

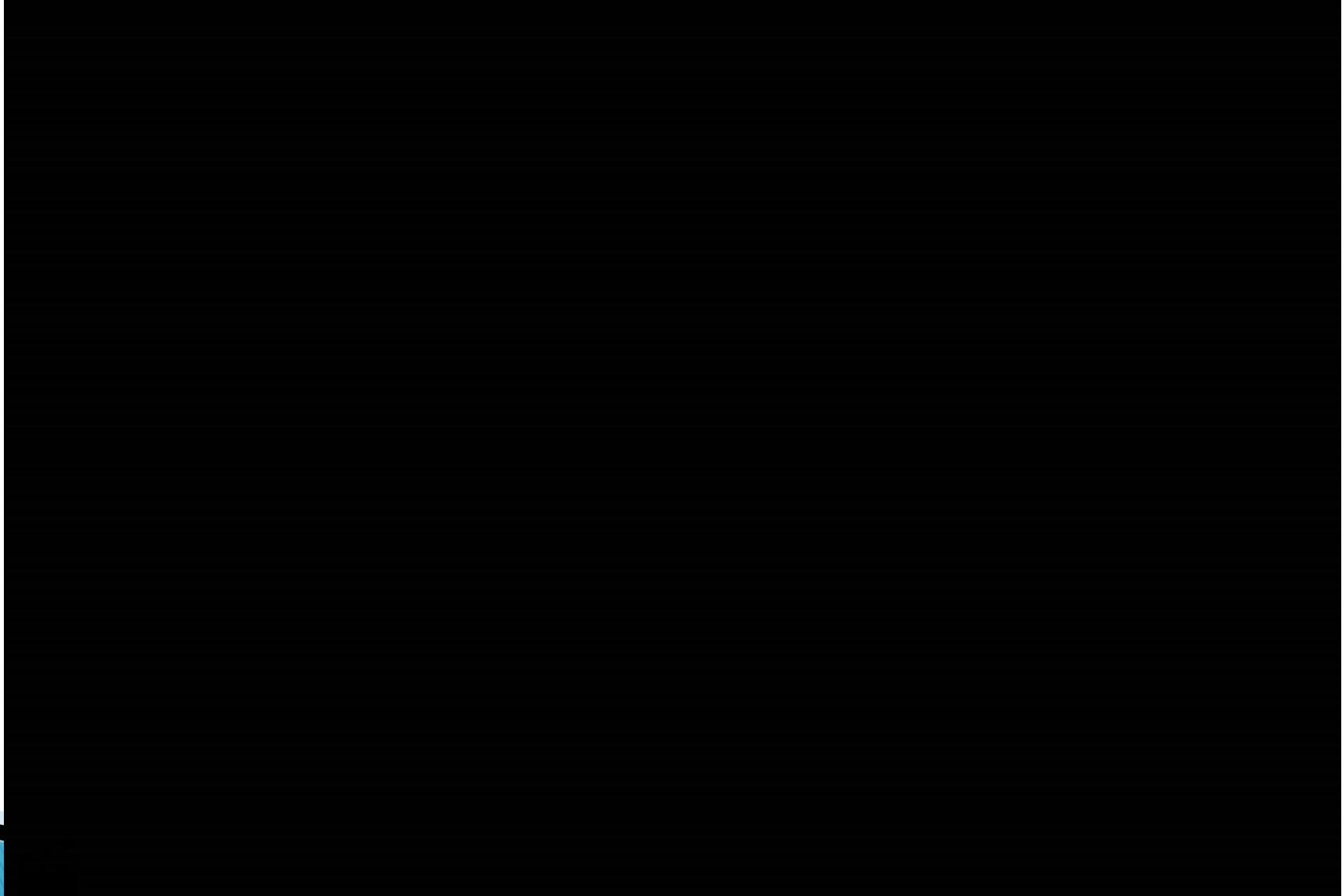
Weather 101 – The Basics

Get To Know Your National Weather Service

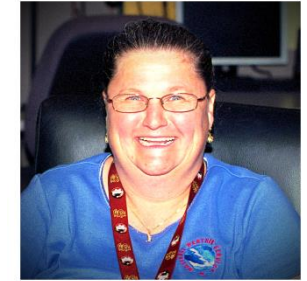
Faith Borden
Observation Program Leader – NWS Nashville

