76	1.04 (1.03,1.05)	90 - 92
	76 - 77	1.05 (1.02,1.08)	92 - 94
	77 - 78	1.06 (1.01,1.10)	94 - 96
	78 - 79	1.06 (1.01,1.12)	96 - 98
	79 - 80	1.07 (1.00,1.13)	98 - 100

Results

Statistically significant associations:

- Max temp
- Min temp*
- Mean temp
- 3 day cumulative for each

- No significant differences in race, slight differences by region

Threshold: two degree temperature groups of analysis

Odds Ratio: increased percent in odds of preterm birth associated with temperature threshold (upper and lower confidence interval ranges at 95% confidence interval

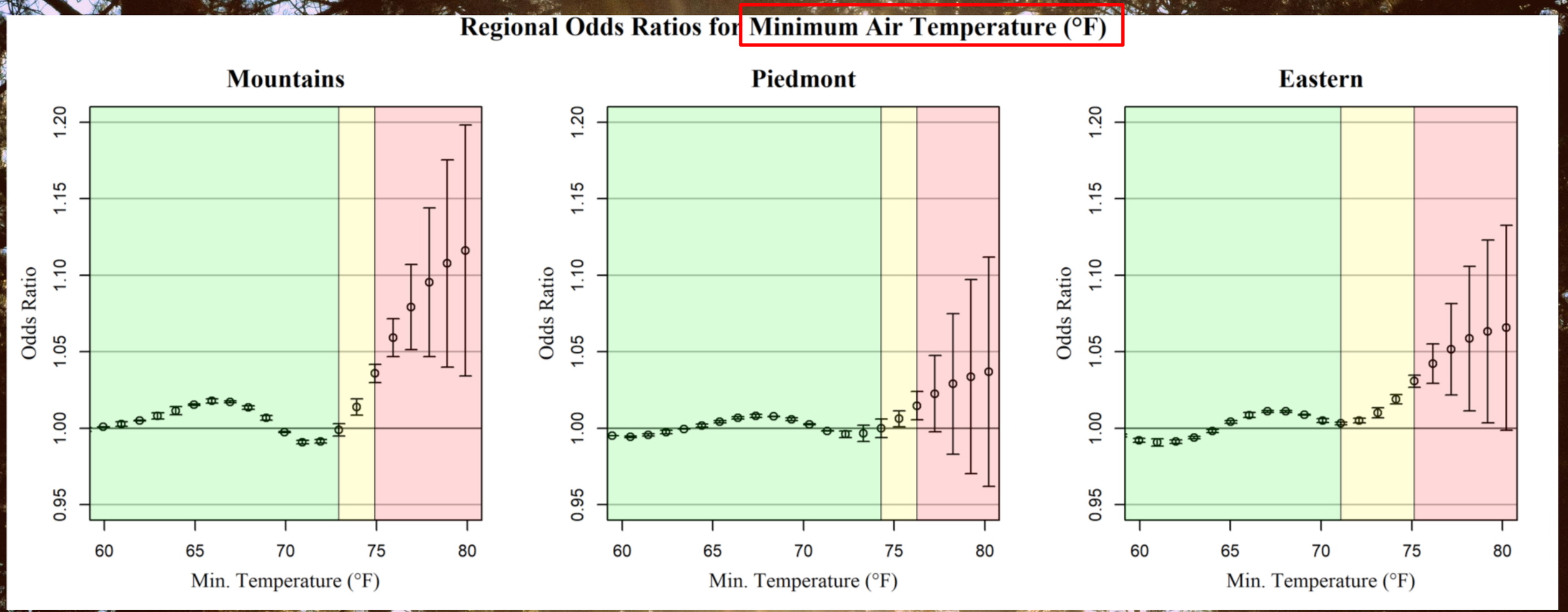
Percentile: placement of respective threshold temperature among regional distribution of temperature

Where to go from here?

Heat Early Warning System

Understanding changes in risk

Engaging with pregnant women to understand contextual factors around risk



Suggested thresholds for warnings

Yellow: temperatures at which any impact to preterm birth is detected

Red: temperatures in the 90th percentile with notably higher impacts to preterm birth

