



Heat-Related Illness in North Carolina: Who's at Risk?

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Why Heat?

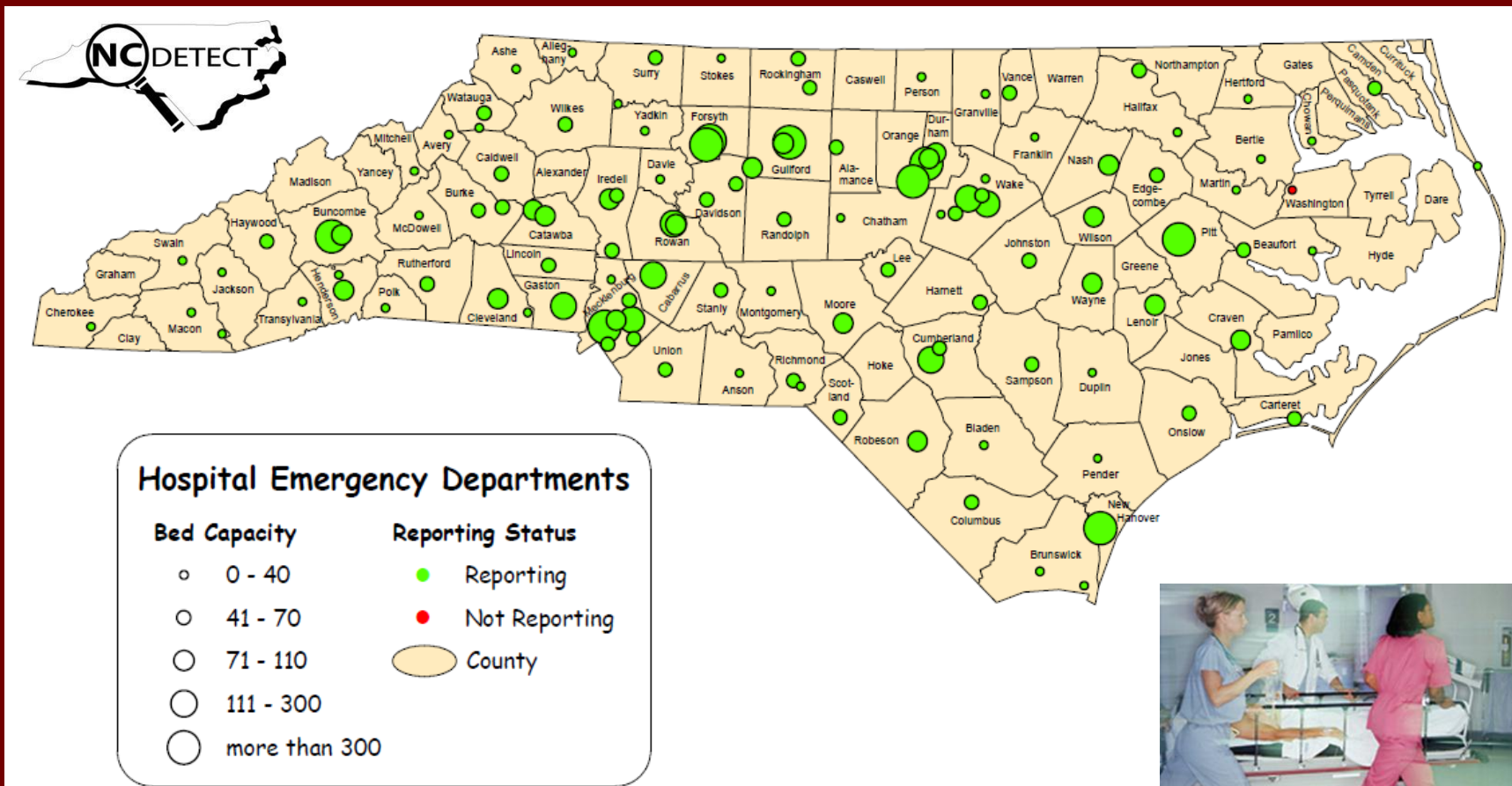
- **The #1 weather-related killer** (~700 deaths annually across the US; more than from floods, lightning, tornadoes, and hurricanes combined)
- **Heat stroke is deadly**; mortality rates exceed 80%; about 15% of those who survive heat stroke suffer impairments to the nervous, renal, or respiratory system
- **Heat-related illness is entirely preventable** with access to air conditioning and aggressive public health messaging and education
- Many locations (including NC) are expected to see an **increase in temperature and in the intensity, frequency, and duration of extreme heat events** due to climate change