The NWS

<https://youtu.be/V2yR7l14Kuw>



Your Tour Guide



Locations I have Worked

Anchorage, AK
Albuquerque, NM
Miami, FL
Birmingham, AL
Las Vegas, NV
Charleston, WV
Nashville, TN



NWS Nashville, TN

(Old Hickory, TN)

500 Weather Station Road

Old Army Corp Campground at Old Hickory Lake

***January 22, 2016**



All workstations for the six main desks are identical, so it doesn't matter where you sit.

2 large AWIPS Graphics Screens

1 large Text Screens

1 PC with dual Monitors

Each workstation has line of site to the Situational Awareness Display.

Nashville Forecast Area

38 Counties in Mid TN (95 total)

16,438 Miles² ~2.7 mil People
(2018)

Lowest Point 771' French Hollow
Stewart County

Highest Point 3048' Hinch
Mountain Cumberland County



STAFFING

- ▶ 13 CORE METEOROLOGISTS
 - 5 Lead Forecasters
 - 7 Meteorologists
- ▶ 3 ELECTRONICS TECHNICIANS
- ▶ 1 INFO TECHNOLOGY OFFICER
- ▶ 1 SERVICE HYDROLOGIST
- ▶ 3 SPECIALIST METEOROLOGISTS
 - Science and Operations Met
 - Warning Coordination Met
 - Observation Program Leader
- ▶ 1 METEOROLOGIST IN CHARGE
- ▶ 1 ADMINISTRATIVE ASSISTANT

