Identifying Heat Vulnerability in North Carolina

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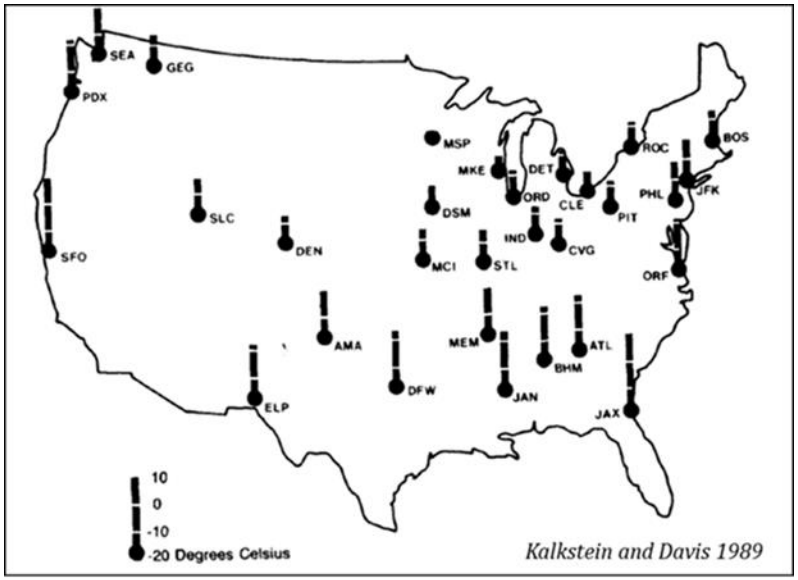
Why Heat?

- Heat stroke is deadly; about 15% of those who survive suffer impairments to the nervous, renal, or respiratory system
- Heat-related illness is entirely preventable with access to air conditioning and effective public health messaging, education, and awareness
- Most heat – health research focuses on urban areas and heat mortality.

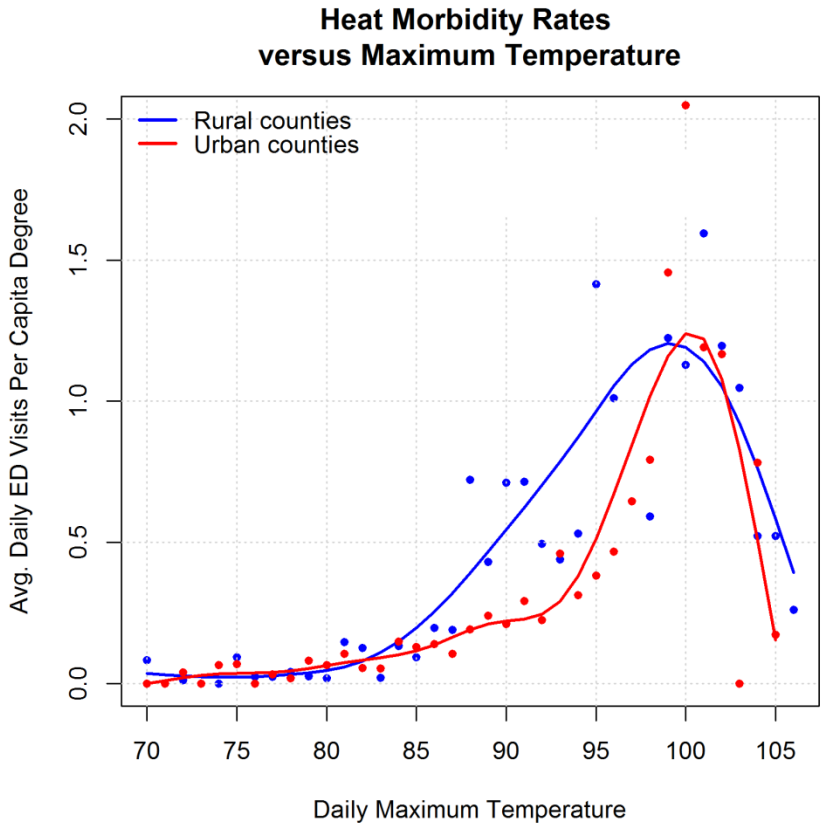


Research Questions

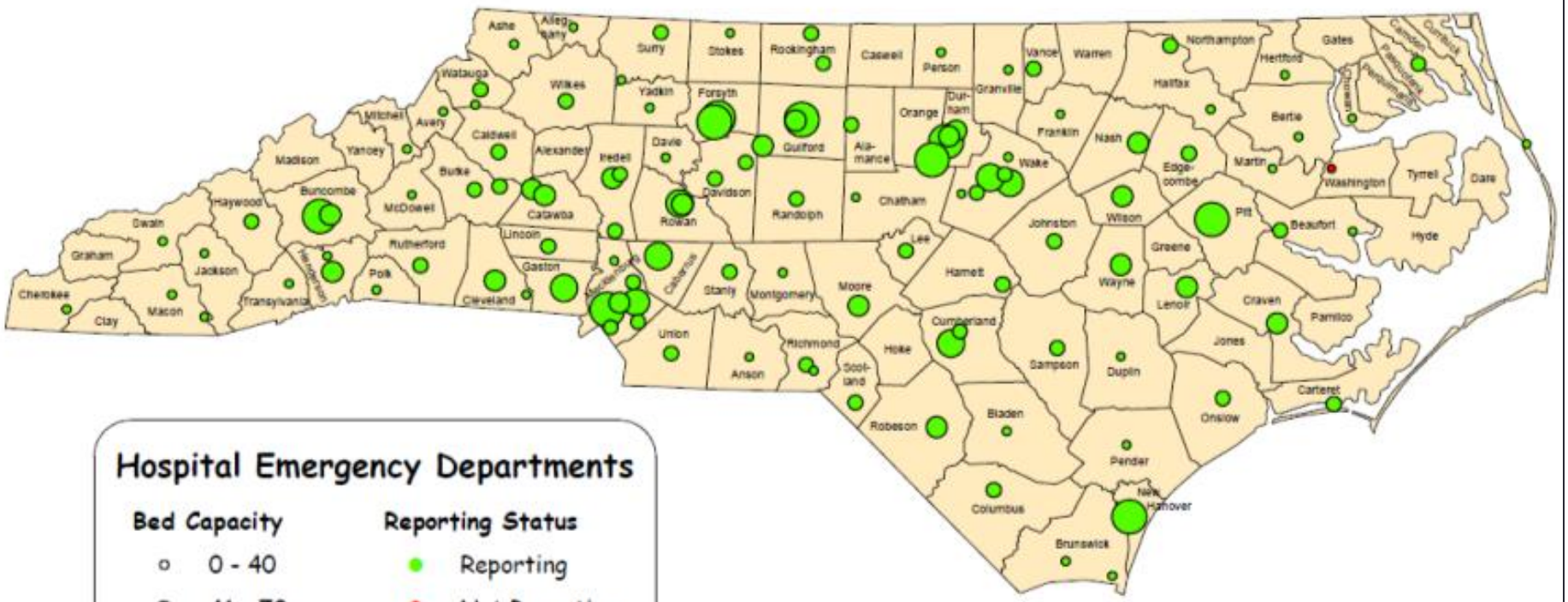
What is the relationship between maximum temperature and heat related illness? How does this relationship vary temporally, regionally, and across different demographics?

