



NATIONAL WEATHER SERVICE

Seattle

Extreme Heat & Warning Systems

Reid Wolcott

Warning Coordination Meteorologist

National Weather Service - Seattle



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NWS Mission

Provide weather, water, and climate **data, forecasts, warnings, and impact-based decision support services** for the **protection of life** and property and enhancement of the national economy.

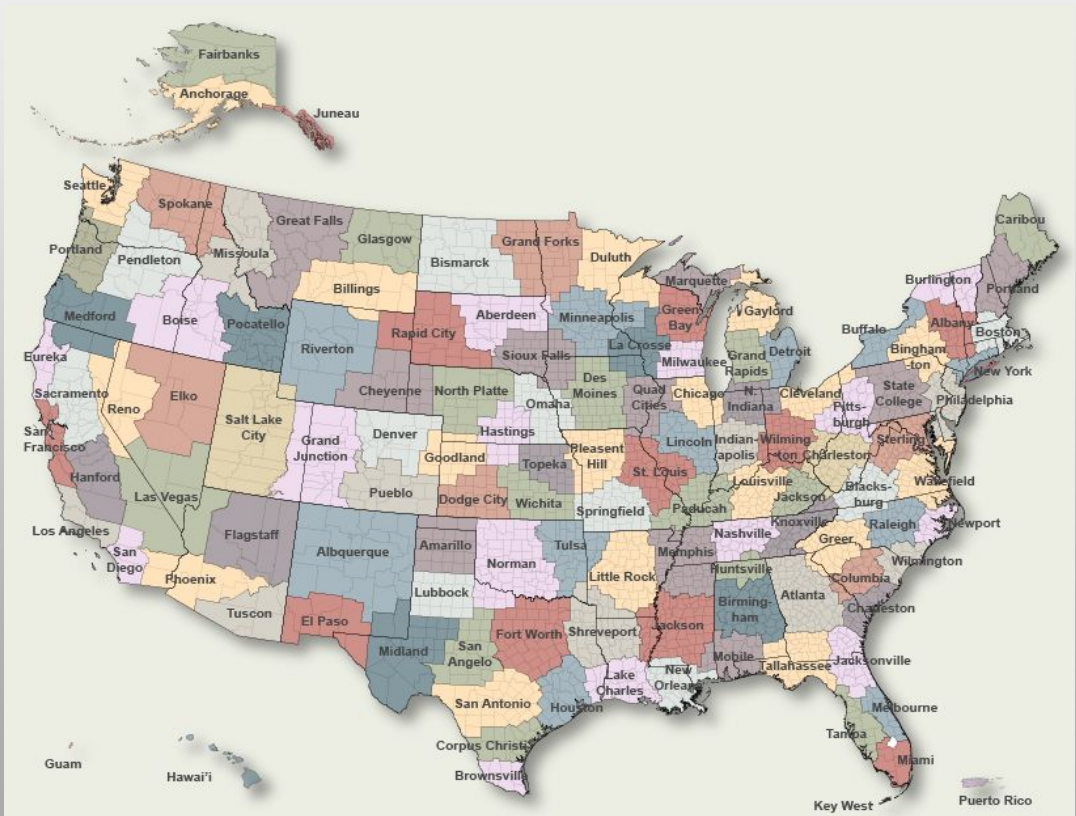


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- 122** FORECAST OFFICES
- 21** AVIATION OFFICES
- 13** RIVER FORECAST CENTERS
- 9** OTHER CENTERS



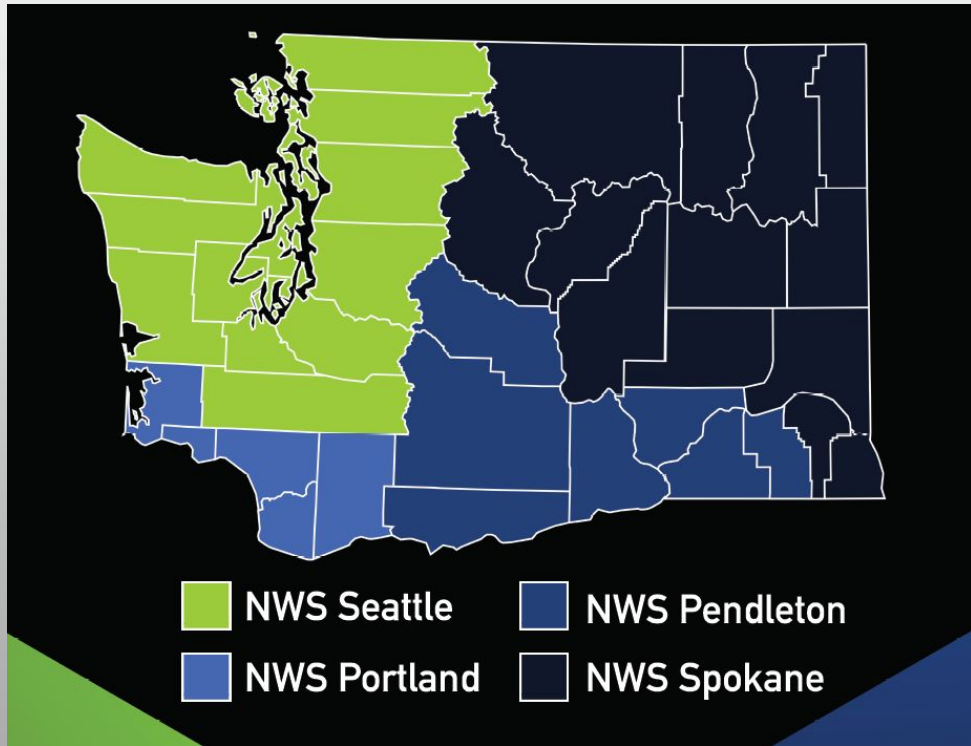


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NWS Seattle Operations

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24 HOURS PER DAY

2 METEOROLOGISTS ON DUTY 24/7

8 OPERATIONAL WORKSTATIONS

18 TOTAL METEOROLOGISTS





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Climatology





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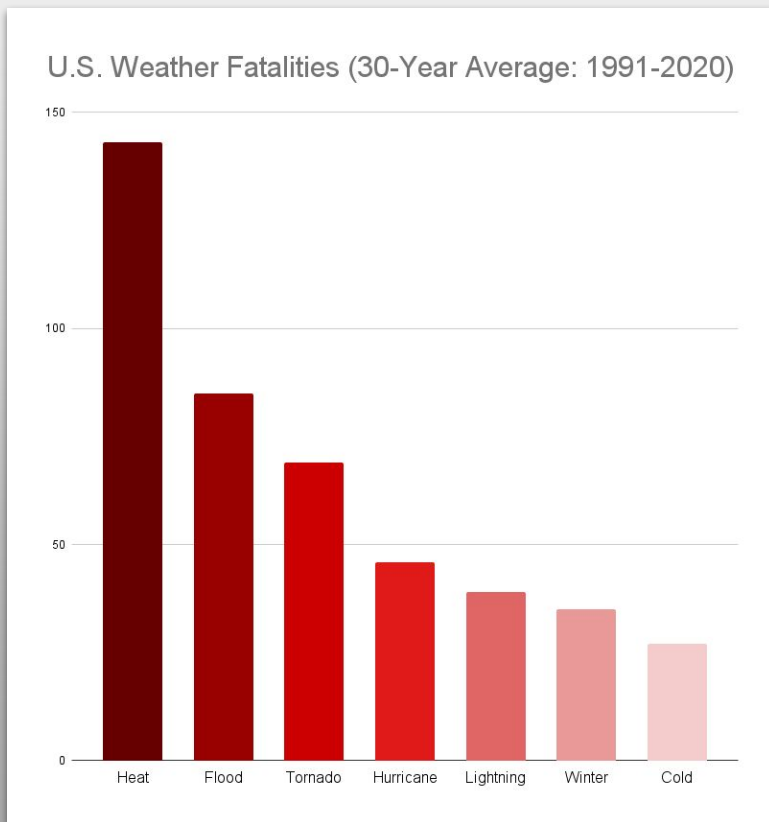
Hazard Description