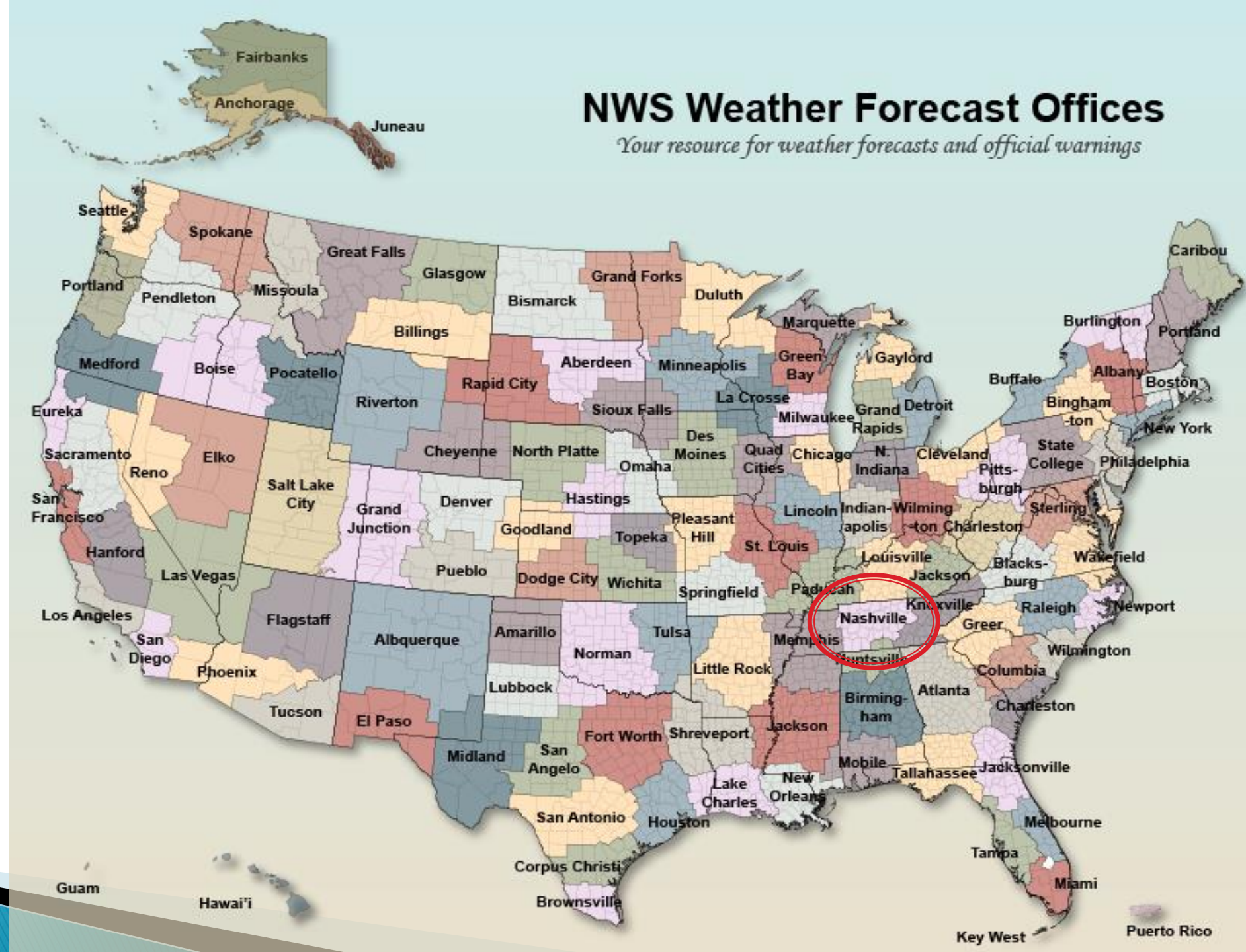


- ▶ 11–13 personnel on duty
M–F
- ▶ 2–4 personnel on duty
weekends and overnight
- ▶ Open 24 hours a day, 7
days a week, and 365
days a year!

