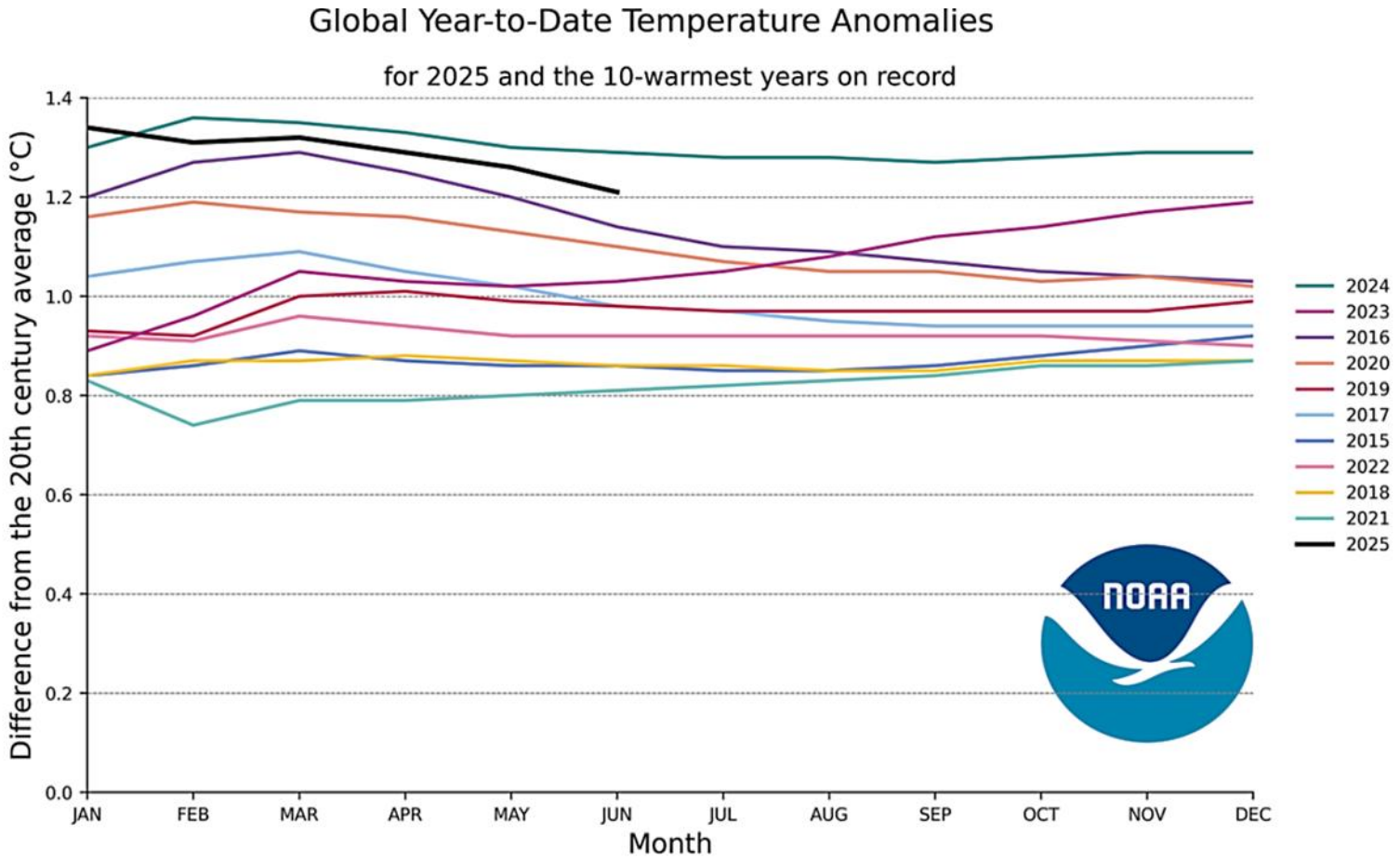
Amplifying Barometric Swings Yield Extreme Trends in Severe Weather

*"The 10 warmest years in the 143-year record have all occurred **since 2015**. The 2024 January–December 2024 global surface temperature ranked warmest in the 175-year record at 1.29°C (2.32°F) above the 20th century average" (NOAA).*



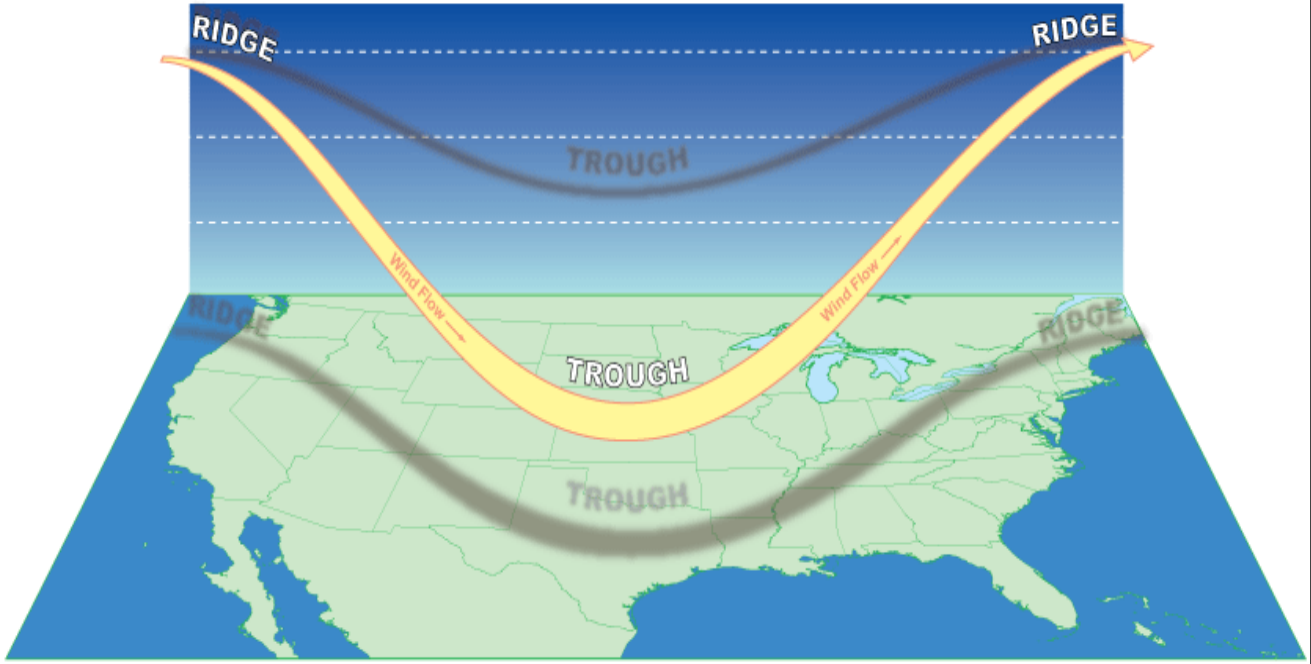
Chief Meteorologist Ms. Sunny Wescott
Critical Infrastructure and Emergency Response Operations

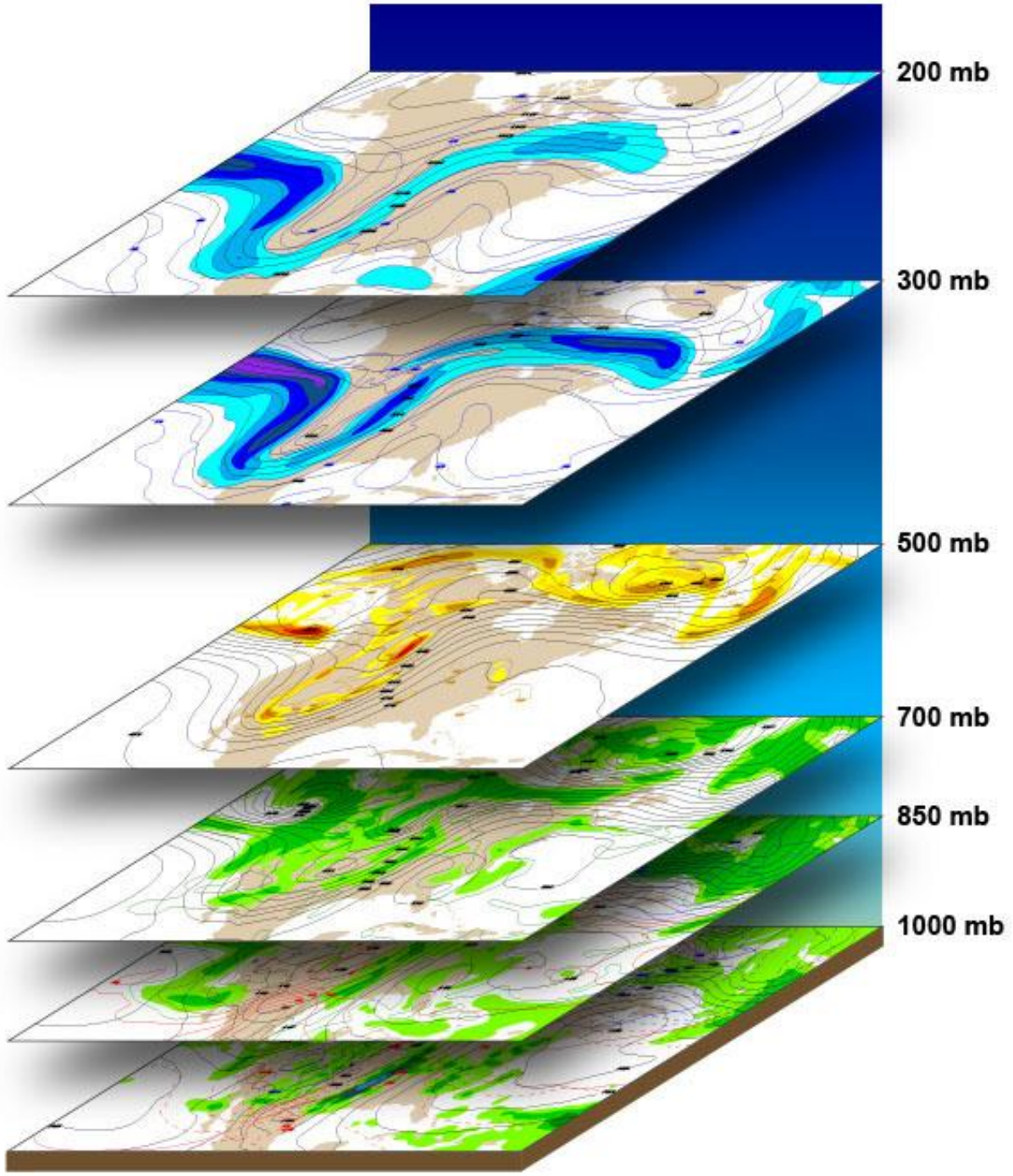
Atmospheric Pressure - Millibar 101

In essence, upper air charts show the atmosphere in three dimensions.

- Wind flowing from a ridge toward a trough is decreasing in height above the surface. Conversely, wind flowing from a trough into a ridge is increasing in height.
- Between the colder, more dense air and the warmer, less dense air is the location of the greatest change (gradient) in heights of any pressure level. (NWS Jet Stream)
- By looking at these contours we observe patterns of higher heights (called ridges) and lower heights (called troughs). These ridges and troughs drive the weather we experience at the surface.

Atmospheric Pressure is measured with an instrument called a barometer, which is why it is also referred to as barometric pressure.





High and Low Pressures: the Carousel of Weather

A **low-pressure system** has lower pressure at its center than the areas around it. Winds blow towards the low pressure, and the air rises in the atmosphere where they meet.

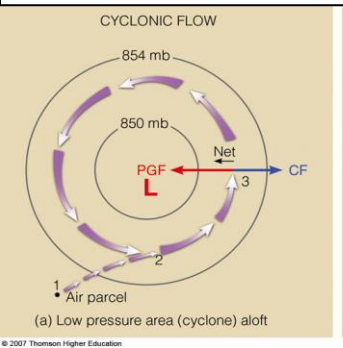
- Because of Earth's spin and the Coriolis effect, winds of a low-pressure system swirl counterclockwise north of the equator.
- As the air rises, the water vapor within it condenses, forming clouds and often precipitation.
- On weather maps, a low-pressure system is labeled with red L.

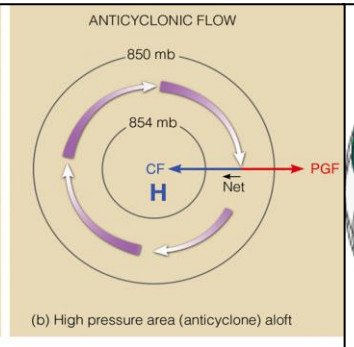
A **high-pressure system** has higher pressure at its center than the areas around it. Winds blow away from high pressure.

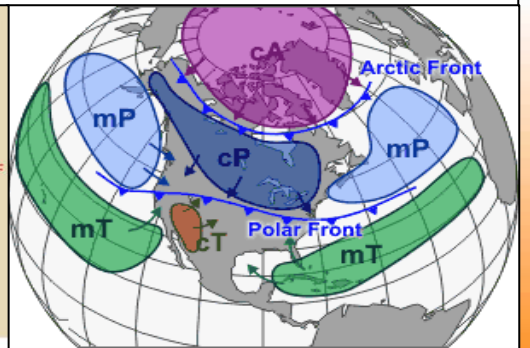
- Swirling in the opposite direction from a low-pressure system, the winds of a high-pressure system rotate clockwise north of the equator (anticyclonic flow).
- Air from higher in the atmosphere sinks down to fill the space left as air is blown outward. On a weather map, you may notice a blue H, denoting the location of a high-pressure system.

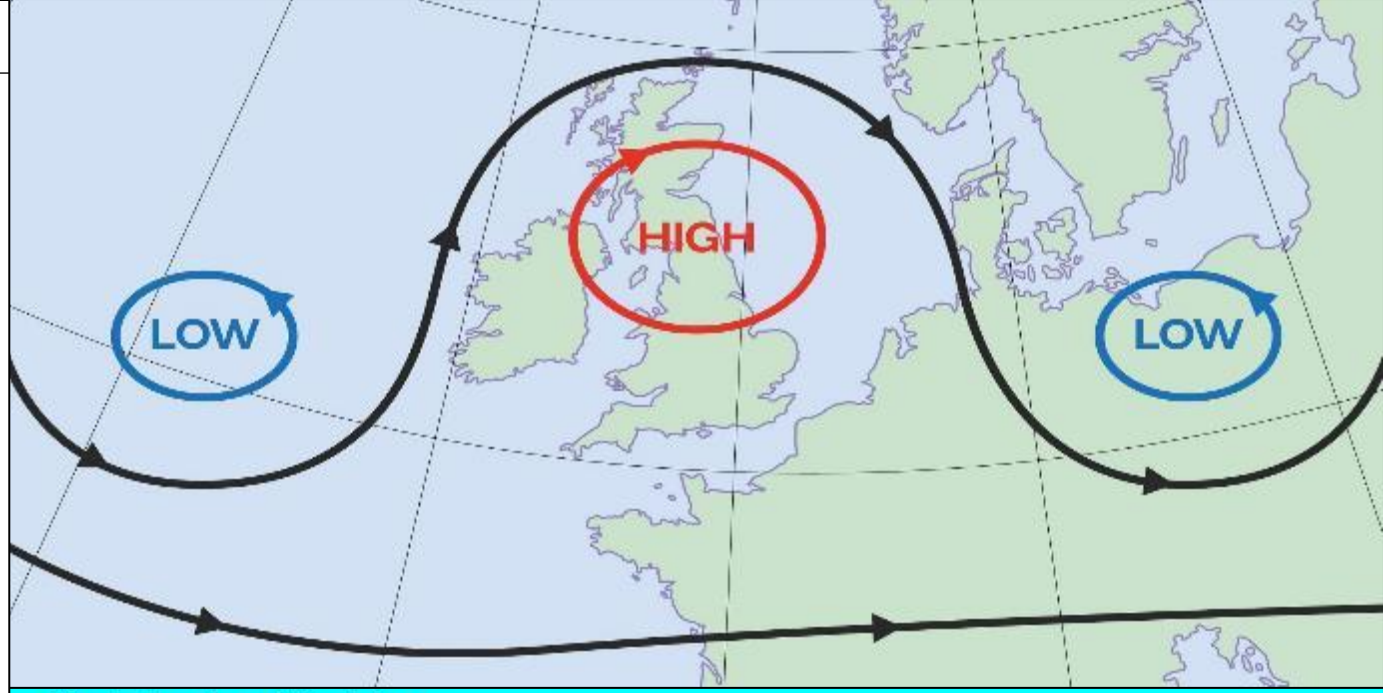
Air pressure depends on the temperature of the air and the density of the air molecules. Air masses differ based off their prevailing fields.

