

Heat Risk Tools: Wet bulb globe temperature (WBGT)

NOAA Eastern Region Climate Services Webinar, September 30th

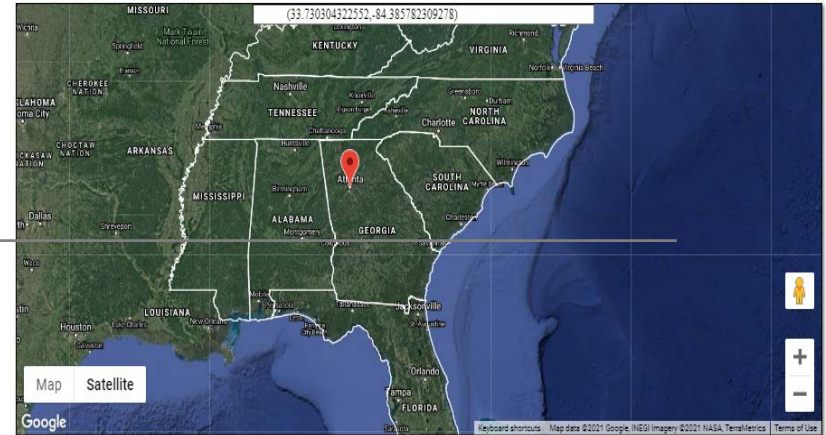
SANDRA RAYNE

SOUTHEAST REGIONAL CLIMATE CENTER (SERCC) AT UNC – CHAPEL HILL

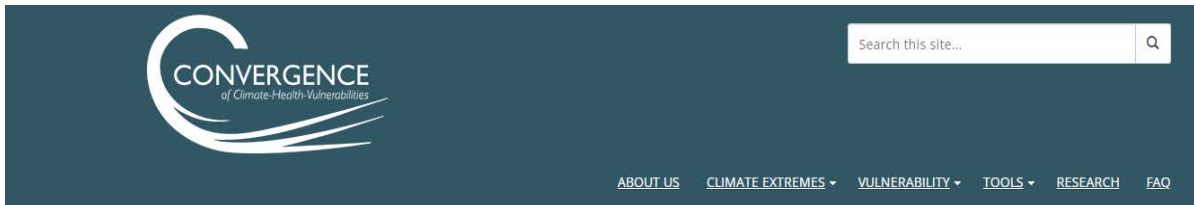


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Wet Bulb Globe Temperature (WBGT) Tool

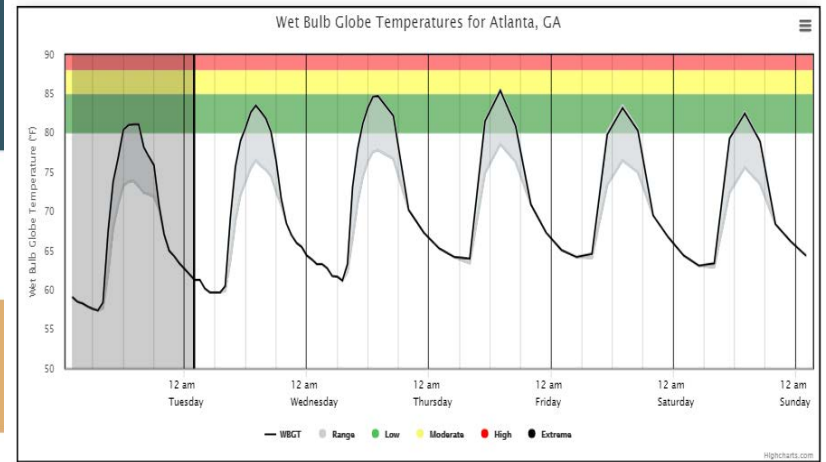
[What is WBGT](#)

[How to measure WBGT](#)

[Understanding the Tool](#)