Attributes of this relationship:

1. Slope of rising limb
2. Slope of recessing limb
3. Threshold Temperature
4. Greatest Difference

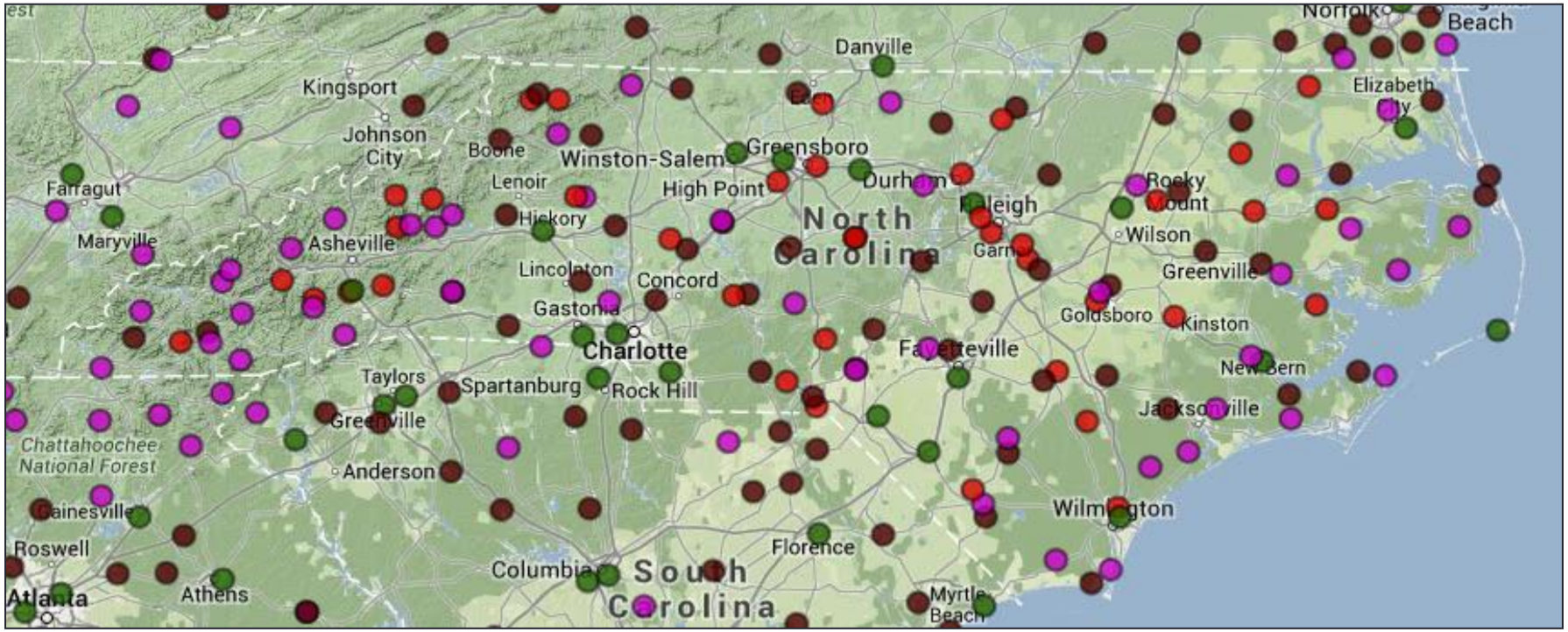


North Carolina Disease Event Tracking and Epidemiologic Tool (NC DETECT)



Dates Available: 01/01/2007 – 12/31/2012
ICD-9: 992.xx for both primary and secondary diagnostic codes

