

Changing weather and impacts on our health

A look at different weather hazards that lead to the most fatalities in the US



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Federal Government



Executive Branch



Department of Commerce



**National Oceanic and
Atmospheric Administration**



National Weather Service

Your tax dollars at work for you!

The annual cost to the average taxpayer to fund the National Weather Service is equivalent to the cost of a cup of coffee.

U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service

Most People Only See the TIP of the Iceberg...

Weather Apps
TV & Radio
Phone Alerts
NOAA Weather Radio

River Forecast Centers

River Forecasts, Hydropower, Flood warnings, Irrigation, River Navigation

Weather Forecast Offices

Impact-based Decision Support Services, Forecasts & Warnings, Data Collection, Public Education

National Centers for Environmental Prediction

Model simulations, Space Weather, Climate & Seasonal Outlooks, Aviation & Marine Forecasts, Storm & Tornado Protection, Hurricane Tracks, Storm Surge

Observations

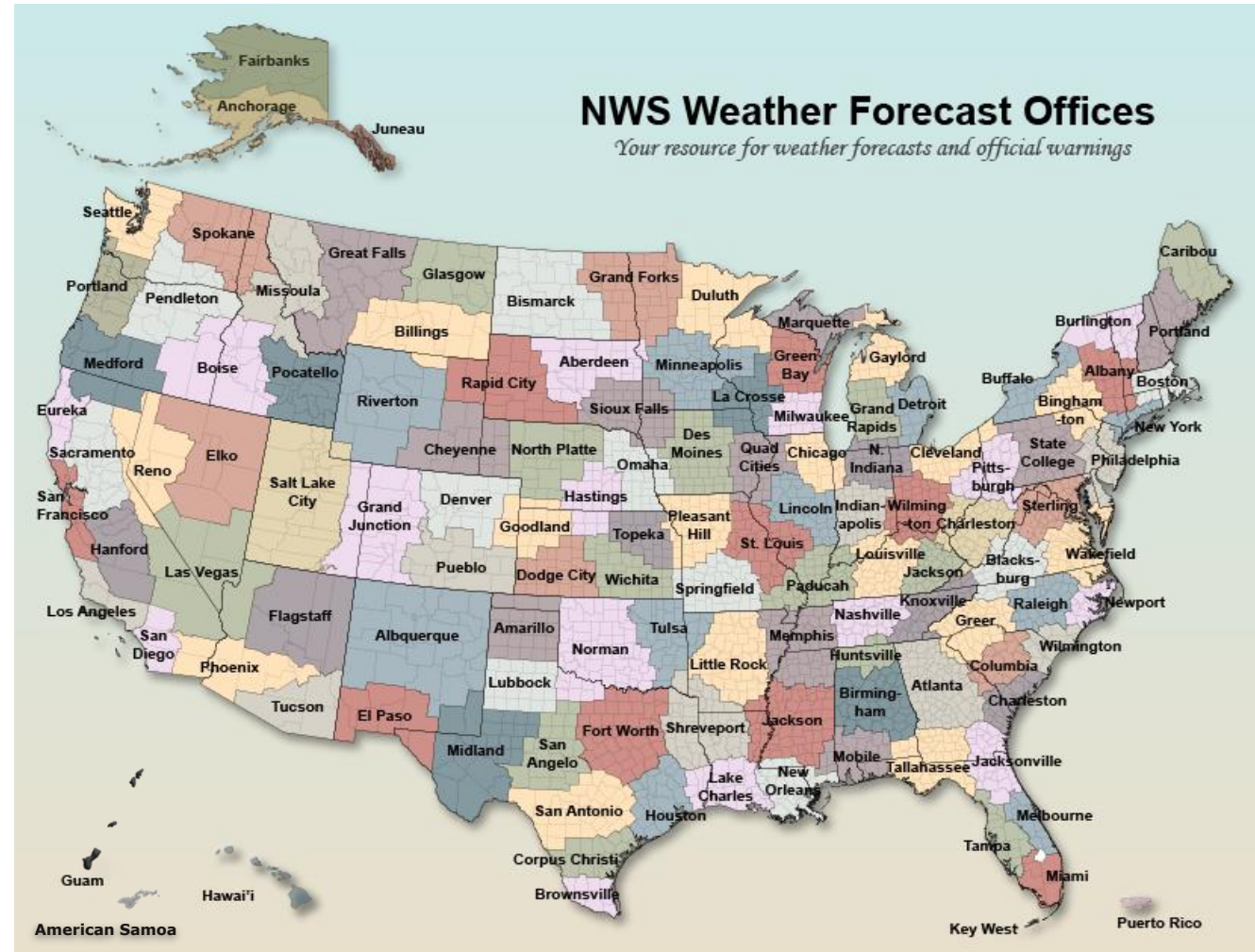
Radars, Satellites, Weather Balloons, Surface Obs, Lightning, Stream Gauges, 11,000 Volunteer Daily Data Collectors, Thousands of Volunteer Storm Spotters

\$4 Approximate cost to each taxpayer to fund the NWS for a year



Local NWS Forecast Offices

- Operations 24 hr/365 days a year
- Numerous forecasts/updates daily:
 - 7-day forecast, Aviation, Fire Weather, Rivers
 - Great Lakes: Marine, Beach
- Issue official Watches, Warnings, Advisories & other forecasts for hazardous weather
- Provide Decision Support Services to Core Partners in Emergency Management
 - Large outdoor events
 - Hazardous weather briefings
 - Exercise support
 - Emergency and/or disaster recovery support
- Data collection/quality control



A LITTLE ABOUT US - NATIONAL WEATHER SERVICE WAKEFIELD

Mission: Protection of **life** and **property** and enhancement of the national economy

- 1 of 122 offices nationwide
- Forecasts, watches, warnings, and advisories 24/7/365 operations
- 24 staff members
- At least 2-3 meteorologists per shift



Impacts from Weather

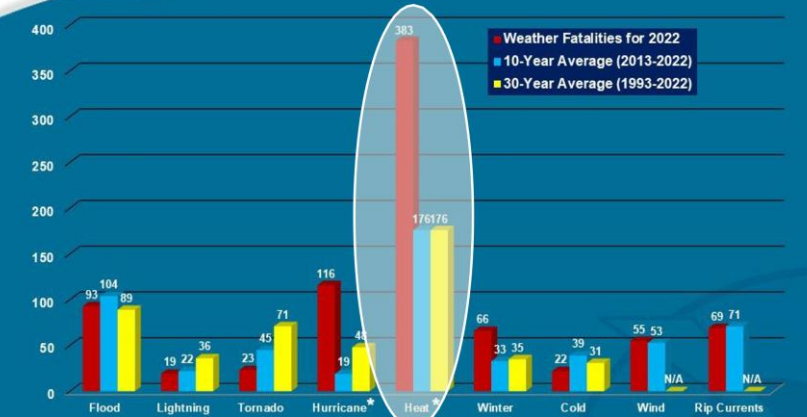


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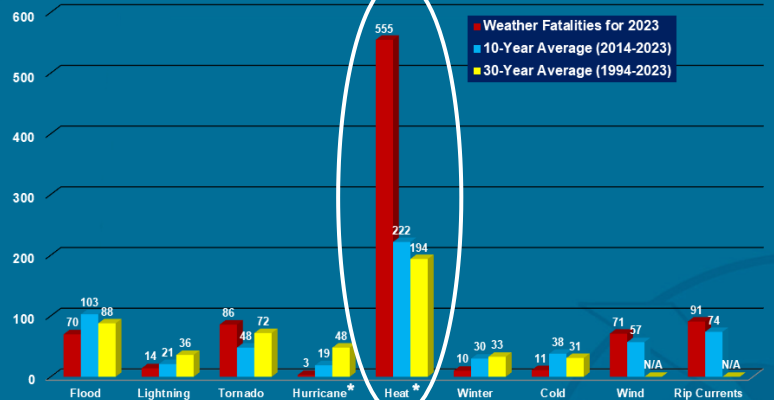
Fatalities by Weather Type

Weather Fatalities 2022



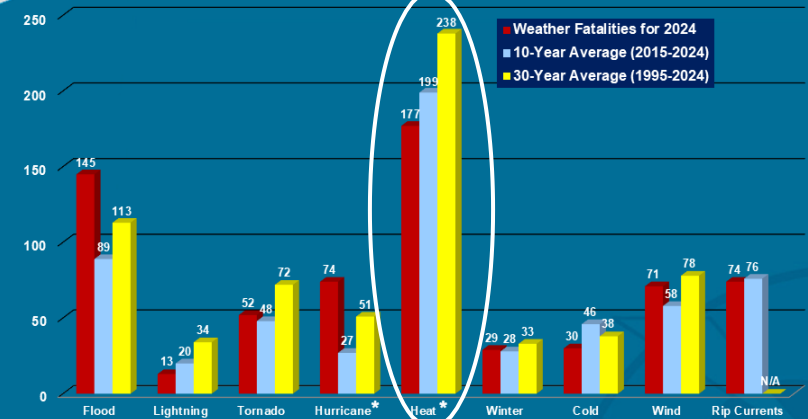
*Due to an inherent delay in the reporting of official heat fatalities in some jurisdictions, this number will likely rise in subsequent updates.
 *The fatalities, injuries, and damage estimates found under Hurricane/Tropical Cyclone events are attributed only to the wind.

Weather Fatalities 2023



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Weather Fatalities 2024



*Due to an inherent delay in the reporting of official heat fatalities in some jurisdictions, this number will likely rise in subsequent updates.
 *The fatalities, injuries, and damage estimates found under Hurricane/Tropical Cyclone events are attributed only to the wind.

- Heat is the leading weather-related killer
- Flooding is generally second and can be counted different columns.