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WBGT Background

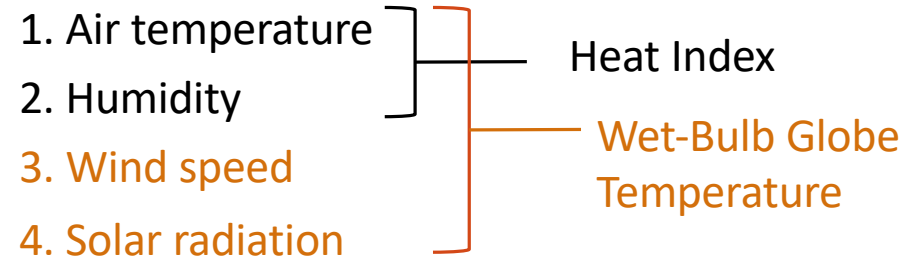
How Does Heat Impact Public Health?

					
<p>Heart Health Diagnoses with a higher admission risk on heat wave days (2-day, 99th %ile) include congestive heart failure, non-hypertensive (Hopp et al., 2018). Cardiovascular disease, especially in the elderly, has been reported as the primary cause of excess deaths during heat waves: 94% of excess deaths during Chicago heat wave; 51% and 64% of deaths in two Milwaukee heat waves (Kenney et al., 2014).</p>	<p>Kidney Health One multi-city study in the US found that extreme heat events were associated with a 15% increase in hospitalizations for renal diseases (Gronlound et al., 2014; n=114 cities, United States). The risk of developing kidney stones was almost 1.5 times higher at a temperature of 86°F than at 50°F (Tasian et al., 2014; n=60,433, Atlanta, Chicago, Dallas, and Philadelphia).</p>	<p>Mental Health Socially isolated individuals, including those with mental illness, may be particularly vulnerable to heat wave events (Reid et al., 2009; n=39,794 census tracts, US). Increased risk of suicide; increased risk of mortality for alcohol and substance misuse; increased risk of admissions for bipolar disorder, schizophrenia, and other mental health outcomes including dementia (Thompson et al., 2018).</p>	<p>Neonatal/Maternal Health Heat waves were associated with 32.4% higher preterm births (Kent et al., 2014; n=60,466, Alabama, US).</p>	<p>Respiratory Health One multi-city study of the US found that extreme heat events were associated with a 4% increase in hospitalizations for respiratory diseases (Gronlound et al., 2014; n=114 cities, US).</p>	<p>Health Emergency A US national study found that during extreme heat events, young adults had the highest rates for visiting the ER and being released while elderly populations had the highest ER case fatality rate (Jess et al., 2014; n=308,372, US).</p>

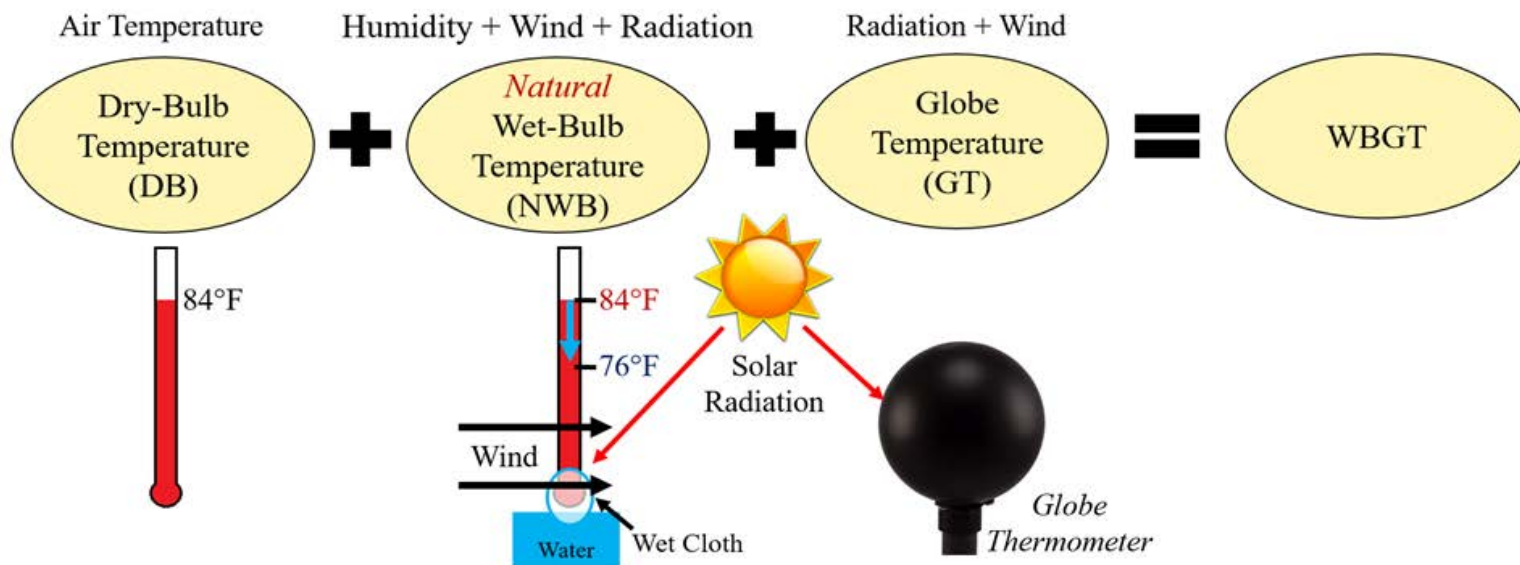
Diagnoses with a higher admission risk on heat wave days (2-day, 99th %ile; Hopp et al., 2018):