Climate Data

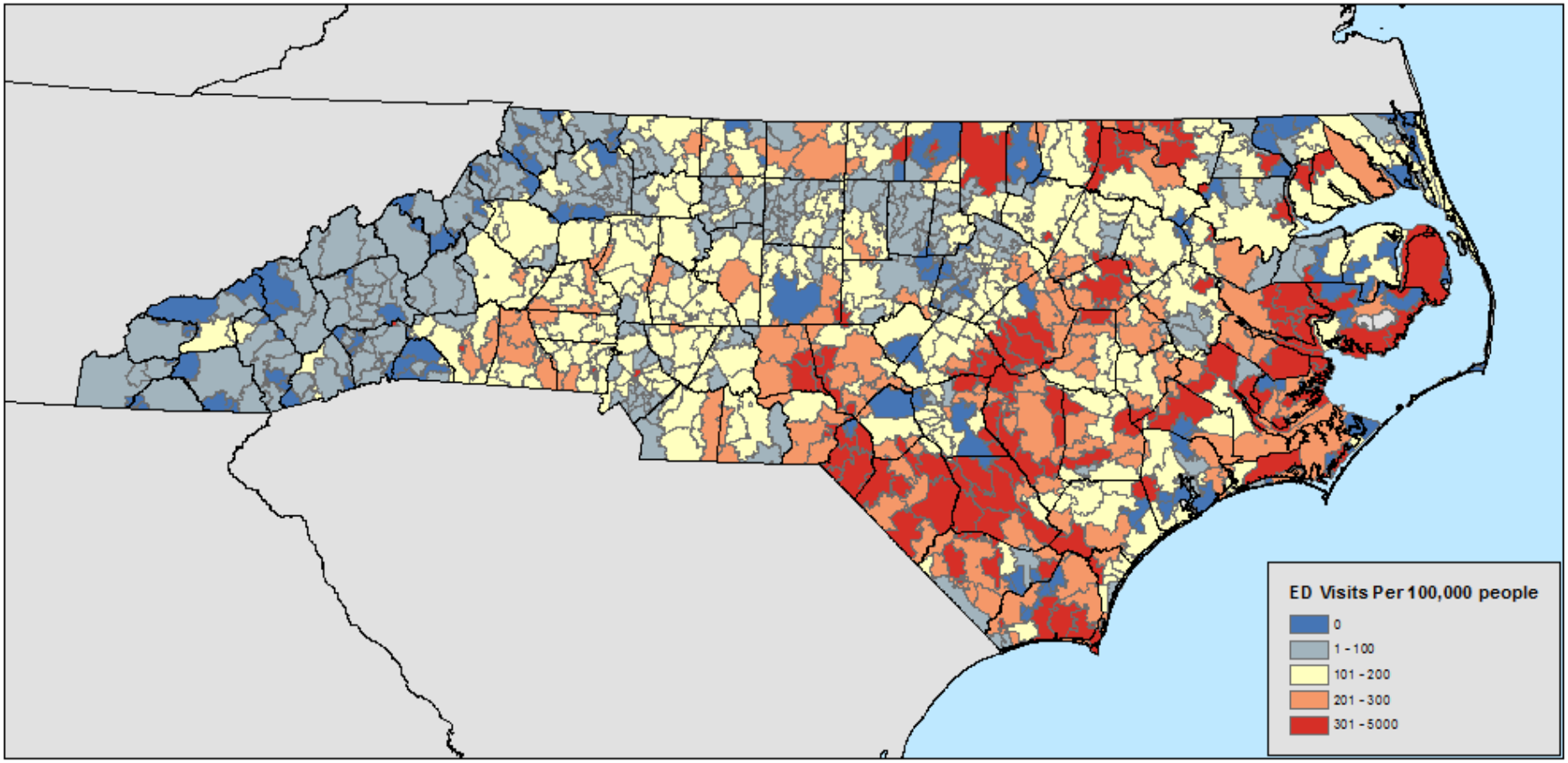


Hourly Weather Stations: EcoNet, AWOS, RAWS, ASOS

Relationships with HRI will be evaluated for:

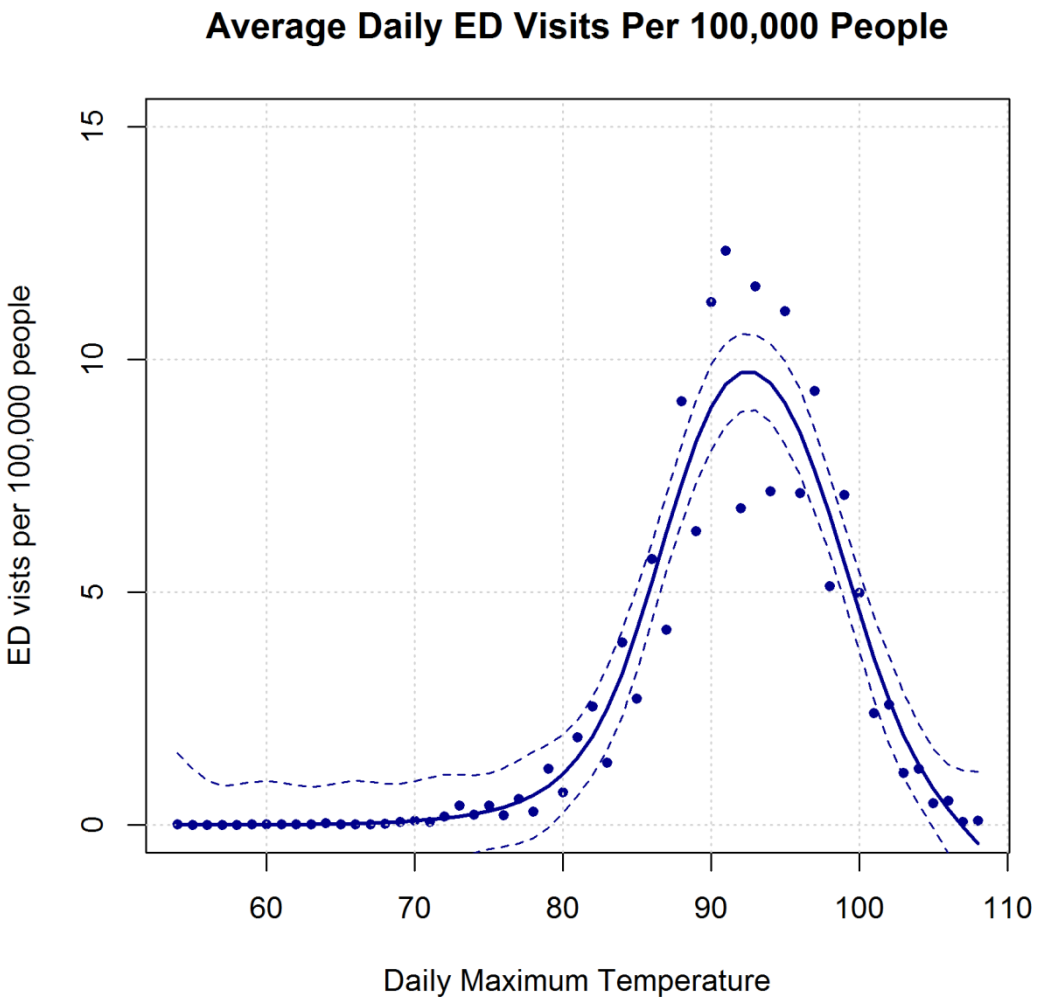
1.) Heat Index 2.) Maximum Temperature and 3.) Minimum Temperature 4.) Departure from Normal Maximum Temperature 5.) Departure from Normal Minimum Temperature