How NWS Heat products and tools can be used to help EM decision making



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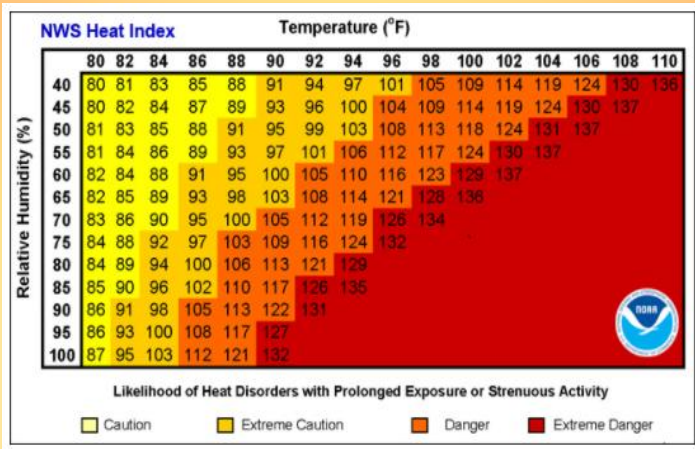
Who is Most At Risk to Extreme Heat

- Children and Older Adults
- People who are Pregnant
- People with Disabilities
- People with Chronic Health Conditions
- First Responders
- Outdoor Workers
- People exercising or doing strenuous activities outdoors
- People who lack access to cooling
- People who lack housing and/or quality housing
- Pets and Service and Support Animals



NWS Forecast Tools to Assess Heat

Heat Index



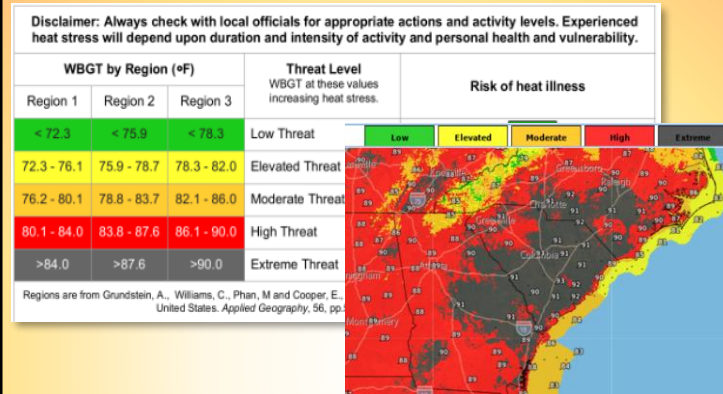
Heat stress in context for **general public.**

- Relatively simple: T + RH
- Light physical activity in



5'7" adult, 147.7 lbs, walking outside at 3.1 mph, wearing trousers and shortleeved shirt

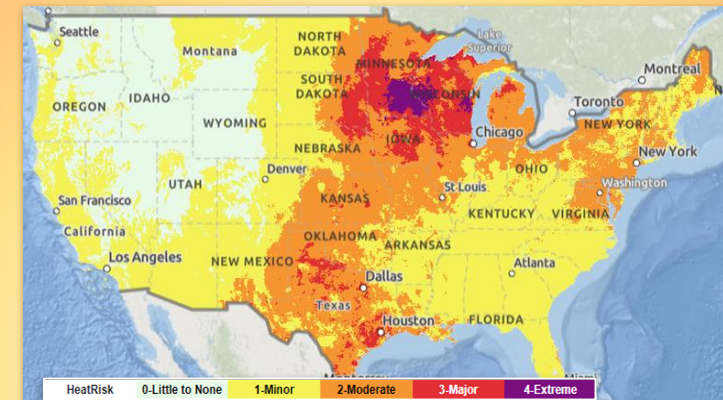
Wet Bulb Globe Temperature



Heat stress in context for **healthy, active outdoor** communities.

- More Complex: T + RH + wind + solar radiation
- High levels of outdoor physical activity

HeatRisk (experimental)

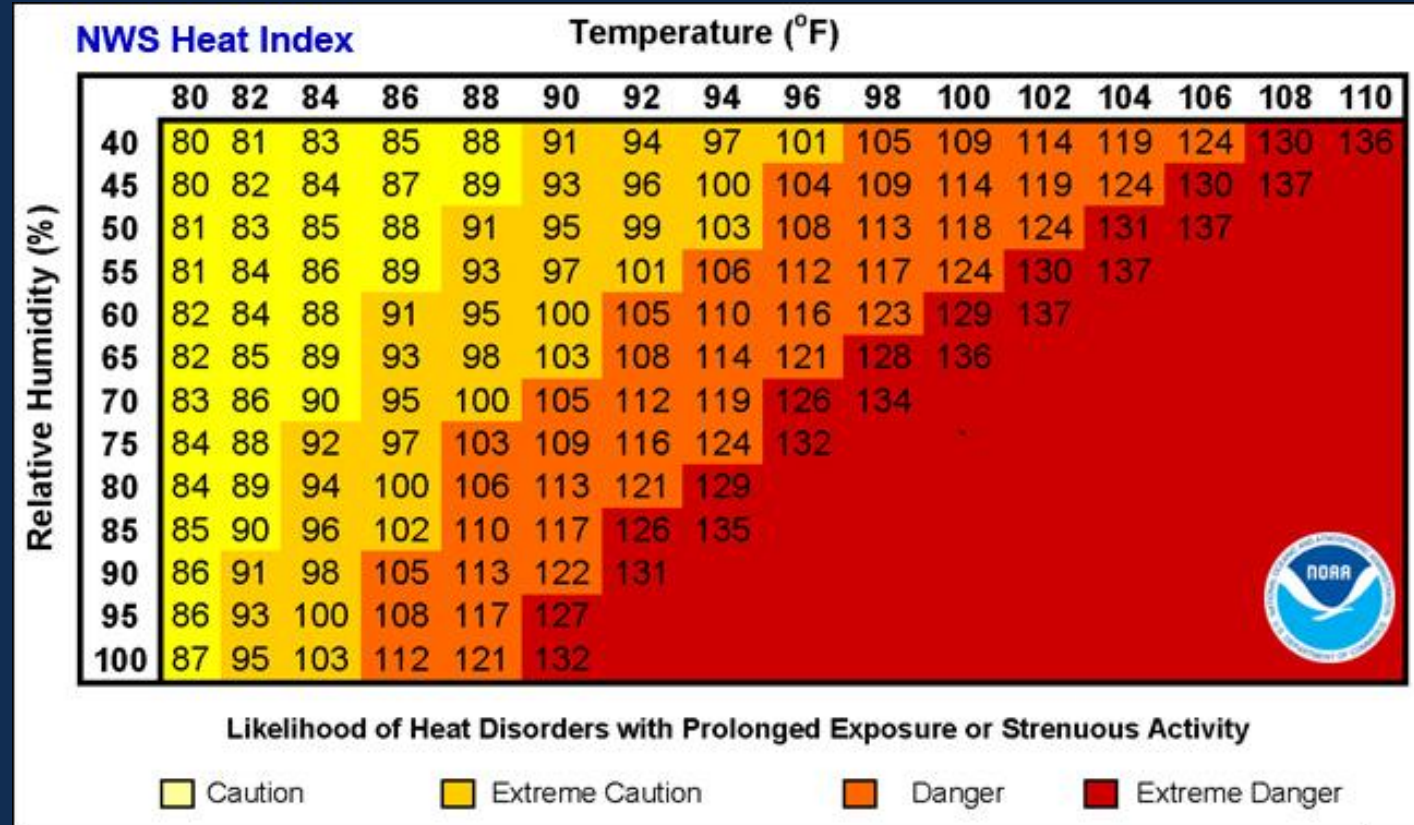


Risk of heat related impacts in **climatological context** with CDC heat-health information.

- Impacts-based: MaxT + MinT + CDC heat-health data
- Spectrum of heat-health impacts for *all* populations

Heat Index

- Measure of how hot it really feels when **relative humidity** is factored in with **actual air temperature**
- Heat stress in context with the **general public**
- **Light physical activity in the shade**




Wet Bulb Globe Temperature


- Uses temperature, wind, relative humidity, solar radiation, and other weather parameters
- Effective indicator of heat stress for active populations such as outdoor workers and athletes
- **Can be used to inform activity modifications during exercise or outdoor work**

**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 is a planning tool by the military, some schools and OSHA
- Requires a special meter to be able to measure the WBGT.



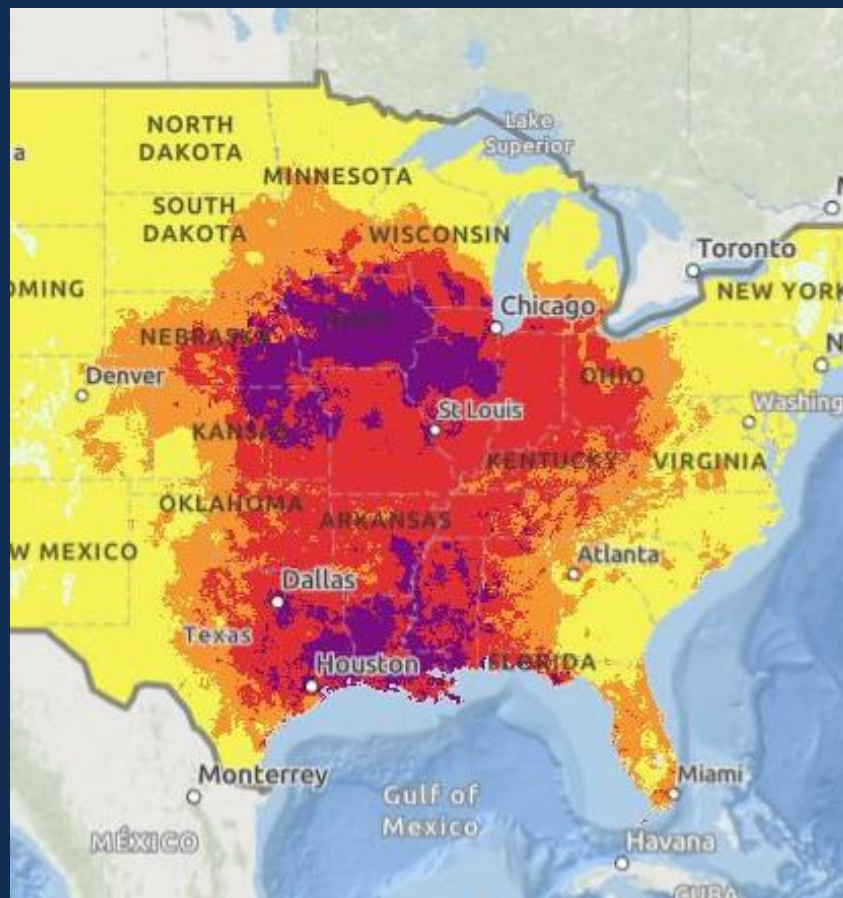
Suggested Actions and Impact Prevention		
WBGT(F)	Effects	Precautionary Actions
< 80		
80-85	Working or exercising in direct sunlight will stress your body after 45 minutes.	Take at least 15 minutes of breaks each hour if working or exercising in direct sunlight
85-88	Working or exercising in direct sunlight will stress your body after 30 minutes.	Take at least 30 minutes of breaks each hour if working or exercising in direct sunlight
88-90	Working or exercising in direct sunlight will stress your body after 20 minutes.	Take at least 40 minutes of breaks each hour if working or exercising in direct sunlight
>90	Working or exercising in direct sunlight will stress your body after 15 minutes.	Take at least 45 minutes of breaks each hour if working or exercising in direct sunlight

What is HeatRisk?