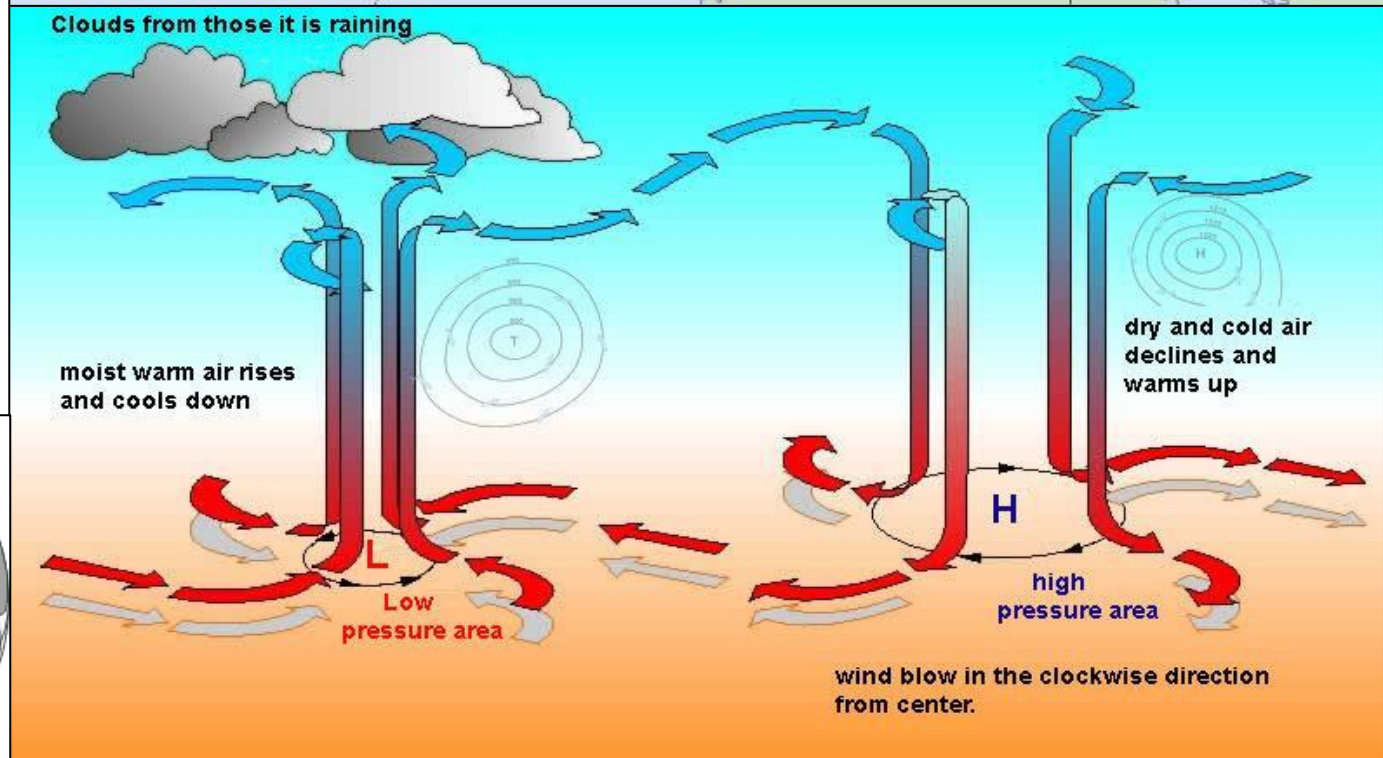
The tighter the gradient between the high and the incoming low, the stronger the winds will be as they mix down from the upper levels.

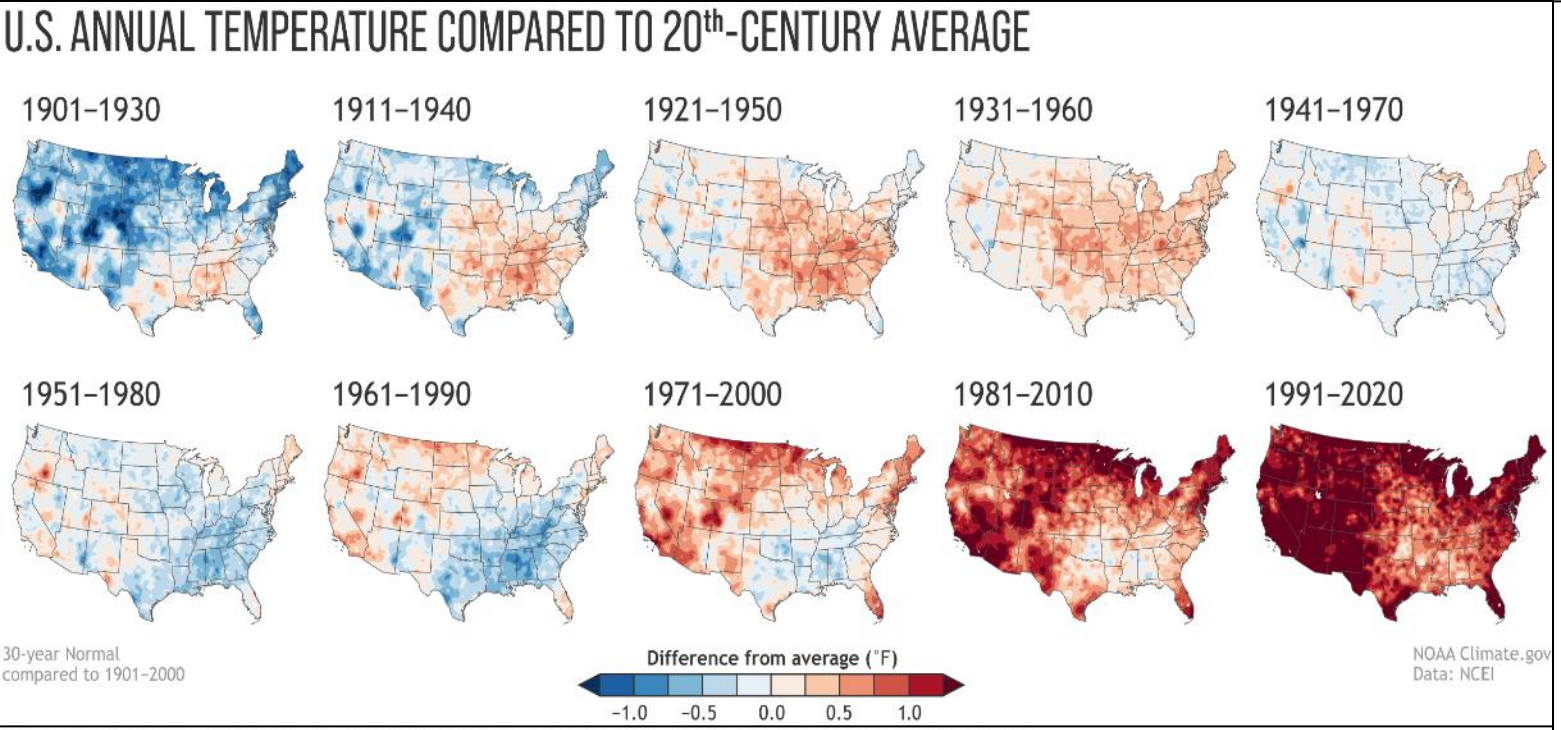


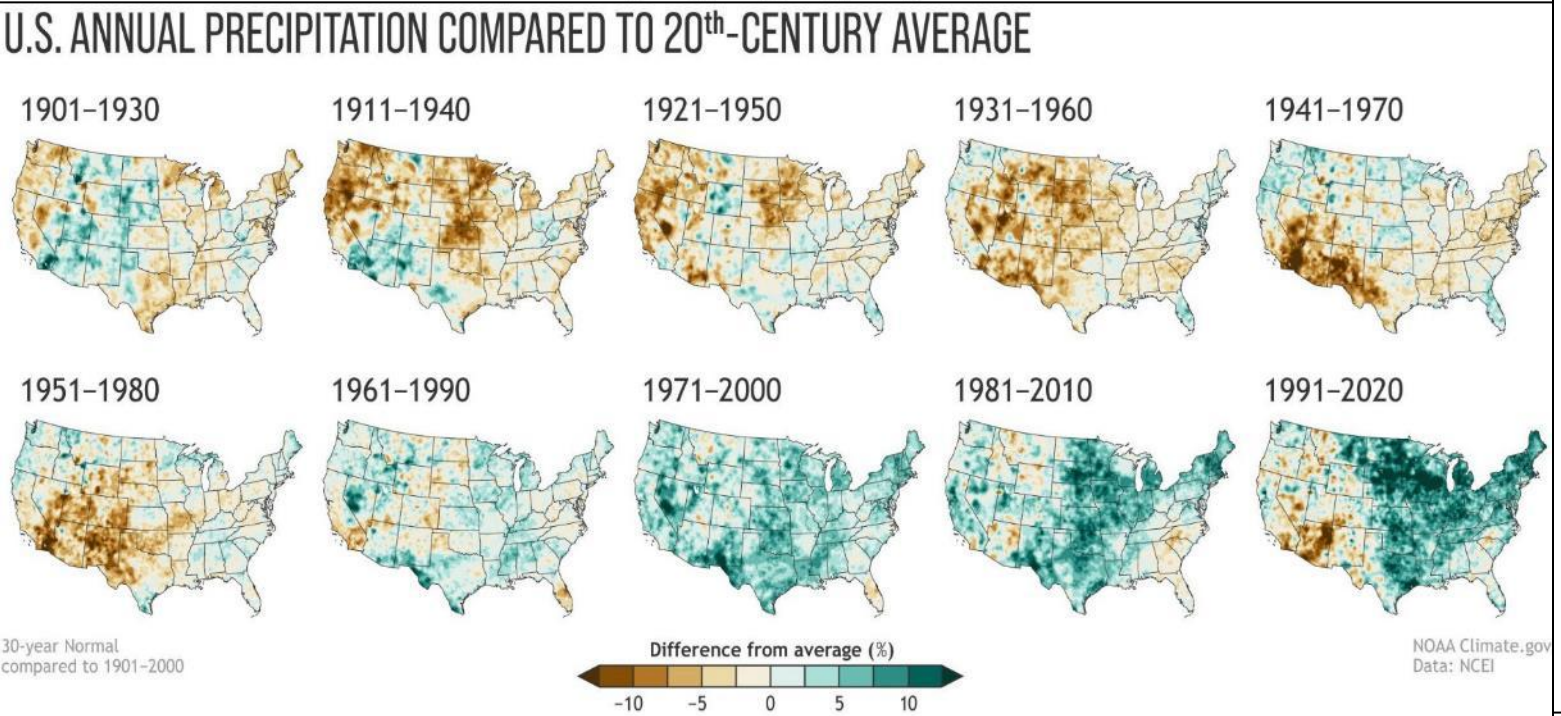












By 2050, about 63% of the US may be forced to endure temperatures over 100°F. Areas where triple-digit temperatures are seasonal already, will see baseline temperatures and frequency of high heat events increase.

As average temperatures at the Earth's surface rise, **more evaporation occurs**, which increases overall precipitation. For every 1.8°F of warming, the atmosphere can hold about 7% more moisture.

- Warmer air holds more water because the water vapor molecules it contains move faster than those in colder air making them less likely to condense back to liquid.
- Sea surface temperatures have risen by 0.5–0.6°C since the 1950s, and over the oceans this has led to 4% more atmospheric water vapor since the 1970s.
- As water vapor condenses to form rain it produces heat, brings warm air down and causing friction on impact, heating the surface.

As temperatures increase, short-burst heavy rainfall events will increase. The air is on average warmer and moister than it was prior to 1970, leading to a 5-10% effect on precipitation and storms causing extreme downpours.

Upper-Level Winds

A recent study, in *Nature Climate Change,* suggests that the fastest upper-level jet stream winds will accelerate by about 2% for every degree Celsius (1.8° Fahrenheit) that the world warms.

- Furthermore, the fastest winds will speed up 2.5 times faster than the average wind.

The Intergovernmental Panel on Climate Change (IPCC) states that climate change will affect aggregate global windspeeds with projected average annual wind speeds dropping by 10% by 2100.

- A 2019 study found that in the preceding nine years the global average wind speed increased nearly 6%.

Extreme regional wind events such as the Santa Ana, Diablo, and Chinook, have increased in general over the last 60 years.

- Shifts in winds carrying major seasonal precipitation like Atmospheric Rivers and Monsoons are forecast to amplify while variations in frequency and timeliness.

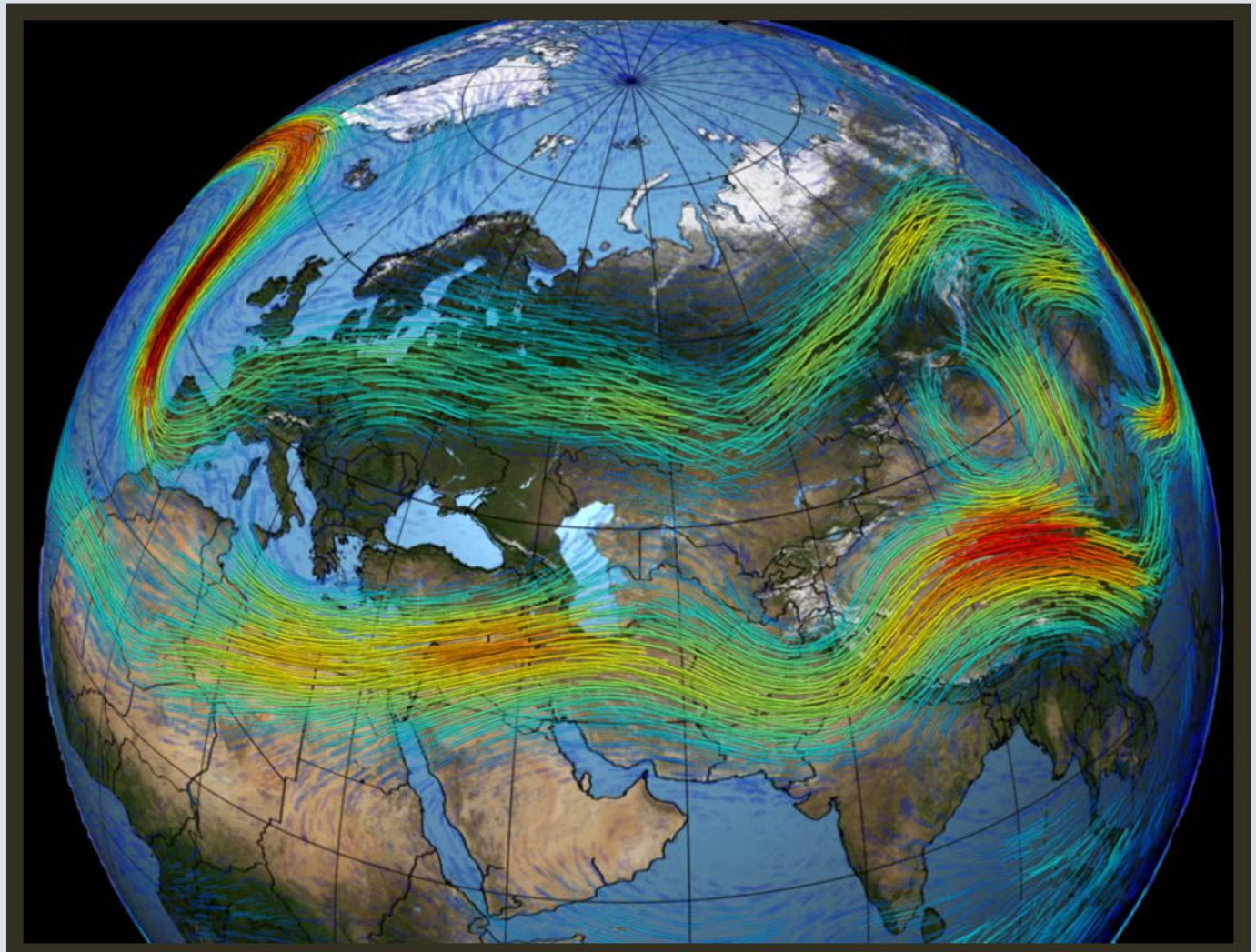
Studies over the past 45 years indicate changes to the tropopause, the top of the troposphere, and the width of the tropical belt may be shrinking, changing the overall storm pattern across the globe.

- The tropopause, has climbed about 50 to 60 meters per decade in the past 20 years.
- The troposphere is the bottom layer of Earth's atmosphere and contains most of the atmosphere's mass, clouds and weather phenomena, and is where the global population and wildlife lives.

JET STREAM WINDS WILL ACCELERATE WITH WARMING CLIMATE

Faster winds likely to cause bumpier flights, more severe weather

DEC 6, 2023 - BY STAFF



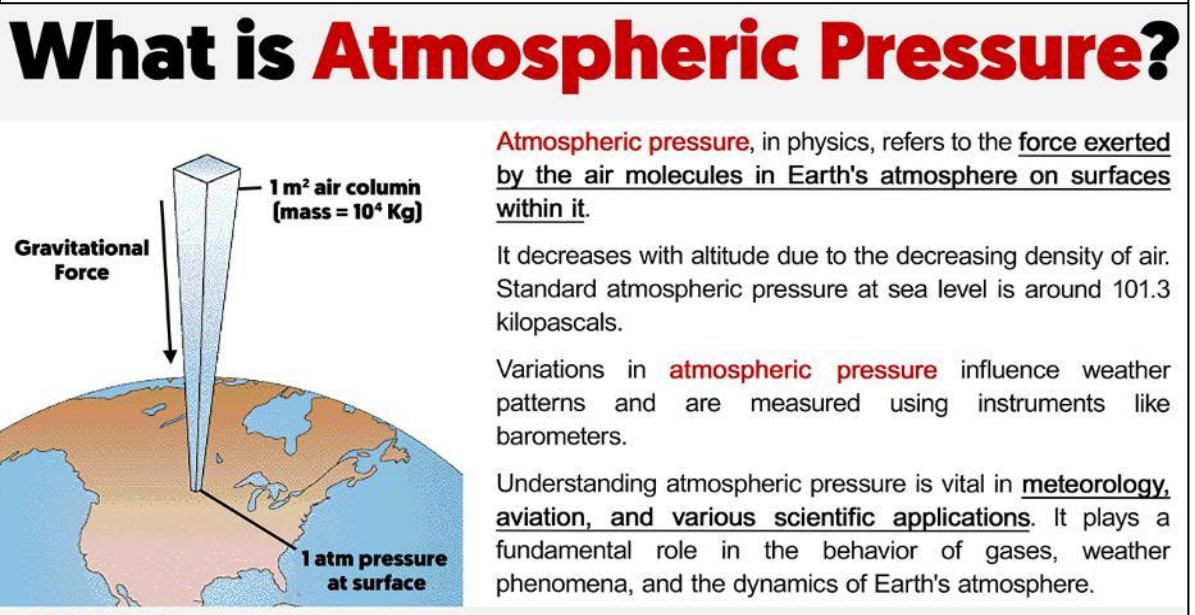
New research shows that the fastest jet stream winds will accelerate with climate change. (Image by NASA/Goddard Space Flight Center Scientific Visualization Studio.)

