Presentation Summary

Heat Forecasting Tools

- Heat Index
- Wet Bulb Globe Temperature
- HeatRisk
- NOAA UHI Campaign

National Blend of Models

- Calibration
- Probabilistic
Heat Index
Robert Steadman developed mathematical equations to measure the impacts of high temperatures and high humidity on the human body; and to quantify the effects of clothing, sunshine, wind, and other parameters.

- Includes several (21) parameters and assumptions:
  - body mass & height
  - Clothing
  - physical activity
  - heat tolerance
  - sunlight and UV exposure
  - wind speed

Heat Index Equation

Derived from Steadman’s work and simplified by Lans Rothfusz

- The NWS Peachtree Office color coded Steadman’s chart

\[
HI = -42.379 + 2.04901523T + 10.1433127R - 0.22475541TR - 6.83783x10^3T^2
- 5.48177x10^3R^2 + 1.22874x10^3TR + 8.5282x10^4T^3R - 1.99x10^6T^2R^2
\]

where \( T \) = ambient dry bulb temperature (°F)  
\( R \) = relative humidity (integer percentage)
Heat Index: Known Issues

- Discrepancies between the calculator and the chart
  - Rounding errors
- HI chart data does not go beyond 137°F
  - Max temperature parameter in original equations is 122°F
- HI is calculated for shady areas
  - Steadman notes that full sun can increase the apparent temperature.
  - Disclaimer on NWS website: “...exposure to full sunshine can increase heat index values by up to 15°F.”
Heat Index: Known Issues

- Assumptions
  - 5’6” adult
  - 147.7 lbs
  - Walking outside at 3.1 mph
  - Wearing trousers and short sleeved shirt or blouse

- Not an accurate measure of heat impacts on active individuals who are outdoors
- May not be the best indicator of heat impacts in areas with low humidity
Resources for Heat Index

- Tech Attachment:
  - https://www.weather.gov/media/ffc/ta_htindx.PDF
- NWS Heat Safety Page:
  - www.weather.gov/safety/heat
Wet Bulb Globe Temperature (WBGT)
# Wet Bulb Globe Temperature (WBGT)

<table>
<thead>
<tr>
<th>WBGT</th>
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<tbody>
<tr>
<td>Measured in the sun</td>
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<tr>
<td>Uses temperature</td>
<td></td>
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<tr>
<td>Uses relative humidity</td>
<td></td>
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<tr>
<td>Uses wind</td>
<td></td>
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<tr>
<td>Uses cloud cover</td>
<td></td>
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<tr>
<td>Uses sun angle*</td>
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**WBGT = 0.7T_w + 0.2T_g + 0.1T_d**

where:
- $T_w =$ Wet-Bulb Temperature (indicates humidity)
- $T_g =$ Globe temperature (indicates radiant heat)
- $T_d =$ ambient air (dry) temperature
Wet Bulb Globe Temperature (WBGT)

WHO CAN BENEFIT FROM the USE of WET BULB GLOBE TEMPERATURE

Heat is a major weather-related hazard. Although heat hazards are common in outdoor work environments or during physical activity, heat-related illness and fatalities are preventable.

Outdoor Workers  People Doing Strenuous Outdoor Activities  Active People  Athletes and Marching Band
Wet Bulb Globe Temperature (WBGT)

Public display available at
https://digital.mdl.nws.noaa.gov/

- Uses NWS forecast
  - Temperature
  - Dewpoint
  - Wind
  - Sky Cover
- Surface Pressure & Solar Radiation (sun angle) are calculated
- WBGT centrally post-processed
Wet Bulb Globe Temperature (WBGT)

- Color bin thresholds based on Grundstien’s work on WBGT climatology and widely accepted across the nation.
  
- We do not provide recommendations for activity modifications and/or work-rest ratios
  - Activity modifications vary geographically and are activity-specific
Wet Bulb Globe: Considerations

- WBGT highly sensitive to:
  - surface conditions (e.g. grass vs asphalt)
  - wind speed and wind fetch (e.g. area sheltered by trees, wind coming from moisture source such as a lake)
- WBGT is not directly comparable to temperature or heat index scales
  - WBGT can be lower than Heat Index and air temperature, complicating messaging of heat stress
Public display available at
https://digital.mdl.nws.noaa.gov/

NWS Heat Safety Page
www.weather.gov/safety/heat
HeatRisk
HeatRisk

- A numeric/color-based index that serves as a framework for leveraging peer-reviewed heat-health science and data consistently across the CONUS

- Developed as a heat service, to include serving the heat-vulnerable populations

- Unique local thresholds are based on local climatology and CDC heat-health relationships
HeatRisk

- Puts expected heat into a climatological context using NWS official forecast and CDC heat-health data

What does it take into account?