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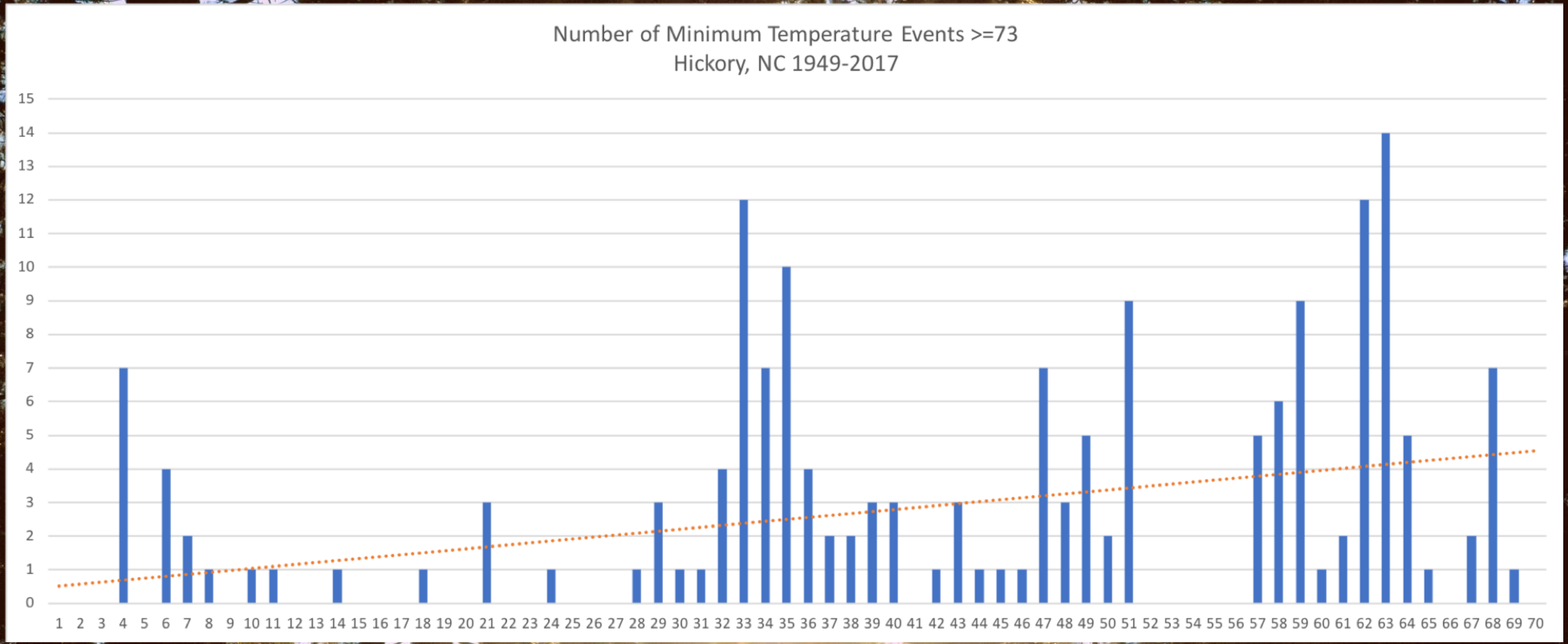
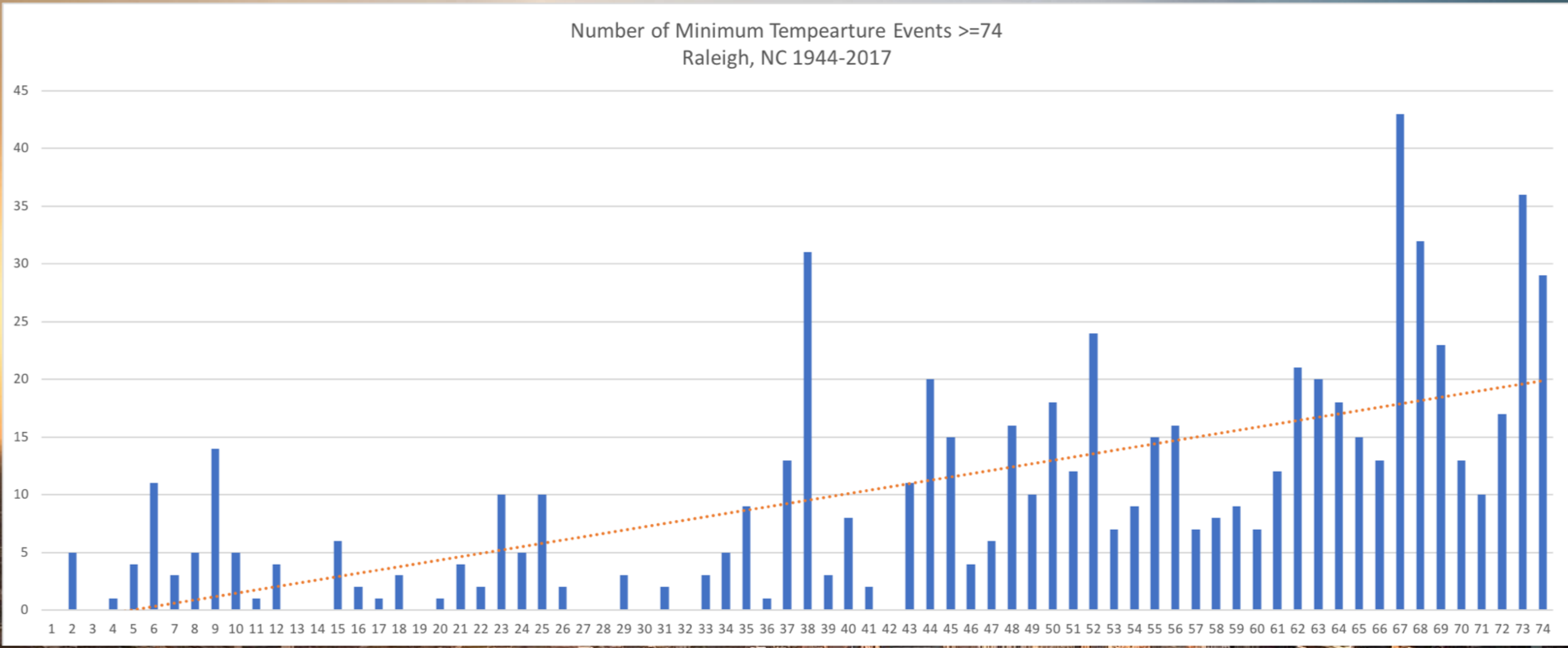
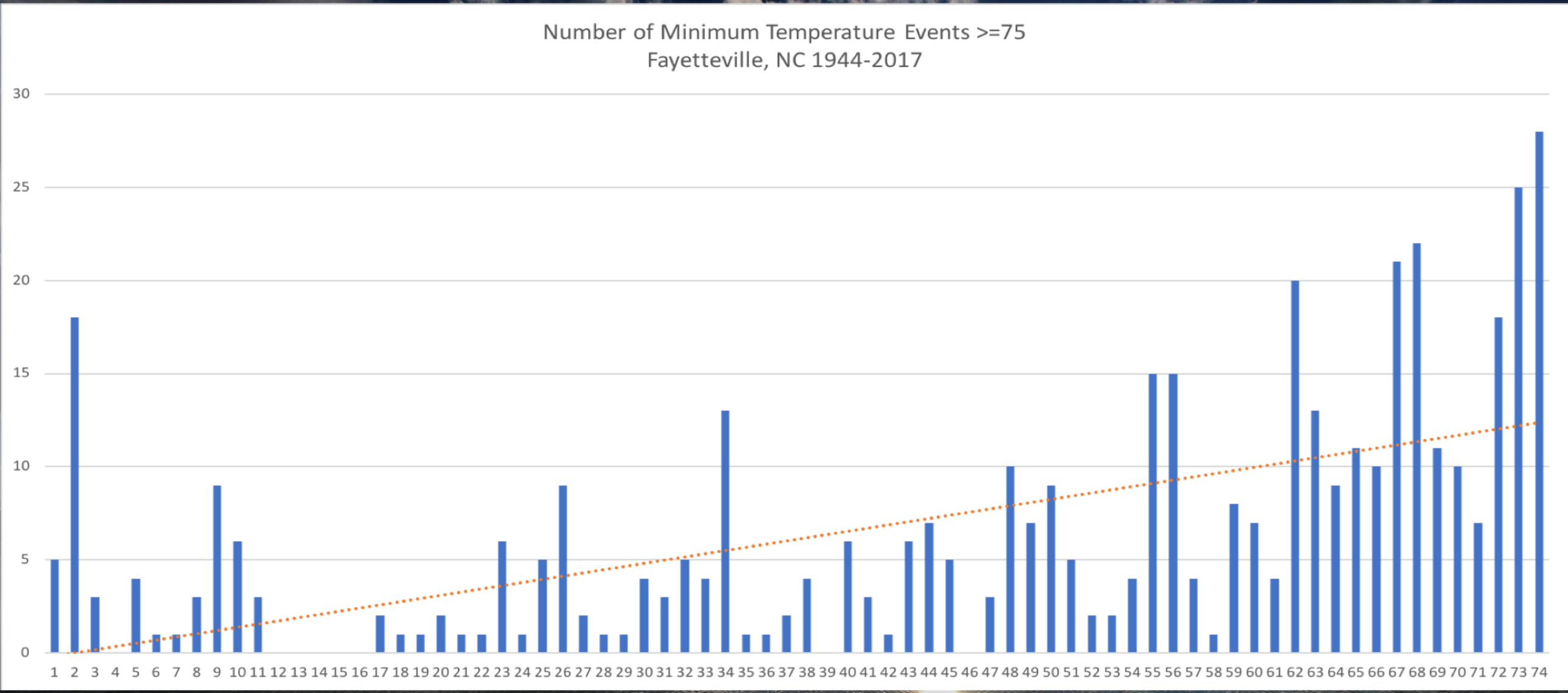


*Stations queried: Asheville, NC; Hickory, NC
Note: Asheville, NC did not register any events at threshold temperatures



*Stations queried: Raleigh, NC; Greensboro, NC



* Stations queried: Fayetteville, NC

Low threshold frequency very high – this graph represents the point of 4% or greater increase in odds of preterm labor

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Special thanks

Co-Authors

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