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

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.

Simple Numeric/Color System



Excellent Geographical Coverage

Kind of like AQI...

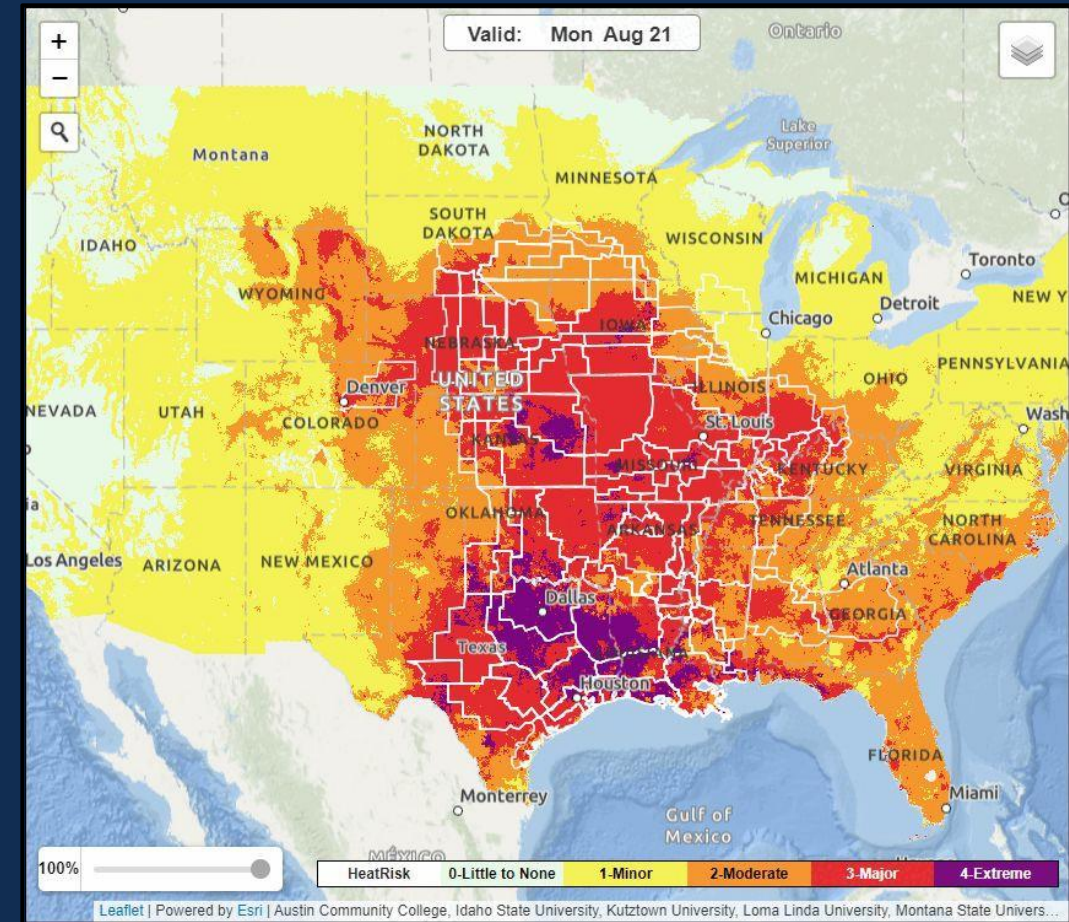


But for Heat!

HeatRisk Considerations

What does it take into account?

- How significantly above normal high and low temps are for a location (24h period, 7 days out)
- Time of the year
- Duration of unusual heat
- Overnight relief
- If temperatures are at high enough levels to pose an elevated risk for heat complications (based on CDC heat-health thresholds)



HeatRisk Categories

None (0)

- Little to no risk from expected heat.

Minor (1)

- Minor risk for “at higher risk” populations. Minor spike in heat illness. Non-zero, but very low, risk of mortality expected.

Moderate (2)

- Moderate risk of heat-related impacts, mostly in “at higher risk” populations without effective cooling and/or hydration.
- Primarily heat-related illness. Non-zero, but low, risk of heat-related mortality expected.



HeatRisk Categories

Major (3)

- Major risk of widespread heat-related impacts (including illness and mortality) for anyone without effective cooling and/or hydration.
- Excessively warm day and nights (generally above 95th percentile).

Extreme (4)

- *Rare long duration and/or extreme event*
- Extreme risk of widespread heat-related impacts (including illness and mortality) for anyone without effective cooling and/or hydration.
- Temps above 95th percentile for 2+ days and/or near all-time records.



Primary difference between Extreme and Major is duration and/or maximum intensity of heat. Both are potentially VERY impactful!

Heat Tools Summary

Heat Index

- Uses temp/humidity in the calculation assuming shade and light winds
- Can be forecast hourly
- Is still the basis for NWS Watch/Warning/Advisory decisions

Wet Bulb Globe Temperature

- Uses temp/humidity/wind/solar radiation/climatology in the calculation
- Can be forecast hourly
- Used for acclimated, healthy, active and outdoor users
- Need special meter to measure real-time

Heat Risk

- Uses temperature/climatology/duration in the calculation and infers humidity
- Created using a 24 hour forecast period.
- Can be used for healthy or vulnerable populations



Watch and Warning product changes

EXTREME HEAT WATCH

An Extreme Heat Watch is issued when **dangerous heat is possible**.

Reschedule outdoor activities in the coming days. Make sure that children, the elderly, and pets have a place to cool off during the heat.

Be Prepared.



weather.gov

EXTREME HEAT WARNING

An Extreme Heat Warning is issued when **dangerous heat is happening or about to happen**.

Avoid heavy activity & direct sunlight. Stay hydrated, find a cool indoor place, and check on children, elderly & pets.

Take Action!

The term **extreme** has replaced the term **excessive**.



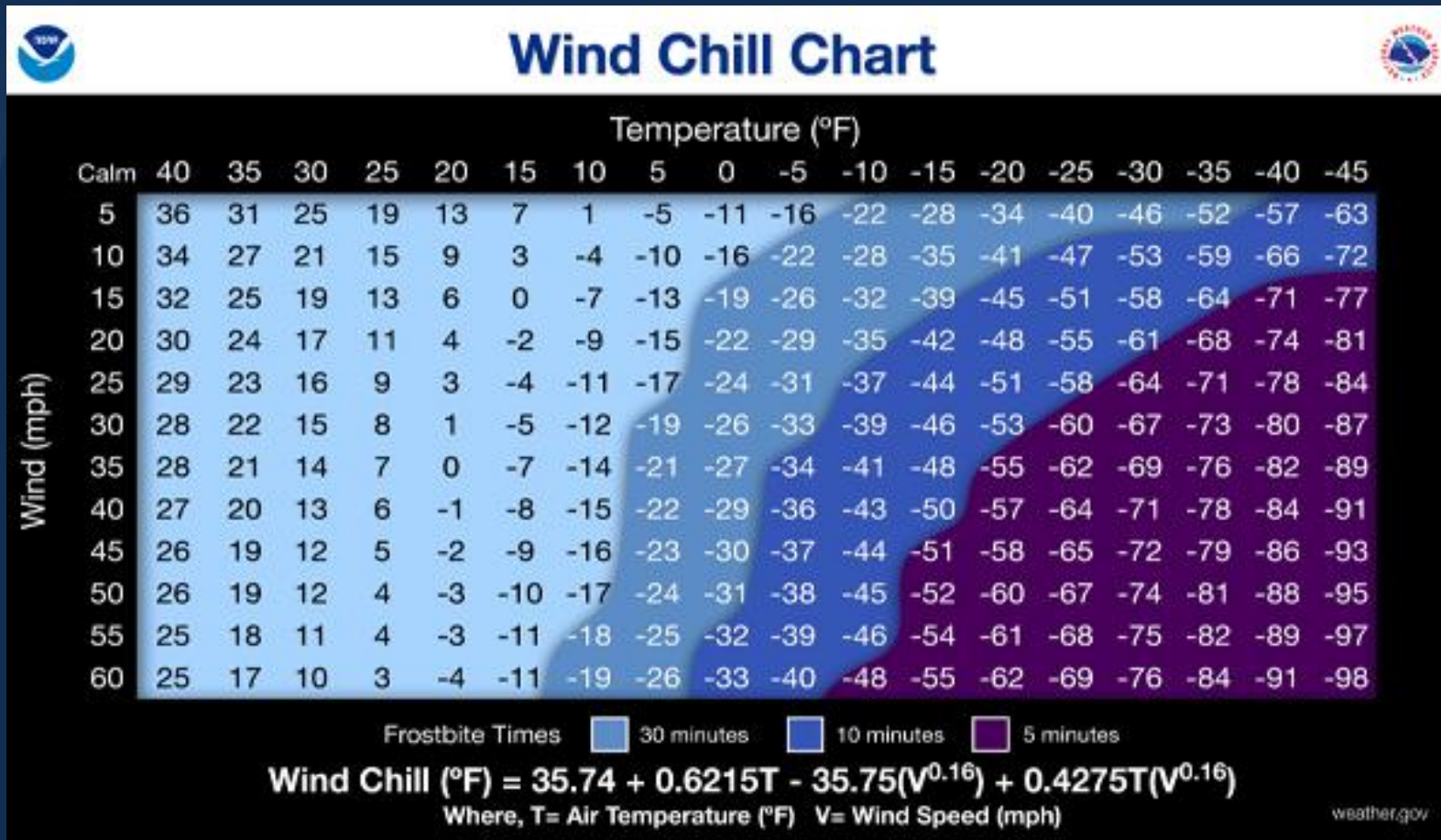
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NWS Cold products



Wind Chills



This is what the temperature feels like to the skin based on temperature and wind speed.