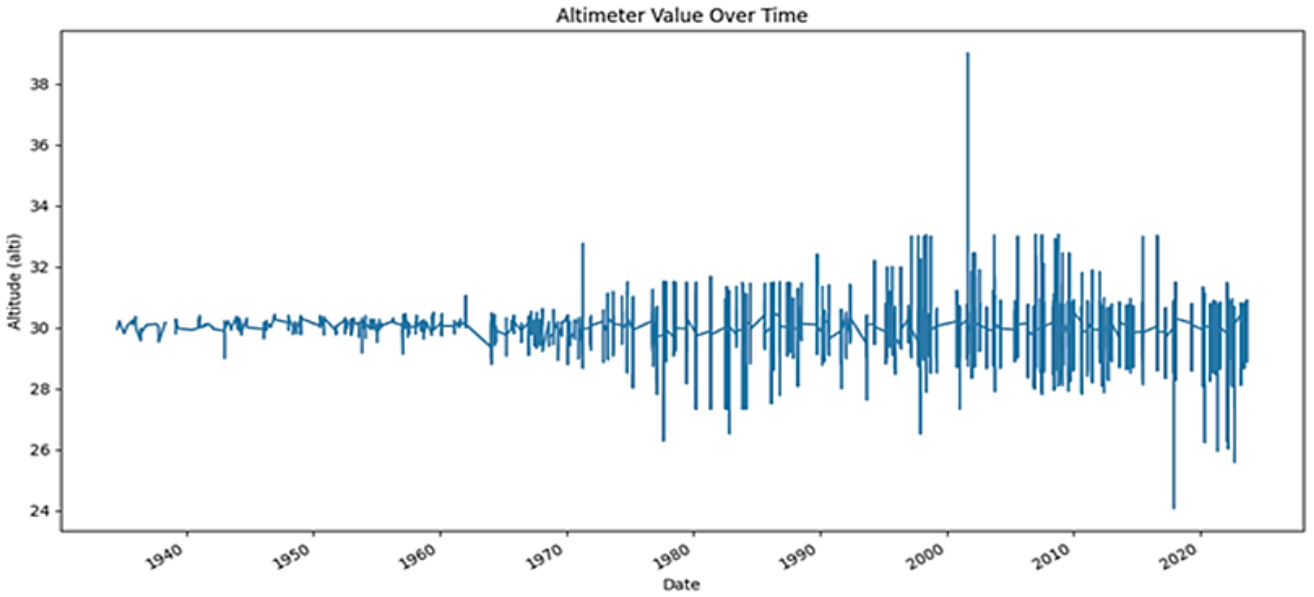
Major Pressure Swings Begin

As low pressures continue to change in depth and intensity, the high-pressure events are left to dominate for longer periods, increase coverage area, and promote significant levels of humidity and water vapor adding to trapped heat.

- The low-pressures drive global cooling winds, bring rainfall and storm events, and are responsible for all notable cloud coverage.
- High-pressures yield clear skies, heat domes, haze, stagnant air, and even the cold air damming periods.

This means a change in either pressure consistency or strength brings immediate consequences for the water cycle.





ASOS Raw Data
National Overview

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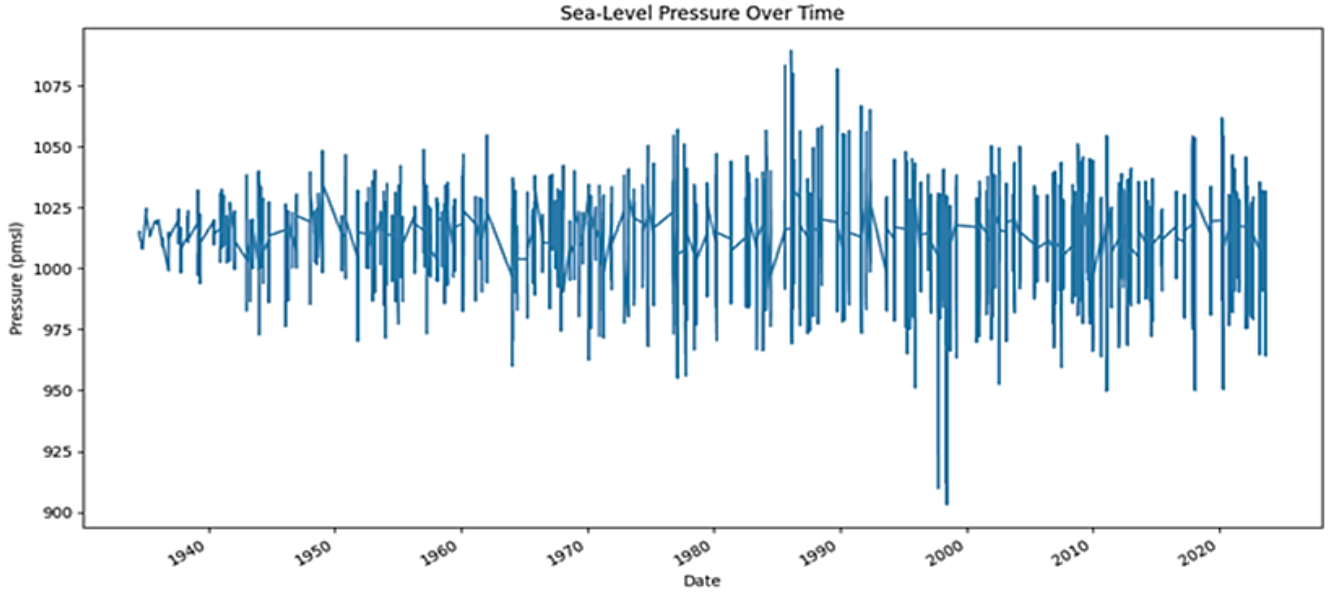

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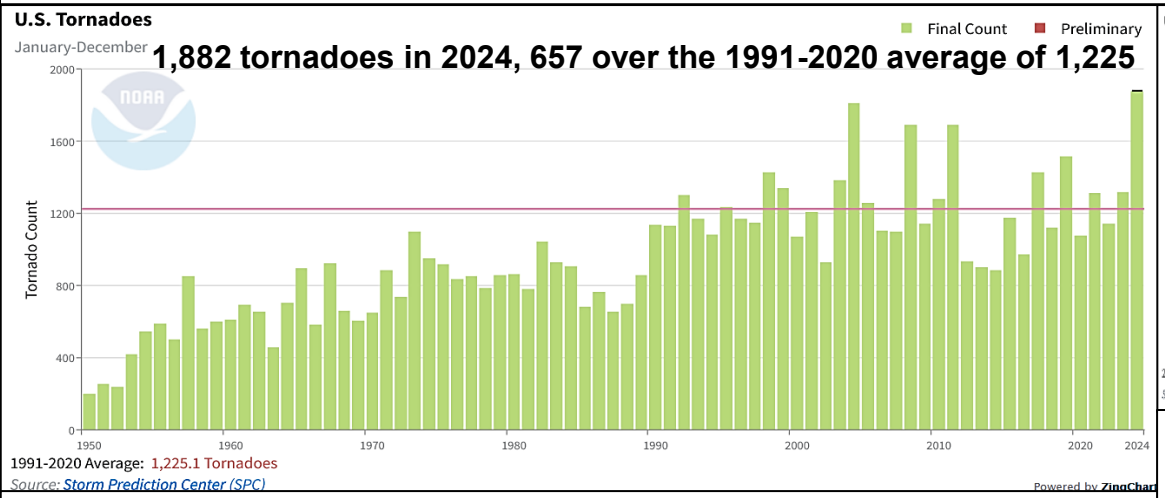
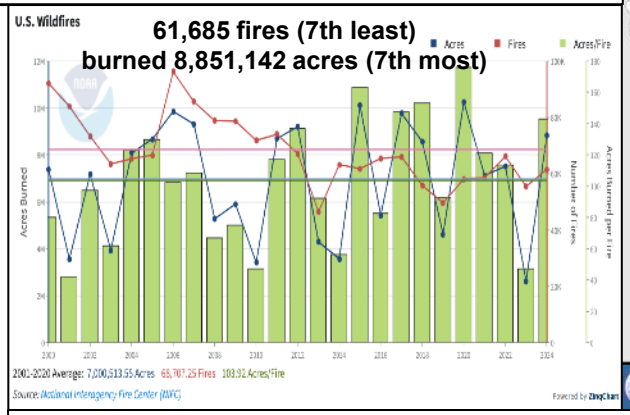
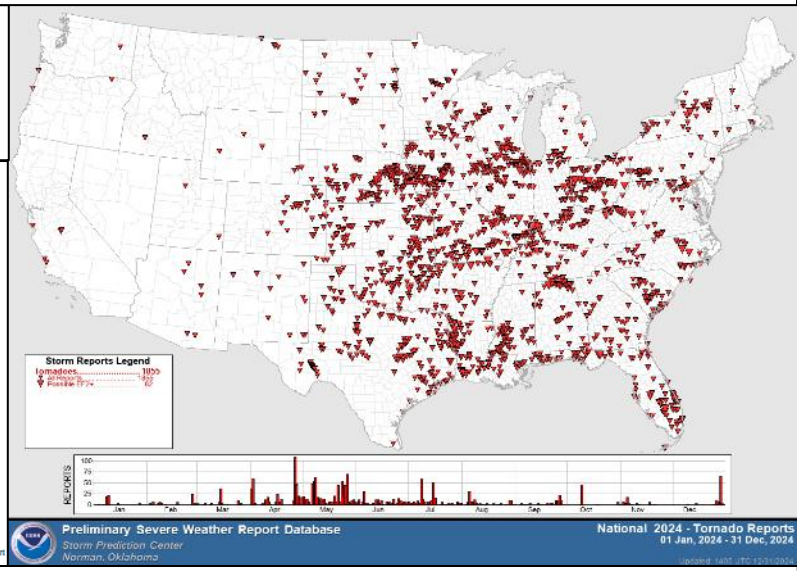
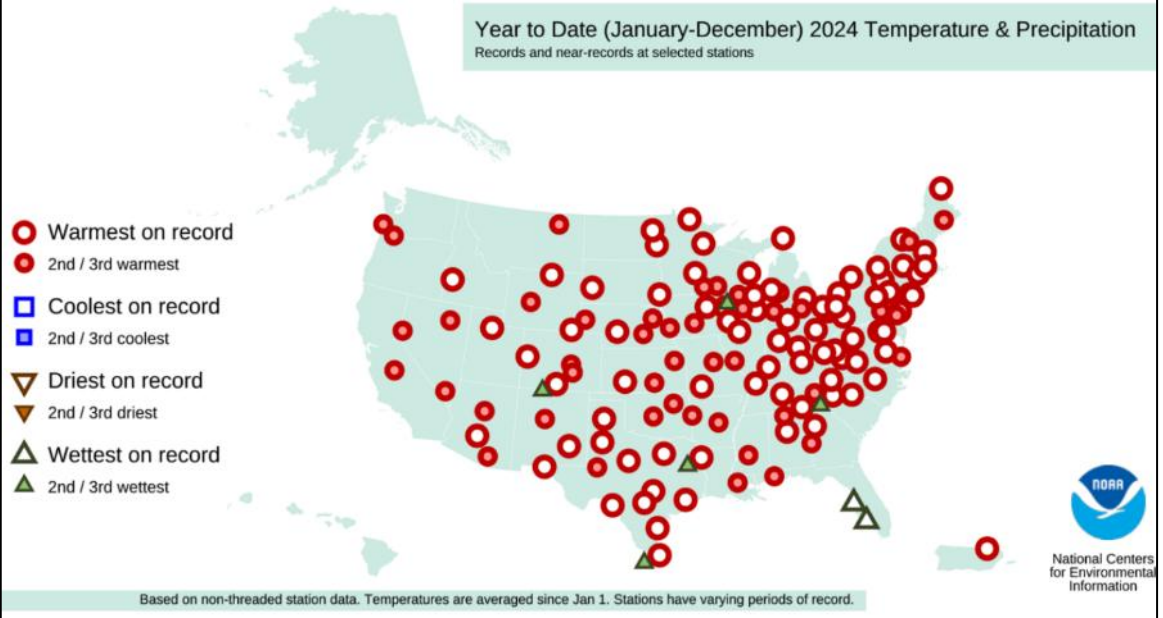
National Temperature Swings Yield Extremes

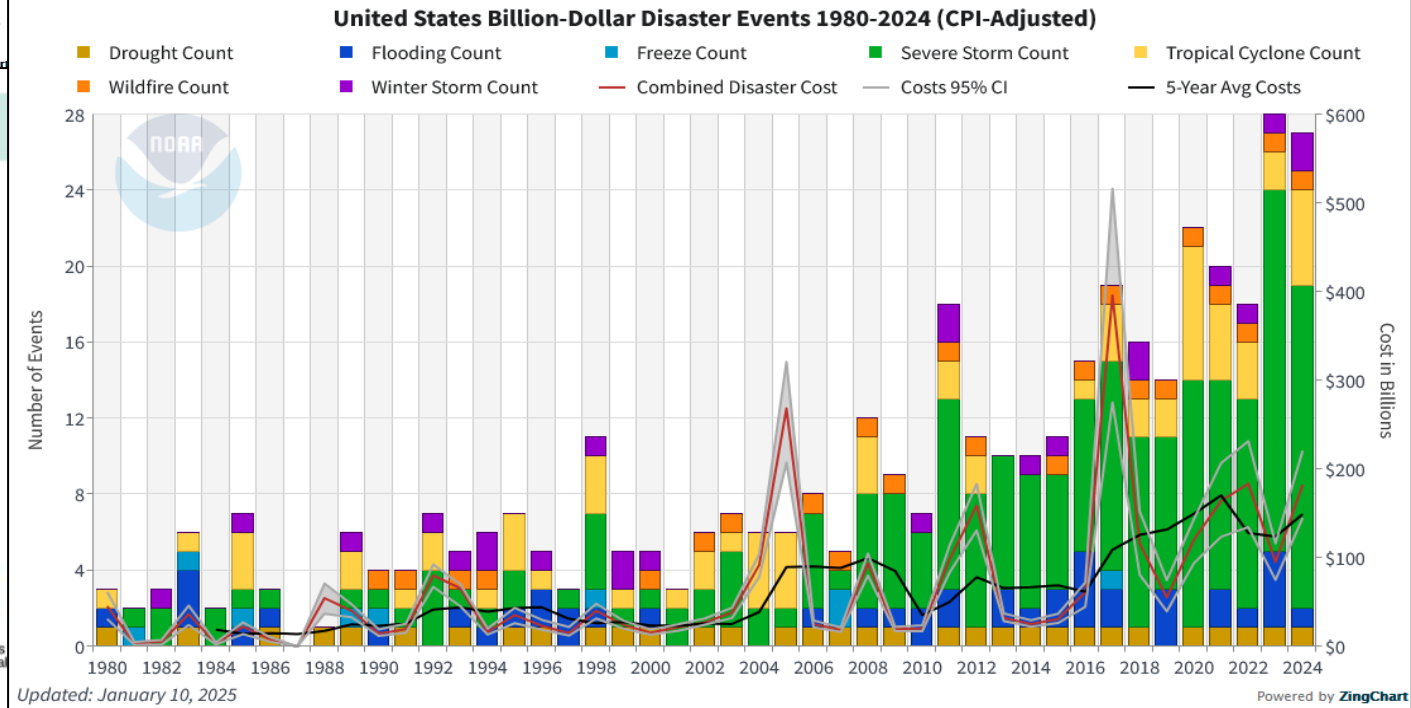
In 2024, there were 27 confirmed weather/climate disaster events with losses exceeding $1 billion each to affect US following the 2023 record 28 billion-dollar events. The total cost from 2024 was $182.7 billion via *17 severe storms, 5 Tropical Cyclones, 1 wildfire, 1 drought/heat event, and 2 winter weather events.*











Severe Weather on the Rise

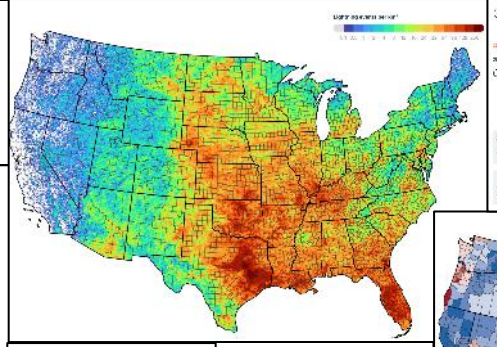
Hail events throughout the US are forecasted to intensify regarding size of the hailstones as warmer seasons across multiple regions can enable stronger updrafts for supercell storms responsible for large hail especially across less hardened areas.

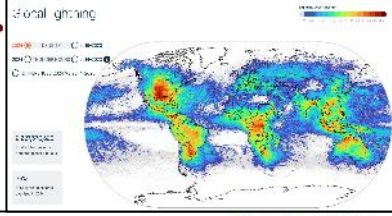
- Insured U.S. hail losses average $8 billion - $14 billion per year, or $80-140 billion per decade.

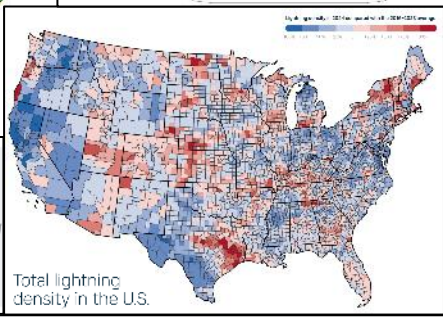
A new study published by the National Center for Atmospheric Research finds there has been "a fivefold increase in the area affected by straight-line winds since the early 1980s" in the central U.S. Straight-line winds are often produced by thunderstorms and can impacts like that of a tornado. These winds have increased at a rate of 13% per degree of warming.

Tornado activity from 2008-2021 in comparison with 1991-2010 indicates the seasonal frequency has remained the same but the location and intensity of tornadic supercells has expanded from "Tornado Alley" to "Dixie Alley" producing larger, longer supercells. Dixie Alley includes Eastern TX, AR, LA, TN, KY, MS, AL, GA, South MO, Southeast OK, and the FL panhandle.