- Acute and unspecified renal failure
- Congestive heart failure; nonhypertensive
- Fluid and electrolyte disorders (i.e. dehydration)
- Heat exhaustion, stroke & sunstroke
- Septicemia (i.e. blood poisoning)
- Urinary tract infection

Heat Index is used by the National Weather Service, but other factors affect heat stress



WBGT Background



$$\text{WBGT} = 0.1 * \text{Dry Bulb T} + 0.7 * \text{Natural Wet Bulb T} + 0.2 * \text{Globe T}$$

High School Athletics



WBGT Activity Guidelines and Rest/Break Guidelines for Athletes

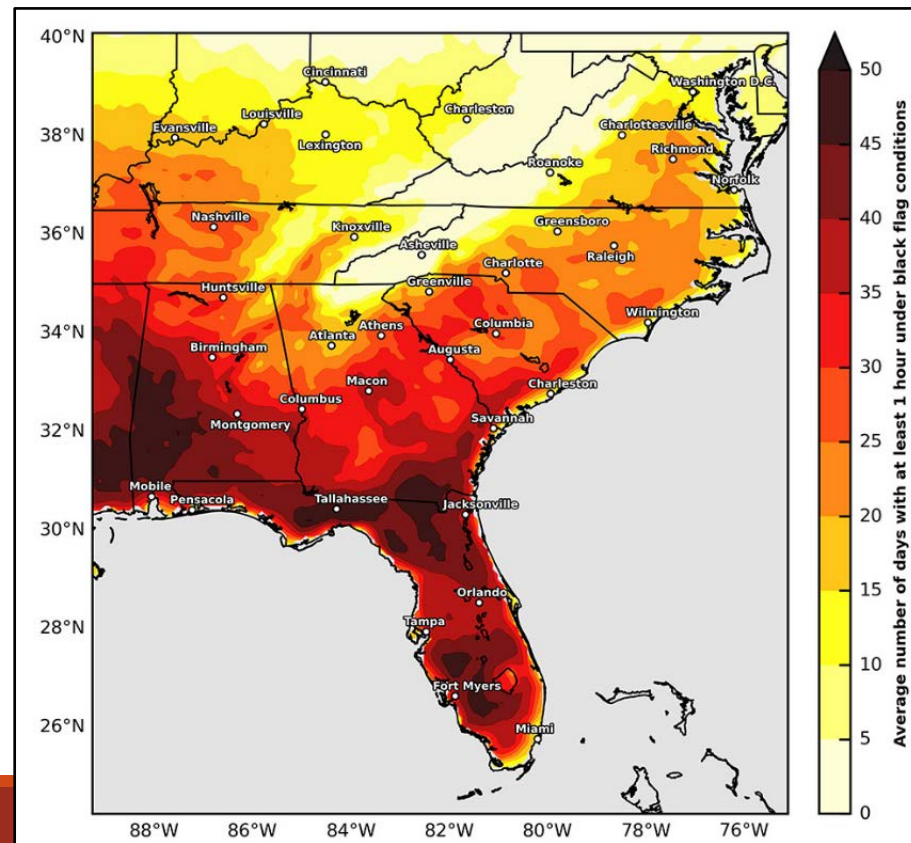
Heat Category	WBGT Index (F)	Activity Guidelines
No Flag	Under 80	Unlimited activity with primary cautions for new or unconditioned athletes or extreme exertion; schedule mandatory rest/water breaks. (5 min rest/water break every 30 min)
Low (Green Flag)	80-84.9	Normal practice for athletes; closely monitor new or unconditioned athletes and all athletes during extreme exertion. Schedule mandatory rest/water breaks. (5 min water/rest break every 25 min)
Moderate (Yellow Flag)	85-87.9	New or unconditioned athletes should have reduced intensity practice and modifications in clothing. Well-conditioned athletes should have more frequent rest breaks and hydration as well as cautious monitoring for symptoms of heat illness. Schedule frequent mandatory rest/water breaks. (5 min rest/water break every 20 min) Have cold or ice immersion pool on site for practice.
High (Red Flag)	88-89.9	All athletes must be under constant observation and supervision. Remove pads and equipment. Schedule frequent mandatory rest/water breaks. (5 min rest/water break every 15 min) Have cold or ice immersion pool on site for practice.
Extreme (Black Flag)	Over 90	SUSPEND PRACTICE