Cold Weather Products

Extreme Cold Consolidation and Renaming

Current

Extreme Cold Watch

Wind Chill Watch

Extreme Cold Warning

Wind Chill Warning

Wind Chill Advisory

Consolidated to →

Upcoming

Extreme Cold Watch

Consolidated to →

Extreme Cold Warning

Replaced with →

Cold Weather Advisory

The criteria for these products was based off climatology for how often the criteria has been reached in the past.

Watch and Warning product changes

EXTREME COLD WATCH

An Extreme Cold Watch is issued when dangerously cold air, with or without wind, is **possible**.

Check the forecast, and be prepared in case a Warning is issued.

Be Prepared

EXTREME COLD WARNING

An Extreme Cold Warning is issued when dangerously cold air, with or without wind, is **expected**.

Conditions could lead to frostbite or hypothermia. Limit time outside, dress in layers, and cover up exposed skin.

Take Action!

weather.gov



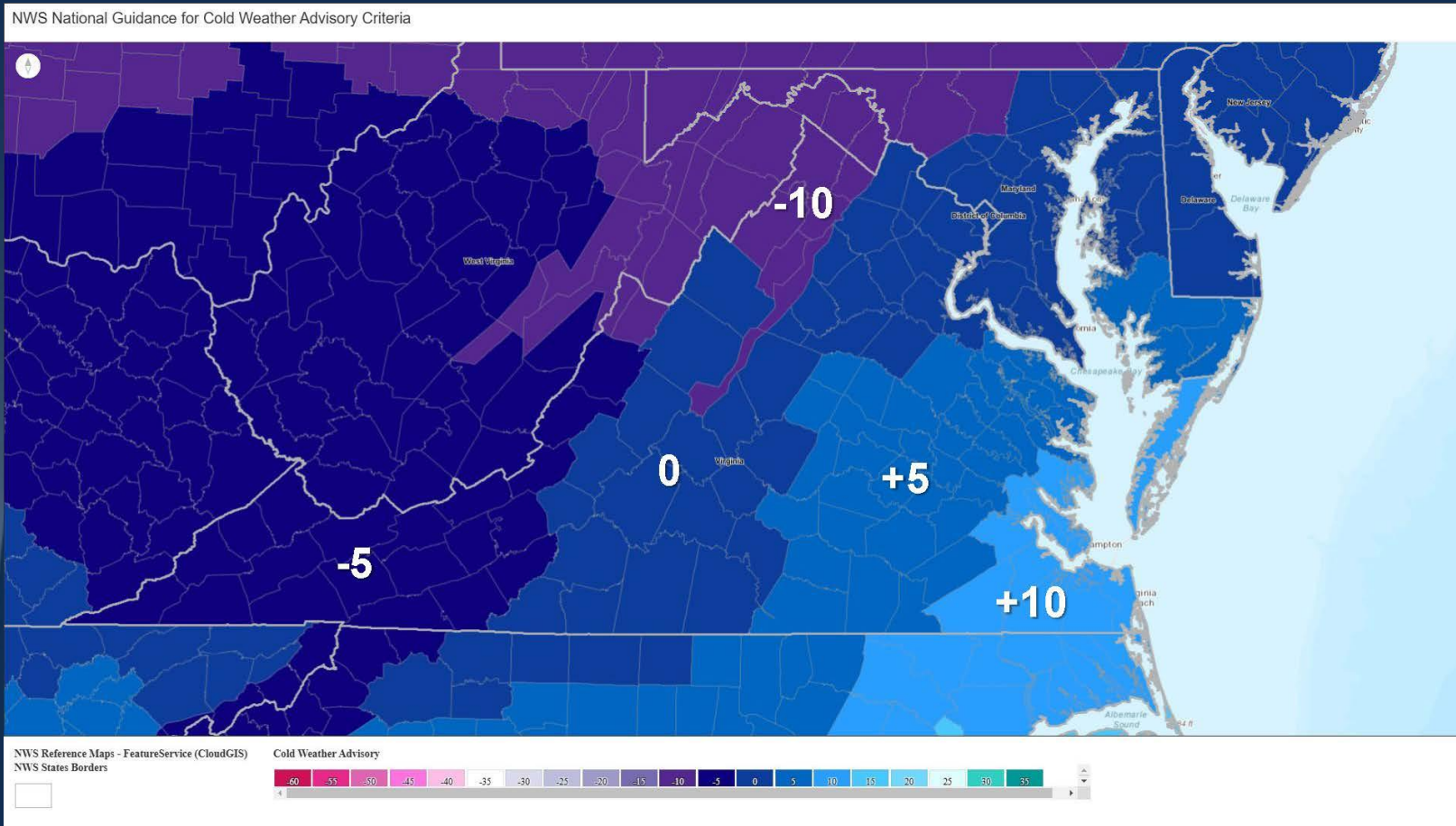
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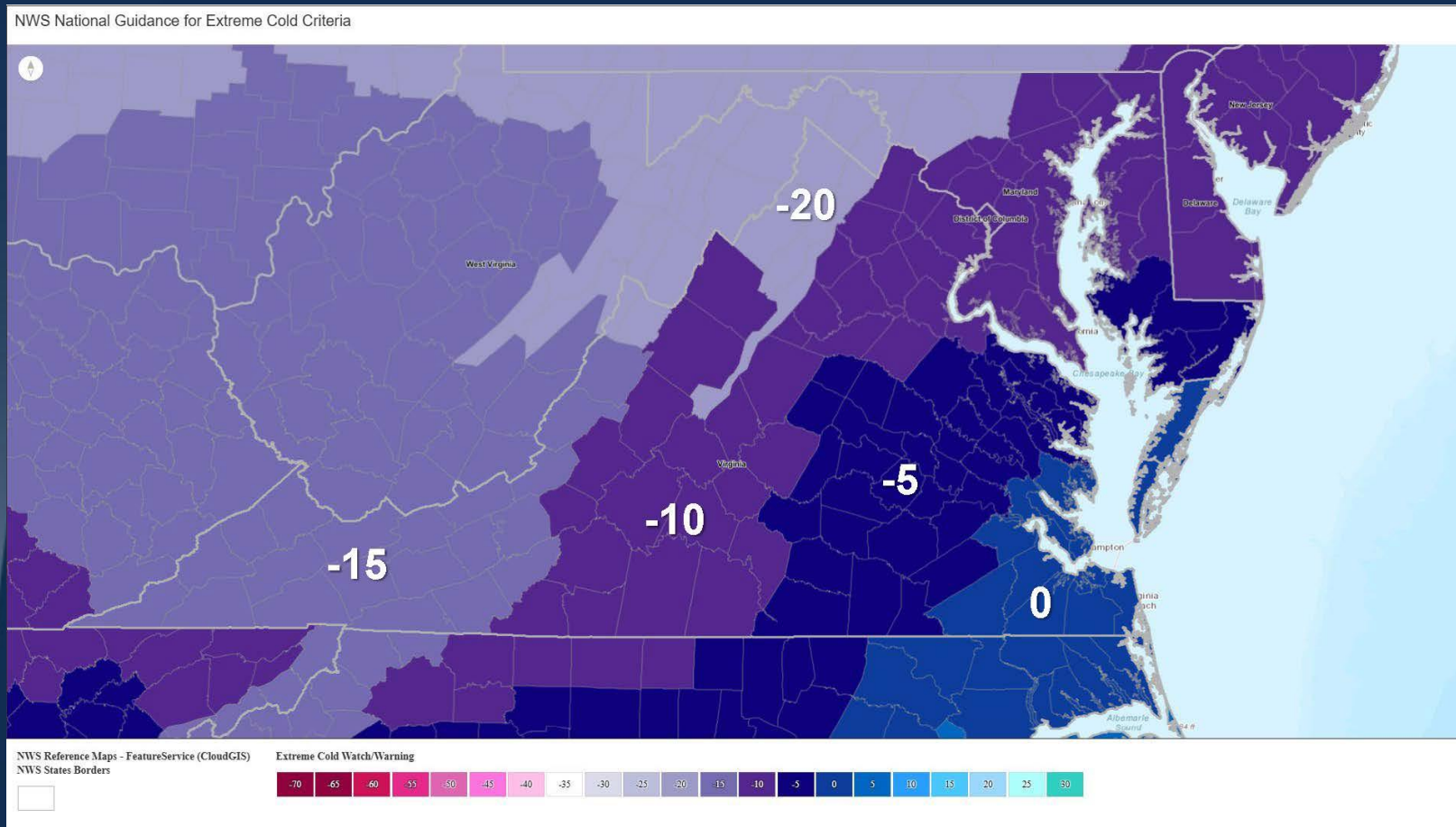


Cold Advisory Criteria



The value is lowest of either the ambient temperature or Wind Chill Temperature

Extreme Cold Warning Criteria



The value is lowest of either the ambient temperature or Wind Chill Temperature

NWS Cold products

At what temperature do health systems begin to see and increase in hospital visits dues to exposure to cold?

At what temperatures are shelters opened?



