NWS Experimental HeatRisk

Overview

The National Weather Service (NWS) experimental HeatRisk forecast provides a color and numeric value that places forecast heat for a specific location into an appropriate level of heat concern, along with identifying groups potentially most at risk at that level. The HeatRisk is accompanied by recommendations for heat protection and is a useful tool for planning for upcoming heat and its associated potential risk. Based on the high resolution NWS national gridded forecast database, a daily HeatRisk value is calculated for each location from the current date through seven days in the future. *At this time, the experimental HeatRisk forecast is being used to influence the issuance of, and to add value, to the NWS's official heat watches, advisories, and warnings across much of the western United States in an experimental capacity.* This product is another NWS tool that can be used to protect lives and property from the potential risk of excessive heat, being especially useful for those who are more easily affected by heat or those who provide support to those communities of heat vulnerable individuals. The experimental HeatRisk product ensures that communities have the right information at the right time to be better prepared for upcoming heat events.

Who are most susceptible to heat?

Heat commonly affects certain groups, typically identified as heat sensitive or heat vulnerable, at lower thresholds than other populations. Some of these groups include:

- The elderly and the very young;
- Those on certain medications and/or those with preexisting conditions which make them more sensitive to heat (your doctor can let you know if this is you);
- Those working outdoors -- especially new workers, temporary workers, or those returning to outdoor work after a week or more off;
- Those exercising or doing strenuous activities outdoors during the heat of the day – especially those not used to the level of heat expected, those who are not drinking enough fluids, or those new to that type of activity;
- Those without a reliable source of cooling and/or hydration;
- Those not acclimated to the level of heat expected – especially those who are new to a much warmer climate
- Some economic sectors that are affected by increasing levels of heat, such as energy, agriculture, and transportation.

Understanding the HeatRisk Product

The purpose of the NWS experimental HeatRisk product is to help you understand what forecasted heat means to you. To make it easier to understand, the HeatRisk is divided into five categories:

HeatRisk Values	Risk of Heat Effects	Levels of Heat Concern
When the HeatRisk is this value:	…the risk of heat effects are:	…as symbolized by this color:
0	Very low	Green
1	Low	Yellow
2	Medium	Orange
3	High	Red
4	Very High	Magenta

Simply put, the higher the value, the greater the level of heat concern would be for that location. If both the overnight lows and daytime highs are exceptionally warm for that date at a given location over a period of at least 48 hours, at levels that pose an elevated risk for heat complications, the highest level of 4 for HeatRisk is achieved.

Essentially when HeatRisk values are 1 or greater, heat is considered to be of concern – at first for those who are extremely sensitive to heat, then for everyone as HeatRisk values get to the highest levels. For example, a HeatRisk value of 0 represents no *elevated* risk for heat concerns; a HeatRisk value of 2 represents a moderate potential risk for members of heat sensitive groups; while a HeatRisk value of 3 represents a high potential risk of heat effects for anyone without proper hydration and adequate cooling.

The NWS has assigned a specific color to each HeatRisk category to make it easier for people to understand quickly whether heat is reaching a high enough level to create heat concerns for their unique situation. Each HeatRisk category corresponds to a different level of potential heat concern. The five levels of heat concern and what they mean are shown in the table below.

Numerical Value	Meaning	Who/What is at Risk?	How Common is this Heat?	For those at risk, what actions can be taken?
0	• Level of heat poses **little to no risk**	• No elevated risk	Very Common	• No additional preventative actions should be necessary.
1	• Heat of this type is **tolerated by most**; however there is a **low risk for sensitive groups** to experience health effects	• Primarily those who are extremely sensitive to heat	Very Common	• Increase hydration • Reduce time spent outdoors or stay in the shade when the sun is strongest • Open windows at night and use fans to bring cooler air inside buildings
2	• **Moderate risk for members of heat sensitive groups** to experience health effects • **Some risk for the general population who are exposed to the sun and are active** • For those without air conditioning, **living spaces**	• Primarily heat sensitive groups, especially those without effective cooling or hydration • Some transportation and utilities sectors	• Fairly common most locations • Very common in southern regions of country	• Reduce time in the sun between 10 a.m. and 4 p.m. • Stay hydrated • Stay in a cool place during the heat of the day • Move outdoor activities to cooler times of the day • Open windows at night and use fans to bring cooler air