Source: North Carolina High School Athletics Association

Regional Patterns of WBGT across the SE U.S.

Number of days with Black Flag conditions for the summer season (May-September)

<https://sercc.com/wbgt-climatology/>



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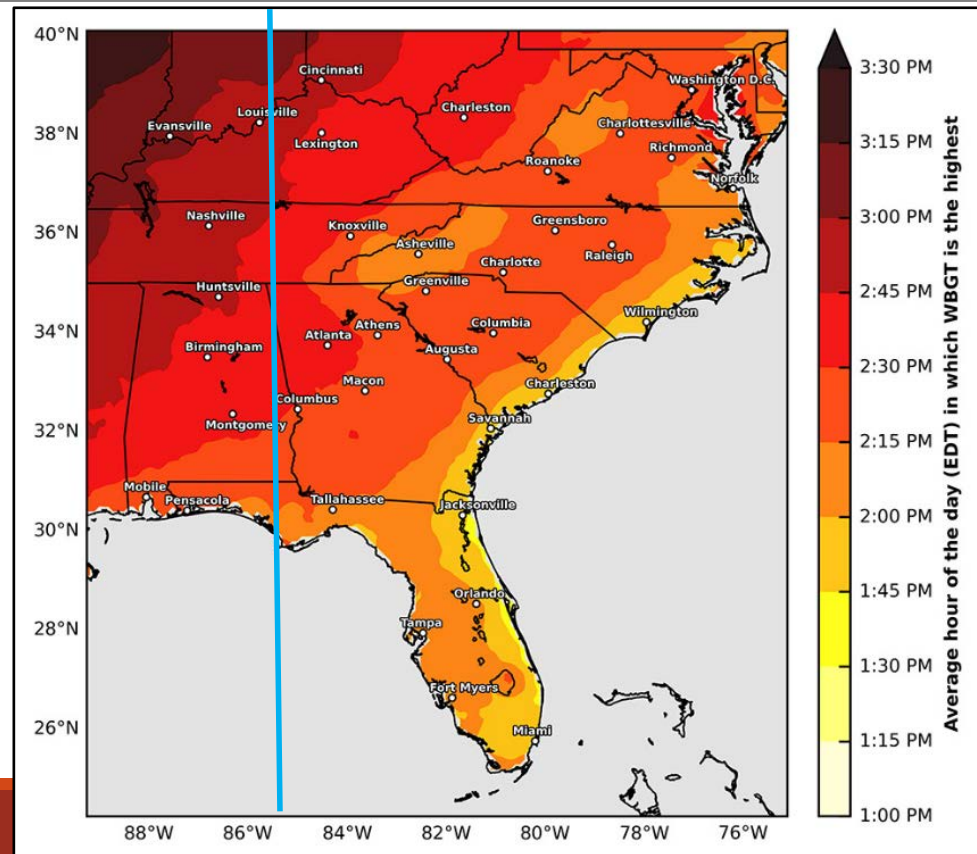
Maps produced from hourly gridded (9X9 km) ERA-interim dataset from 1981-2020