A recent study predicts a nationwide 6.6% increase in supercells and a 25.8% expansion in the area and time supercells remain over land by the year 2100. This may result in areas which do not often see tornadic activity reporting an increase in events too.





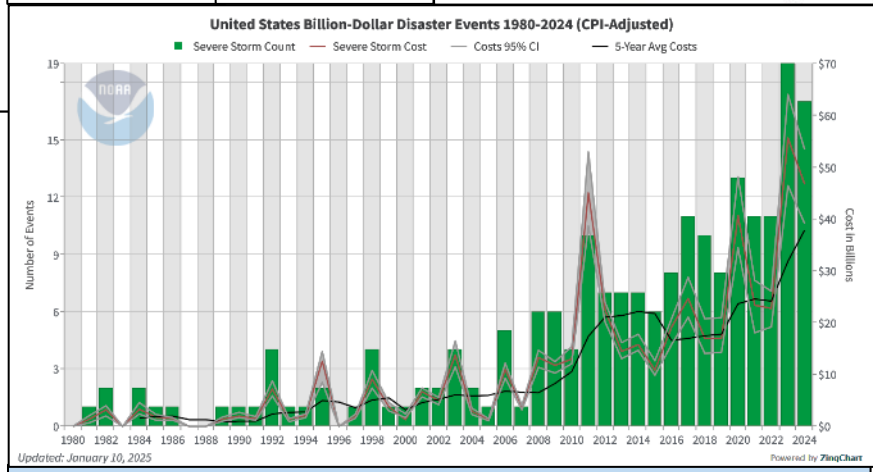


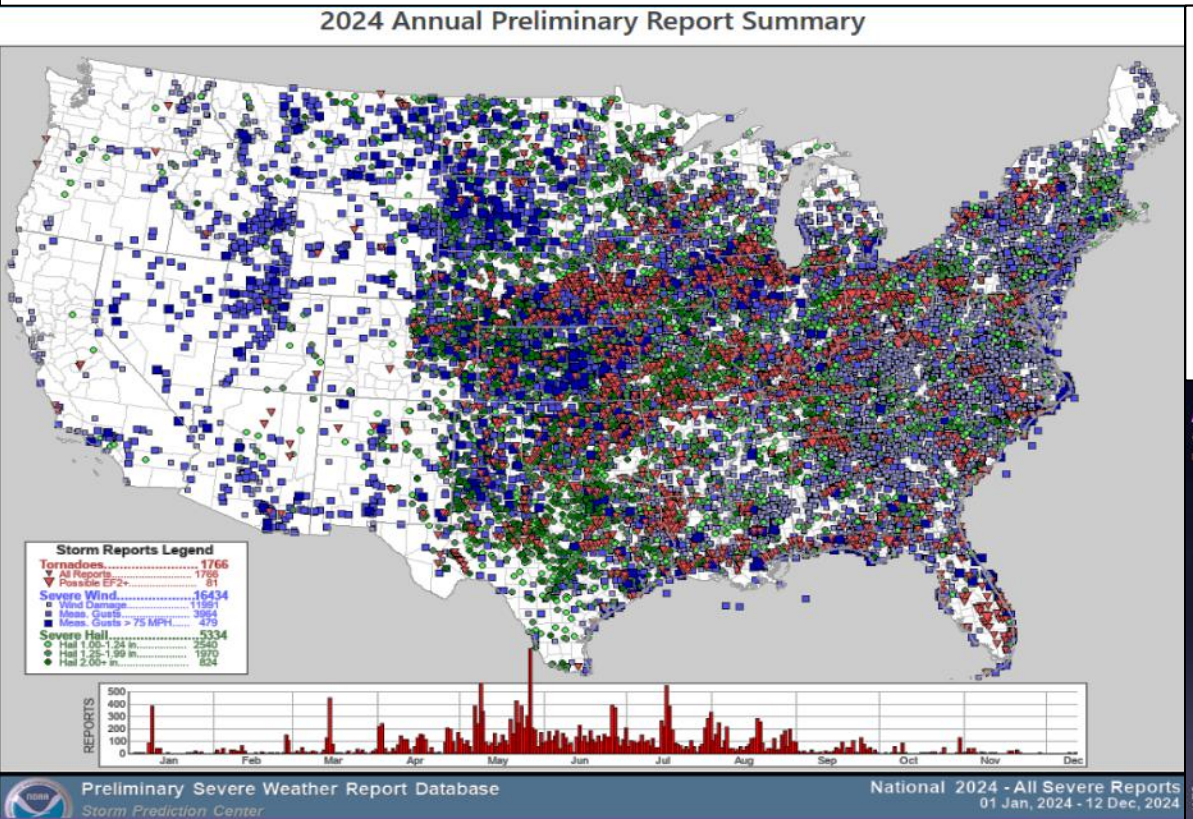
#1 by count

Polk County, Florida, saw 851,938 lightning events in 2024

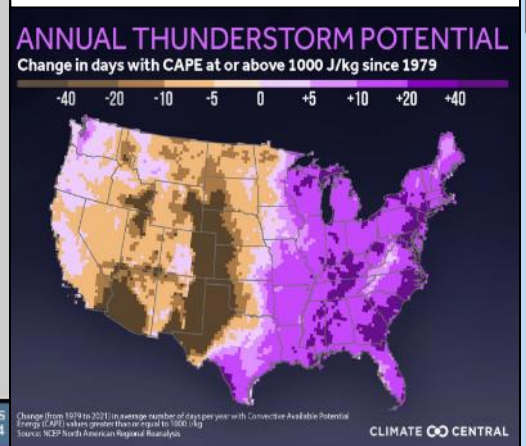
#1 by density

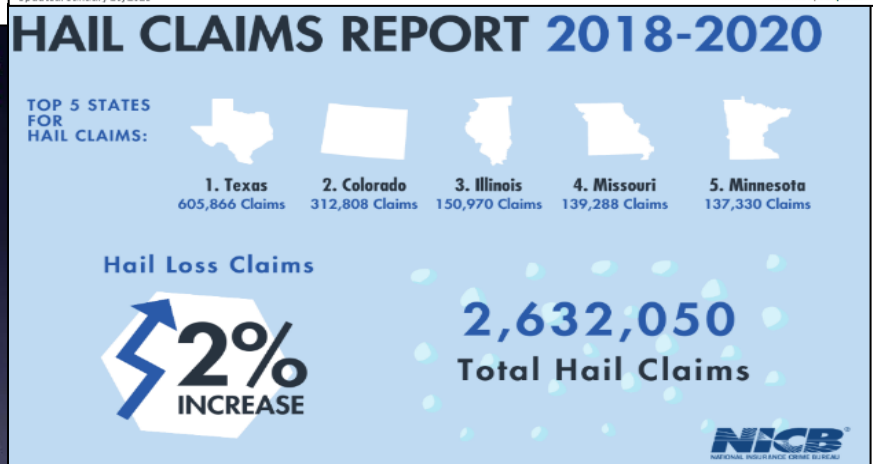
Walker County, Texas, saw 318 lightning events per km² (825 per square mile)





March 2025 produced a new record for tornadic activity in the US while April yielded 2x the average tornado count. Hail reaching DVD size (4-5 inches) aka grapefruit size, was reported in multiple states at increasing rates with last year producing melon size (+6 inches). May 2025 is in the top 10 for most tornadic activity on record and June produced over 215 tornadoes, placing the first 6 months of 2025 +1,200 tornadoes.





The Role of Heat in Storm Growth

Severe thunderstorms are defined as having sustained winds above 93 kilometers (58 miles) per hour or unusually large hail, and there are two key factors that fuel their formation: convective available potential energy (CAPE) and strong wind shear.

- Research by Climate Central has shown an increase of 10 to 15 high-CAPE-value days annually between 1979 and 2021 across much of the eastern US.
- Cities such as Atlanta and New York City could see a doubling of the number of days that severe thunderstorms could occur.

Lightning: *Each 1 degree Celsius of warming could spur a 12% increase in lightning frequency*, boosting the flash rate to about four times per second by 2090, up from nearly three times per second in 2011. Many sites across the US reportedly do not invest in lightning protection systems.

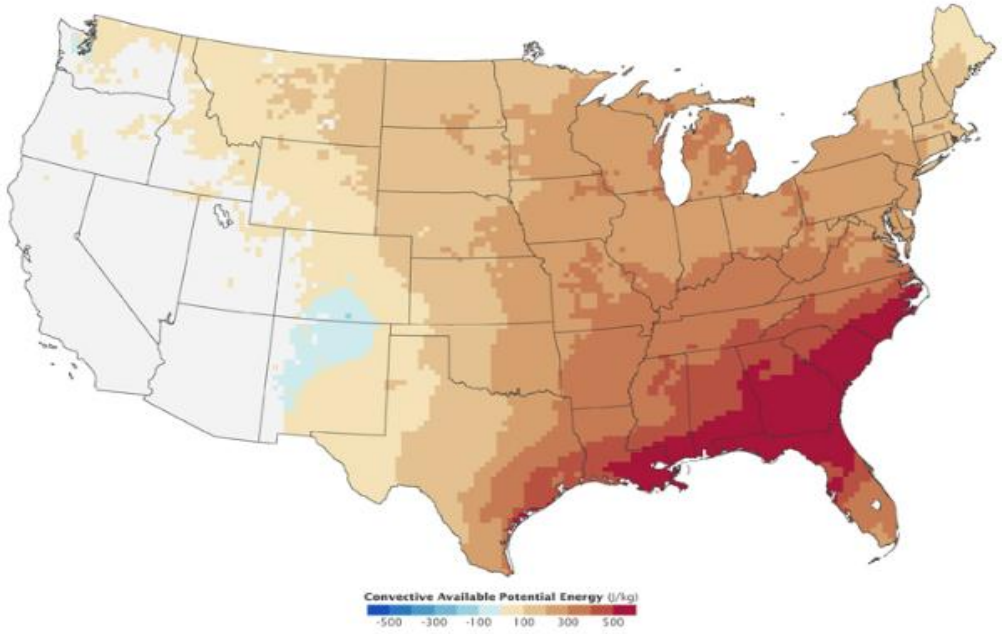
- Flashes that touch down amid minimal or no rainfall, known as dry lightning, are especially effective fire starters.
- Currently about 20 million lightning bolts touch down each year within the US.
- Hotter days may boost updraft within thunderstorms, causing lightning flashes to increase in frequency to about 4 strikes per second globally — about a 40% increase from 2011.
- The rate of all cloud-to-ground strikes increasing to ~8 flashes per second (+28%).

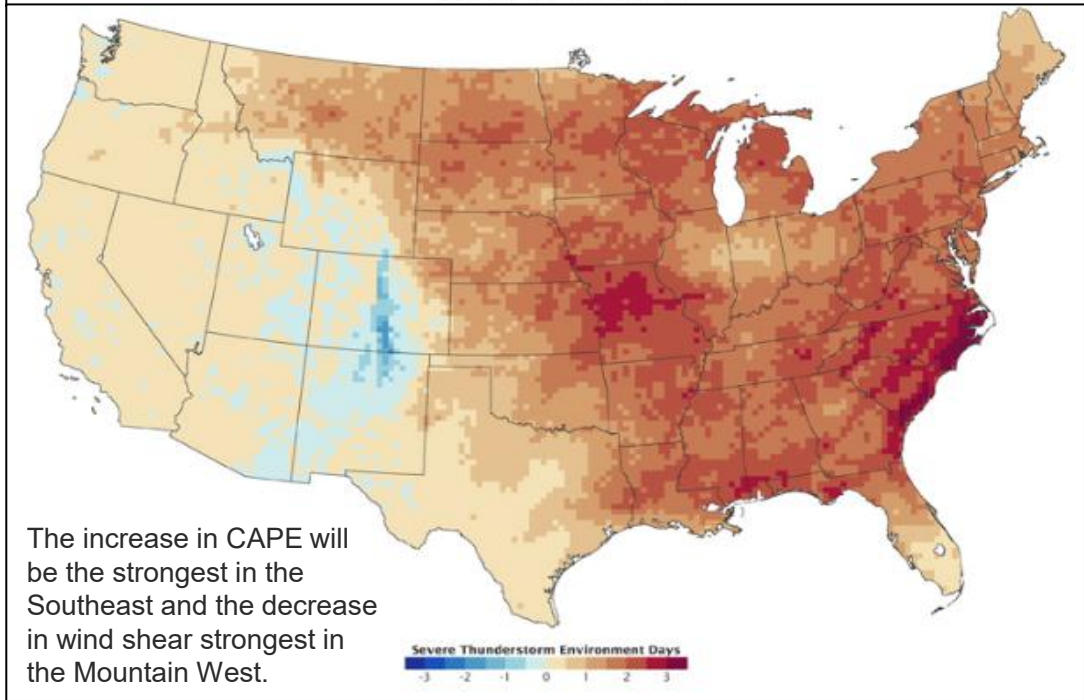
Hail: increasing temperatures and humidity could fuel larger hail and could mean smaller pellets are more likely to melt before hitting the ground.

- Damage from severe thunderstorms has been inching up by about 7% annually for 30 years.
- Worldwide, thunderstorm losses were almost 90% higher than the previous five-year average of $32 billion and over <u>double</u> the previous 10-year average of $27 billion.

Severe thunderstorms and climate change

Models compare the summer climate from 1962–1989 to future climate projections for CAPE indices in 2072–2099.





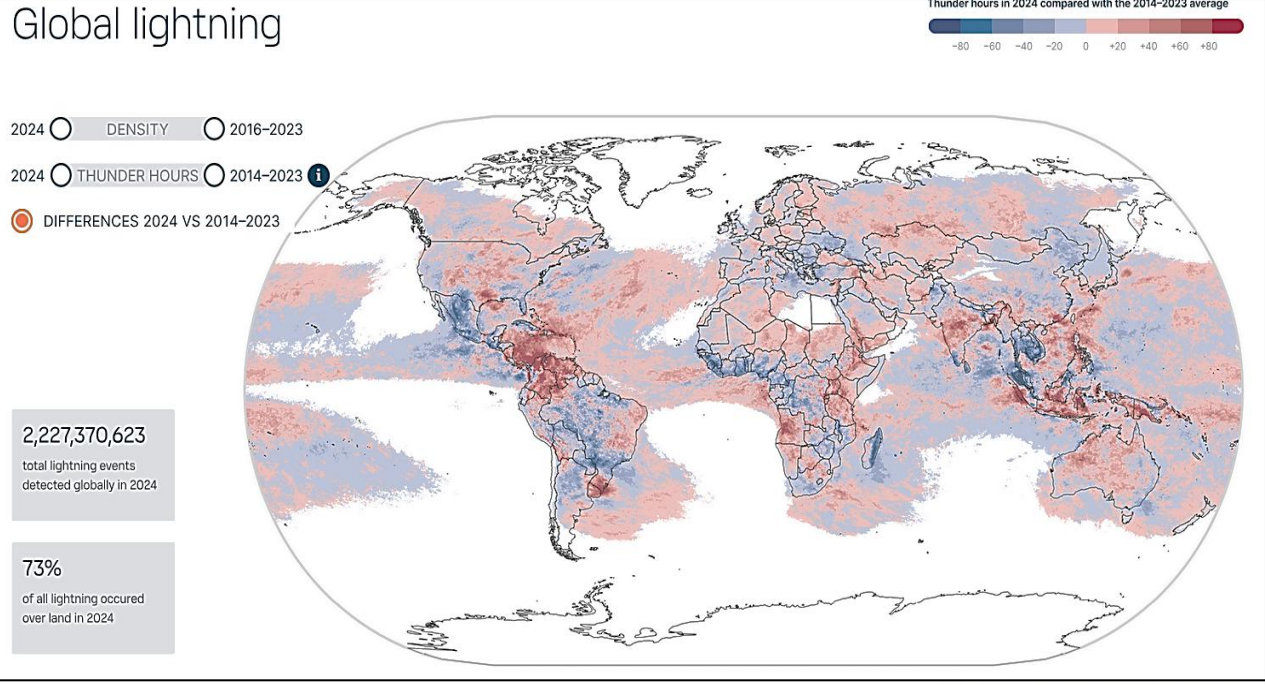
The increase in CAPE will be the strongest in the Southeast and the decrease in wind shear strongest in the Mountain West.