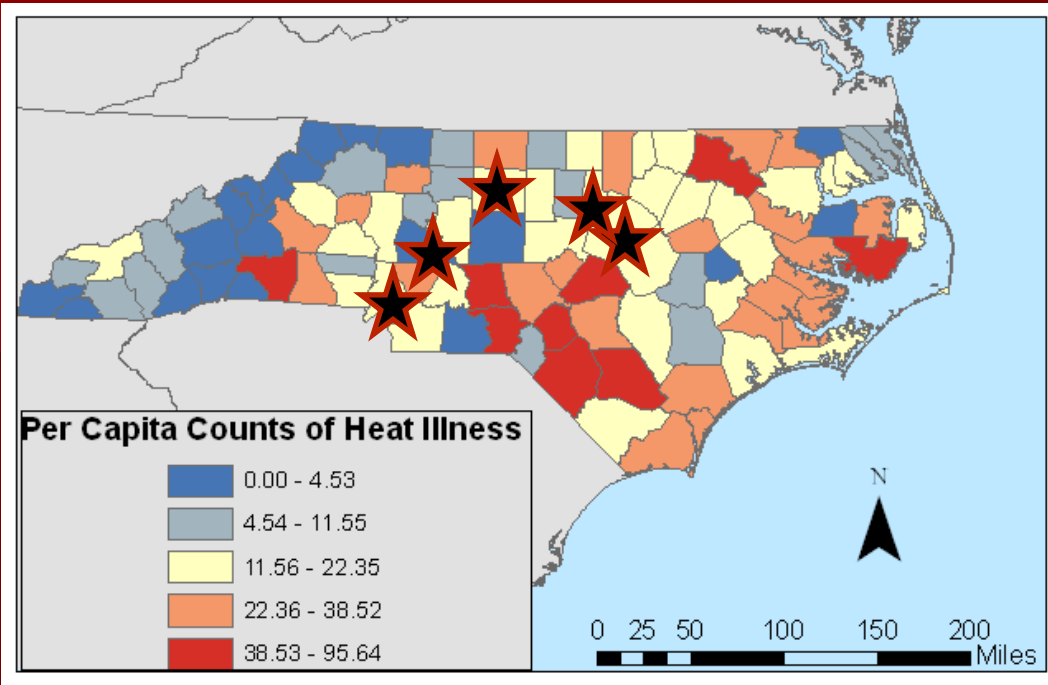
Heat-Health Research and Activities in NC

- A set of collaborative projects focused on the prevention of heat-related morbidity in North Carolina by reducing vulnerability
- Vulnerability = sensitivity, exposure, coping capacity
- Reducing vulnerability involves
 - *an understanding of intrinsic sensitivities (identifying and mapping at-risk groups and communities)*
 - *accurate and timely prediction of exposure (heat advisories and warnings)*
 - *building adaptive capacity (strategic planning, response plans)*