Regional Patterns of WBGT across the SE U.S.

Eastern Daylight Time (EDT)

Timing of highest WBGT values
in Eastern Daylight Time (EDT)

<https://sercc.com/wbgt-climatology/>



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Maps produced from hourly gridded (9X9 km) ERA-interim dataset from 1981-2020

WBGT Forecast Tool

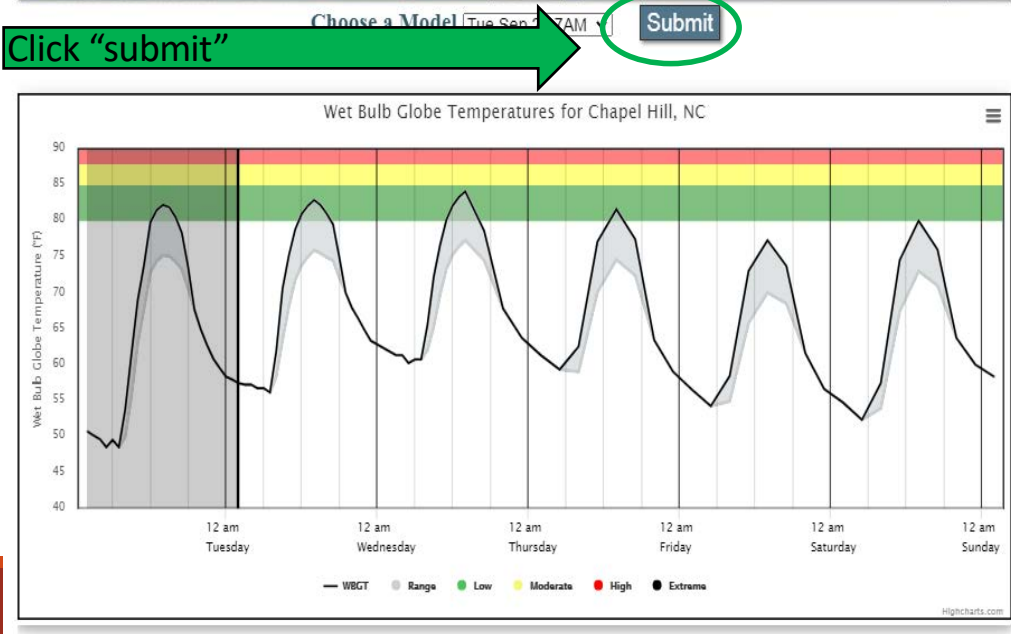