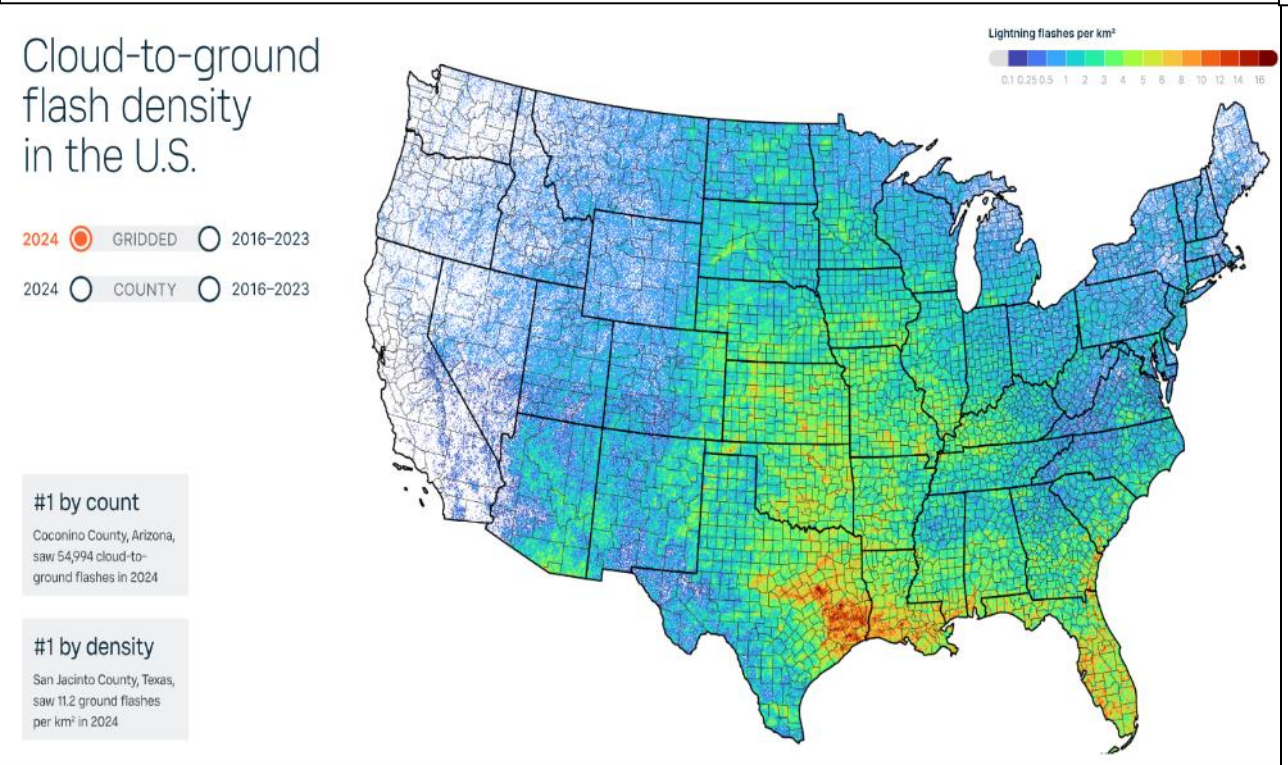
Lightning Distribution Updates

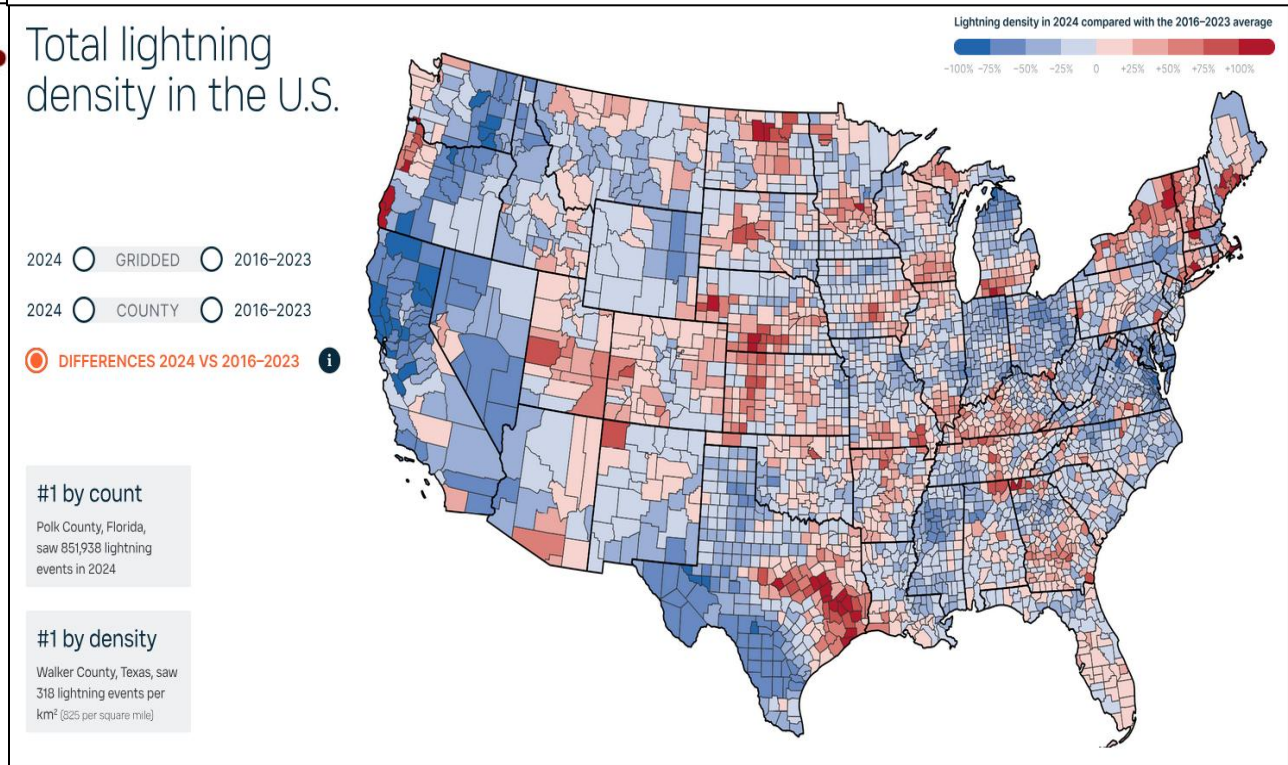
Hailstorms are by far the costliest hazard associated with severe thunderstorms. Hail will become less common but larger and more damaging because of human-caused climate change.

- Column-maximum severe hail days are projected to increase robustly in most locations outside of the southern Plains, a distribution that closely mimics projections of thunderstorm days.
- The global mean lightning rate increased by 7.1% from the pre-industrial period to the present day, which was attributed to increased graupel occurrence.

From 1980–2024, 48 severe storm events producing 1-billion dollars or more in damages with the most severe storms on record in 2024.







Pollutants Change Weather – Convective Storms and Rain

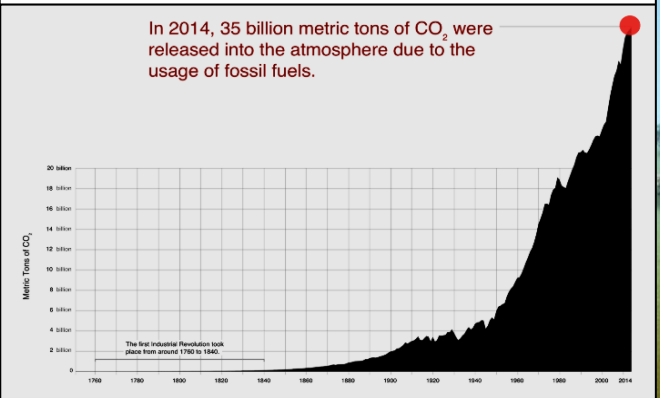
Air pollution is increasing the severity of summertime thunderstorms, according to a recent study conducted by researchers at James Madison University and published in the journal *Atmospheric Research*.

- JMU geography professor Mace Bentley, the lead author of the study, says, "Pollution acts as cloud nuclei. It gets brought into the cloud through the updraft; the updraft and downdraft then separate the pollution particles, which divides the electrical charges in the cloud and **leads to more lightning production**."

A new study finds tiny particles in wildfire smoke affect the way droplets form in clouds, potentially resulting in less rain and exacerbating dry conditions that fuel fires.

Water Vapor increasing also fuels thunderstorms: Increases in atmospheric water vapor also amplify the global water cycle.

- They contribute to making wet regions wetter and dry regions drier.
- The more water vapor that air contains, the more energy it holds.

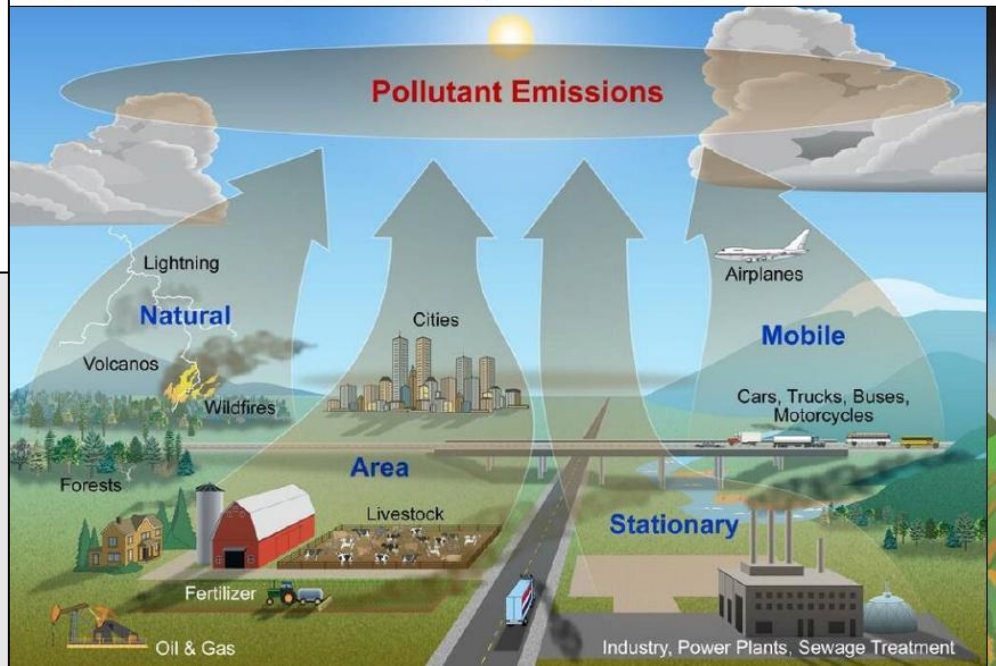


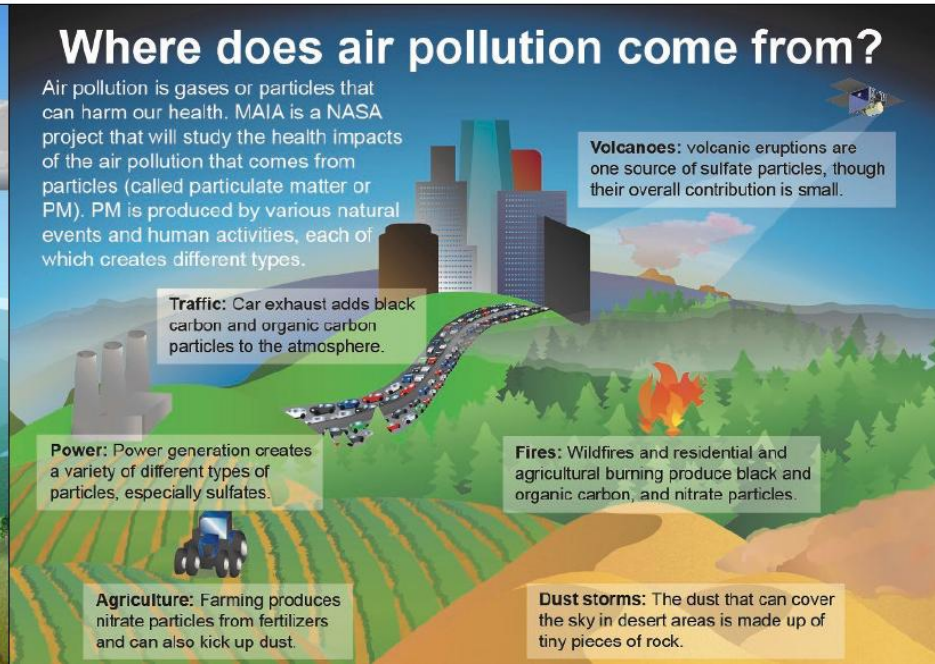
Air pollution is caused by solid and liquid particles and certain gases that are suspended in the air. These particles and gases can come from car and truck exhaust, factories, dust, pollen, mold spores, volcanoes and wildfires. The solid and liquid particles suspended in our air are called **aerosols**. (NASA)

- Any particle that gets picked up into the air or is formed from chemical reactions in the air can be an aerosol. Many aerosols enter the atmosphere when we burn fossil fuels, such as coal and petroleum, and wood. These particles can come from many sources, including car exhaust, factories and even wildfires.
- Some of the particles and gases come directly from these sources, but others form through chemical reactions in the air. Aerosols can come from other places, too, such as ash from an erupting volcano. Dust, pollen from plants and mold spores are also examples of aerosols.
- A gas called **ozone** is a major cause of air pollution. Ozone is also a greenhouse gas that can be both good and bad for our environment.

Ground-level ozone is formed when **volatile organic compounds (VOCs), also known as hydrocarbons, and nitrogen oxides (NOx)** interact in the presence of sunlight.

Sources of VOC and NOx emissions include large industry such as chemical manufacturers, and combustion sources such as power plants burning fossil fuels; small industry such as gasoline-dispensing facilities, autobody paint shops, and print shops; automobiles, trucks and buses; and off-road engines such as aircraft, locomotives, construction equipment and gasoline-powered lawn and garden equipment.





Changes in Severity: Lightning and Hail

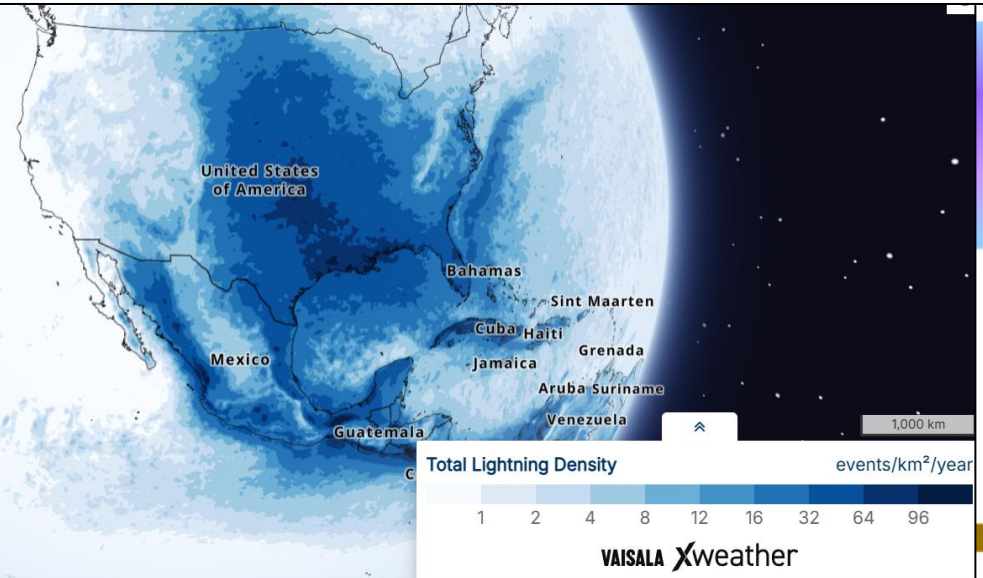
Hail is formed when strong updrafts in thunderstorms lift raindrops high into the atmosphere, where they freeze and grow larger by colliding with supercooled water droplets.

- The updraft essentially acts as a conveyor belt, carrying these frozen droplets upward and allowing them to gather more ice before eventually falling back to the ground as hail.
- As updrafts get taller due to the atmospheric height rising, the general stability of the storm will also weaken, causing a rise in microbursts and outflow events.
- Near-surface hailstones <4 cm are found to decrease in frequency by an average of 25%, whereas the largest stones are found to increase by 15–75% depending on the greenhouse gas emissions pathway.

Cloud heights increasing can be compared to the height of storms in the tropics reaching 19 kilometers versus about 12 kilometers in the temperate regions.

Lightning increases from taller clouds can result in more sprites and elves, which is when lightning pushes into the ionosphere and can mimic EMPs affecting radio wave propagation.

Atmospheric and Ionospheric Gravity Waves are also triggered by lightning modifying storms.



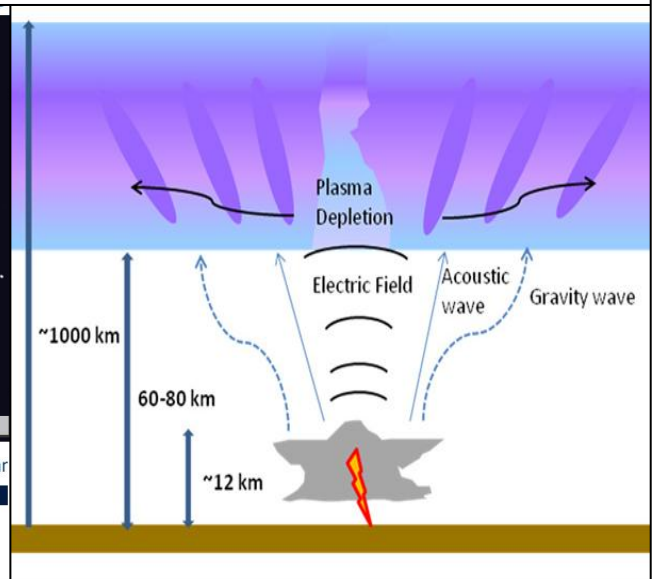
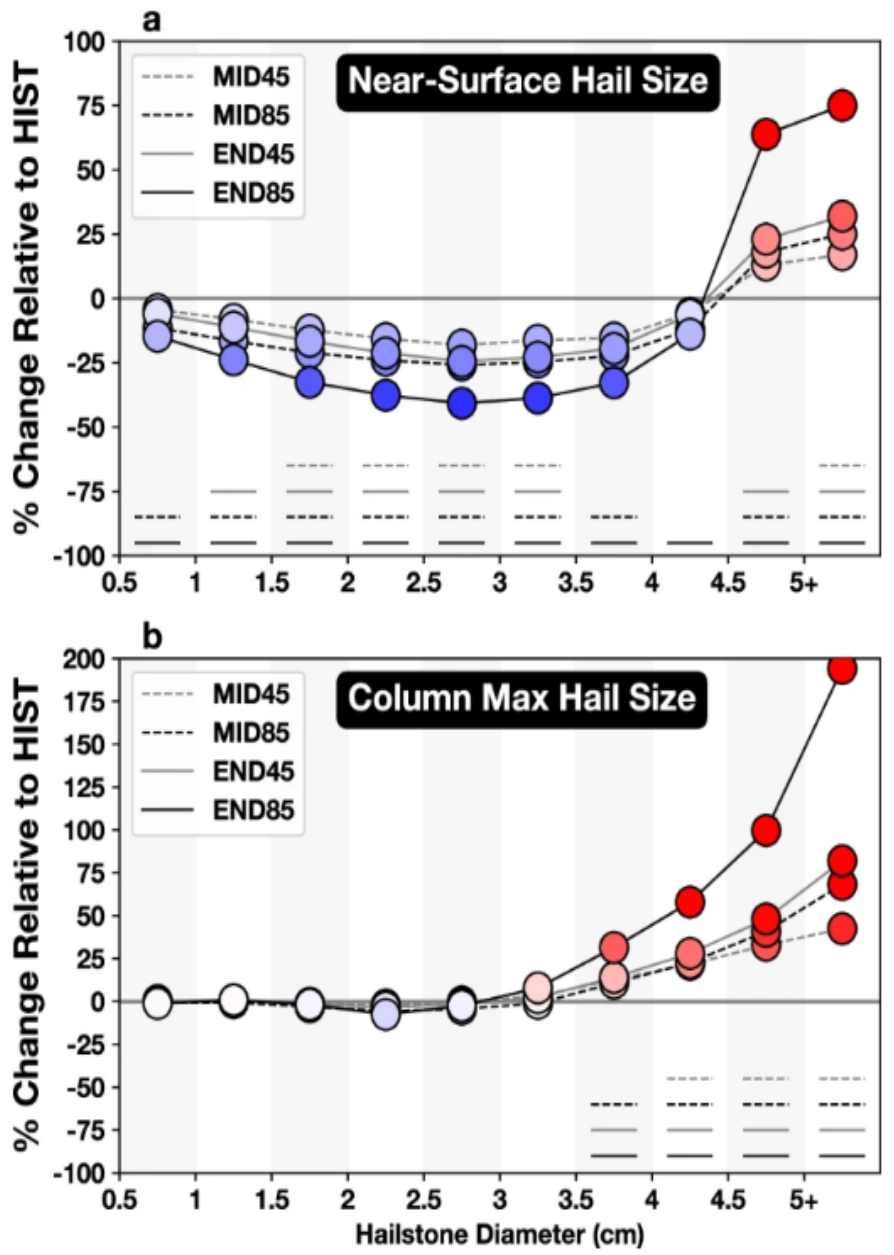


Fig. 1: Projected hailstone size changes.