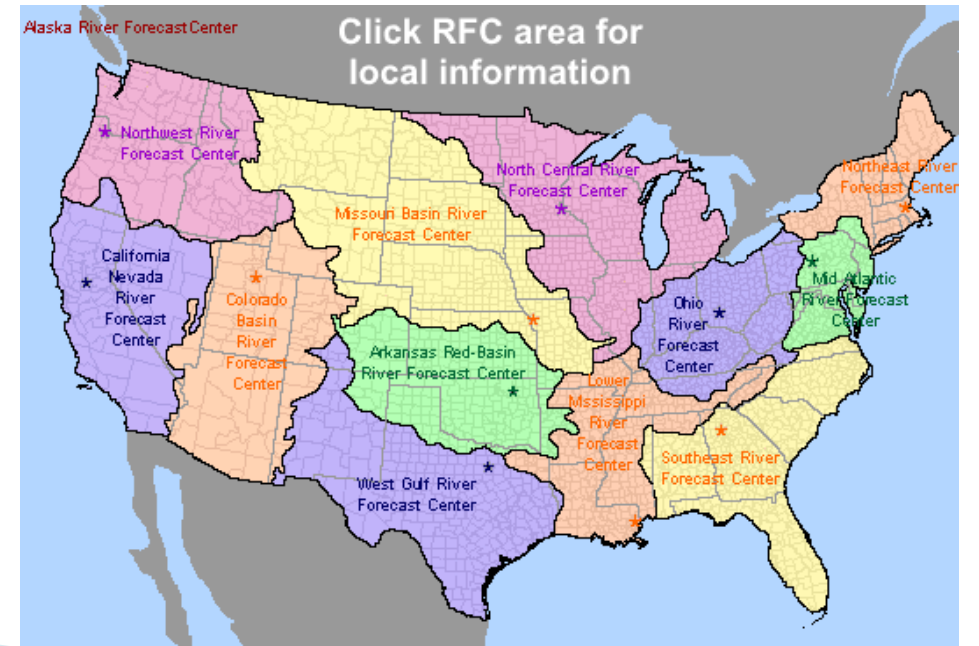
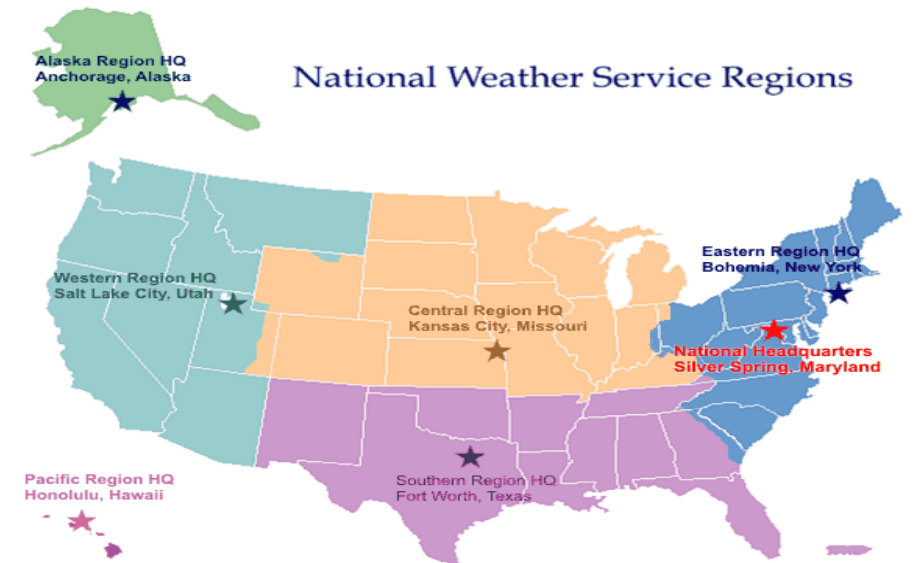
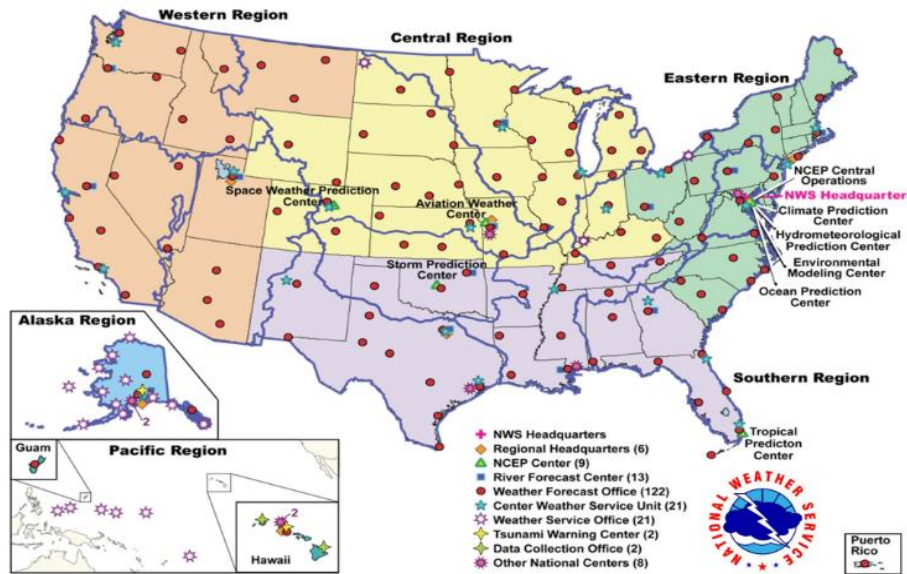
Who is the National Weather Service?

- A federal agency under the Department of Commerce
- Branch of the National Oceanic and Atmospheric Administration (NOAA)
- Operates 122 field offices, plus several national centers
- Annual budget of approximately \$1.204 billion, or less than \$5.00 per U.S. Citizen that pays taxes
- About 4,800 employees nationwide
- The only entity to issue official severe weather watches and warnings