Emergency Department (ED) Admissions for Heat Related Illness



Emergency Department Admissions for Heat Related Illness (ICD9 code 992.xx) between May 1, 2007 through September 31, 2012

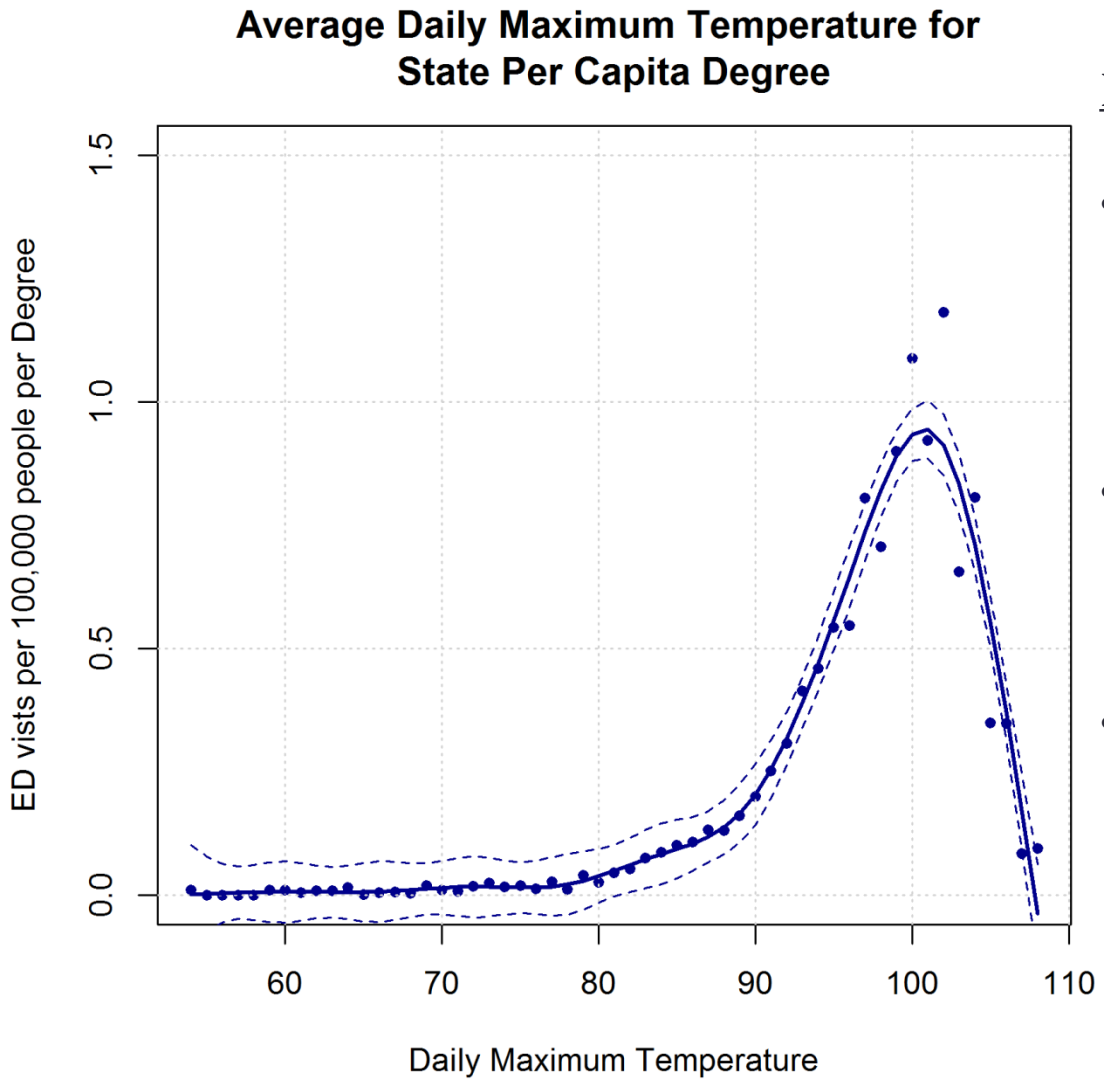
Methods for Selected Preliminary Results



Methodology:

- HRI is standardized by age and gender specific 2010 Census population estimates to provide ***per capita rates.***
- Generalized Additive Model (GAM) with CI 95Th percentile for predicted values smoothes HRI versus temperature plots to examine relationship.
- GAM are used to calculate different measures of this relationship:
  - Ascending slope: 1.07(86^{0}F)
  - Descending slope:-1.04(99^{0}F)
  - Threshold: 81