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Flood Program

Types of flooding:

1. Flash Flooding
2. River Flooding
3. Coastal Flooding and Storm Surge



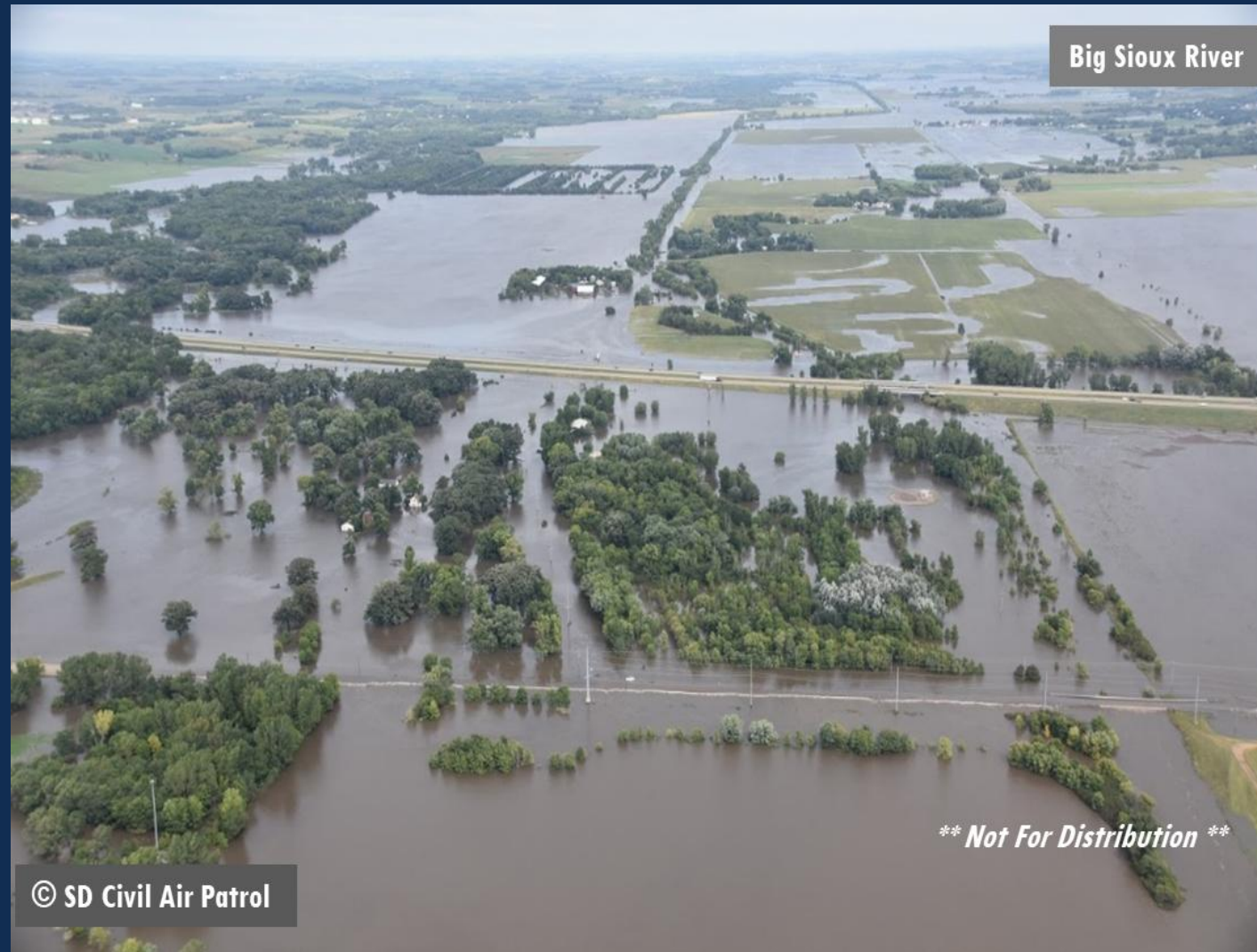
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WEATHER SAFETY: FLASH FLOODING

Flash Flooding – flooding that occurs within 6 hours of the causative event(s)

- Heavy rain
- Repeat (training) thunderstorms
- Wet, saturated soils
- Quicker impact in hillier terrain



WEATHER SAFETY: FLASH FLOODING



Don't underestimate the power of water!



6 inches of fast-moving water can knock over and carry away an adult.



12 inches of fast-moving water can carry away a small car.



18-24 inches of fast-moving water can carry away most large SUVs, vans and trucks.



IT ONLY TAKES about 12-18" to turn your vehicle into a BOAT!

IGNORED BARRICADES



Flood Alert Products

- Flood watches and warnings are all issued by the local forecast office

Flood Watch

Valid Through Late Tonight

Weather Forecast Office
Wakefield, VA

Issued Jul 10, 2025 4:23 AM EDT



NWSWakefieldVA

weather.gov/akq

Flash Flood Warning

Valid Until
8:30 PM EDT Sunday
June 13, 2021

Safety Information

- Move immediately to higher ground!
- Avoid walking or driving through flood waters!

Potential Exposure

- Population: 138
- Schools: 0
- Hospitals: 0



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Impact-Based Flash Flood Warning (FFW) Review

How Will This Impact You?

Previously, Wireless Emergency Alerts (WEA) were activated for all Flash Flood Warnings. WEA is an alerting network in the United States designed to disseminate **emergency alerts/messages** to mobile devices such as cell phones to inform you of imminent threats for extreme weather and other emergencies. Now, WEA will be activated only if a Flash Flood Warning contains a 'considerable' or 'catastrophic' damage tag.

Previously



Now



Flash Flood Warning



Flash Flood Warning
'CONSIDERABLE'
Damage Threat



Flash Flood Warning
'Catastrophic'
Damage Threat



Bottom Line: A "BASE" FFW will not WEA!

BASE (no tag) <i>Minor, Common</i>	<ul style="list-style-type: none"> - Isolated property impacts - Some emergency response - Common stream flooding
CONSIDERABLE <i>Moderate, Unusual</i>	<ul style="list-style-type: none"> - Some structural impacts - Extensive emer. response - Significant stream flooding
CATASTROPHIC <i>Major/Record, Emergency</i>	<ul style="list-style-type: none"> - Widespread prop. impacts - Overwhelming response - Very rare stream flooding



Flash Flood Warnings: Considerable vs Catastrophic

Considerable



Catastrophic



“Are cars being carried away by flood waters or are they stranded in the water?”

“Are motorists able to walk away from flooded cars with assistance?”

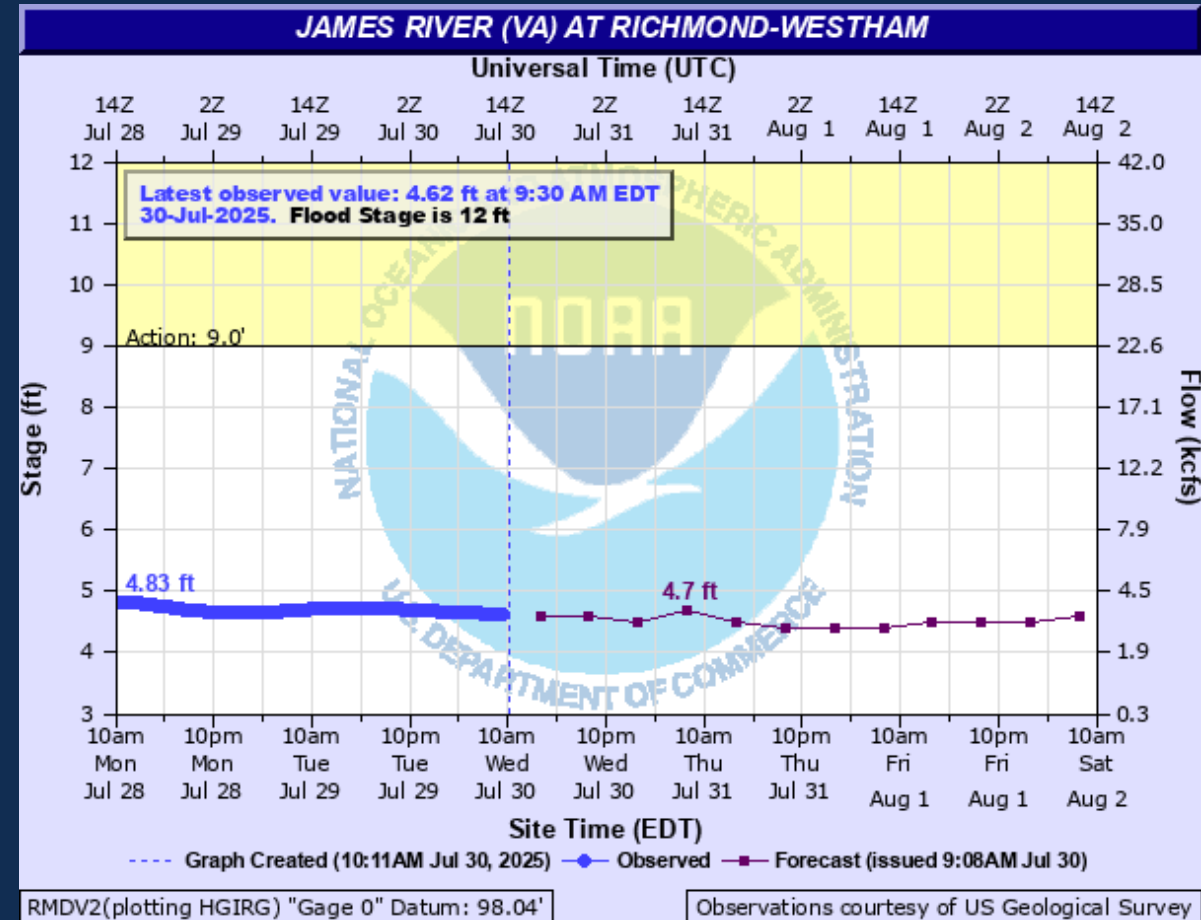
River Flooding

Causes for River flooding

- Heavy Rainfall
- Rapid Snowmelt
- Dam Failures

NWS Forecast for nearly 4000 river points across the US.

<https://water.noaa.gov/>



Coastal Flooding

Causes for Coastal flooding

- High Astronomical Tides (King)
- Storm Surge
 - Tropical cyclones
 - Coastal Lows
 - Onshore flow



Additional Concerns from flooding



HEALTH TIPS AFTER FLOODS

After typhoons, heavy rains and flooding, the potential risk of diseases increases, such as **water-borne diseases**, (e.g., typhoid fever, and leptospirosis) and **vector-borne diseases** (e.g., malaria, dengue).



WATER

Make sure drinking water is from a safe source.



FOOD

Cook food well, dispose food waste properly.



PERSONAL HYGIENE

Always wash your hands before eating and after using the toilet.



STAGNANT WATER

Clear stagnant water in and around the house to prevent mosquito breeding sites.



SUPERVISION

Do not allow children to wade in floodwaters to avoid diseases, such as leptospirosis.



CLEAN UP

Clean up your surroundings and destroy mosquito breeding sites.