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

Follows a state-wide mandate for near-real time ED data





Rate of ED visits (per capita) for HRI by county from 2007 to 2008

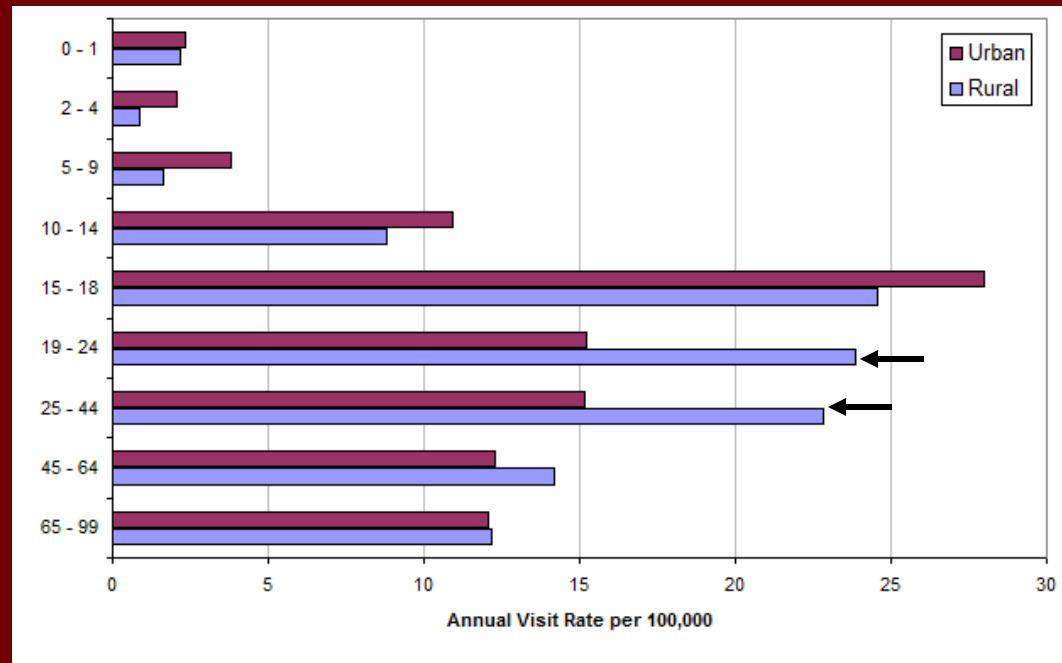
Total Visits:

Urban 1186
Rural 1404 (+218)

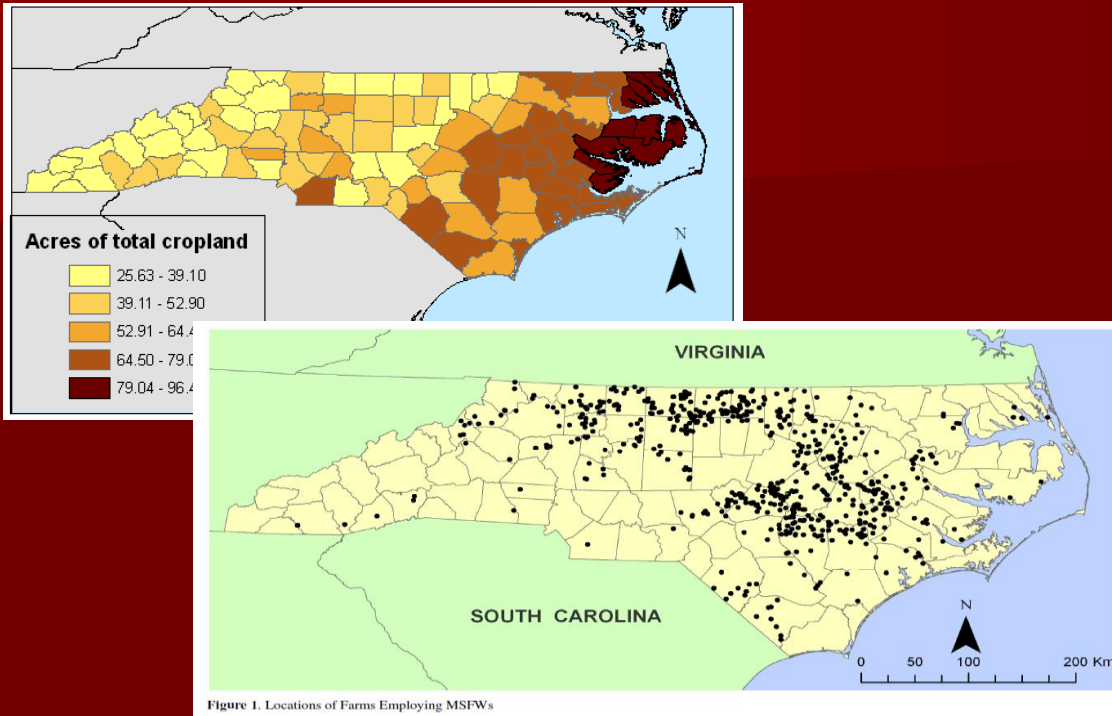
Annual Visit Rate (per 100,000):