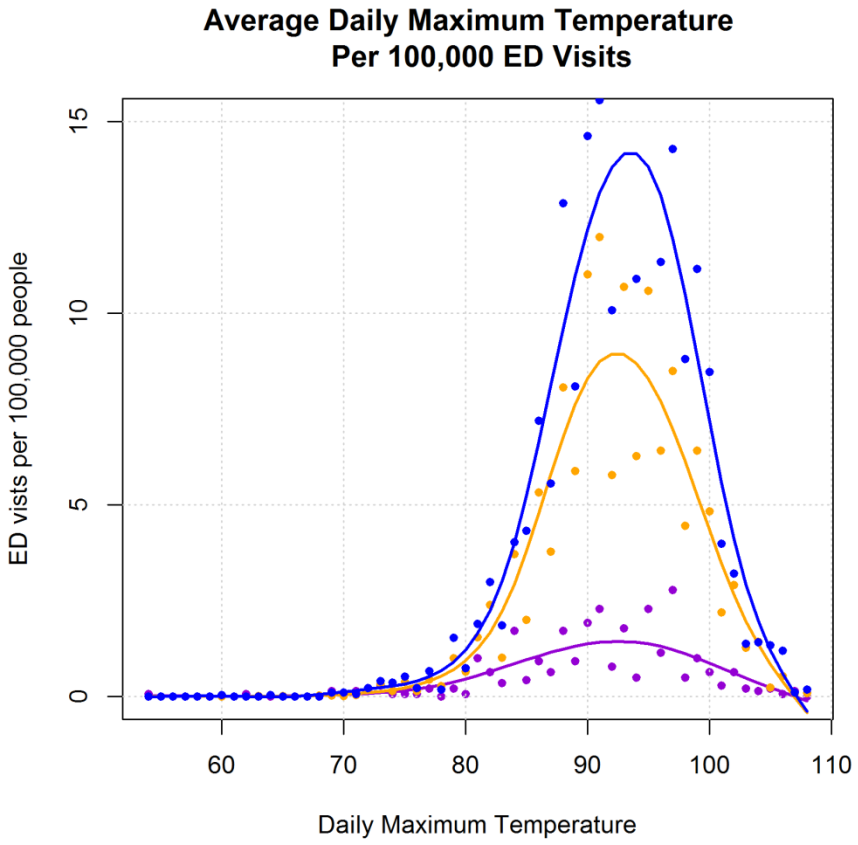
Methods for Selected Preliminary Results

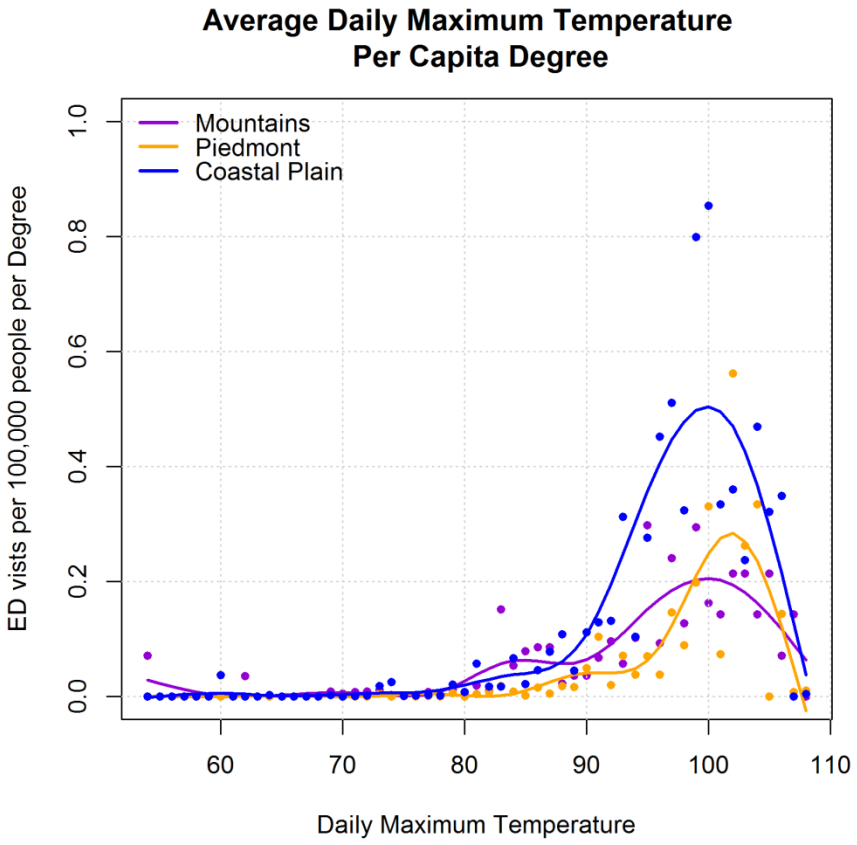


Methodology:

- HRI per capita rates are adjusted for the frequency of temperature observations during the time period (i.e. ***per Degree***).
- This illustrates that more HRI occur on abnormally warm days (but not on days with extreme heat).
- GAM are used to calculate relationships:
  - Ascending slope: 0.09(96^0F)
  - Descending slope: -0.20(107^0F)
  - Threshold: 87