Binned **a** near-surface and **b** column max hailstone diameter frequency for each WRF-BCC future epoch expressed as percent change relative to HIST. Statistically significant differences are displayed along the abscissa for each bin (i.e., horizontal lines corresponding to each experiment).

Hail Records Continue to Rise

2010: A hailstone was discovered in South Dakota measuring 8.0 inches in diameter, 18.625 inches in circumference, and weighing 1.94 pounds.

2016/2022/2024 Colorado reports 2-feet of hail requiring plow trucks to move and triggering flooding as the ice melted quickly at the surface.

2023-2025: Multiple states report melon-size hail (+6-inch diameter).

2025: Texas's new record hailstone reported at 7.25-inch diameter.

Pollution can influence hail formation and potentially lead to larger hailstones.

Pollutants provide cloud condensation nuclei, affecting the size and number of stones.

Hail severity will increase in most regions of the world while Australia and Europe are expected to experience more hailstorms.

Insured U.S. hail losses now average $8 billion to $14 billion per year, or $80-140 billion per decade (as of 2022).

This outpaces the total of $14.1 billion in insured US property loss from tornadoes over the decade from 2010 to 2020.

TEXAS Record MONSTER Hailstone!

Documented 7.25" hailstone 3 miles WNW of Vigo Park, Texas at 7:37pm Sunday set a new state record (pending) shattering the previous record of 6.4" in Hondo, TX in 2021.

Permission: Val and Amy Castor 7:25 PM · Jun 4, 2024

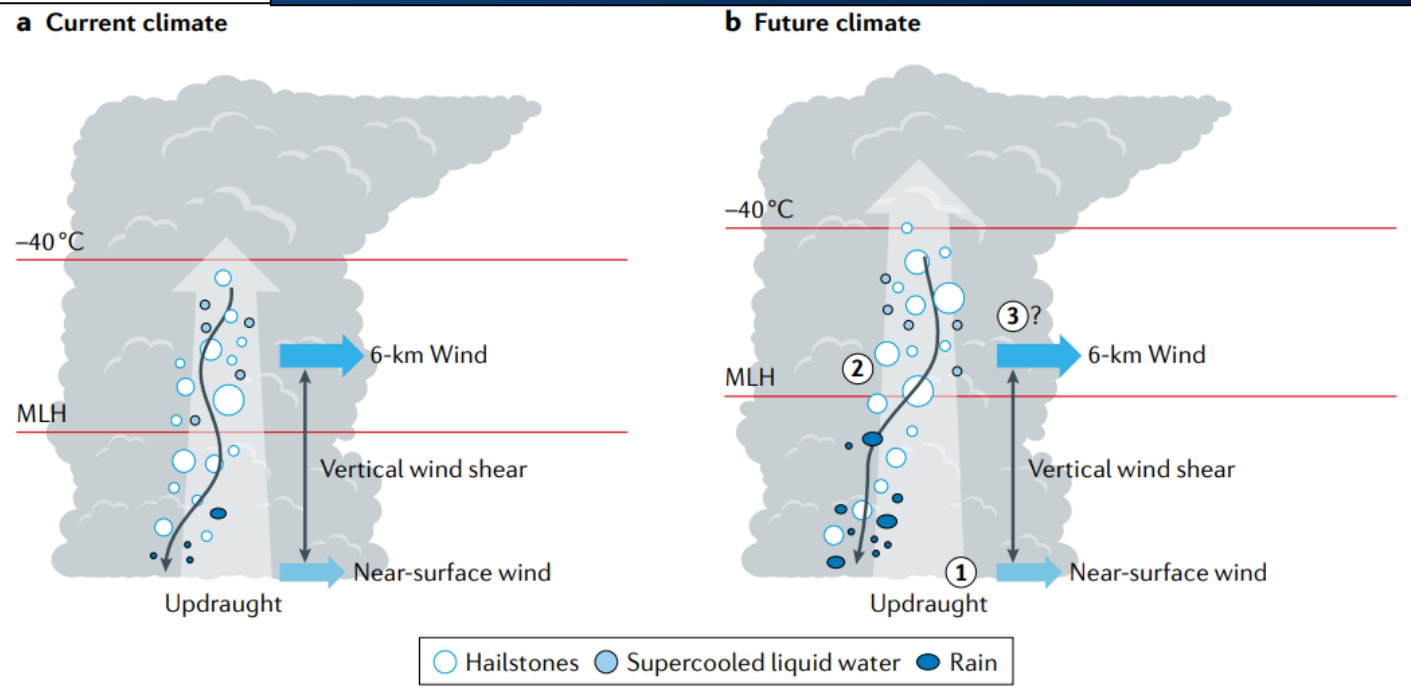


Fig. 1 | **Hail-relevant atmospheric phenomena in current and future climates.** The expected changes in hail-relevant atmospheric phenomena between the current (panel **a**) and future (panel **b**) climates. The numbers in panel **b** correspond to the following changes: (1) increased low-level moisture leads to increased convective instability and updraught strength; (2) an increase in the melting level height (MLH) leads to enhanced melting of hailstones and a shift in the distribution of hailstone sizes towards larger hailstones; and (3) changes in vertical wind shear may affect storm structure and hailstone trajectories, but are generally overshadowed by instability changes.

Inches Per Hour and Peak Wind Risks Rise

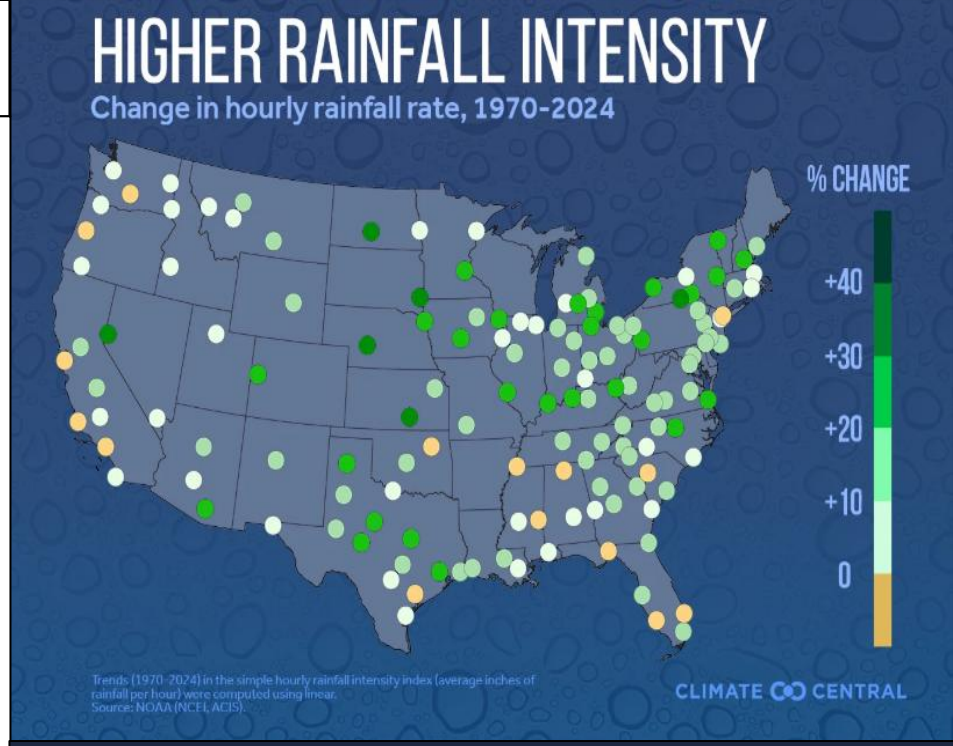
With 2°C (3.6°F) of global warming, the majority (85% or 2,645) of 3,111 total U.S. counties are likely to experience a 10% or higher increase in precipitation falling on the heaviest 1% of days.

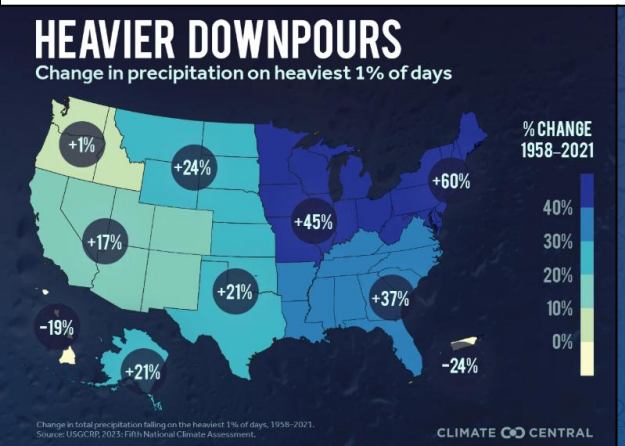
A 2024 study by Climate Central found that 126 of 144 US cities they examined saw an increase in hourly rainfall intensity from 1970 to 2022.

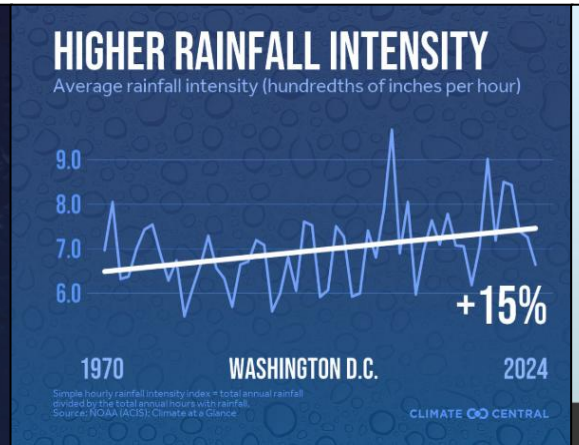
- Rainfall hours became 15% wetter on average across the 126 cities studied with an 88% increase in hourly rainfall rates.
    - The highest known one-hour rainfall total in the US is 12 inches in Holt, Missouri, on June 22, 1947. This rainfall occurred in just 42 minutes.
    - The highest known 1-minute total is also held by the US in Unionville, Maryland at 1.23 inches in 1956.
    - The record 6-hour rainfall was in Smethport, PA at 34.5 inches. A record 42 inches were reported in 24 hours in Alvin, Texas in 1979.

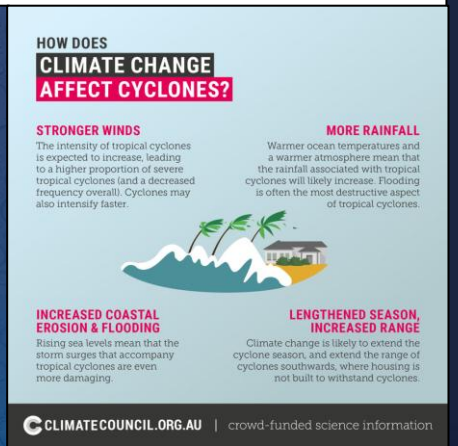
A new study finds the strongest nor'easters have intensified over the last 80 years, with a 6% increase in peak wind speeds resulting in a nearly 20% increase in destruction potential.

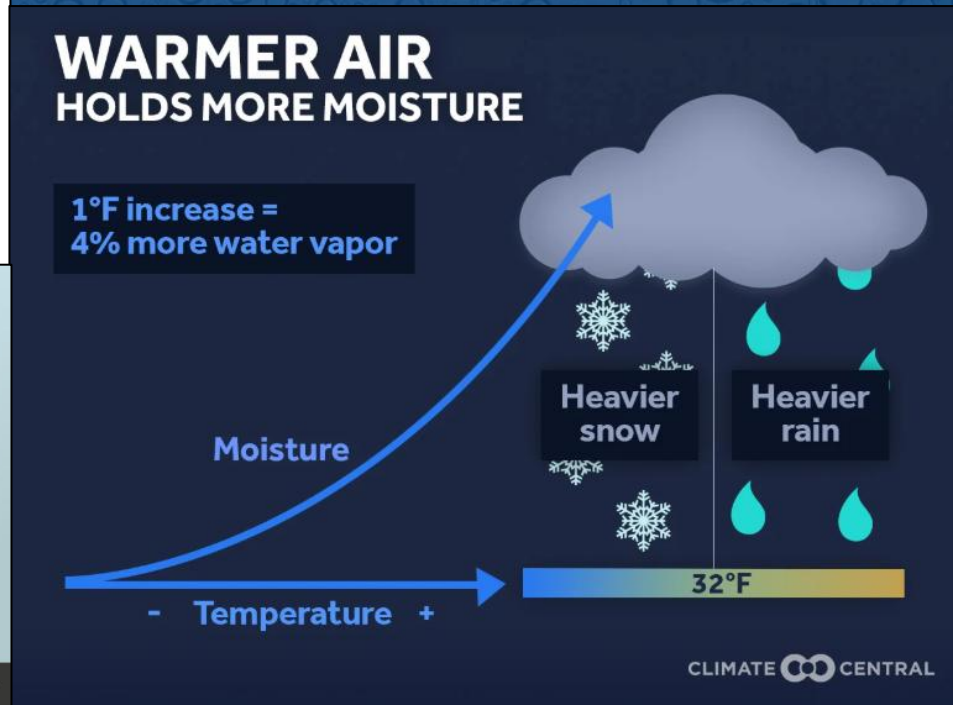
- Previous studies published have predicted an increase in the intensity of extratropical storms close to the northeastern US due to warming during the cool season.
    - The strongest wind gust recorded in the US was 231 mph at Mt. Washington in 1934