Human Health Impacts

- **#1 Cause of Weather-Related Fatalities**
- Heat Cramps
- Heat Exhaustion
- Heat Stroke
- Reduced Air Quality

Infrastructure & Other Impacts

- Damage to roads, bridges, railways, power & telecommunications lines
- Strain on power systems
- Rapid increase in wildfire danger
- Agriculture/Aquaculture impacts





Hazard Description

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Human Health Impacts

- #1 Cause of Weather-Related Fatalities
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Infrastructure & Other Impacts

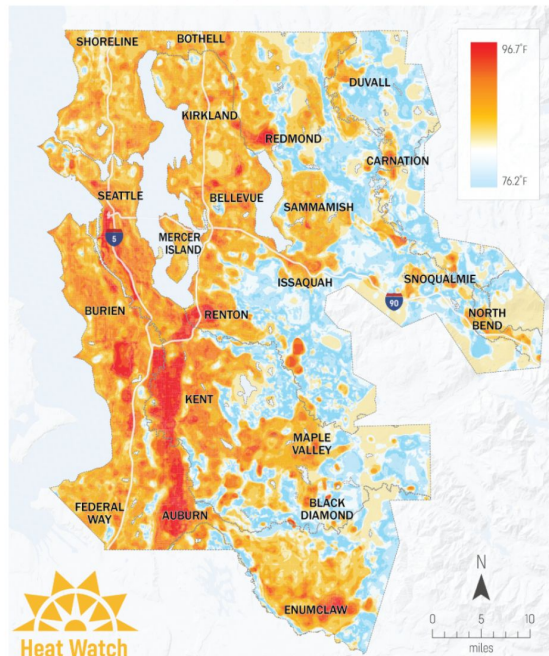
- Damage to roads, bridges, railways, power & telecommunications lines
- Strain on power systems
- Rapid increase in wildfire danger
- Agriculture/Aquaculture impacts

Urban Heat Island

- Significant warming due to urbanization & human activities
- Effect most noticeable overnight

Areas with more natural landscapes retain less heat

Evening Study Results



The use of the information in this map is subject to the terms and conditions listed at: <https://www.kingcounty.gov/transportation/transportation/heat-watch>. Your access to and use is restricted to your organization's use only. For more information, please contact: HeatWatch@kingcounty.gov

Image Courtesy King County

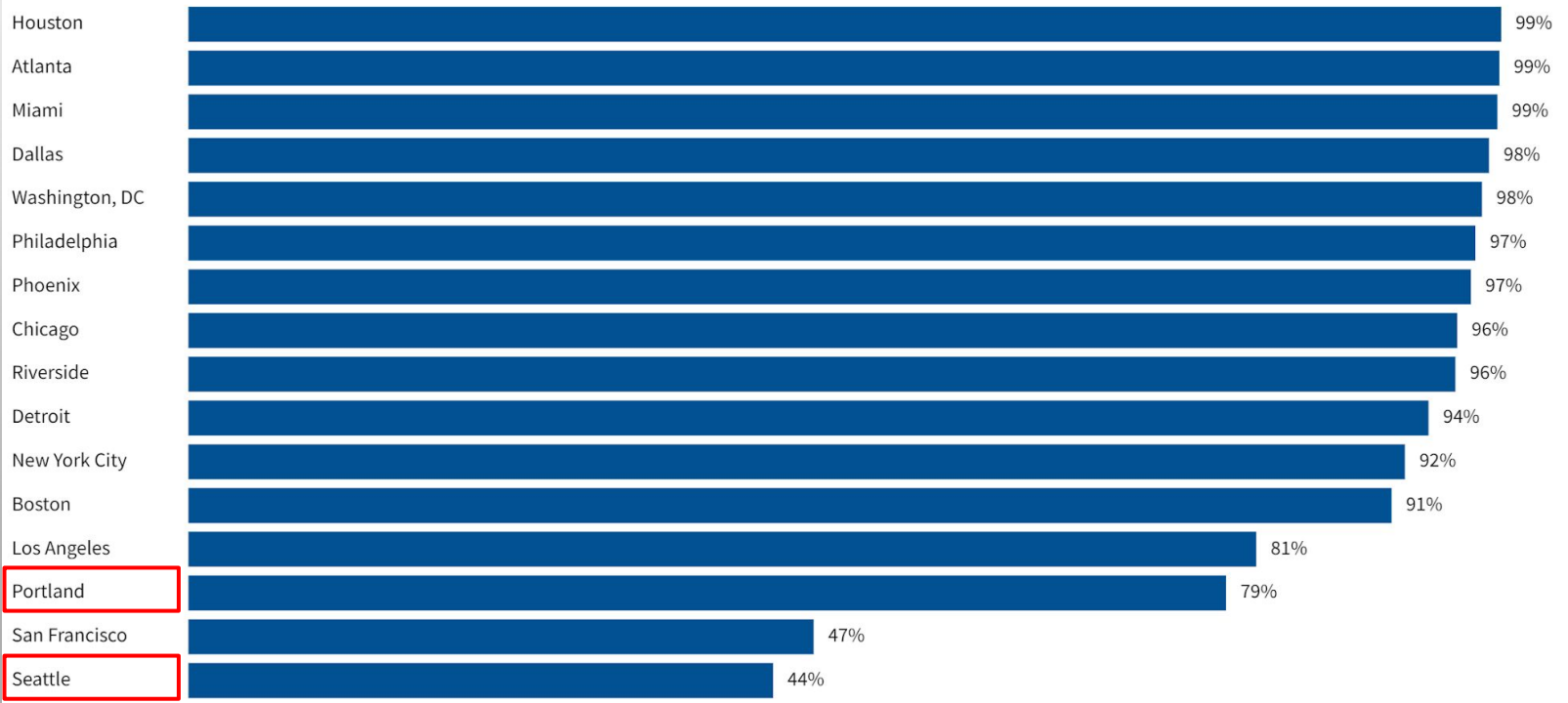


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Hazard Description

2019
Percentage of households with air conditioning in the top 15 metro areas and Portland





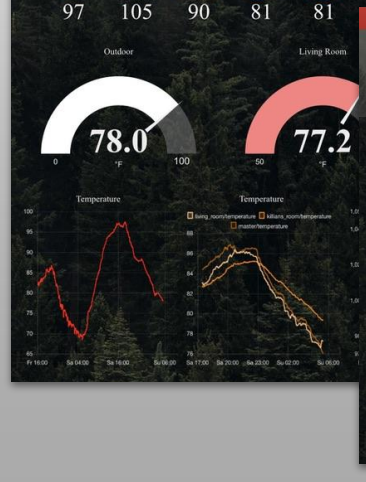
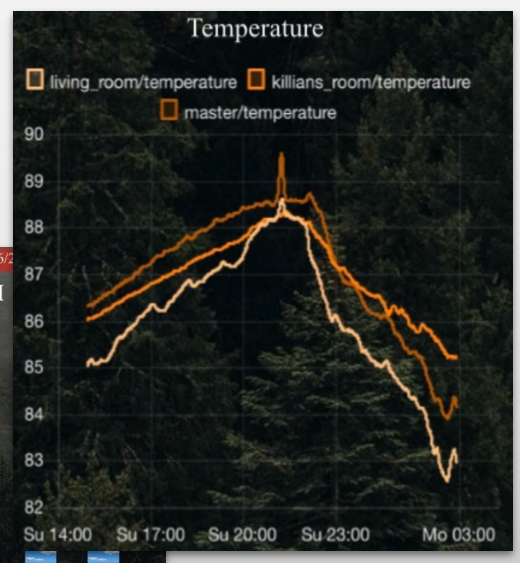
Hazard Description