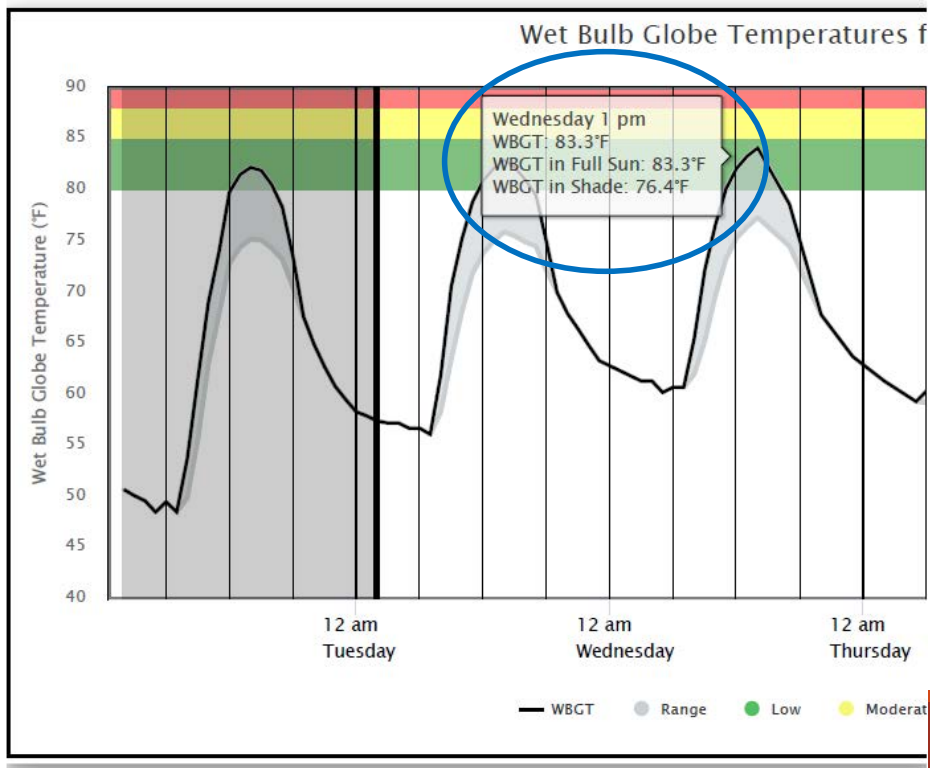
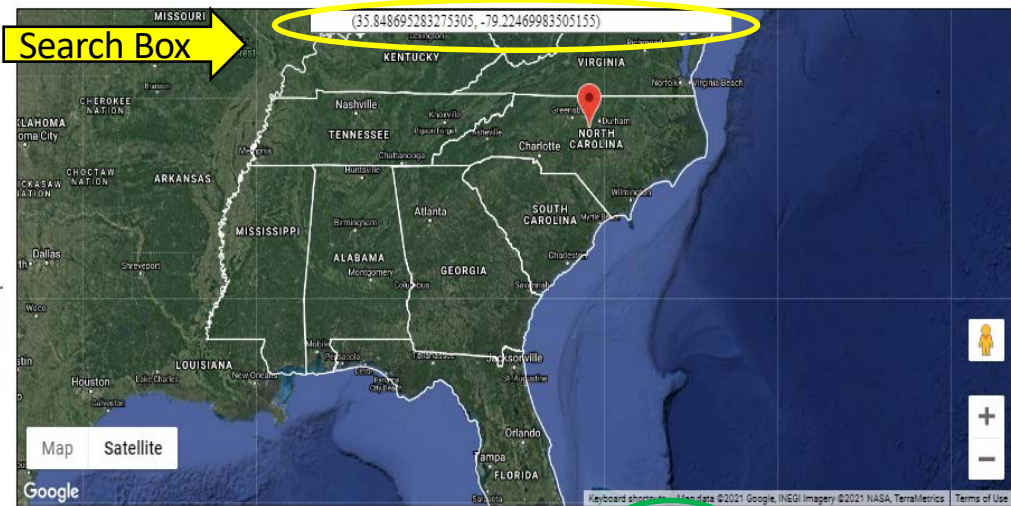
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How does it work?

Ingests hourly gridded forecasts from the National Weather Service – used to estimate WBGT

1. Air Temperature
2. Dew Point/Relative Humidity
3. Cloud Cover %
 - Converted to solar radiation estimate
4. Wind Speed
 - Downscaling 10m to 2m