CONTAMINATED FOOD

Throw out any food that has come into contact with floodwater, and any food that has perished.



Consult a doctor at once if you, or any household member, have any sign or symptom of infection.

This will help prevent the spread of infection especially if you are in the evacuation area.



World Health Organization

Additional issues include:

- Mold and mildew in homes and buildings.

Weather vs Climate

✓ Weather is what you get Now:

- Temperature
- Moisture
- Air Pressure
- Wind Speed/Direction

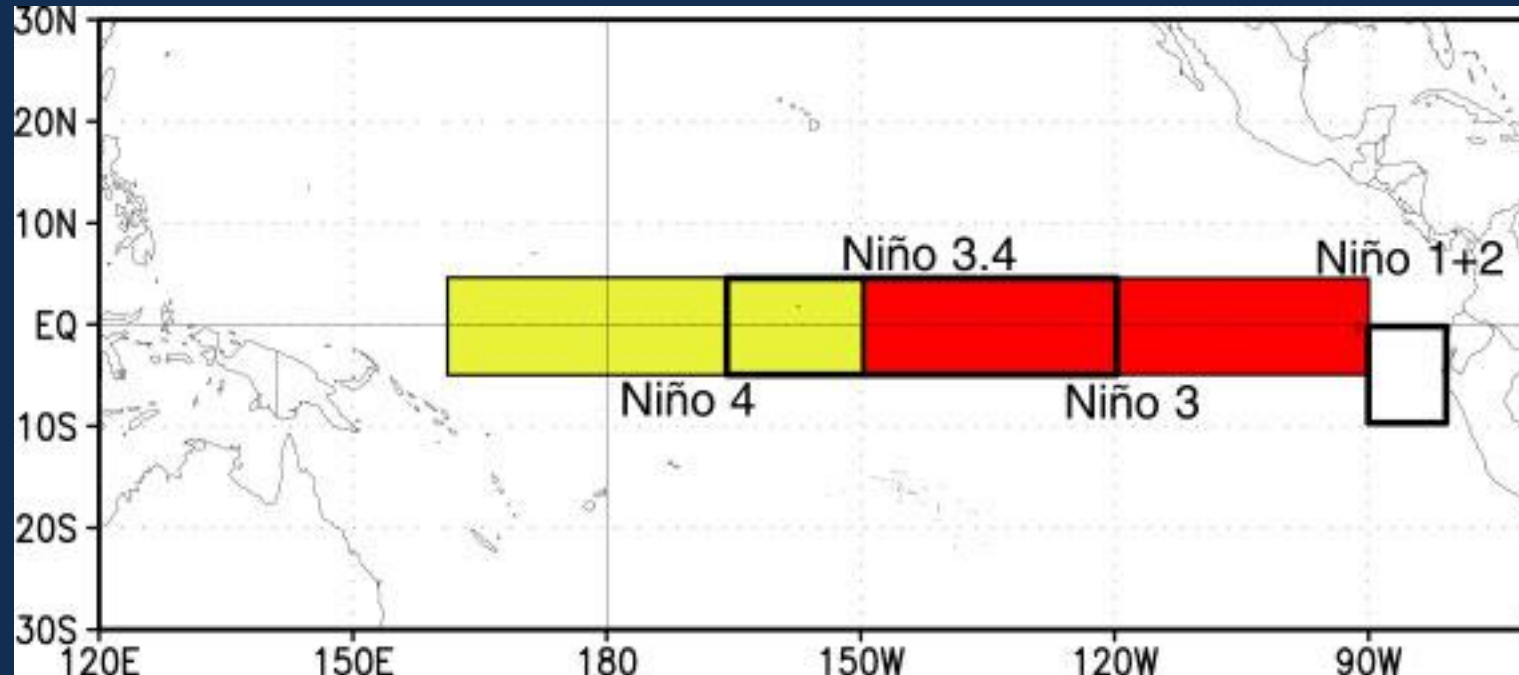
✓ Climate is what happened in the past, and what you might expect in the Future:

- Based upon recent past
- Defined by the World Meteorological Organization (WMO)
- 30 year average of daily weather

Seasonal Forecasting: A Sample of Major Indexes and Patterns Used to Make Seasonal Forecasts

- **ENSO** (El Niño Southern Oscillation)
- **NAO/AO** (North Atlantic/Arctic Oscillation)
- **MJO** (Madden Julian Oscillation)
- **AMO** (Atlantic Multidecadal Oscillation)

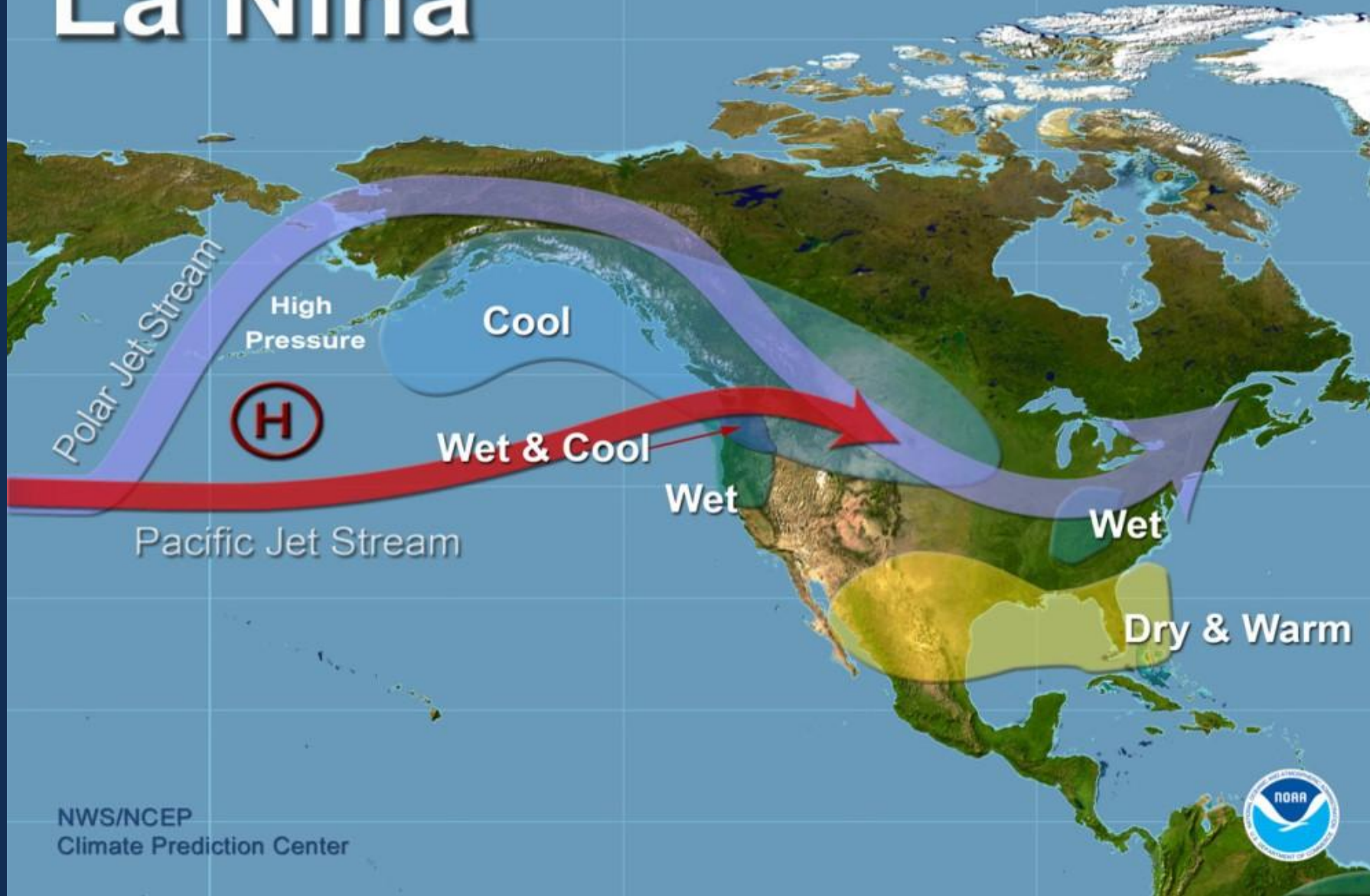
El Niño Regions: Locations in Central Pacific



The SST for a subset of El Niño regions 3 and 4 make up target area of region 3.4.