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Indoor Temperatures & Low Temperatures

- PNW homes are designed to let in and retain heat (south facing windows, insulation, etc.)
- For locations without A/C, indoor temperatures don't typically peak until the outdoor temperature is cooler than the indoor temperature
- **The hotter the event, the later this crossover occurs**
- June 2021 heat wave example: indoor temperatures didn't peak (85°-93°) until between 10pm - 11pm at a 3rd (top) floor apartment in Shoreline, WA
- Once windows are opened, the indoor temperature will only cool as fast as the outdoor temperature, and only as low as the morning low - making **overnight low temperatures critically important.**
- These factors should be taken into account when considering cooling center hours





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Climate 30-Year (1992-2021) Averages

Bellingham		Seattle (Seatac)		Olympia		Quillayute	
Threshold	Average # Days/Year	Threshold	Average # Days/Year	Threshold	Average # Days/Year	Threshold	Average # Days/Year
>= 80°F	10.6	>= 80°F	27.0	>= 80°F	36.6	>= 80°F	8.8
>= 85°F	2.6	>= 85°F	11.0	>= 85°F	17.4	>= 85°F	3.9
>= 90°F	0.4	>= 90°F	3.1	>= 90°F	6.1	>= 90°F	1.2
>= 95°F	0.1	>= 95°F	0.6	>= 95°F	1.4	>= 95°F	0.2
>= 100°F	--	>= 100°F	--	>= 100°F	0.2	>= 100°F	--



Climate Records

Most western Washington heat records were shattered in June 2021

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RECORD SUMMARY — JUNE 2021

NEW & EXISTING RECORDS

	FRI 6/25	SAT 6/26	SUN 6/27	MON 6/28	ALL OF JUNE	ALL TIME
Bellingham	86° (2021)	95° (2021)	95° (2021)	99° (2021)	99° (6/28/2021)	99° (6/28/2021)
Seattle (Sea-Tac)	96° (2017)	102° (2021)	104° (2021)	108° (2021)	108° (6/28/2021)	108° (6/28/2021)
Olympia	98° (2017)	102° (2021)	105° (2021)	110° (2021)	110° (6/28/2021)	110° (6/28/2021)
Hoquiam	82° (2017)	87° (2021)	103° (2021)	95° (2021)	103° (6/27/2021)	103° (6/27/2021)
Quillayute	86° (2017)	90° (2021)**	90° (2021)**	110° (2021)	110° (6/28/2021)	110° (6/28/2021)

In some cases, records may have occurred multiple times, only the most recent date is shown in the table above.

**Quillayute ASOS experienced a data outage on 6/26-6/27. The highest temperature recorded both days was 90, which breaks/ties the existing records. However these observations may not be considered official due to the data outage.



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NATIONAL OCEANIC & ATMOSPHERIC ADMINISTRATION

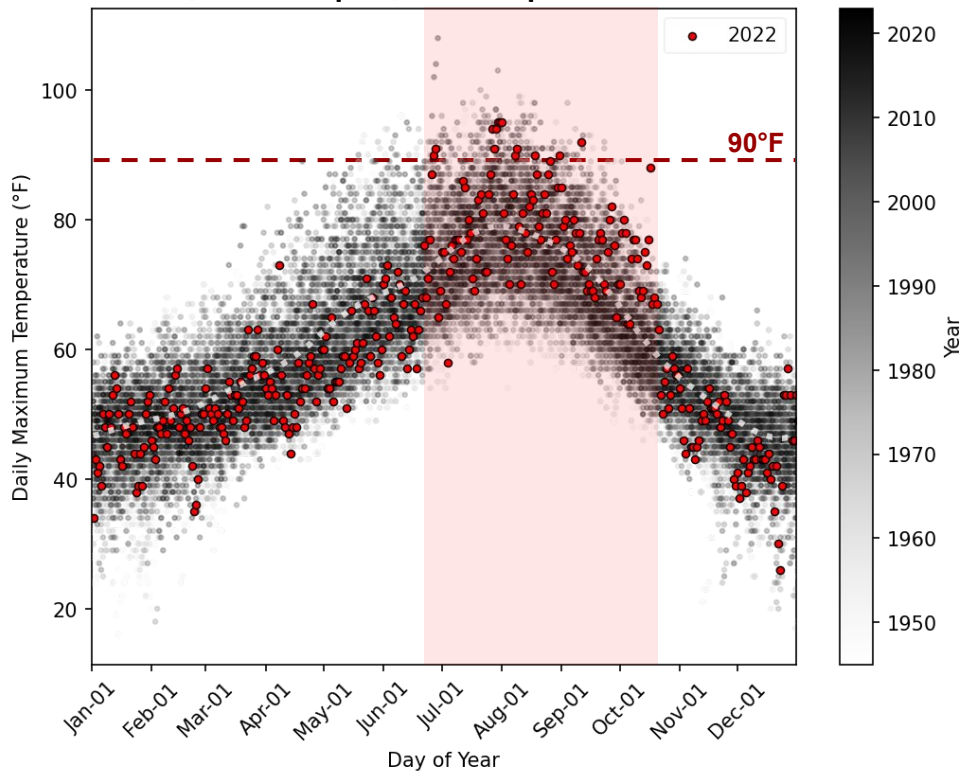
Seattle, WA

7:50 AM — Tuesday, June 29, 2021



Record-Breaking Heat & Dry Conditions Seattle, WA

Seattle (SeaTac Airport) Max Temperatures 1945-2023



New Seattle (SeaTac) Records in 2022

- **NEW:** 13 Total days at/above 90°F
- **NEW:** 6 Consecutive Days at/above 90°F
- **NEW:** Jul - Oct 2022: Hottest on Record
- 10 New Daily Record High Temperatures
 - Jul: 2 (5th Hottest July on Record)
 - Aug: 1 (3rd Hottest August on Record)
 - Sep: 2 (3rd Hottest September on Record)
 - Oct: 5 (2nd Hottest October on Record)
- Driest 120 Day (~4-Month) Period on Record (ending Oct 19, 2022): 0.54" of Rain
 - The only other year with a 120 day stretch under 1.00" was 2018 (0.96")



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Extreme Heat Services



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Heat Decision Metrics:

- Ambient Temperature
- **Heat Index***
- **Wet-Bulb Globe Temperature***
- **HeatRisk***
- Kalkstein & Other Systems

***Most frequently used by the National Weather Service**

	WBGT	HEAT INDEX
Measured in the sun	●	●
Measured in the shade	●	●
Uses temperature	●	●
Uses relative humidity	●	●
Uses wind	●	●
Uses cloud cover	●	●
Uses sun angle	●	●

Heat Index

Traditional measure of what the temperatures feels like to the human body when humidity is combined with air temperature.