	can become uncomfortable during the day, but should cool below dangerous levels at night			inside buildings and circulate air
3	• **High Risk for much of the population who are 1) exposed to the sun and active or 2) are in a heat sensitive group** • **Dangerous to anyone without proper hydration or adequate cooling** • **Poor air quality** is possible • **Power interruptions may occur** as electrical demands increase	• Much of the population, especially those who are heat sensitive and anyone without effective cooling or hydration • Most transportation and utilities sectors	• Uncommon most northern locations • Fairly common in southern regions of country	• Try to avoid being outdoors in the sun between 10 a.m. and 4 p.m. • Stay hydrated • Stay in a cool place especially during the heat of the day • If you have access to air conditioning, use it. Fans may not be adequate • Cancel outdoor activities during the heat of the day
4	• **Very High Risk for entire population** • **Very dangerous to anyone without proper hydration or adequate cooling.** • **This is a multi-day excessive heat event.** Prolonged heat is dangerous to anyone not prepared. • **Poor air quality** is likely. • **Power outages are increasingly likely** as electrical demands may reach critical levels.	• Entire population is at risk. • For heat sensitive groups, especially people without effective cooling, **this level of heat can be deadly**. • Most transportation and utilities sectors	• Rare most locations • Occurs up to a few times a year in southern regions of country, especially the Desert Southwest	• Avoid being outdoors in the sun between 10 a.m. and 4 p.m. • Stay hydrated • Stay in a cool place, including overnight • If you have access to air conditioning, use it. Fans will not be adequate • Cancel outdoor activities during the heat of the day

Because heat affects people and various economic sectors in very individual and different ways, the level of HeatRisk that is important to you may be different than for another person. It also may be different depending on what activities you are engaged in, or medication you are on.

So for someone who is in a heat sensitive group, monitoring the HeatRisk forecasts and taking specific actions to avoid adverse heat effects when the forecast is calling for an “orange” day or greater would make sense for them. For someone not in a heat sensitive group with routine access to air conditioned spaces, “red” or “magenta” might be the only levels they would pay attention to and take specific actions to avoid adverse heat effects. In this way the HeatRisk allows for decisions to be made based on individual heat tolerance and situation and for appropriate actions to be taken when that level is forecast.

Your Level May Change As Your Activities Do

The level of HeatRisk that is important for you is not always the same. For example, if you decide to take up jogging in July during your lunch break, you may want to monitor the forecast for “orange” HeatRisk forecasts for the first few weeks until you get used to both jogging and the heat of the day. So initially, when “orange” levels or greater are forecast, you might follow the suggested action of moving the time you jog to before work, and avoid the heat of the day. Once you get used to the heat and to jogging, you may decide to start modifying your activities only when “red” levels are forecast.

Or let's say you are traveling in April from a northern climate to the desert Southwest for a week of hiking and exploring the landscape in some of our national parks. You haven't gotten used to temperatures in the 80s or 90s yet, but these temperatures are not that uncommon in the desert regions at this time of year. So, you may want to monitor the forecast for "orange" levels or greater during the vacation to identify days that you may want to begin taking additional steps to ensure proper hydration, schedule activities around the heat of the day, etc. Taking just these few actions may make the difference in having an enjoyable and safe trip. Meanwhile, those that live in the desert Southwest and are not in a heat sensitive group are doing their normal day-to-day activities when "orange" levels are forecast, because they have already become acclimated to these types of temperatures and are able to stay hydrated and cool.

The HeatRisk product can also be used by industry as well as public health sectors. For example, for a HeatRisk of 4 or "magenta", the power industry might anticipate a significantly increased demand and load on the power grid. They could take appropriate actions based on the NWS forecast of potential heat effects.

So you can see that the NWS HeatRisk forecast is something that can be adapted to your particular needs and heat sensitivity, allowing you to track the forecast and take the actions that you need to take, when you need to take them.

How does the HeatRisk work?

The HeatRisk takes into consideration:

1) how significantly above normal the temperatures are at your location,
2) the time of the year (for example, is this early season heat that you likely haven't become used to, or late season heat that you have become more used to),
3) the duration of unusual heat (for example, are temperatures overnight at cool enough levels that would lower heat stress, or will warm overnight low temperatures continue to add to the level of heat stress), and
4) if those temperatures are at levels that pose an elevated risk for heat complications, such as heat stress, based on peer reviewed science.