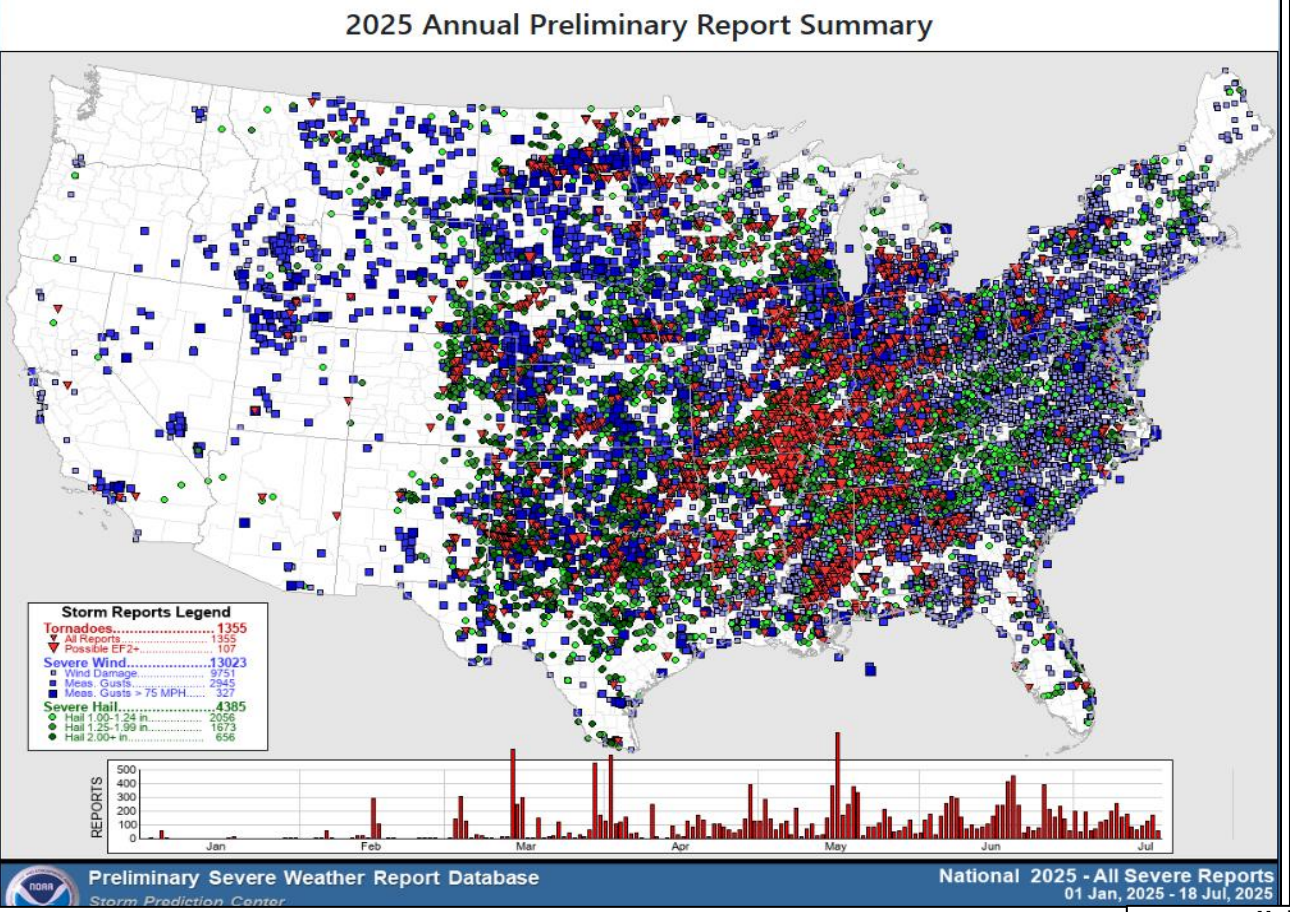


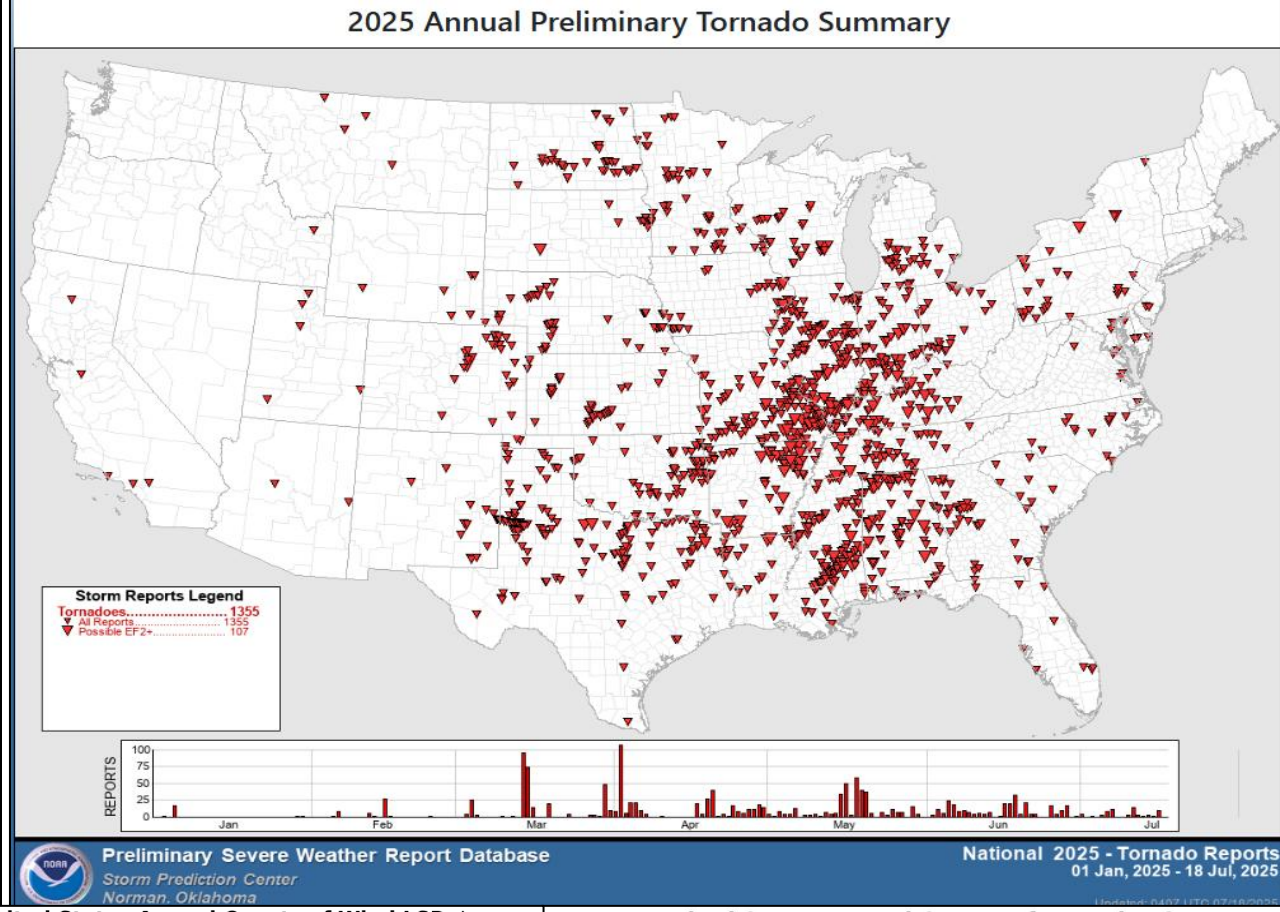






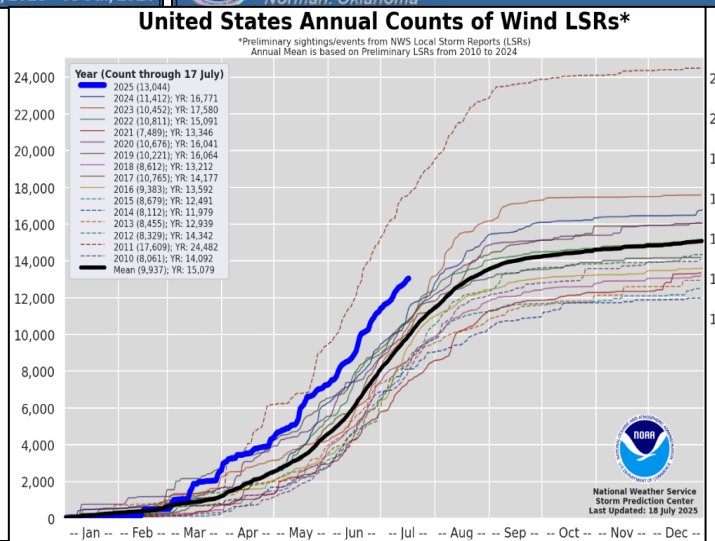


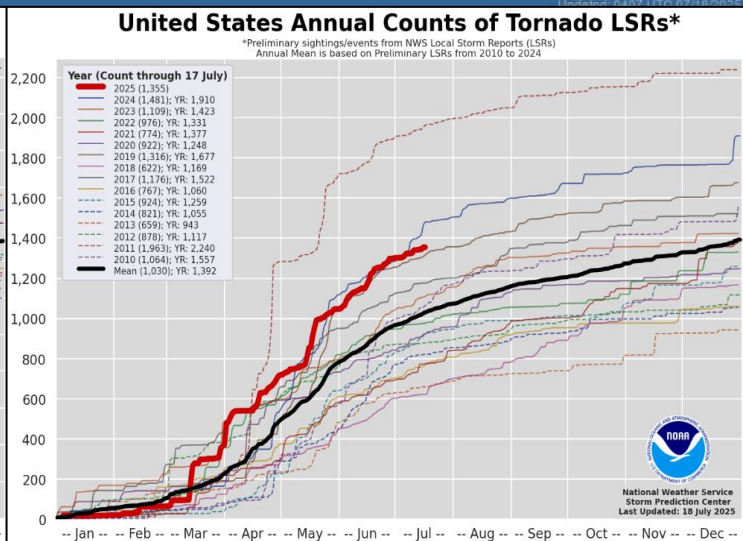




Awareness: So far, the US is well above the annual average for tornadic activity with the only years in the past with more tornadic activity to date being 2011 and 2024.

- For the year-to-date period January-July, there were 711 preliminary tornado occurrences, with places us over the annual average already by 155 tornadoes.
- This year has already produced more tornadoes than the entire year of all prior years except 2024, 2023, 2019, 2017, 2011, and 2010 but is on track to be a top 3 year easily.
- Wind reports show this year is well above average for this period and is likely to be in the top two years, behind 2011.

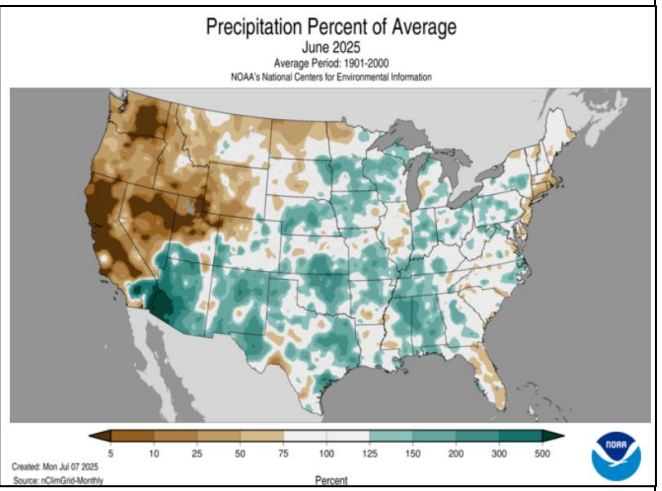


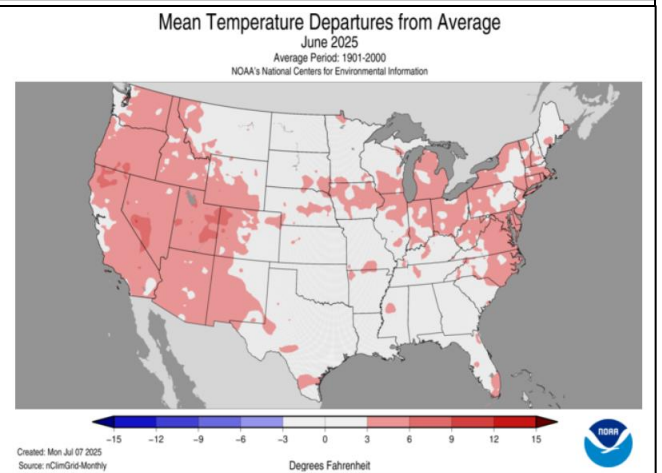


The CONUS maximum (daytime) temperature for June was 83.8°F, 2.4°F above the 20th-century average, while the minimum (nighttime) temperature averaged 58.7°F, 3.1°F above average.

The total precipitation averaged across the CONUS in June was 3.22 inches, 0.30 inch above the 20th-century average.

The average temperature for CONUS in June 2025 was 71.2°F, 2.8°F above the 20th-century average





U.S. Selected Significant Climate Anomalies and Events June 2025

In Jun, Fairbanks, AK swung from cold, with the first 70°F day of the year—its latest on record—to warm, bringing a rare 80°F streak as well as extensive lightning and wildfires.

On Jul 1, about 32.4% of the contiguous U.S. was in drought, an increase of about 2.8% since the beginning of the month.

On Jun 20, a powerful EF-3 wedge tornado struck near Enderlin, ND, resulting in three fatalities. The same system evolved into a derecho on Jun 21 that swept across northern MN, causing widespread wind damage and leaving thousands without power.

A widespread late-Jun heatwave impacted millions across the central and eastern U.S. Several Northeast counties exceeded their previous Jun daily maximum records by more than 2°F.

Parts of north-central CA and south-central WA recorded no measurable rainfall for the entire month.

In early Jun, rare heavy rain fell across central and southern AZ as tropical moisture from TS Alvin combined with a low-pressure system.

On Jun 14–15, heavy rain triggered major flash flooding in northern WV, resulting in widespread damage and multiple fatalities.

In mid Jun, multiple brush fires fueled by strong winds burned hundreds of acres on Maui, HI, prompting evacuations and road closures.

In late Jun, a system of severe storms swept across the Southeast, producing widespread damaging winds and large hail up to 1.75 in., with notable impacts in SC and NC.

On Jun 12–13, catastrophic flash flooding struck San Antonio, TX, with over 6 in. of rain, causing record river rises, widespread water rescues and multiple fatalities.

A significant Saharan dust plume affected PR in early Jun, leading to hazy skies and reduced visibility.

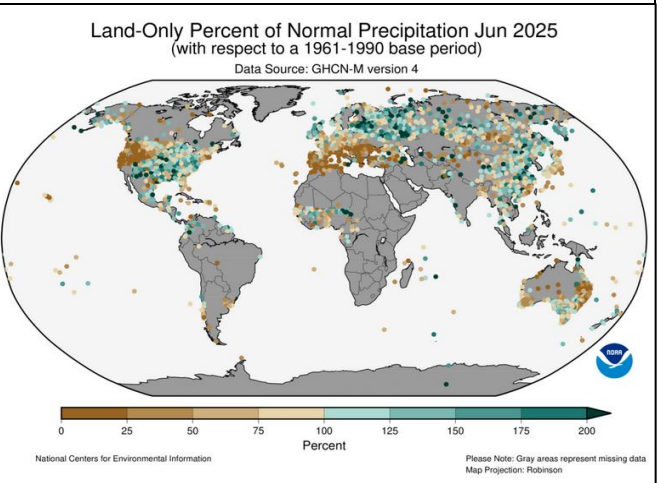
The average U.S. temperature for Jun was 71.2°F, 2.8°F above average, ranking as the seventh-warmest in the 131-year record. The U.S. precipitation average for Jun was 3.22 in., 0.30 in. above average for the month.

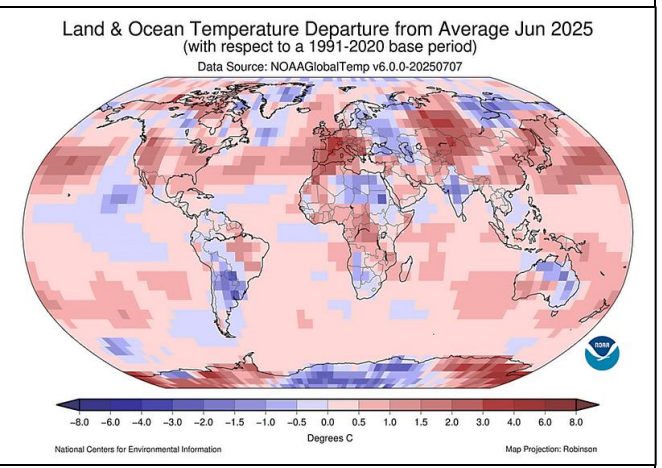
Please Note: Material provided in this map was compiled from NOAA's State of the Climate Reports. For more information please visit: https://www.ncei.noaa.gov/access/monitoring/monthly-report/

June 2025 recorded the third-highest June global surface temperature in NOAA's 176-year record, which dates to 1850.

All ten warmest Junes on record have occurred since 2016. June 2025 extended the streak of consecutive Junes with above-average global temperatures to 49 years.

Japan recorded its warmest June since national records began in 1898, with a national average temperature of 2.34°C (4.21°F) above average.





Selected Significant Climate Anomalies and Events: June 2025

GLOBAL AVERAGE TEMPERATURE
Average global surface temperature was the third warmest for Jun and second-warmest Jan–Jun since global records began in 1850.

ARCTIC SEA ICE EXTENT
Arctic sea ice extent was below normal and was the second lowest on record for Jun.

GLOBAL SEA ICE EXTENT
Sea ice extent for the globe was near record low for Jun. Only Jun 2023 had a lower sea ice extent.

GLOBAL LAND
The global land surface had its sixth-warmest Jun on record.

NORTH AMERICA
North America had its eighth-warmest Jun on record.

EUROPE
Jun was the fifth warmest on record. Several western European countries experienced an intense heat wave during June. The intense heat fueled wildfires and threatened power grids.

ASIA
Asia had its fifth-warmest Jun on record.

TROPICAL STORM BARRY
Barry brought heavy rainfall and strong winds to parts of eastern Mexico. The remnants contributed to extreme flooding over central Texas in early Jul.

TROPICAL STORM WUTIP
Wutip brought heavy rain and strong winds to parts of southern China and coastal Vietnam.

HURRICANE ERICK
Erick was the earliest major hurricane on record to make landfall in Mexico.

AFRICA
Jun temperature was the ninth-warmest on record for Africa.

OCEANIA
Jun temperature was above average for Oceania.

SOUTH AMERICA
South America had a warmer-than-average month; however, it did not rank among the 10 warmest Junes on record.

SOUTH AFRICA
A cold front brought snow, heavy rain and strong winds to Eastern Cape Province. Rivers overflowed their banks, leading to deadly floods.

GLOBAL TROPICAL CYCLONES
Globally, tropical cyclone activity was above average with nine named storms.

BRAZIL
Heavy rain in Rio Grande do Sul triggered widespread flooding as rivers overflowed.

GLOBAL OCEAN
The global ocean surface had its third-warmest Jun on record.

ANTARCTIC SEA ICE EXTENT
The Antarctic's Jun sea ice extent ranked third smallest on record.

Please note: Material provided in this map was compiled from NOAA's State of the Climate Reports. For more information please visit: https://www.ncei.noaa.gov/access/monitoring/monthly-report/global/

Extreme Weather Impacts Economic Stability

On June 24, temperatures near or above 100°F covered most of the Interstate 95 corridor from Washington, D.C., to Portland, Maine. Many state June high temperature records were set on June 24, 2025, and several all-time (any-day) records were set or tied on June 23-24.

Lightning strikes last summer caused 60 datacenters in Virginia to drop off the grid due to an arrestor trigger, a similar issue repeated in January 2025 for Brazil in January when a datacenter was struck by lightning and taken offline.

2025: There were 252 tornadoes in June (119% of average), following a record setting March, twice as many tornadoes than average in April, and severe outbreaks in May.

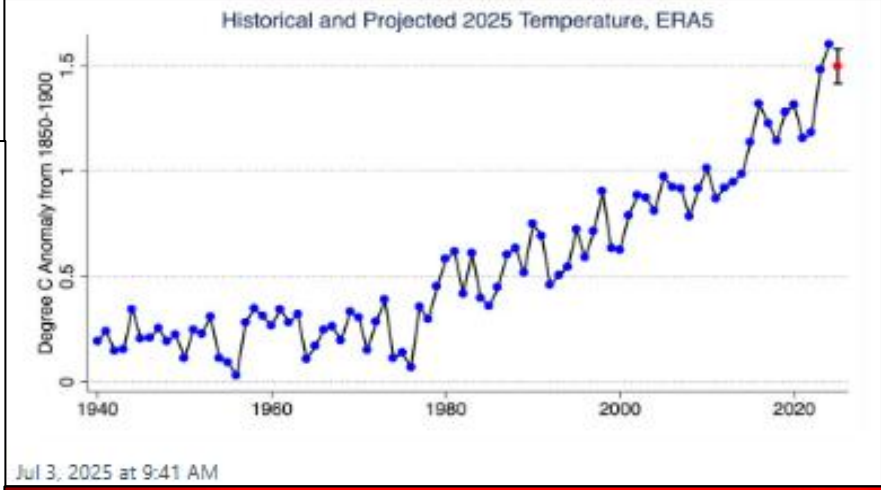
- The preliminary total of 1,324 US tornadoes observed from January 1 to July 8 ranks as the second-highest year-to-date total since 2010, behind 2011 (1,919).