However, there is a limited humidity climatology, particularly in the western US. Most heat index approaches do not consider overnight temperatures.

Wet Bulb Globe Temperature (WBGT)

Parameter that estimates the effect of temperature, humidity, wind, and solar radiation on humans.

This hyper-local index is a particularly useful measure for acclimatized, healthy, & physically active people including the military, outdoor workers, athletes/marching bands, etc. However, it is not a universal measure for the risk posed by heat. WBGT can be difficult to predict on the local scale, however NWS does provide WBGT forecasts.



NWS HeatRisk

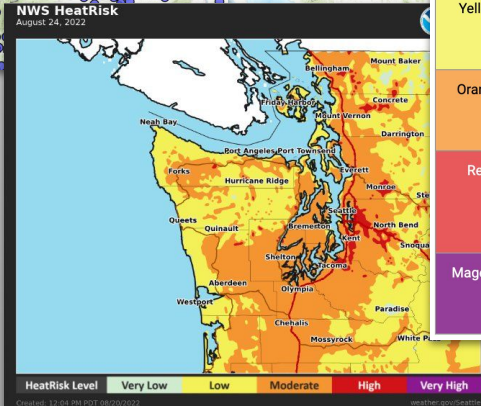
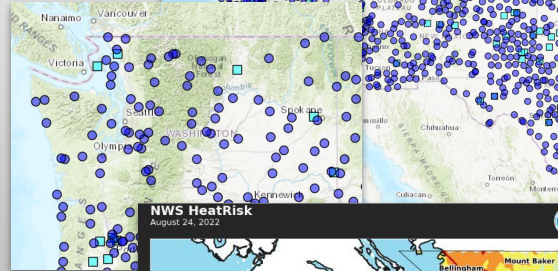
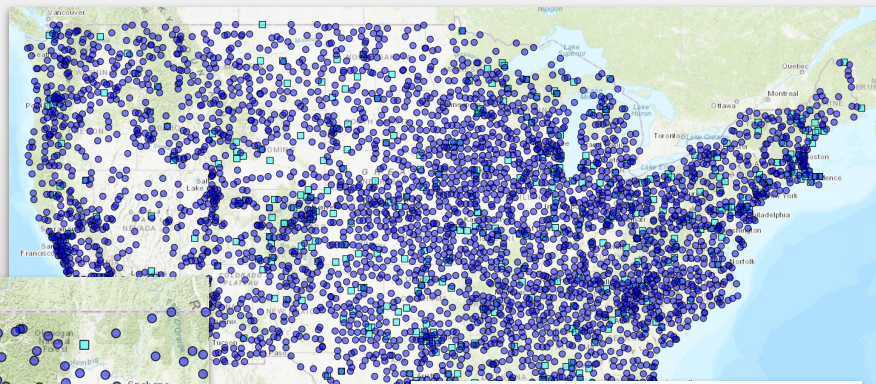
Puts heat into an actionable, impacts-based context to support decision-making at a local level.

HeatRisk takes into account:

- **Local Climatology**
 - Location
 - Time of Year
- **Forecast**
 - Forecast High Temperature
 - Forecast Low Temperature
 - Event Duration
- **Impacts**
 - Uses CDC heat health data to identify at-risk groups for a given level of heat.

HeatRisk is the primary driver of NWS heat-related Watch, Warning, & Advisory products

[HeatRisk Forecast](#) | [Historical Data](#) | [About](#)



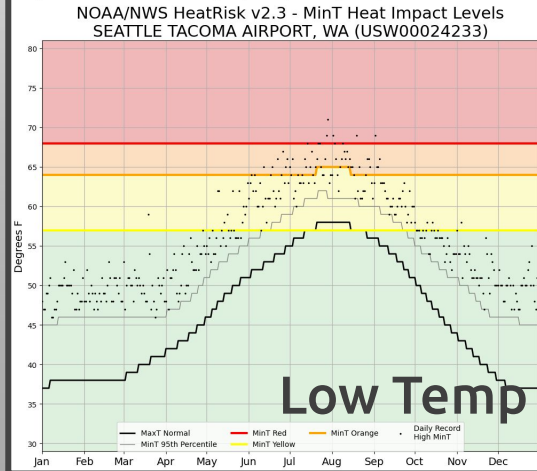
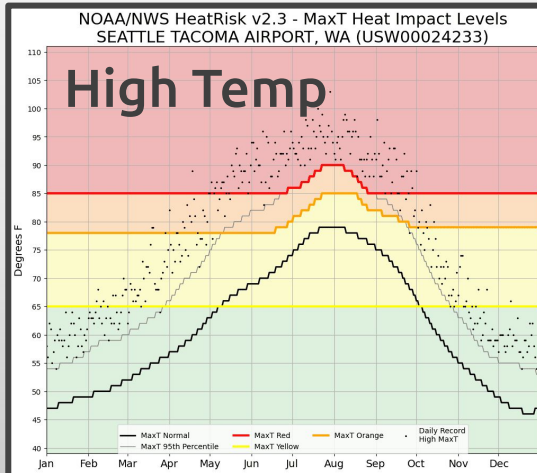
Category	Level	Meaning
Green	0	No Elevated Risk
Yellow	1	Low Risk for those extremely sensitive to heat, especially those without effective cooling and/or adequate hydration
Orange	2	Moderate Risk for those who are sensitive to heat, especially those without effective cooling and/or adequate hydration
Red	3	High Risk for much of the population, especially those who are heat sensitive and those without effective cooling and/or adequate hydration
Magenta	4	Very High Risk for entire population due to long duration heat, with little to no relief overnight



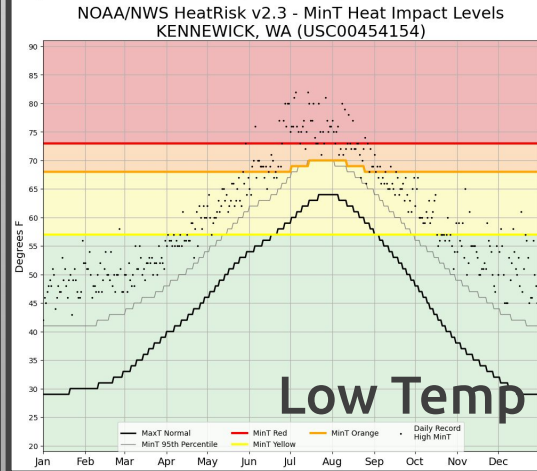
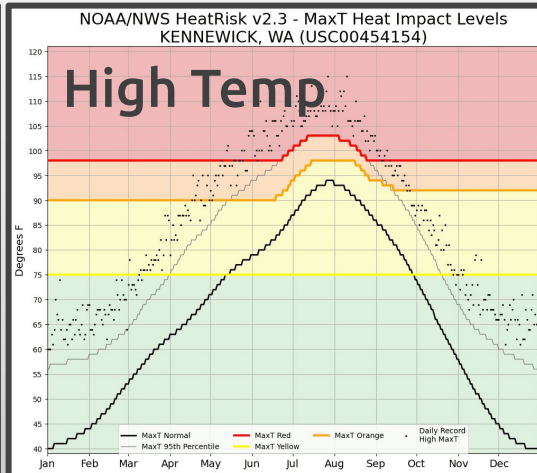
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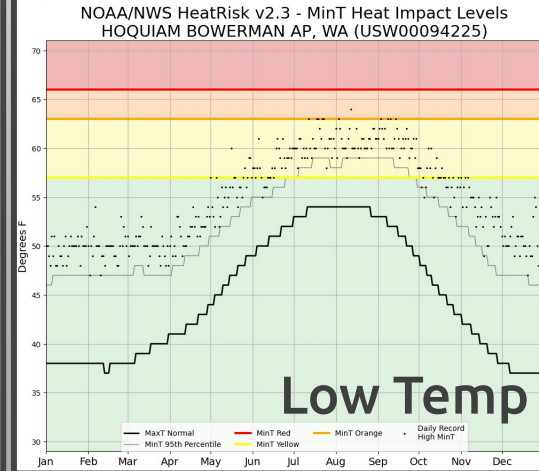
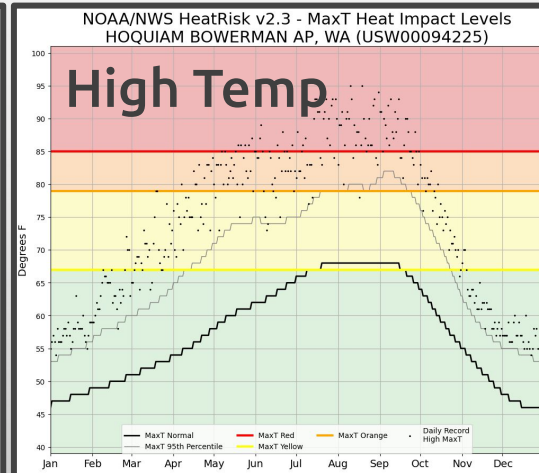
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Kennewick