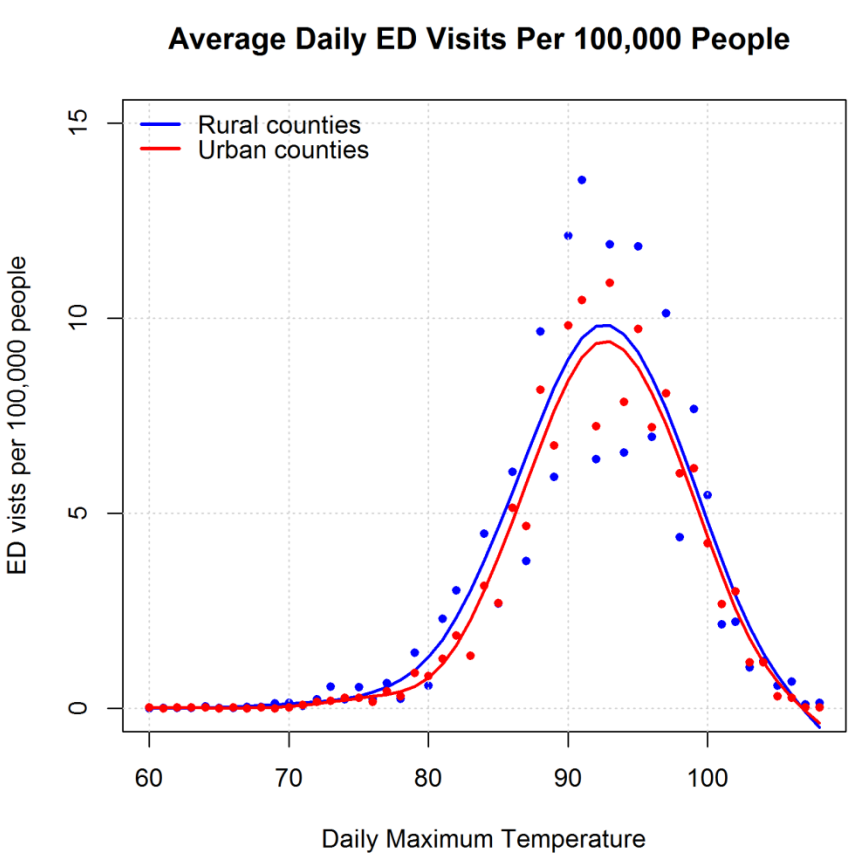
Selected Preliminary Results – Regional Heat morbidity vs Daily Max Temp

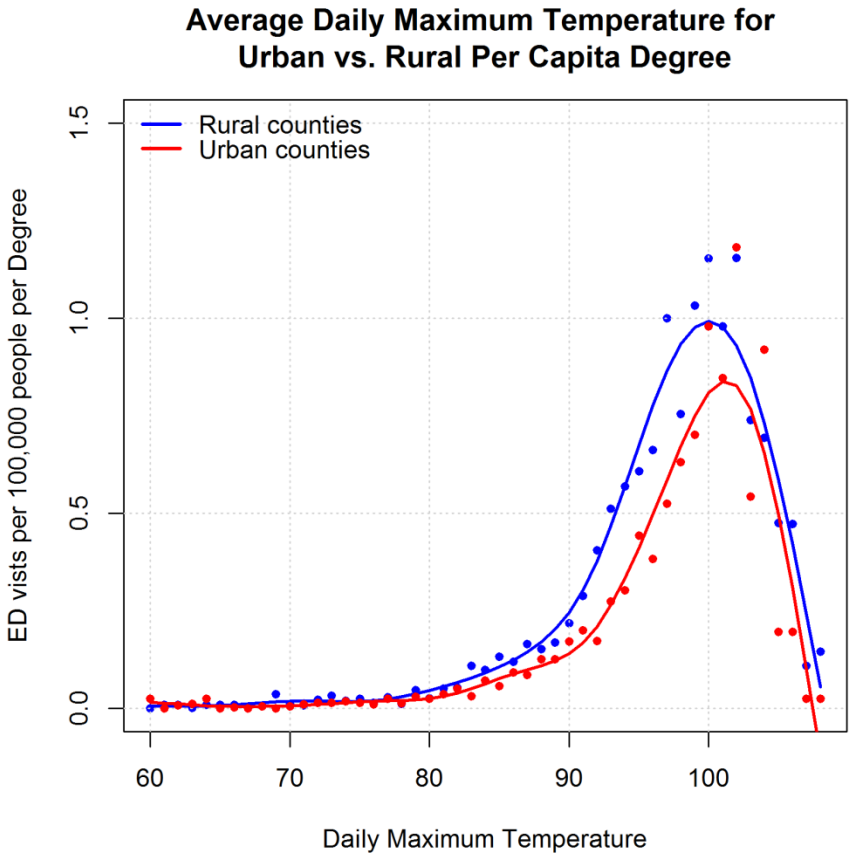




	Mountain	Piedmont	Coastal Plain		Mountain	Piedmont	Coastal Plain
AS(Temp)	0.10(83)	1.01(86)	1.48(86)		0.02(93)	0.04(98)	0.06(93)
DS(Temp)	-0.13(100)	-0.9(99)	-1.68(99)		-0.02(107)	-0.08(107)	-0.09(107)
Threshold	88	84	85		91	91	91

Heat morbidity vs Daily Maximum Temp for Rural vs. Urban





	Rural	Urban		Rural	Urban
AS(Temp):	0.92(86)	0.96(87)		1.48(94)	0.09(96)
DS(Temp):	-1.00(99)	-0.99(99)		-1.68(107)	-0.22(107)
Threshold:	85	85		88	92
Gdiff:	84			97	

