

# SCIPP RESEARCH BRIEF: A CLIMATOLOGY OF GRIDDED WET-BULB GLOBE TEMPERATURE FOR THE SOUTHEASTERN UNITED STATES

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## BEFORE YOU READ:

Wet Bulb Globe Temperature (WBGT) is a heat metric that combines natural wet-bulb, globe, and dry-bulb temperatures into a weighted average. Measurement of WBGT requires specialized instruments, leading it to commonly be estimated rather than measured directly. Despite this, it is still recommended as international standard and is used in organizations across the country to monitor heat exposure of workers and athletes.

## GOALS:

This paper focuses on the southeastern United States and aims to:

1. Evaluate reanalysis-based WBGT accuracy by comparison with WBGT calculated from in situ data;
2. Develop a WBGT climatology using ERA5-Land ( $0.1^\circ \times 0.1^\circ$ ; native 9-km resolution; hourly), emphasizing athlete and worker safety; and
3. Examine potential causes for unique WBGT characteristics across spatial and temporal scales.

## RESULTS:

### AVERAGE WBGT

Average WBGT varies by around  $10^\circ\text{C}$  with the highest values in southern Texas and Southern Florida and lowest near western Texas, the Oklahoma/Texas Panhandle, and the Appalachian Mountains. Monthly, averages range from a minimum of  $10.0^\circ\text{C}$  in October to a maximum  $27.5^\circ\text{C}$  in August.

### MAXIMUM WBGT

The highest values were found in the eastern and south-central portions of the study regions. Lower Max WBGT values were found in areas with large rivers, sea breeze influence, and high elevation regions. Higher maximum WBGT values were found near other large bodies of water such as reservoirs along with forests.

### ATHLETE SAFETY

Athlete safety can be measured by a five-level color scheme: green, yellow (WBGT  $\geq 27.9^\circ\text{C}$ ), orange (WBGT  $\geq 30.6^\circ\text{C}$ ), red (WBGT  $\geq 32.3^\circ\text{C}$ ), and black (WBGT  $\geq 33.4^\circ\text{C}$ ). Conditions meeting or exceeding yellow flag require activity modifications. The table below details the range of average hours, days with at least one hour, and hours per day reaching the conditions of each level per warm season (May–October) in the southeast.

	Hours	Days	Hours per Day
Yellow	14-1191	7-162	1.6-7.7
Orange	2-496	1-108	1.1-5.4
Red	1-215	<1-59	1-3.9
Black	1-108	<1-37	1-3.2

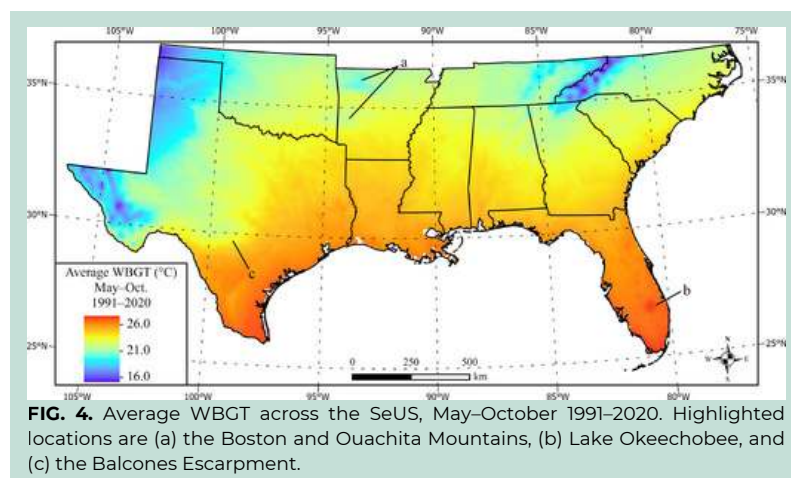


FIG. 4. Average WBGT across the SeUS, May–October 1991–2020. Highlighted locations are (a) the Boston and Ouachita Mountains, (b) Lake Okeechobee, and (c) the Balcones Escarpment.

### WORKER SAFETY

Worker safety can be measured in thresholds ranging from class zero (lowest intensity) to four (highest). These classes vary by clothing type and worker acclimation. More information about worker thresholds can be found [here](#). Overall, high intensity work is most commonly hazardous in the southern portion of the study region while low intensity work is most commonly hazardous in the central portion. As threshold level increases, conditions are influenced by proximity to moisture sources such as lakes, rivers, and wetlands.

### BLACK FLAG SPATIAL ANALYSIS

Out of the study region's states, Texas was the only one with substantial and significant increase in area experiencing  $\geq 1$  hour of black flag conditions. In terms of area that experienced  $\geq 30$  black flag hours, Oklahoma had the only statistically significant increase, particularly starting after 2005. Centroids calculated using these data did not show any significant shift in the geography of black flag conditions.