You may wonder where humidity is in this process. We know that humidity plays a significant role in making warm temperatures feel even more oppressive. Unfortunately, there are not an adequate number of weather stations across the country which report humidity values for a long enough period of time to be used directly in the HeatRisk approach. But there are many more stations that report temperature. Because of this, we use well known physical relationships of temperature to humidity to approximate the role of humid air. This is done by considering:

1) how unusually warm the overnight temperatures are (more humid air usually leads to warmer overnight low temperatures than are typical for an area), and
2) how large the difference is between overnight lows and daytime high temperatures (the difference tends to be smaller the more humid the air is).

All of these factors are used to create daily dynamic heat thresholds. These thresholds differ from one location to another, especially between cities and rural locations and in areas where elevation changes. As appropriate, these thresholds also change based on the day of year so that they are lower in the spring than in the summer, for example. The official NWS gridded forecast for high and low temperatures are then compared to these dynamic heat thresholds at each location, and the forecast temperatures are matched to their appropriate HeatRisk color/level. Information from both the overnight lows and daily highs are

combined to create the final output: the experimental 24 hour HeatRisk. This information is available for the entire upcoming seven day period and provides additional information to base heat-related decisions on, not only for human health, but for many sectors that are affected by heat. The experimental HeatRisk product is just one more way the NWS is working toward ensuring that communities have the right information at the right time to be better prepared for upcoming heat events.

Why is this different than the Heat Index, WetBulb Globe Temperature, or official NWS Heat Products?

The biggest difference between the HeatRisk approach and other approaches is that the HeatRisk identifies unusual heat specifically for that particular date and location, rather than just using a single threshold value applied across a large area. This allows the approach to better account for acclimation and the variation in climatology that we know exists across most regions of the United States. To do this, we need to have a high resolution gridded climatology to put the forecast into context.

While the heat index is a valuable component toward understanding heat risk for people, there are not an adequate number of stations across the country, particularly in the West, that report hourly humidity values for a long enough period of years to develop a high resolution gridded climatology. Additionally, in most approaches to heat index warning criteria, the impacts of excessively warm nights are not considered. The HeatRisk approach utilizes the many more observations of temperature that exist across the country, along with leveraging well known relationships between temperature and humidity to approximates the role of humidity. So, the HeatRisk approach does account for humidity, but in a more general sense, and its output will differ somewhat from specifically calculated heat index values.

The WetBulb Globe Temperature is another useful index that measures heat stress in direct sunlight, taking many factors into account. If you work or exercise in direct sunlight, this can be a good element to monitor. However, it is not a universal measure for heat risk, especially for the heat sensitive whose thresholds are much lower, for the homebound where the impacts of overnight temperatures are important, and it is quite challenging to accurately predict due to the many factors that need to be accounted for on the local scale. Experiments in producing gridded forecasts of WetBulb Globe Temperature forecasts have not been highly skillful in capturing the daily local nuances of heat.

As mentioned earlier, the experimental HeatRisk is not an official NWS heat product. *The NWS's heat watches, advisories, and warnings remain the official heat products from the NWS*. The HeatRisk represents additional information that can be used to better identify those days of the year when heat may be at levels that pose a risk to certain populations or economic sectors. As we have discussed, for groups who are heat sensitive, their individual levels of action may be below NWS established heat criteria which is meant to warn the entire general population to specific action. Additionally, while methodologies for specific heat criteria can be different from one NWS office to another, a goal of the experimental HeatRisk product is to explore applying a scientific and consistent methodology nationally to provide potential risk from upcoming heat in a uniform manner with output available for any level of heat, not just for the most extreme heat events.

Where can I go for more information on how to protect myself from heat?

NWS Weather Ready Nation "Beat the Heat" Resources:
URL: http://www.nws.noaa.gov/os/heat/index.shtml

CDC Tips for Preventing Heat-Related Illness:
URL: http://emergency.cdc.gov/disasters/extremeheat/heattips.asp

CDC Info for Specific "Heat Sensitive" Groups:
URL: https://www.cdc.gov/disasters/extremeheat/specificgroups.html

American Red Cross Heat Wave Safety: URL: http://www.redcross.org/prepare/disaster/heat-wave

Ready.gov Extreme Heat Resource: URL: http://www.ready.gov/heat

OSHA Heat Educational Resources: URL: https://www.osha.gov/SLTC/heatillness/edresources.html