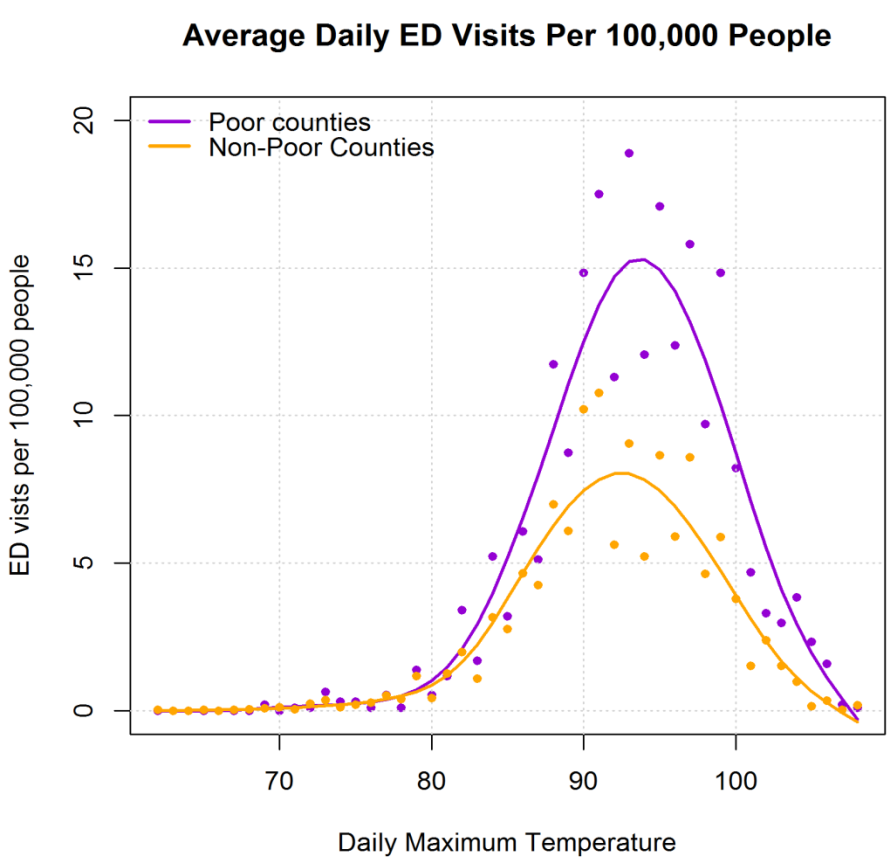
Totals:

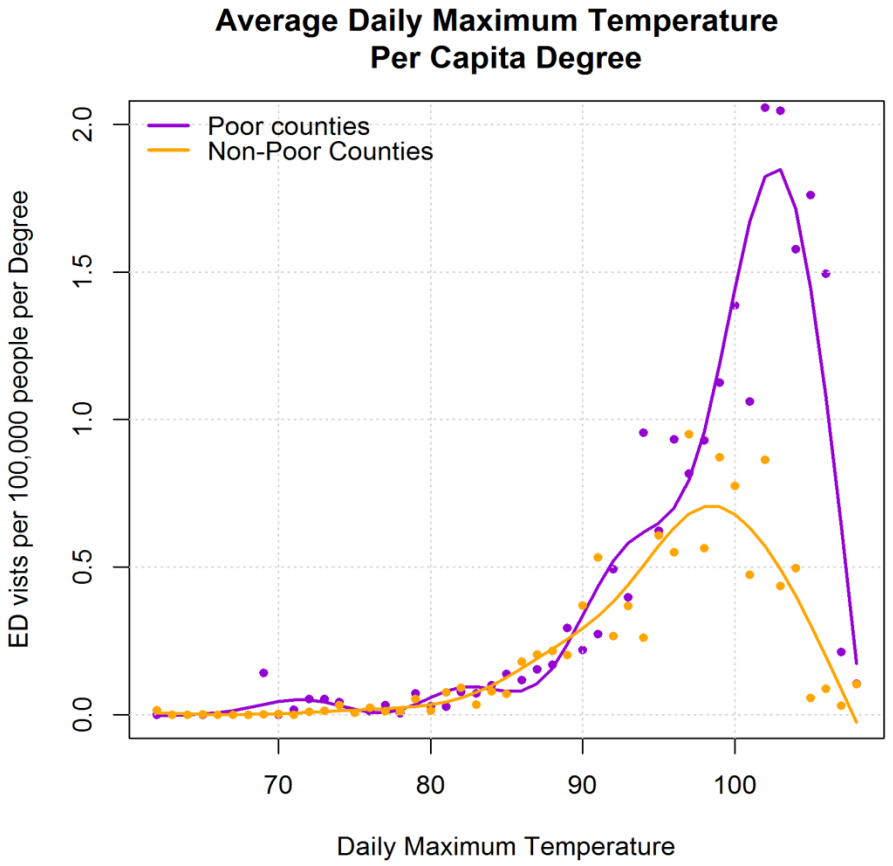
Urban 135 per 100,000 people
Rural 150 (+15)* per 100,000 people

Urban 9.65 per capita per degree
Rural 13.45 (+3.8)* per capita per degree

*significant at p-value = 0.05

Heat morbidity vs Daily Max Temp for Different Socioeconomic Areas





	Poor	Non-Poor		Poor	Non-Poor
AS(Temp):	1.54(88)	0.86(85)		0.26(99)	0.07(85)
DS(Temp):	-1.64(100)	-0.82(99)		-0.47(107)	-0.11(99)
Threshold:	87	85		94	91
Gdiff:	95			103	

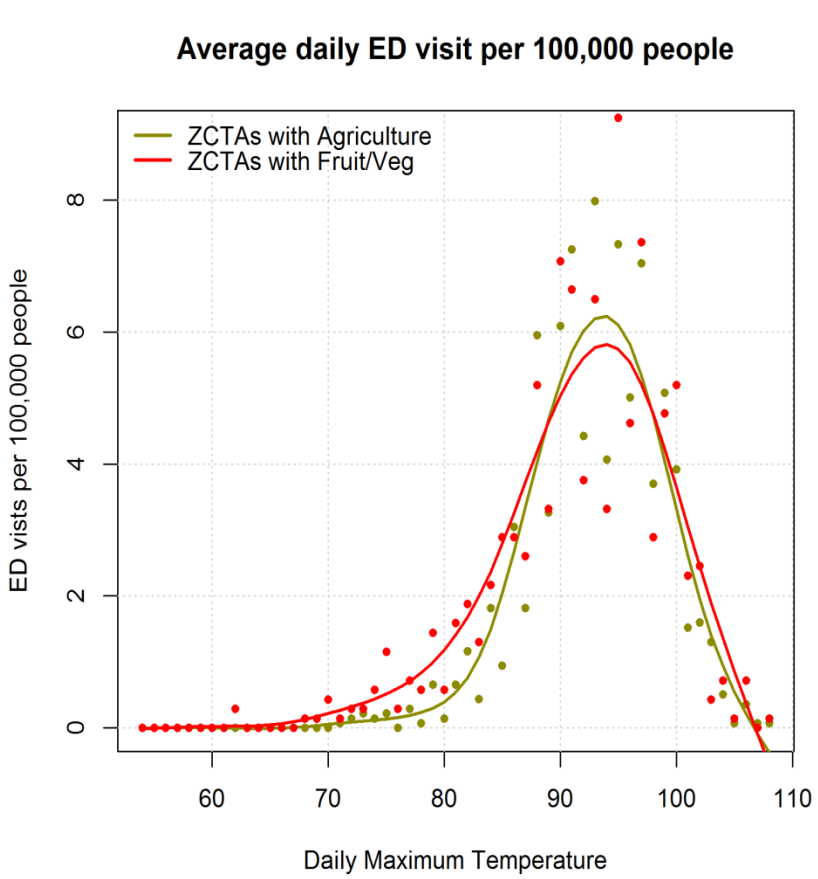
Totals:

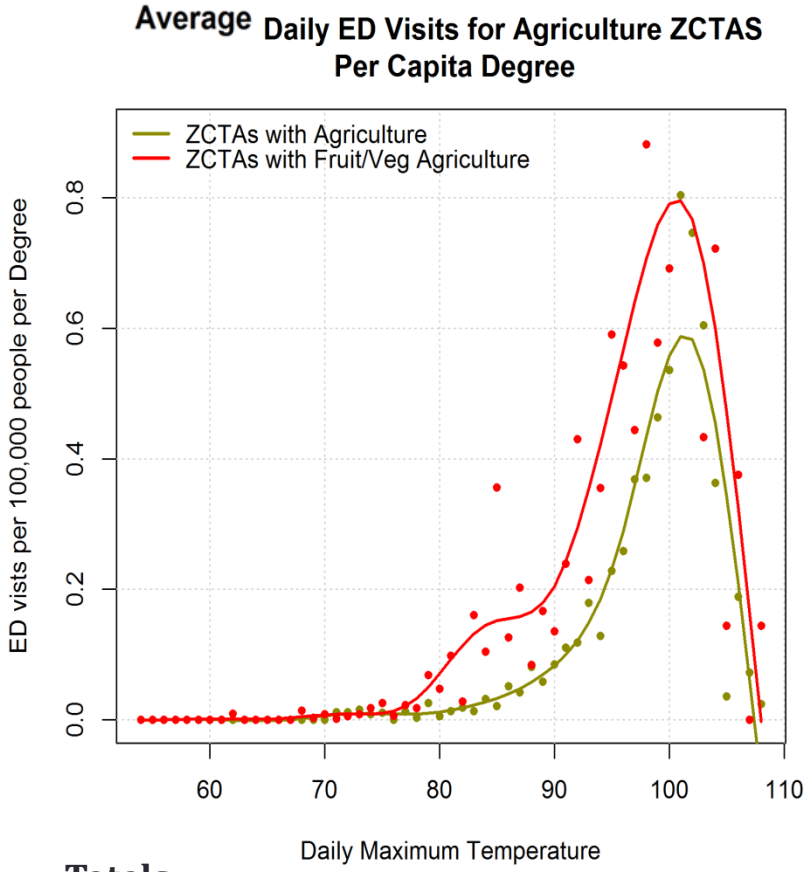
Poor 223 (+101)* per 100,000 people
Non-Poor 122 per 100,000 people

Poor 20.3 (+9.9)* per capita per degree
Non-Poor 10.4 per capita per degree

*significant at p-value = 0.05

Heat morbidity vs Daily Max Temperature for Different Agricultural Regions





	Agr	Fruit/Veg		Agr	Fruit/Veg
AS(Temp):	0.68(87)	0.48(86)		0.07(98)	0.48(95)
DS(Temp):	-0.72(99)	-0.60(100)		-0.16(107)	-0.60(107)
Threshold:	82	77		94	86
Gdiff:		83			97

Totals:

Fruit/Veg 99 (+11)* per 100,000 people
Agriculture 88 per 100,000 people

Fruit/Veg 10.8(+4.7)* per capita per degree
Agriculture 6.1 per capita per degree

*significant at p-value = 0.05

Long term goals of this research:

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  1. Identify vulnerable regions and share results with state public health officials.
  2. Develop a predictive tool through these empirical relationships that can provide useful information regarding public health interventions.

Source: Alabama Department of Public Health

Web page output

Date	Forecasted max temperature	Predicted # ER visits	Normal # ER visits	Percent normal
Today	97	134	83	161%
Tomorrow	100	156	76	205%
Next Day	84	25	80	31%

User interface:
Select population/region of interest

Lookup tables for regions, ages & demographic groups, NWS regions, weekend vs. weekday etc.

Temperature	Avg # ER visits
80	12
81	18
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--	--
105	123
106	88

From NC SCO:

NWS Temperature Forecasts
Day 0, day 1 and day 2

Web page output

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User interface: Select population or region of interest

Examples:

Age groups
15-18: high school athletes
Male 18-45 weekdays: "male laborers"
>65: senior citizens

Region of state
Coastal Plain
Piedmont
Mountains

NWS region
Raleigh
Morehead City
Wilmington

Rural vs Urban
Coastal Plain rural and urban
Piedmont rural and urban

Day of week
Weekday
Weekend

Demographic group (zip code)
Rural poor
Urban poor
Urban non-poor

Considerations:

- *Identify useful categories for messaging or staffing of ERs – what variables are useful?*
- *To get robust patterns, we need to select groups that can be identified from a sufficiently large sample of cases.*

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Questions for Audience

What variables would be useful to project?

ER visits/day relative to normal. What is normal?

What sort of output would be best for public health officials to work with in terms of targeting their messaging?

Acknowledgements:

- The NC DETECT Data Oversight Committee does not take responsibility for the scientific validity or accuracy of methodology, results, statistical analyses or conclusions presented.

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