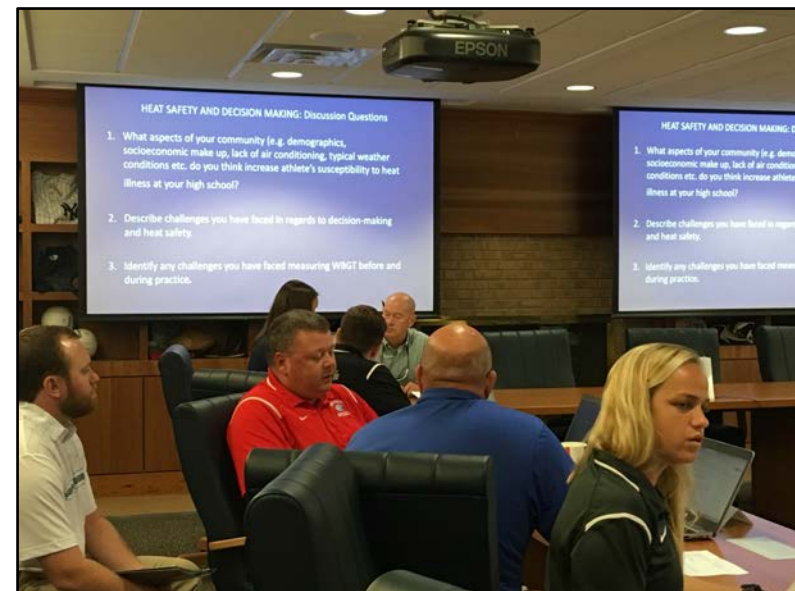
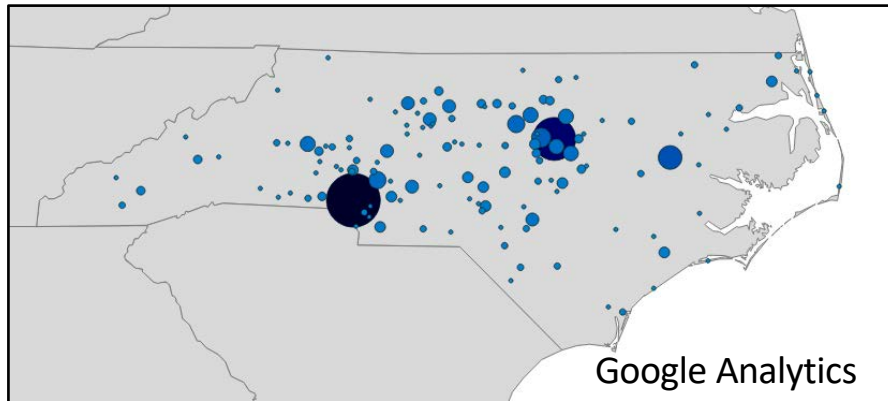
WBGT Forecast Tool