- How above normal temps (high & low) are for a location
- Time of the year
- Duration of unusual heat
- Overnight relief
- Difference between lows and highs
- If temperatures are at high enough levels to pose an elevated risk for heat complications (based on CDC heat-health thresholds)
HeatRisk can provide awareness to more sensitive groups without overwarning the entire population.

What are the benefits?

- Helps people understand what forecasted heat means to them
- Provides heat risk guidance for decision makers and heat sensitive populations who may need to take action below NWS heat product levels

What are the limitations?

- Only tested in the western US
- Unknown how this will perform with humidity
HeatRisk Resources

Public display for Western US available at
https://www.wrh.noaa.gov/wrh/heatrisk/

NWS Heat Safety Page
www.weather.gov/safety/heat
NWS Forecast Tools to Assess Heat

**Heat Index**

Heat stress context for **general public**.
- Simple (T + RH); Light physical activity in shade

**How/When to use?**
- Messaging heat & humidity
- WWA decision making

**WBGT**

Heat stress context for **healthy, active outdoor** communities.
- Complex (T+RH+wind+solar rad.); High physical activity

**How/When to use?**
- IDSS for those familiar
- Inform WWA decision making

**Exp. HeatRisk**

Climatological context, CDC-based health impact messaging.
- Complex (TX/TN climo, duration, etc)
- Messaging: more sensitive groups

**How/When to use?**
- IDSS & messaging highlight spectrum of heat impacts
- Inform WWA decision making
Urban Heat Island Mapping
Urban Heat Island Mapping

- NWS working with the Office of Oceanic and Atmospheric Research (OAR) to gain a better understanding of UHI across the country.

- NWS WFOs, WPC, and CPC support UHI Mapping Campaigns via outlooks and forecasts to help determine best days each city should conduct mapping.
The detailed maps resulting from these campaigns can be used to inform emergency managers where to focus efforts in emergency response to extreme heat events, inform city planners where to focus green space efforts, and inform NWS forecasters where hottest areas will be for targeted outreach, decision support, and messaging.
Urban Heat Island Mapping

Initial Observations

The distribution of heat across a region often varies by qualities of the land and its use. Here are several observations of how this phenomenon may be occurring in your region.

- Areas with large amounts of dark, low-reflectance surfaces (like asphalt roadways) seem to concentrate heat.
- Residential neighborhoods with all-white rooftops appear to reflect away solar radiation and heat.

The GIS and "Dynamic Range Adjustment" is helpful for more closely viewing differences in heat between areas.

FLIR

Transit amenities at a bus stop outside the Clark County Government Center.

Artificial turf and walkway next to bus stop.

Transit amenities at a bus stop outside the Clark County Government Center.
Urban Heat Island Mapping

Relationship between Temperature and Populations with Limited English Proficiency (LEP), San Diego City, CA, 2020
National Blend of Models (NBM)
National Blend of Models

A nationally consistent and skillful suite of calibrated forecast guidance based on a blend of both National Weather Service and external numerical weather prediction model data and post-processed model guidance.

A highly accurate, skillful and consistent starting point for the gridded forecast.

Providing forecasters with a suite of information to use for their forecasts.

Probabilistic and bias-corrected weather elements across several service areas.

An important part of the efforts to evolve NWS capabilities to achieve a Weather-Ready Nation.

NBM Inputs

- WRF MEM2
- WRF ARW
- RAP
- RAPX
- HRRR
- HRRRX
- GFS GMOS
- NAM GMOS
- EKDMOS/BMOS
- GLMP
- WW3D (0.5)
- WW3E (0.5)
- WW3D-Regional
- GLW
- HWRF
- HMON
- wTCM

- GEFS
- GFS
- NAM-Parent
- SREF
- NAM-Nest
- NEMS NMMB
- WRF ARW
- CMC GDPS
- CMC RDPS
- CMC REPS
- CMC GEPS
- ECMWF
- ECMWF
- NAVGEMD
- NAVGEME
- FNMOC
- ACCESS-G

- NOAA
- Canadian Meteorological Centre
- European Centre for Medium-Range Weather Forecasts
- U.S. Navy Fleet Numerical Meteorology and Oceanography Center
- Australia Bureau of Meteorology
National Blend of Models

Wednesday, June 2, 2021

Chance of High Temp
95°F or Above

This graphic displays the probability of the temperature reaching or exceeding 95°F.
Thank You!

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