Urban 13.0
Rural 15.6 (+2.6)

Age distribution of per capita ED visits for HRI between urban and rural counties



Possible at-risk groups



Agricultural workers*



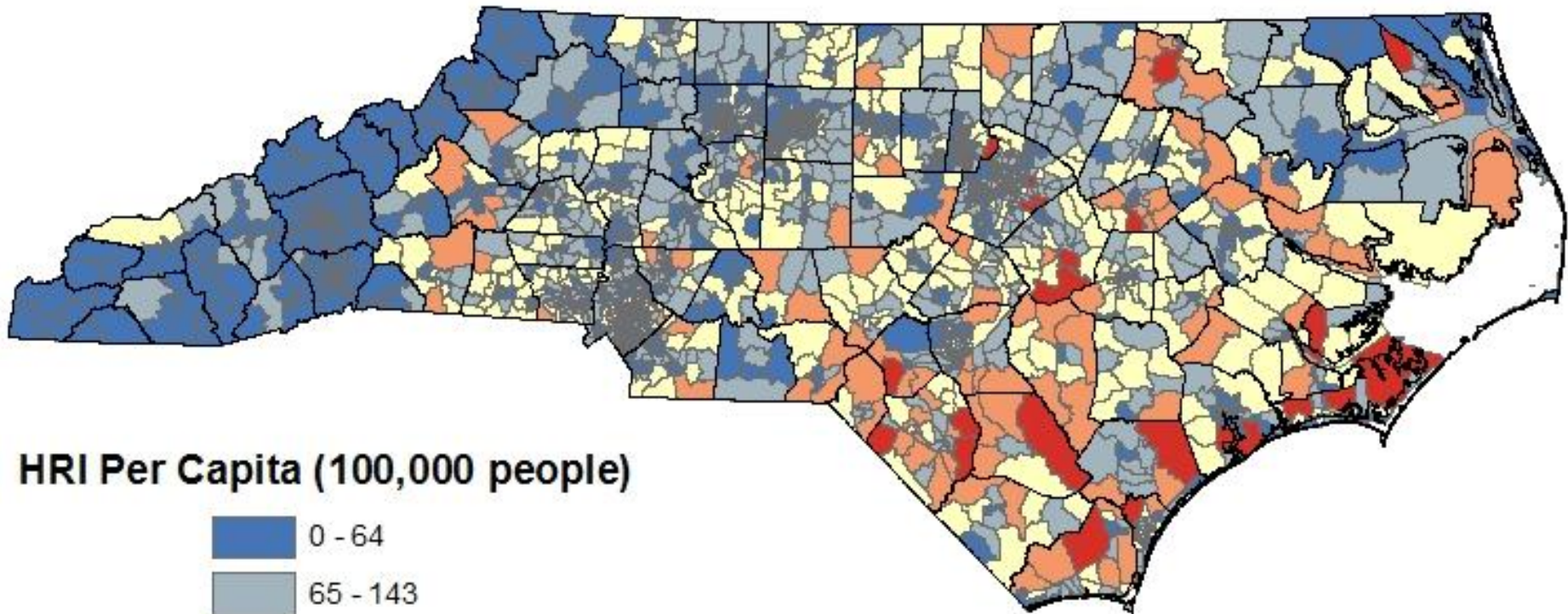
**NC accounts for 57% of all US heat-related deaths among crop workers from 1992-2006*