Typical Wintertime Pattern

La Niña



NWS/NCEP
Climate Prediction Center

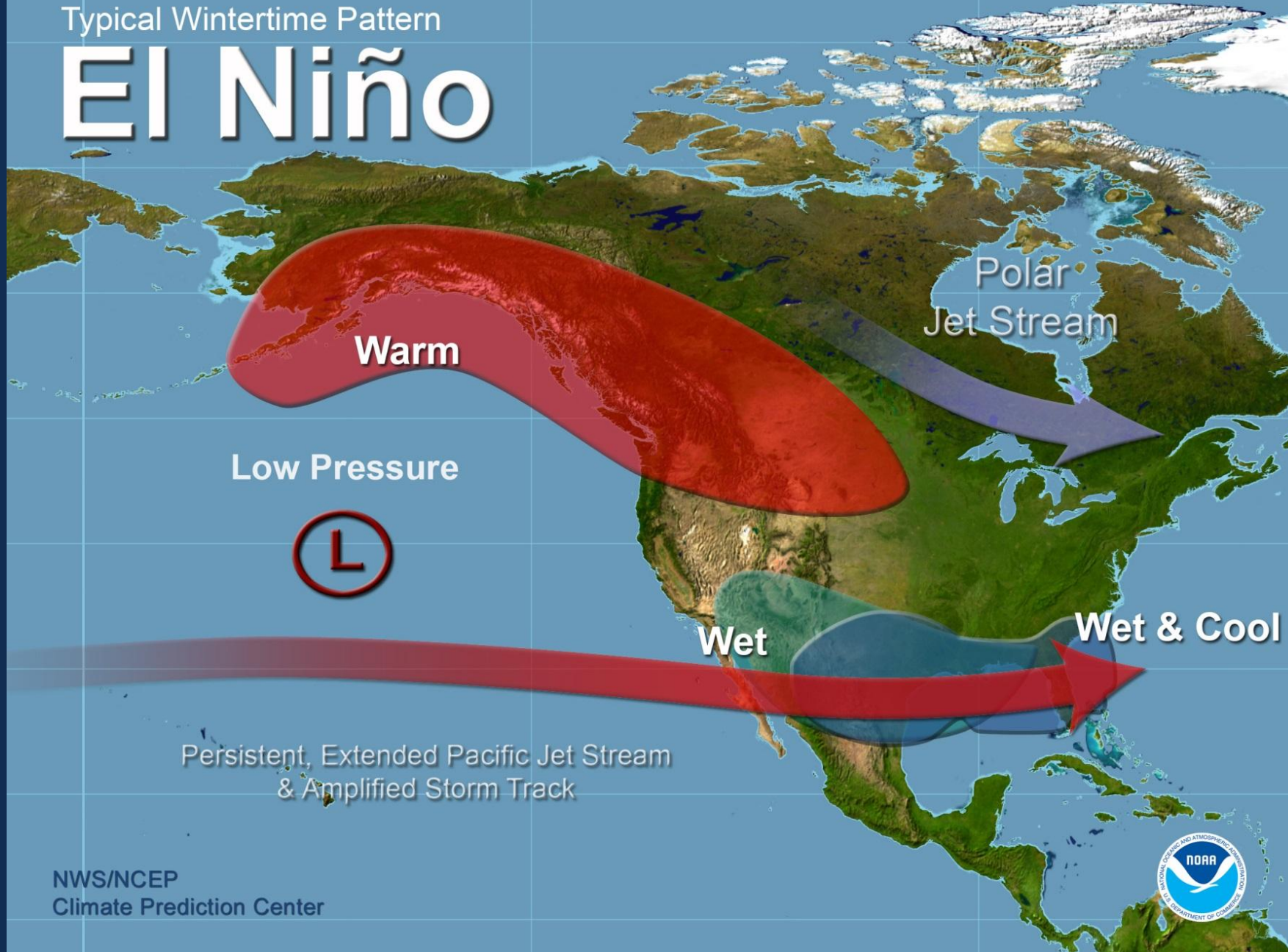


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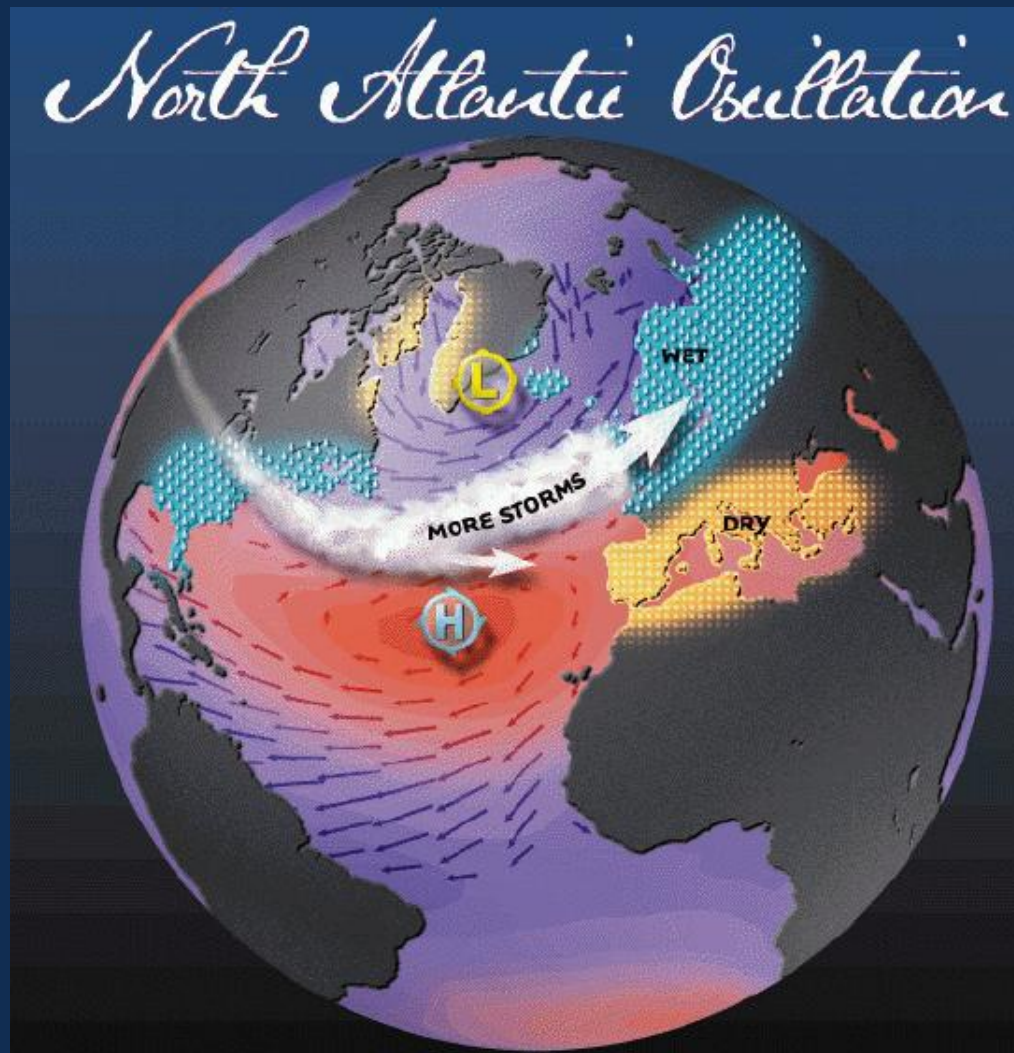
National Oceanic and Atmospheric Administration

Office of Education



North Atlantic Oscillation (NAO)

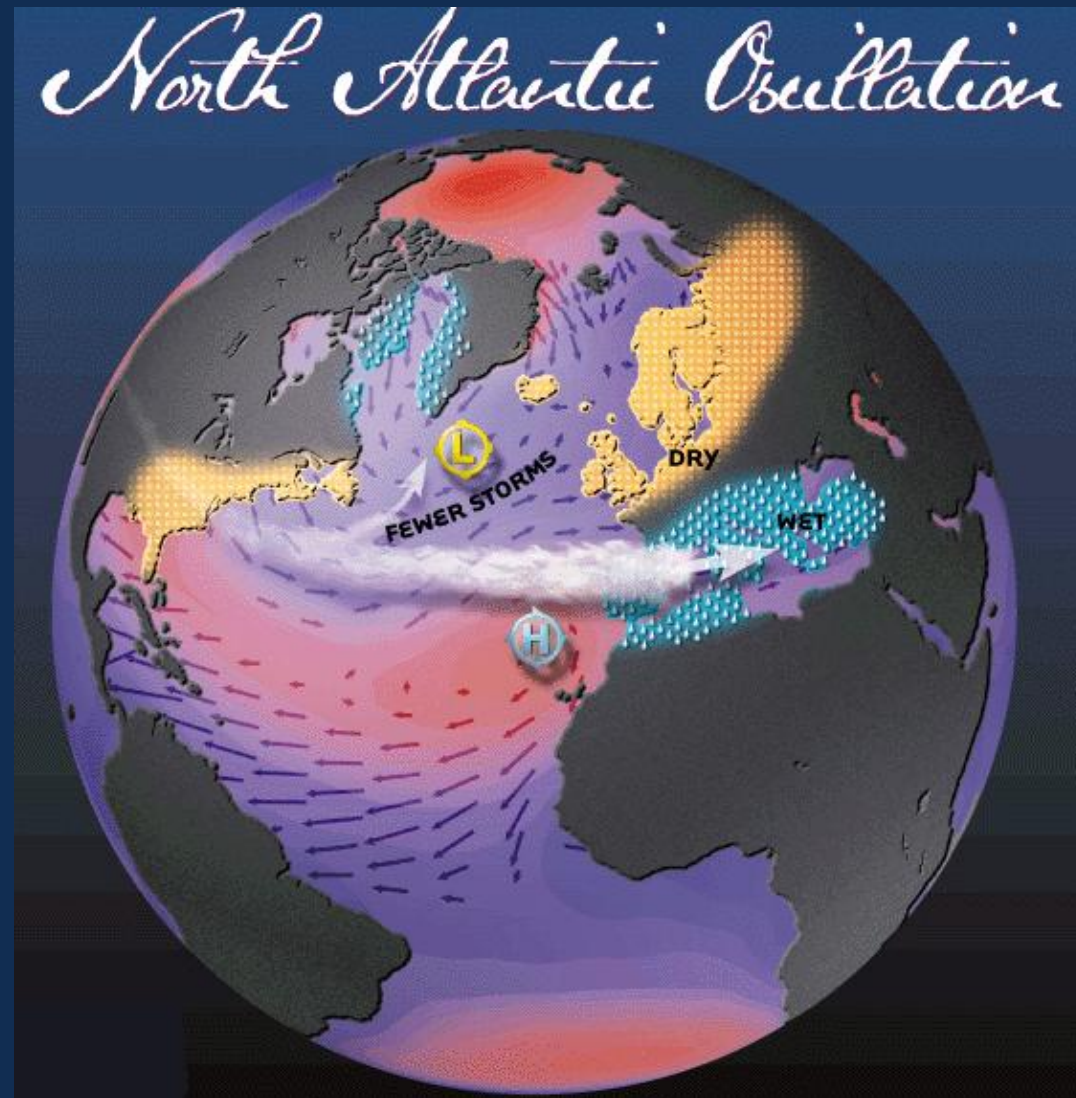
- POSITIVE PHASE
- Stronger Atlantic High Pressure
- Very Stormy in Europe
- Warmer, with Less Snow in the Eastern U.S.