Hoquiam






HeatRisk Forecast Webpage

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Best way to maintain situational awareness of potential heat events out to 7 days.

- Click through each day to update the map
- Click any map location to get a point HeatRisk forecast
- Overlay counties, cities, alerts, and more



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National Oceanic and Atmospheric Administration

[Bookmark](#) [Download](#) [KML](#) [Graphics](#)

NWS HeatRisk Prototype
Identifying Potential Heat Risks in the Seven Day Forecast

Fri 6/9	Sat 6/10	Sun 6/11	Mon 6/12	Tue 6/13	Wed 6/14	Thu 6/15
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Click map for potential heat risks and NWS forecast for a location.

The NWS HeatRisk Prototype is a color-numeric-based index that provides a forecast risk of heat-related impacts to occur over a 24-hour period. HeatRisk takes into consideration:

- How unusual the heat is for the time of the year
- The duration of the heat including both daytime and nighttime temperatures
- If those temperatures pose an elevated risk of heat-related impacts based on data from the CDC

This index is supplementary to official NWS heat products and is meant to provide risk guidance for those decision makers and heat-sensitive populations who need to take actions at levels that may be below current NWS heat product levels.

Category	Risk of Heat-Related Impacts
Green 0	Little to no risk from expected heat.
Yellow 1	Minor - This level of heat affects primarily those individuals extremely sensitive to heat, especially when outdoors without effective cooling and/or adequate hydration.
Orange 2	Moderate - This level of heat affects most individuals sensitive to heat, especially those without effective cooling and/or adequate hydration. Impacts possible in some health systems and in heat-sensitive industries.
Red 3	Major - This level of heat affects anyone without effective cooling and/or adequate hydration. Impacts likely in some health systems, heat-sensitive industries and infrastructure.
Magenta 4	Extreme - This level of rare and/or long-duration extreme heat with little to no overnight relief affects anyone without effective cooling and/or adequate hydration. Impacts likely in most health systems, heat-sensitive industries and infrastructure.

Valid: **Mon Jun 12**

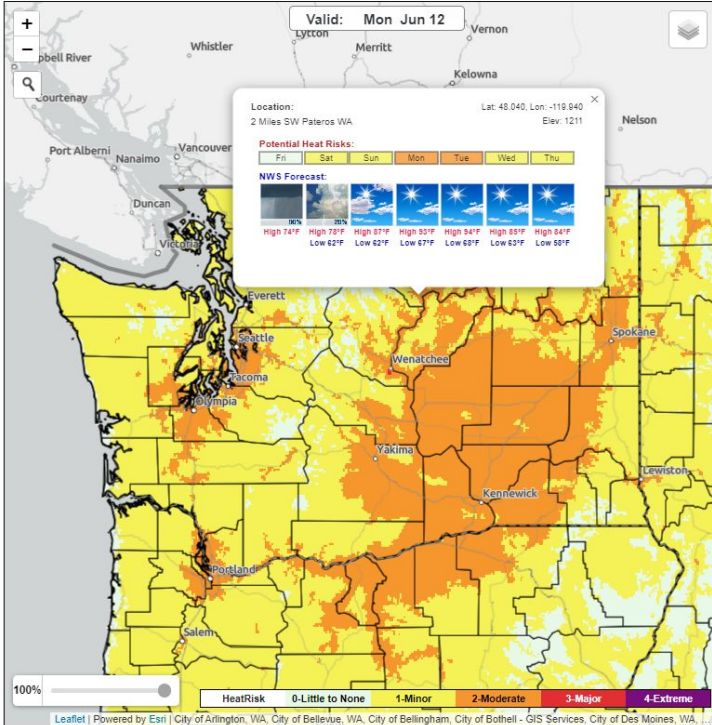
Location: 2 Miles SW Pateros WA
Lat: 48.040, Lon: -119.840
Elev: 1211

Potential Heat Risks:

Fri	Sat	Sun	Mon	Tue	Wed	Thu
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NWS Forecast:

 High 74°F Low 62°F	 High 70°F Low 62°F	 High 87°F Low 67°F	 High 83°F Low 62°F	 High 84°F Low 65°F	 High 85°F Low 65°F	 High 84°F Low 65°F
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[Comments?](#) [Questions?](#) [Please Contact Us.](#)

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Watch/Warning/Advisory (WWA) Products





WWA Products

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TYPE	DEFINITION	THREAT	ACTION
WARNING	Hazard is occurring, imminent, or very likely	Threat to life & property	Take protective action
WATCH	Conditions are <u>favorable</u> for hazard to occur	Threat to life & property	Have a plan of action
ADVISORY	Hazard is occurring, imminent, or very likely	Threat of significant inconvenience	Use caution



TACO WATCH



TACO WARNING



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WWA Products

Watch, Warning, & Advisory products are each associated with a minimum confidence threshold.

Note: Tsunami WWA products do not use confidence thresholds.

Watch Threshold

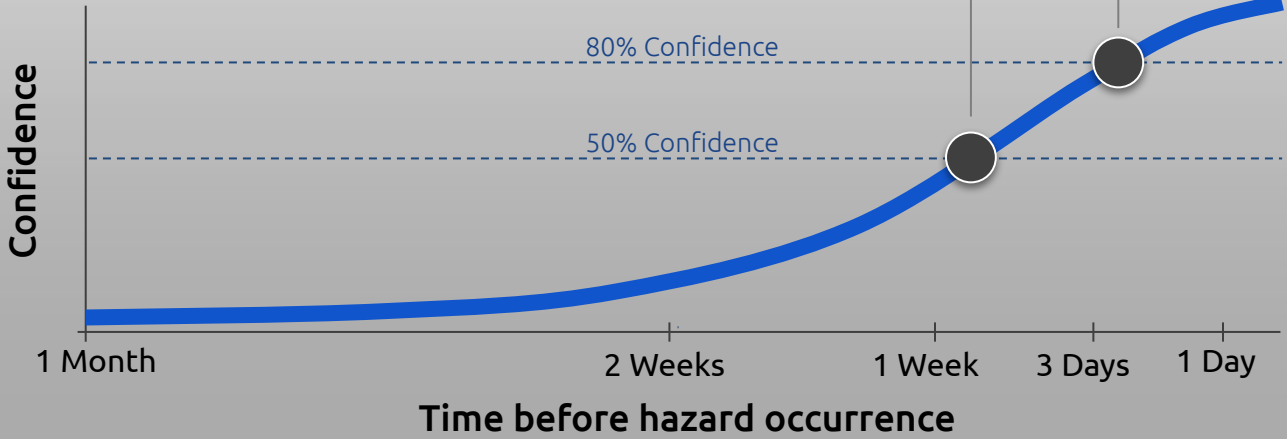
Conditions are expected to be favorable for hazard to occur.
Hazard occurrence confidence is $\geq 50\%$