Young Athletes

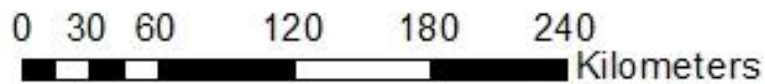
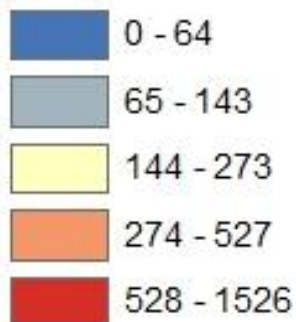


Socioeconomic Indicators of Heat-Related Morbidity in North Carolina

- Examines the statistical relationships between HRI ED visits and various socio-economic and land cover variables
- Analysis conducted by region and climate division
- Socio-economic data retrieved from the American Community Survey (2006-2010); land cover and cropland variables retrieved from the 2008 National Land Cover database
- Relationships evaluated using Pearson correlations and regression analyses (GWR and stepwise regression)



HRI Per Capita (100,000 people)

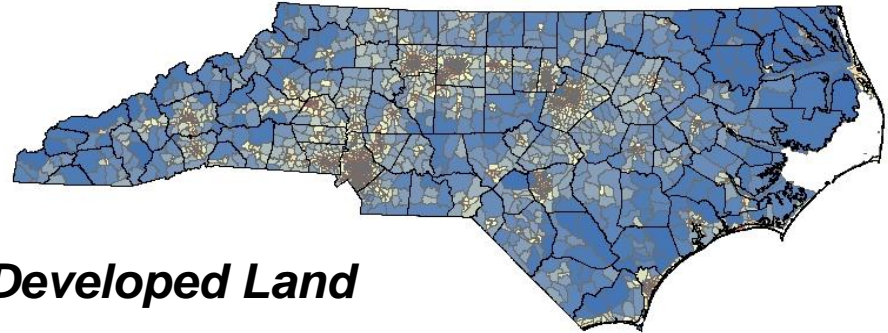


2006 – 2010 ACS 5 Year Estimates	Potential Relationship to HRI	Literature
<u>Demographic</u> : (Age, Race, Gender)	Populations most vulnerable to heat	Harlan et al. (2006); Chow et al. (2011); Kilbourne (1997); Knowlton et al. (2009)
<u>Socioeconomic</u> : (Nativity, Educational Attainment, Household Income, Population movement)	Agricultural workers/social isolation, Wealth or poverty	Fouilett et al. (2006); Chow et al. (2011); Klinenberg (2002); Semenza et al. (1999),
<u>Built Environment</u> : (Median year home built, Mobile Home Density)	Wealth or poverty/Social isolation/Rural or Urban	Meehl & Tebaldi (2004)
National Land Cover Database (2008)	Potential Relationship to HRI	Literature
<u>Built Environment</u> : (Developed Land)	Rural or Urban/Geographic Locations	Ruddell et al. (2009); Buyantuyev and Wu (2009); Oke (1997)
<u>Cultivated Crops</u> : 30 total crops (e.g. tobacco, corn, apples, oats, peanuts)	Agriculture workers/Microclimate of fields	Ruddell et al. (2009); Buyantuyev and Wu (2009); Oke (1997)
<u>Vegetation</u> : Deciduous, Evergreen Forest	Cooling potential/Rural areas	Ruddell et al. (2009); Buyantuyev and Wu (2009); Oke (1997)