From: <http://www.ldeo.columbia.edu/res/pi/NAO/>

North Atlantic Oscillation (NAO)

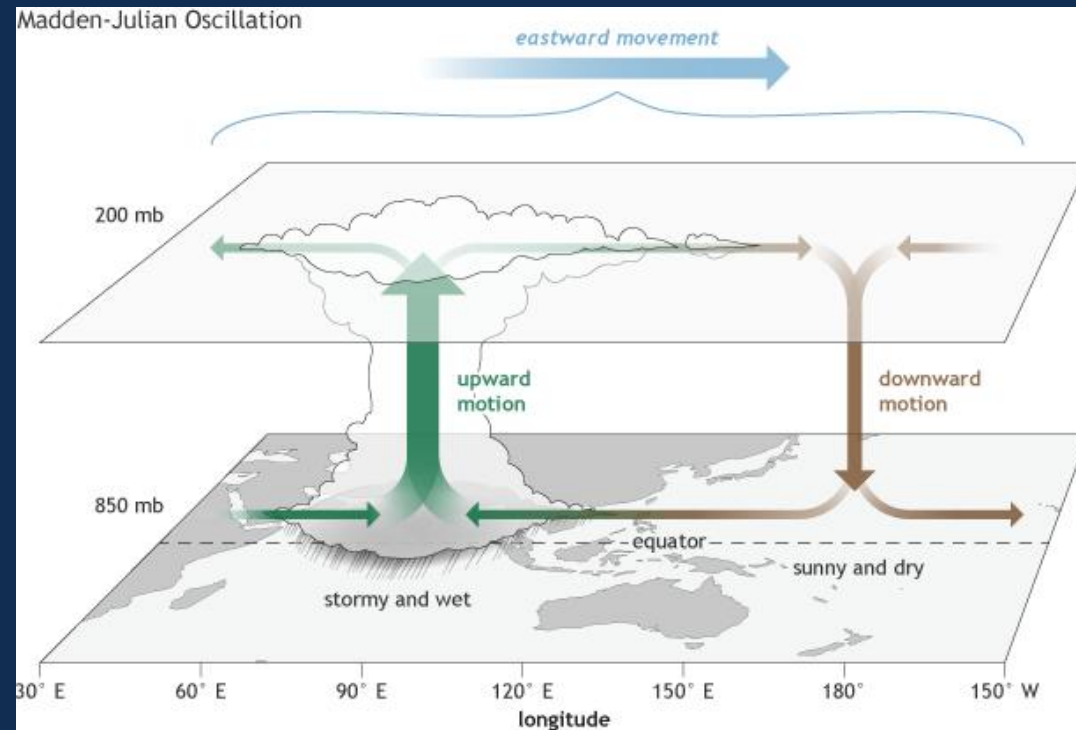
- NEGATIVE PHASE
- Weaker Atlantic High Pressure
- Less Stormy in Europe
- Colder, with More Snow in the Eastern U.S.



From: <http://www.ideo.columbia.edu/res/pi/NAO/>

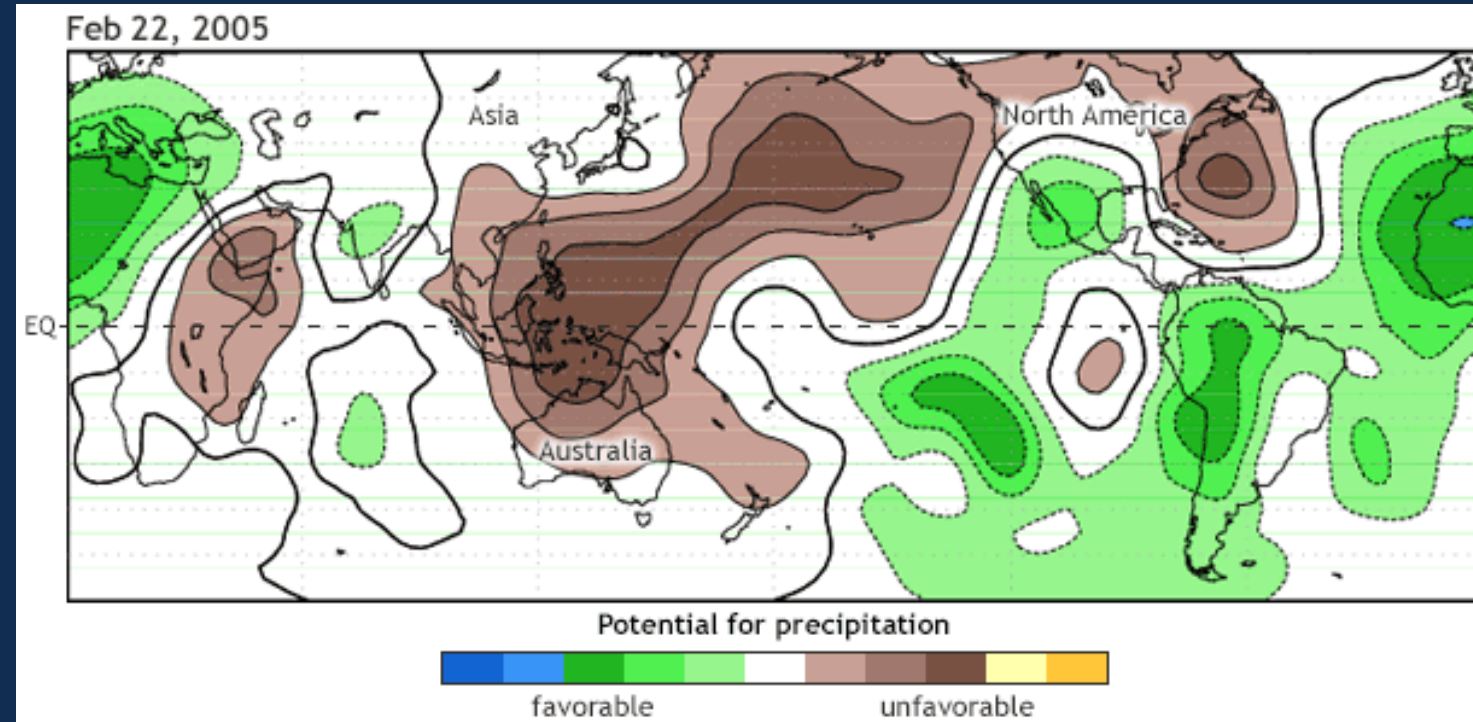
Madden Julian Oscillation

A region of enhanced activity (convection) across the Tropics that moves **eastward** (most of the time), circling the globe on the order of 30 to 60 days. The tropics are divided into 8 sections around the globe and these are referred to as “**phases**”.



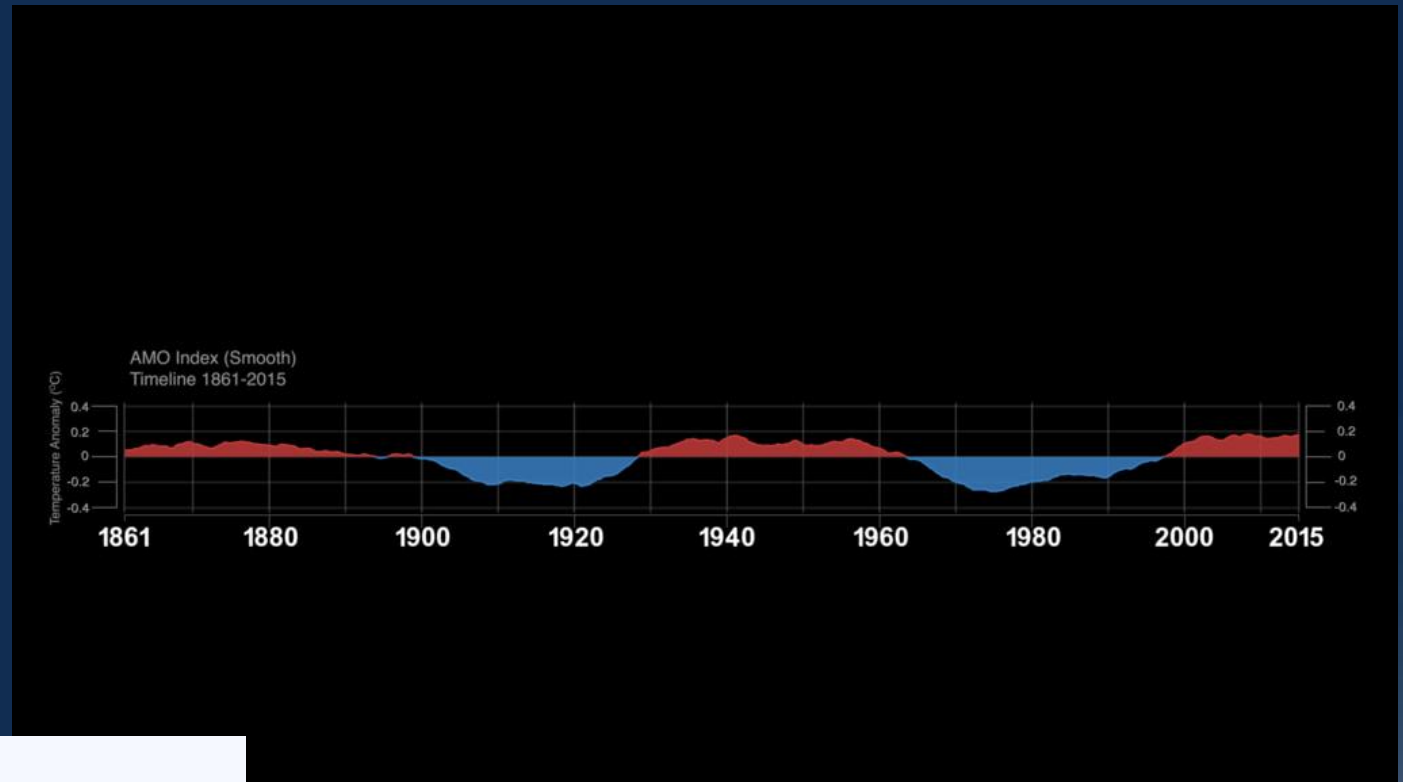
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Atlantic Multidecadal Oscillation

The Atlantic Multidecadal Oscillation (AMO) is a climate phenomenon characterized by variations in sea surface temperatures (SST) in the North Atlantic Ocean. It operates on a timescale of approximately 60 to 80 years, cycling between warm and cool phases.



Phases of the AMO

Phase	Characteristics	Duration
Warm Phase	Higher SSTs, increased hurricane activity, and potential droughts in North America	1926-1963, 1995-present
Cool Phase	Lower SSTs, decreased hurricane activity, and reduced drought conditions	1964-1994

Any Questions?

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