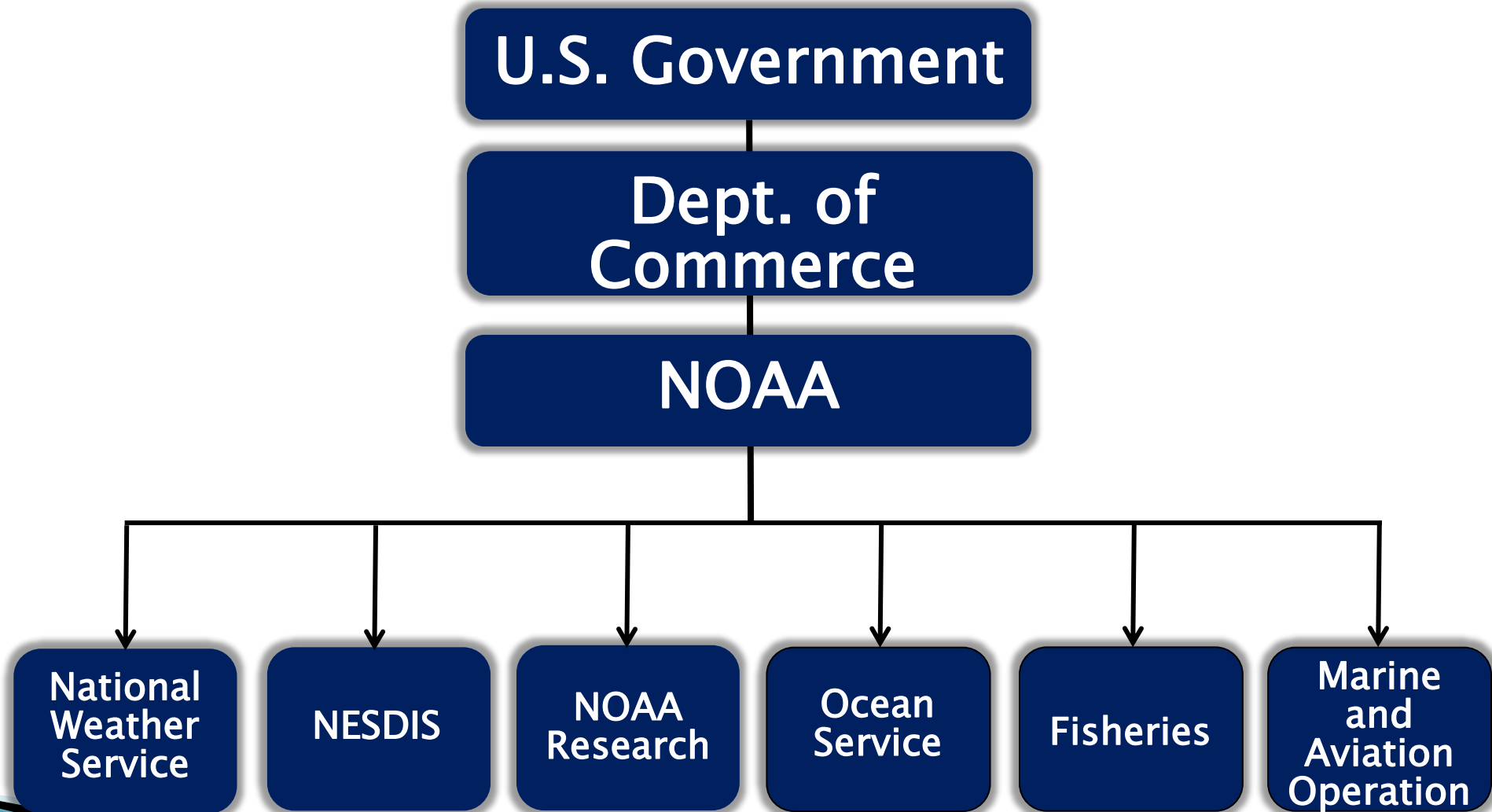
- 122 NWS Forecast offices
- Across the whole US, including Puerto Rico, the Virgin Islands, Hawaii, and Guam



So Much More than a Forecast!



WHO ARE WE?