January-June 2025: The US reported 12-billion-dollar severe weather disasters (tornadoes, hail, wind, and flash flooding: severe thunderstorms); two others cost over $900 million and are pending their final tallies.

- The third most expensive weather disaster globally of 2025 was a March 13-16 severe weather outbreak in the U.S. that cost $9.5 billion.

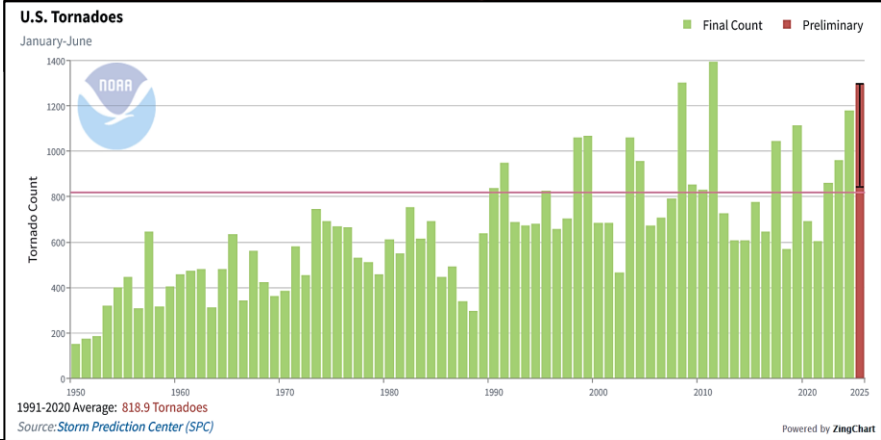
The 2025 Jan-June economic losses from severe thunderstorms are the 4th-costliest on record, behind 2024 ($62 billion), 2023 ($61 billion), and 2011 ($50 billion).

- Over 2.6 million acres have burned through mid-July, as +40K fire incidents, the most on record in the past decade.
    - The U.S. has also suffered over $1 billion in drought costs so far in 2025



Costliest Wildfires Globally, 1900-2025 (Inflation-adjusted)

Rank	Location	Year	Cost	Deaths
1	Los Angeles, California	2025	$65 Billion*	30
2	Paradise, California (Camp Fire)	2018	$20 Billion	85
3	California (Tubbs/Atlas/Nunn Fires)	2017	$16 Billion	43
4	Indonesia	1997	$15 Billion	240
5	California (August Complex)	2020	$13 Billion	43
6	Fort McMurry, Alberta, Canada	2016	$10 Billion	0
7	California (Woolsey Fire)	2018	$6.3 Billion	2
8	San Bernardino, California	2003	$5.8 Billion	4
9	Oakland, California	1991	$5.6 Billion	26
10	Maui, Hawaii, U.S.	2023	$5.5 billion	102



Tropical Threats 2025

Tropical cyclones recently produced +31.5 inches of rain in March 2025 across multiple areas of Australia.

- These tropical systems produced more than 2 million lightning strikes in one city within 30 hours.
- Queensland had its third-wettest March since records began in 1900, with area-averaged rainfall 124% above average.

In April Cyclone Errol was the first Category 5 of the year for the globe, occurring off the Australian coast with a pressure of 919mb and winds over 160mph.

- This storm jumped from a Tropical Low to a Category 5 storm within 36 hours.

In February 2025, the Southern Hemisphere experienced a rare event with six tropical cyclones swirling simultaneously, last occurring in 1974.

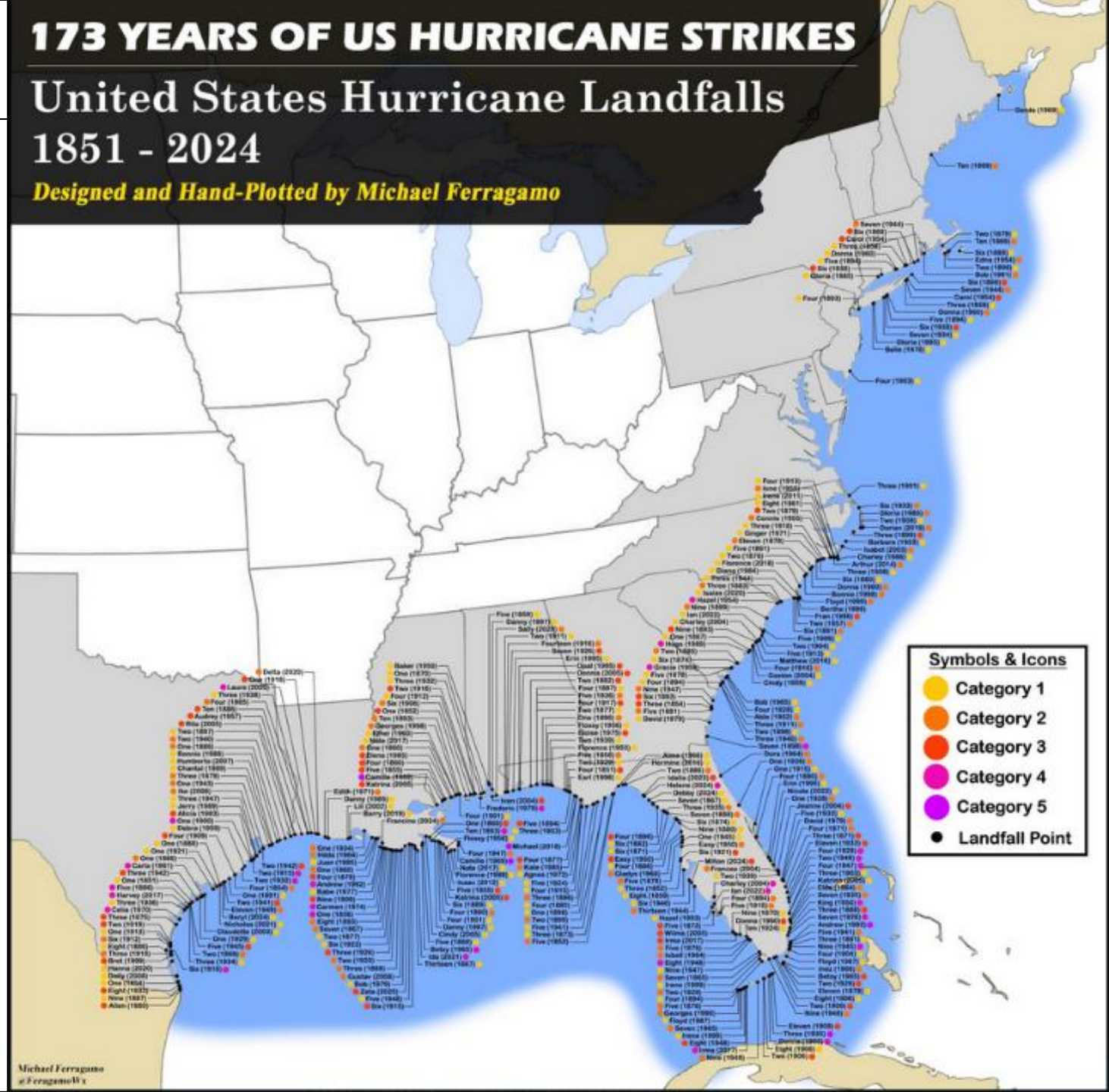
- Experts note there has been an upward trend in the number of hurricanes in the last 40 years with the average number of storms increasing by two events.

Warmer sea surface temperatures intensify tropical cyclone wind speeds, giving them the potential to deliver more damage.

- From 1979-2017, the number of major hurricanes has increased while the number of smaller hurricanes decreased.
- NOAA predicts an increase in Category 4 and 5 hurricanes, alongside increased hurricane wind speeds.

Warmer sea temperatures also cause wetter hurricanes, with 10-15 percent more precipitation from storms projected.

- Recent storms such as Hurricane Harvey in 2017 (which dropped more than 60 inches in some locations), Florence in 2018 (with over 35 inches) and Imelda in 2019 (44 inches) Fiona in 2022 (+33 inches). Even a tropical low can produce over 26 inches of rain (Ft. Lauderdale in 2023).



Changes in Subsidence – Flood Risks

A large area of the East Coast is sinking at least 2 mm per year, with several areas along the mid-Atlantic coast of up to 3,700 square kilometers, or more than 1,400 square miles, sinking more than 5 mm per year, more than the current 4 mm per year global rate of sea level rise.

- Subsidence hazards can be a major concern for specific high-risk infrastructures, such as dams, levees, or airports.
- 2,000 to 74,000 km2 land area, 1.2 to 14 million people, 476,000 to 6.3 million properties, and >50% of infrastructures in major cities such as New York, Baltimore, and Norfolk are exposed to subsidence rates between 1 and 2 mm per year.
- The exposure analysis shows sinking on 81 to 99% of the railway systems (7,452 to 9,221 km out of 9,247 km) and 42% (11 out of 26) of train stations (Fig. S11B), with subsidence rates of >3 mm per year observed along 41 to 846 km stretch of railways on the US east coast.

Subsidence can worsen the effects of flooding by increasing the likelihood and severity of inundation.

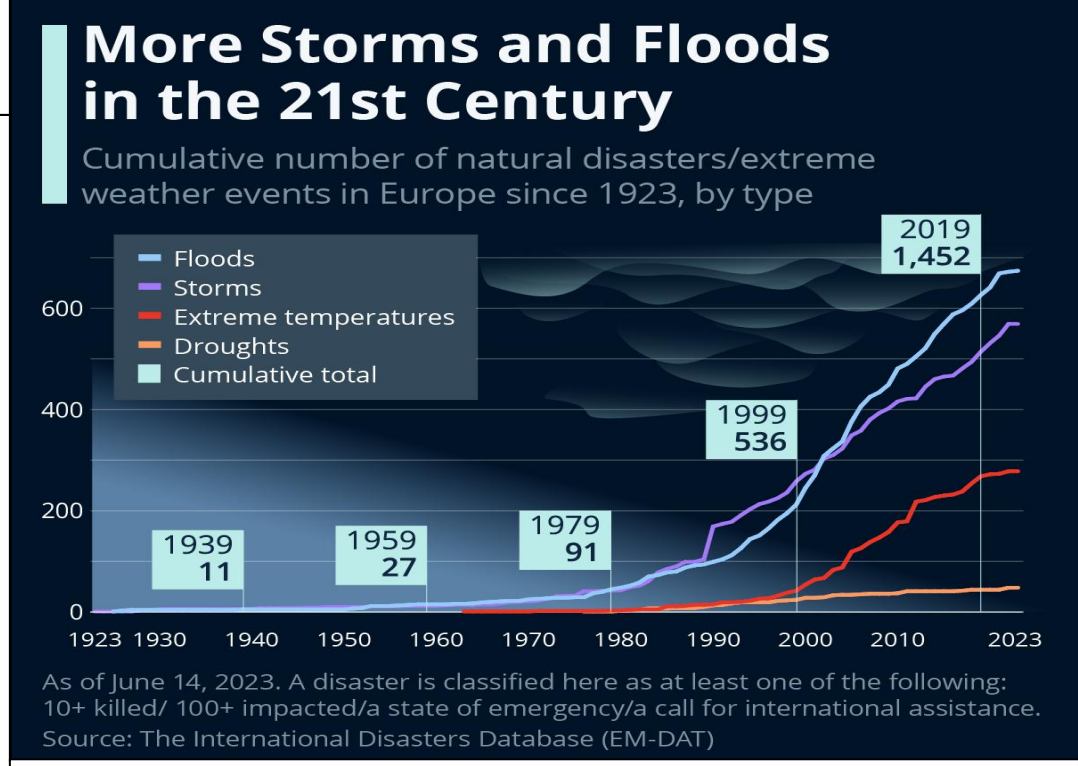
- Subsidence can also disrupt natural drainage systems, leading to localized flooding and changes in water flow patterns in rivers and streams.

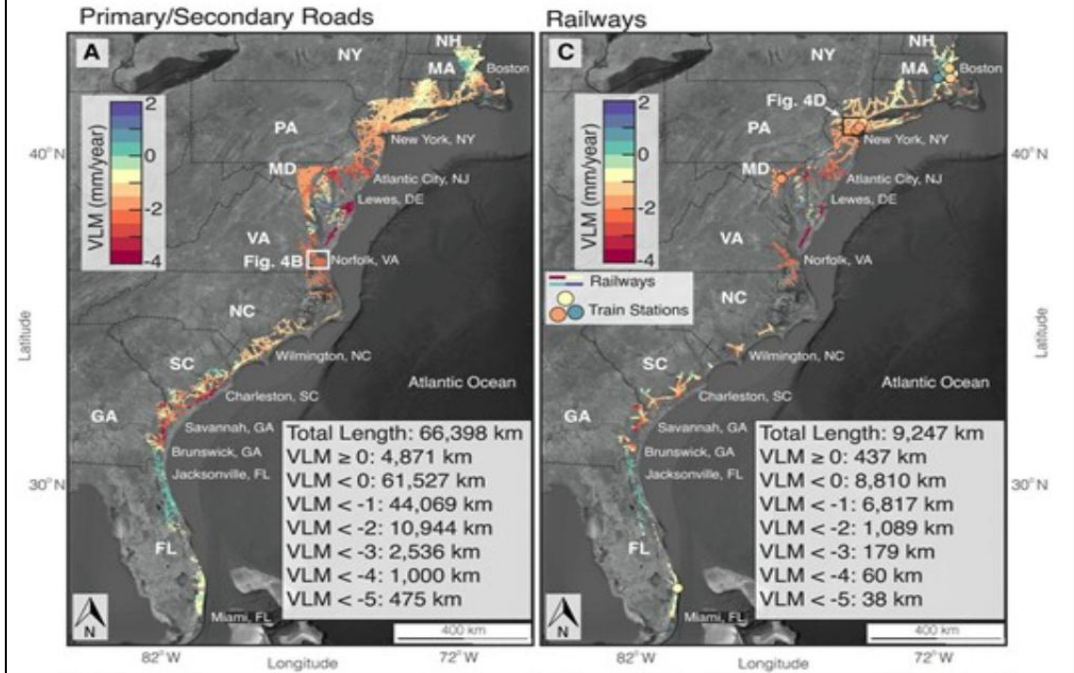
In the two decades between 1990 and 2010, D.C. saw an average of 2.4 tidal flooding events per year. In the last decade, that increased to 7.6 per year.

- That means the average number of flooding events in D.C. more than tripled (3.2x).

The Chesapeake Bay area is the third most vulnerable area of the US to sea level rise (SLR), behind Louisiana and South Florida.

- Tide-gauge records show that sea level in the Chesapeake Bay has been increasing at an average rate of 1.3 to 1.5 inches per decade over the past 100 years, 50% more than the global historical average observed over the same time period.





E-Scooters: Bomb Risks

Threats: A growing concern is the availability of materials already assembled being used for destruction during amplifying weather events such as heatwaves.

- Lithium-ion batteries in larger devices like e-bikes and scooters are volatile during major heatwaves as internal cooling systems are often missing and the equipment is recommended to be left in the external hazardous weather conditions.
- Many of these devices have been in operation for nearly a decade in the US and for over two decades in other countries resulting in wear-and-tear from general use and material fails.

From 2019 to 2022, there's been a more than 1,000% increase in injuries from fires that started with an e-bike or e-scooter, and there's been a more than 600% increase in the fires themselves.

- In December 2022, the federal government's Consumer Product Safety Commission sent a letter to more than 2,000 manufacturers, imploring them to meet safety standards and urging them to review their product line immediately.
- Burn surgeons who treat these often life-changing injuries are calling for hazard labels to increase public awareness, while predicting cases will increase as the number of e-bikes and e-scooters in the UK – currently around 550,000 – continues to rise.
    - The London Fire Brigade, however, has said 143 fires were caused by e-bikes and 36 by e-scooters in London in 2023, causing three deaths and 60 injuries.

Personal Mobility Devices (PMDs) use lithium-ion batteries, which are cheaper to make and more powerful than older types of rechargeable batteries but contain flammable chemicals.

- The other danger from PMD batteries is when the charger terminals are touched – particularly by children. In a fraction of a second, their temperature can rise above 400C, causing burns.

Dockless bikeshare and e-scooter systems expanded coverage, first appearing in the US in 2017 whereas areas like India have had them in use since the early 2000s.

- As of June 30, 2024, there are 60 dockless bikeshare systems and 194 e-scooter systems (not counting systems limited to college / employer sites).
- There is an open-access interactive map showing all the major cities were e-scooters/bikes have been adopted and are in use today.

Damage to a property caused by an e-scooter, in West Hampstead, north-west London earlier this week

India's transport ministry has ordered a government investigation into the deadly fires while three manufacturers have recalled over 6,600 scooters over safety fears Credit: India Times

Urgent warning over 'an epidemic' of patients as young as THREE with horrific burns from exploding e-scooters

By ANDY BEAVEN
PUBLISHED: 20:34 EDT, 8 February 2025 | **UPDATED:** 20:57 EDT, 8 February 2025

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More Questions?
Reach out instantly
on Aid Arena!

HELPFUL STARTS

- NOAA Repository:

https://www.ncei.noaa.gov/cdo-web/

- Frontal Boundaries:

https://aviationweather.gov/gfa/#progchart

- Infographics:

https://www.climatecentral.org/

- World Meteorological Organization:

https://wmo.int/topics/extreme-weather