Warning Threshold

OR
Advisory Threshold
Hazard is imminent or occurring.
Hazard occurrence confidence is $\geq 80\%$

Idealized Example

Note: times, confidence path varies for each event. (e.g confidence grows much earlier for heat events than for snow events)





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WWA Products & Criteria

Current Heat Alert Products:

- Excessive Heat Warning
- Excessive Heat Watch
- Heat Advisory

Heat Alert Changes:

- “Excessive” wording will change to “Extreme” ~Spring 2024
- All Advisories will become plain language alerts no earlier than 2025



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WWA Products & Criteria

Excessive Heat Warning

Impacts criteria: Very hot conditions that are likely to result life-threatening illness for those unable to escape the heat or significant impacts to commerce/travel (e.g. road/bridge expansion damage, railway impacts, etc.).

Numerical criteria: Criteria varies by location. NWS HeatRisk is used to assess the potential heat impacts. Typically an event with widespread red or magenta HeatRisk will trigger an Excessive Heat Warning.

Confidence Level Required: $\geq 80\%$

Excessive Heat Watch

Issued when conditions reaching Excessive Heat Warning level are possible in the coming days.

Confidence Level Required: $\geq 50\%$



WWA Products & Criteria

Heat Advisory

Impacts criteria: Hot conditions that will not reach the warning threshold but could cause impacts to life/commerce/travel (e.g. impacts to a large outdoor event).

Numerical criteria: Criteria varies by location. NWS HeatRisk is used to assess the potential heat impacts. Typically an event with widespread HeatRisk near the orange/red threshold will trigger a Heat Advisory.

Confidence Level Required: $\geq 80\%$

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NWS Public Forecast Zones

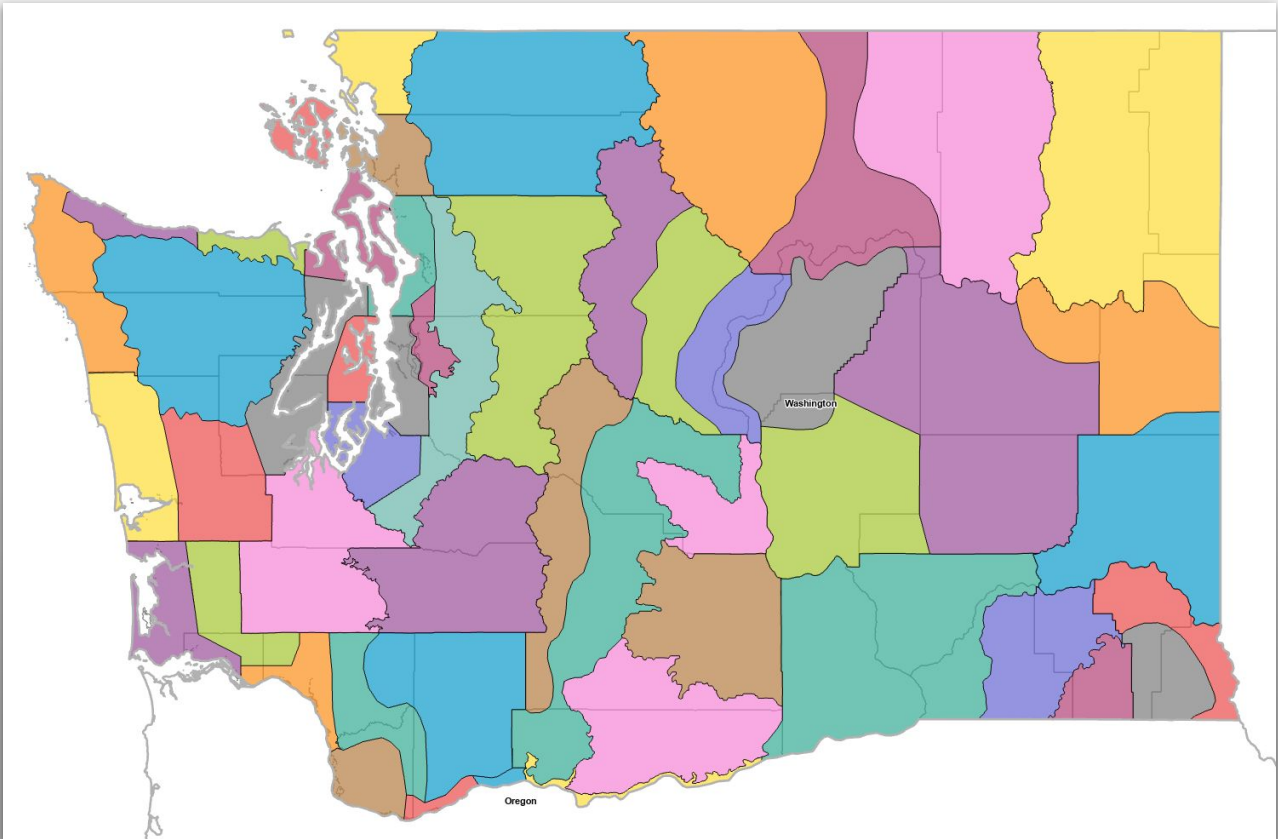
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NWS Heat Alerts are issued for NWS Public Forecast Zones.

Issuance decisions consider area coverage within a zone as well as other contextual factors.

Note:
NWS Seattle & NWS Portland are in the process of redrawing Public Forecast Zones. Estimated implementation March 2024.





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How Many Events Per Year?

Heat Advisories & Excessive Heat Warnings are mapped separately.