Summer 2019 NCHSAA Engagement

Heat Safety Summit with Athletics Officials
from 8 High Schools Across NC

Visited 13 High Schools Across NC



WBGT Forecast Tool: Field Work

Open Landscape:
Ashley HS, Carolina Beach, NC

Football Practice Field

1. Few trees
2. Flat land
3. Sea breeze in the afternoon

Steady breeze on many days



WBGT Forecast Tool: Field Work

Sheltered Landscape:
Cedar Ridge HS, Hillsborough, NC

Football Practice Field

1. Sheltered- Ringed by forest & 60 feet below high school

➤ Little or no wind

2. Adjacent to wetland

➤ Exceptionally moist



The Importance of Wind

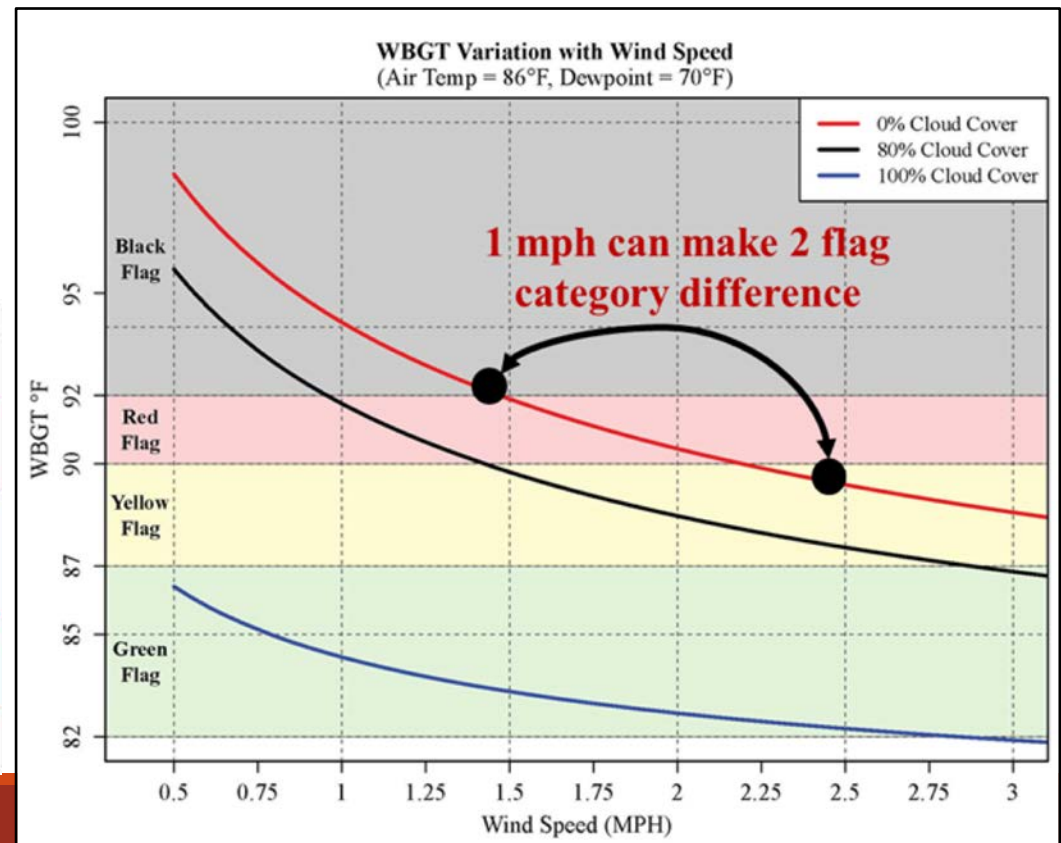
Warm, humid day in Georgia:

1 MPH = 94 F WBGT – Black Flag

2 MPH = 91 F WBGT – Red Flag


3 MPH = 88 F WBGT – Yellow Flag

WBGT READING	ACTIVITY GUIDELINES & REST BREAK GUIDELINES
UNDER 82.0	NORMAL ACTIVITIES -- Provide at least three separate rest breaks each hour of minimum duration of 3 minutes each during workout.
82.0 - 86.9	USE DISCRETION for intense or prolonged exercise; watch at-risk players carefully; Provide at least three separate rest breaks each hour of a minimum of four minutes duration each.
87.0 - 89.9	MAXIMUM PRACTICE TIME IS TWO HOURS. For Football: players restricted to helmet, shoulder pads, and shorts during practice. All protective equipment must be removed for conditioning activities. For all sports: Provide at least four separate rest breaks each hour of a minimum of four minutes each.
90.0 - 92.0	MAXIMUM LENGTH OF PRACTICE IS ONE HOUR, no protective equipment may be worn during practice and there may be no conditioning activities. There must be 20 minutes of rest breaks provided during the hour of practice.
OVER 92	NO OUTDOOR WORKOUTS; CANCEL EXERCISE; delay practices until a cooler WBGT reading occurs.



Next Steps

Current work

- Tune the tool to the local landscape
 - Continue to engage with high school athletics on heat safety and the use of the tool
 - Expand the geographical domain of the tool to the entire eastern U.S. in May 2022
 - Expand the tool to other sectors – e.g. outdoor workers
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Thank You!

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Acknowledgments:

- NOAA Southeast Regional Climate Center
(Chip Konrad, William Schmitz, Jordan Mcleod)
- NOAA-funded Carolinas Regional Integrated Science
and Assessments (CISA) Program
(Jordan Clark)
- North Carolina High School Athletic Association
(NCHSAA) and participating high schools

