Heat Risk Tools: Wet bulb globe temperature (WBGT)

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Convergence

- convergence.unc.edu
- convergence.unc.edu/tools/wbgt
WBGT Background

How Does Heat Impact Public Health?

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

1. Air temperature
2. Humidity
3. Wind speed
4. Solar radiation

Heat Index

Wet-Bulb Globe Temperature
WBGT Background

\[
\text{WBGT} = 0.1 \times \text{Dry Bulb T} + 0.7 \times \text{Natural Wet Bulb T} + 0.2 \times \text{Globe T}
\]
## High School Athletics

### WBGT Activity Guidelines and Rest/Break Guidelines for Athletes

<table>
<thead>
<tr>
<th>Heat Category</th>
<th>WBGT Index (F)</th>
<th>Activity Guidelines</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Flag</td>
<td>Under 80</td>
<td>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)</td>
</tr>
<tr>
<td>Low (Green Flag)</td>
<td>80-84.9</td>
<td>Normal practice for athletes; closely monitor new or unconditioned athletes and all athletes during extreme exertion. Schedule mandatory rest/water breaks. (5 min rest/water break every 25 min)</td>
</tr>
<tr>
<td>Moderate (Yellow Flag)</td>
<td>85-87.9</td>
<td>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.</td>
</tr>
<tr>
<td>High (Red Flag)</td>
<td>88-89.9</td>
<td>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.</td>
</tr>
<tr>
<td>Extreme (Black Flag)</td>
<td>Over 90</td>
<td>SUSPEND PRACTICE</td>
</tr>
</tbody>
</table>

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/

Maps produced from hourly gridded (9X9 km) ERA-interim dataset from 1981-2020
Regional Patterns of WBGT across the SE U.S.

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

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

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

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

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<th>ACTIVITY GUIDELINES &amp; REST BREAK GUIDELINES</th>
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<tbody>
<tr>
<td>UNDER 82.0</td>
<td>NORMAL ACTIVITIES -- Provide at least three separate rest breaks each hour of minimum duration of 3 minutes each during workout.</td>
</tr>
<tr>
<td>82.0 - 86.9</td>
<td>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.</td>
</tr>
<tr>
<td>87.0 - 89.9</td>
<td>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.</td>
</tr>
<tr>
<td>90.0 - 92.0</td>
<td>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.</td>
</tr>
<tr>
<td>OVER 92</td>
<td>NO OUTDOOR WORKOUTS; CANCEL EXERCISE, delay practices until a cooler WBGT reading occurs.</td>
</tr>
</tbody>
</table>
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
Thank You!

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