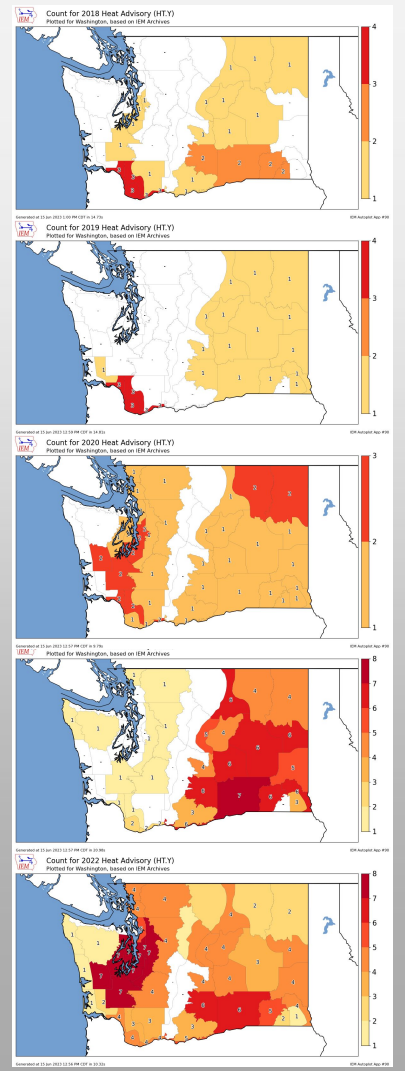
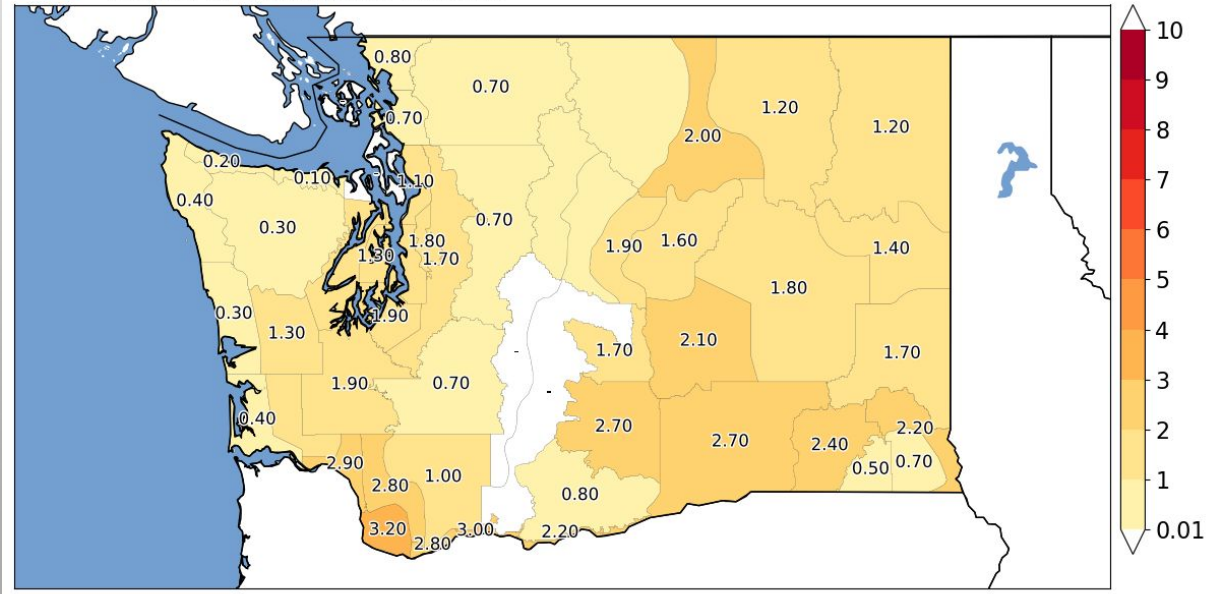
Heat Advisory Event Statistics

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NOTE: → 1 "Event" may span multiple days
 → Color bars are NOT consistent
 → Zone changes in the eastern Cascades effect the numbers

 Yearly Avg: 30 Jun 2013 and 02 Sep 2022 Heat Advisory (HT.Y)
 Plotted for Washington, based on IEM Archives

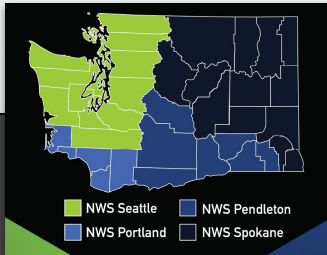




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Days Covered by Heat Advisory or Excessive Heat Warning



Days with at least one alert in effect
calculated by NWS Office

	2018	2019	2020	2021	2022	5-Year Avg	10-Year Avg
NWS Seattle	1	0	4	12	22	7.8	7.5
NWS Spokane	7	3	8	27	18	12.6	8.6
NWS Portland	12	4	8	11	15	10.0	10.1
NWS Pendleton	10	2	8	29	20	13.8	11.0

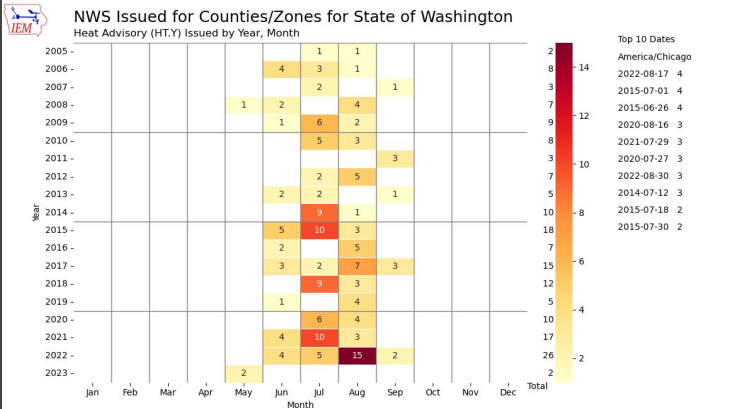
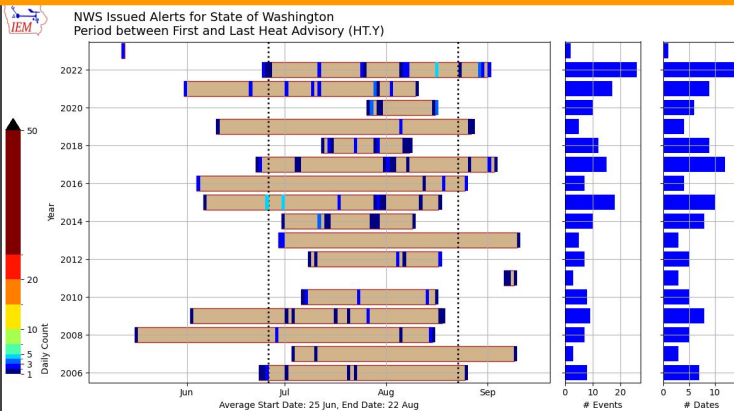


Time of Year Statistics

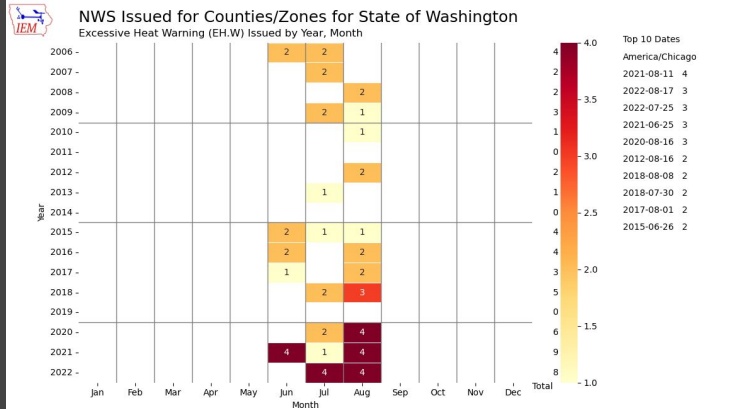
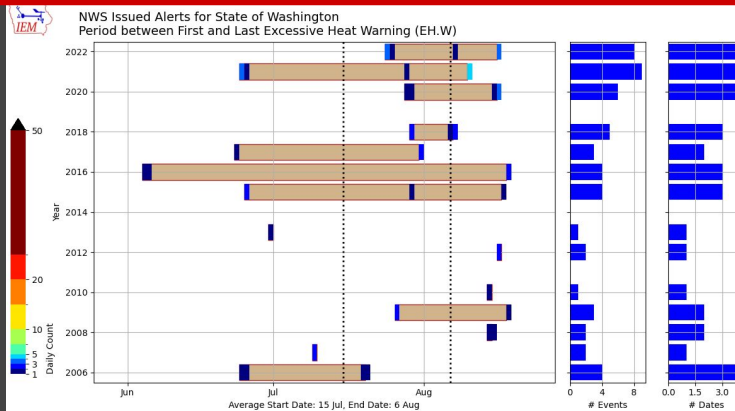
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Heat Advisory



Excessive Heat Warning





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How to receive notifications

1. Sign up for alerts via the [FEMA App](#). FEMA automatically relays watches, warnings, and advisories from the National Weather Service
2. Sign up for alerts through another [3rd party application/service](#)
3. For general weather briefings: Work with your local emergency management agency to receive head-up emails from emergency management/NWS when significant weather is expected. The NWS routes significant weather briefings through local emergency management agencies.
 - Many emergency management agencies also allow you to sign up for "OPT-IN" emergency alerts ([more info](#)) that may or may not include relay of heat alerts.