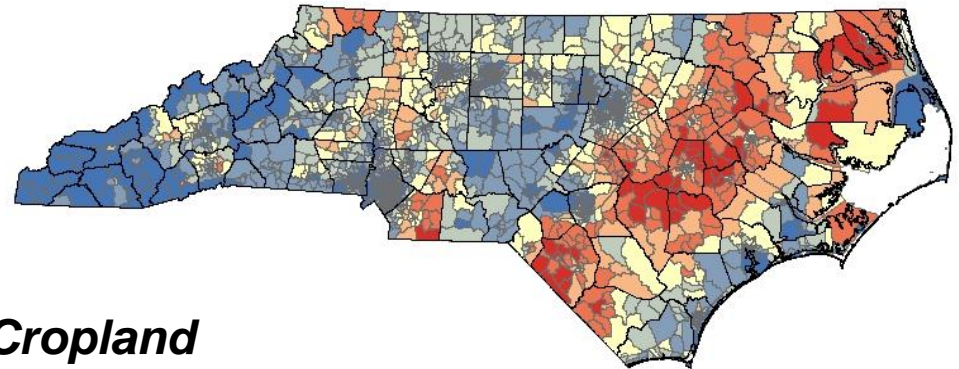
Where is HRI geographically located?

	Variables	R
Urban	Developed Land	-0.40
Rural	Evergreen Land	0.38
	Cropland	0.34

*p-values < 0.05



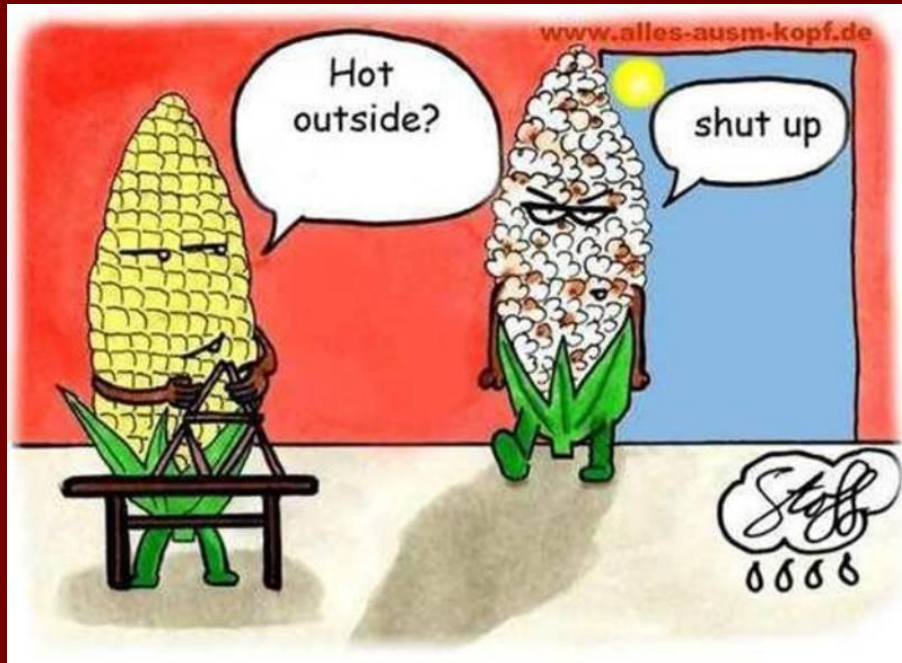
Developed Land



Cropland

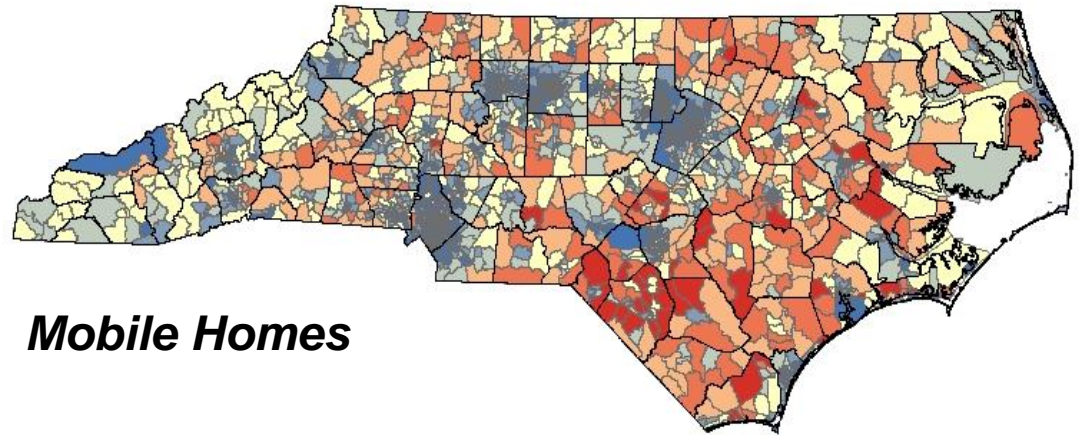
Rural populations of North Carolina are at increased rates for heat related illness compared to urban populations.