FEMA



Note:

For those in the Water Resource Management (i.e. dams, levees, reservoirs, etc.) there is an option to receive alerts from the [iNWS](#) system.



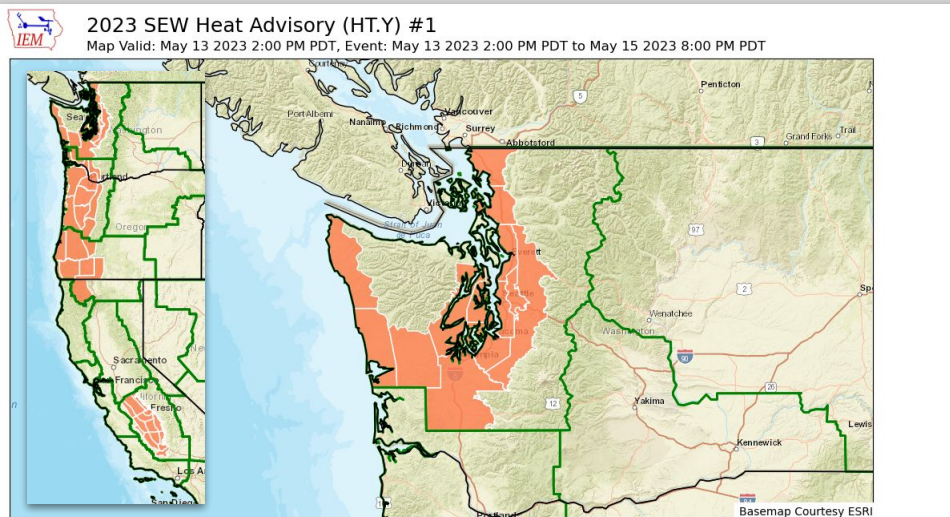
Example Alert

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Heat Advisory **issued** Friday May 12, 2023

Advisory **in effect** for
2pm Saturday May 13 - 8pm Monday May 15



URGENT - WEATHER MESSAGE
National Weather Service Seattle WA
344 AM PDT Fri May 12 2023

WAZ503-504-506-507-509-511-512-516-517-555-556-558-559-122300-
/O.UPG.KSEW.EH.A.0001.230513T2100Z-230516T0000Z/
/O.NEW.KSEW.HT.Y.0001.230513T2100Z-230516T0300Z/
[...]
344 AM PDT Fri May 12 2023

...HEAT ADVISORY IN EFFECT FROM 2 PM SATURDAY TO 8 PM PDT
MONDAY...

- * WHAT...Hot conditions with temperatures in the mid 80s to low 90s expected. This will pose a moderate, to localized major, risk of heat-related illness.
- * WHERE...Portions of northwest and west central Washington.
- * WHEN...From 2 PM Saturday to 8 PM PDT Monday.
- * IMPACTS...Hot conditions will increase the risk of heat-related illnesses for those who are sensitive to heat, especially those without effective cooling or adequate hydration.

PRECAUTIONARY/PREPAREDNESS ACTIONS...

Drink plenty of fluids, stay in an air-conditioned room, stay out of the sun, and check up on relatives and neighbors. Young children and pets should never be left unattended in vehicles under any circumstances.

Take extra precautions if you work or spend time outside. When possible reschedule strenuous activities to early morning or evening. Know the signs and symptoms of heat exhaustion and heat stroke. Wear lightweight and loose fitting clothing when possible. To reduce risk during outdoor work, the Occupational Safety and Health Administration recommends scheduling frequent rest breaks in shaded or air conditioned environments. Anyone overcome by heat should be moved to a cool and shaded location. Heat stroke is an emergency! Call 9 1 1.

For sheltering information and other human services in your area, dial 2 1 1 during business hours or visit wa211.org anytime.

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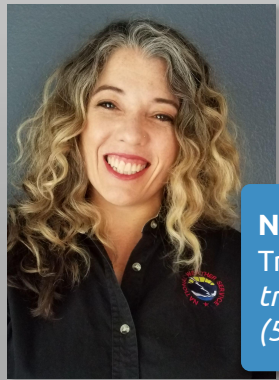
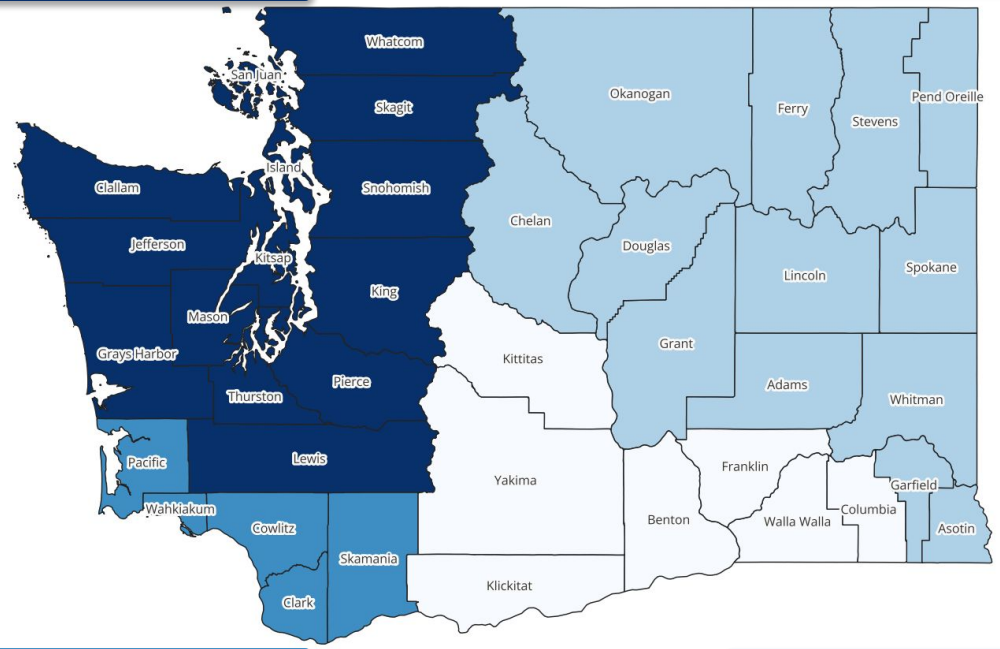
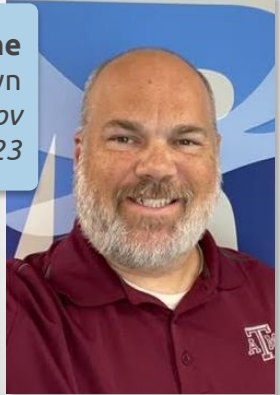
Seattle



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Thank You!

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