Crops and Heat Stress



Is poverty associated with increased HRI?

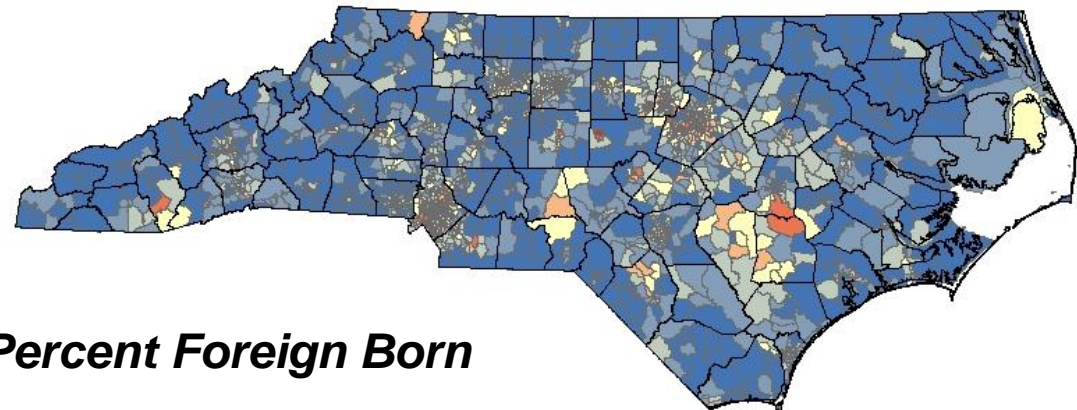
Variables	R
Mobile Homes	0.45



Mobile Homes

Are specific populations at greater risk HRI?

Variables	R
Pop over 65	0.02
Pop over 85	-0.08
Foreign Born	-0.18



Percent Foreign Born

*p-values < 0.05

North Carolina State Emergency Response Team (SERT)

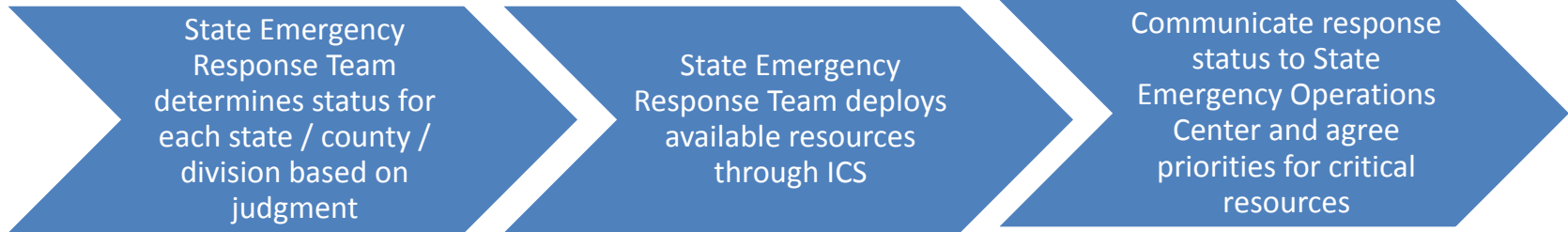
Tactical Heat Emergency Response Plan



North Carolina Division of Public Health

North Carolina Division of Emergency Management

NC Heat Plan Response Trigger Guide



NWS Trigger Level	State Actions	County Actions
<p>Heat Advisory</p>	<ul style="list-style-type: none"> • Outreach to local health agencies • Outreach to local emergency mgrs. • ID locations of vulnerable populations 	<ul style="list-style-type: none"> •Review local emergency heat response plan •Notify all responsible emergency heat response plan agencies •Identify locations of vulnerable populations •Prepare cooling centers •Contact Operation Fan/Heat Relief •Execute outreach to public
<p>Excessive Heat Watch</p>	<ul style="list-style-type: none"> • State Emergency Operations Center Activated @ Level 3 • Outreach to public from Joint Information Center • Public Health Coordinating Center Activated • Public Health Preparedness Offices Alerted • Governor’s Hotline Activated 	<p><u>In Addition to Heat Advisory</u></p> <ul style="list-style-type: none"> •Possible county emergency operations center activation •Initiate cooling center plan •Initiate fan distribution plan
<p>Excessive Heat Warning</p>	<ul style="list-style-type: none"> • Request Emergency Declaration from Governor’s Office • Public Health executes risk assessments & performs predictive modeling 	<p><u>In Addition to Heat Watch</u></p> <ul style="list-style-type: none"> •Continue to manage emergency heat response and be prepared to escalate as required

Evaluation of National Weather Service (NWS) Heat Advisory and Warning Criteria for Triggering a Public Health Response

- Goal is to evaluate the effectiveness of the heat advisory and warning thresholds used by NWS Raleigh in accounting for summer heat morbidity
- Following the methods of Dixon (1999), will investigate alternative thresholds by creating a cost-benefit ratio whereby the benefit of lowered morbidity is compared to the cost of increased issuance of advisories and warnings

Heat-Related Products from the National Weather Service

- **Heat Advisory** – issued when the heat index is expected to reach between 105-109 degF for 2 or more hours OR is expected to reach between 102-105 degF for 3 or more consecutive days
- **Excessive Heat Warning** – issued when the heat index is expected to reach 110 degF or higher for any duration (considered a “dangerous situation”)

Raleigh NWS Heat Products and HRI ED Visits (Primary and Secondary) in the Raleigh NWS County Warning Area (JJA, 2007-2010)

Criteria	Sum	Daily Avg	Max	Min	% of ED Visits	% of Days
HI Below 100°F	1502	5.7	22	0	40.5	77.2
At least 100°F but below HA	854	11.7	39	3	23.0	12.5
Heat Advisory*	1043	26.7	54	4	28.1	8.4
Excessive Heat Warning**	313	46.6	69	25	8.4	1.9
Total	3712				100.0	100.0

**No Advisories issued JJA 2009*

***No Warnings issued JJA 2008 and 2009*

Summary and Recommendations

- Rural populations in NC may be most at-risk for HRI
 - Strong relationship with cropland/agriculture, but no relationship with minority populations
 - Strong relationship with mobile homes
- Recreational heat stress is prevalent across NC, particularly with organized/interscholastic sports
- Heat wave versus non-heat wave morbidity
 - Are at-risk groups the same?
 - How does this affect our response plans?
 - Research need: Long-term exposure to increasing temperatures versus short-term exposure to extreme temperatures
- Consider other public health consequences of heat: violence, depression, suicide, alcohol/drug use, productivity

Acknowledgements

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Thank-you!

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