BUILDING A WEATHER-READY NATION



Vision

A Weather-Ready Nation:
Society is Prepared for and
Responds to Weather-
Dependent Events

Mission

Provide weather, water, and
climate data, forecasts and
warnings

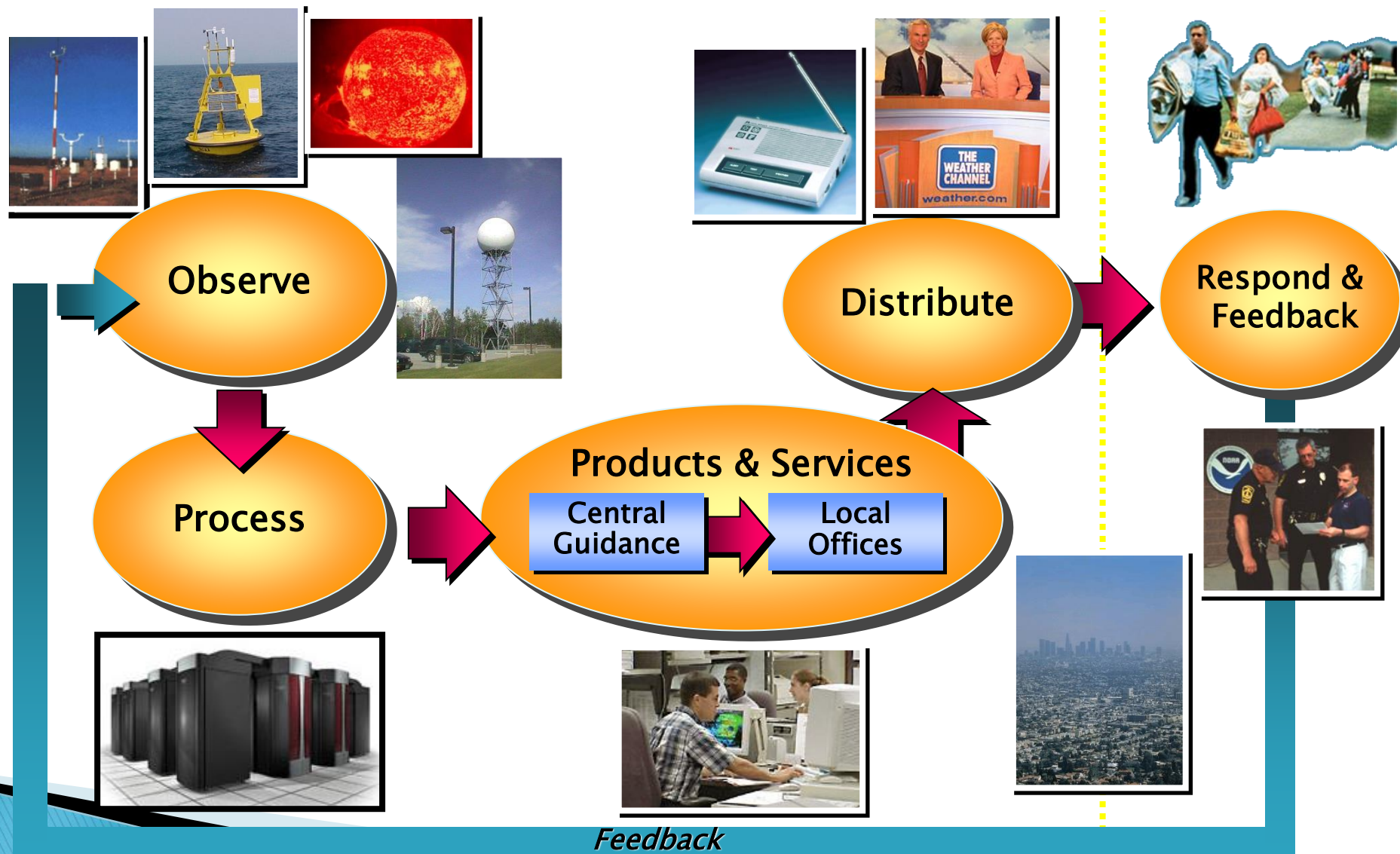
Protect life and property

Enhance national economy

**We maintain a constant
"24/7/365" vigil.
We never close!**

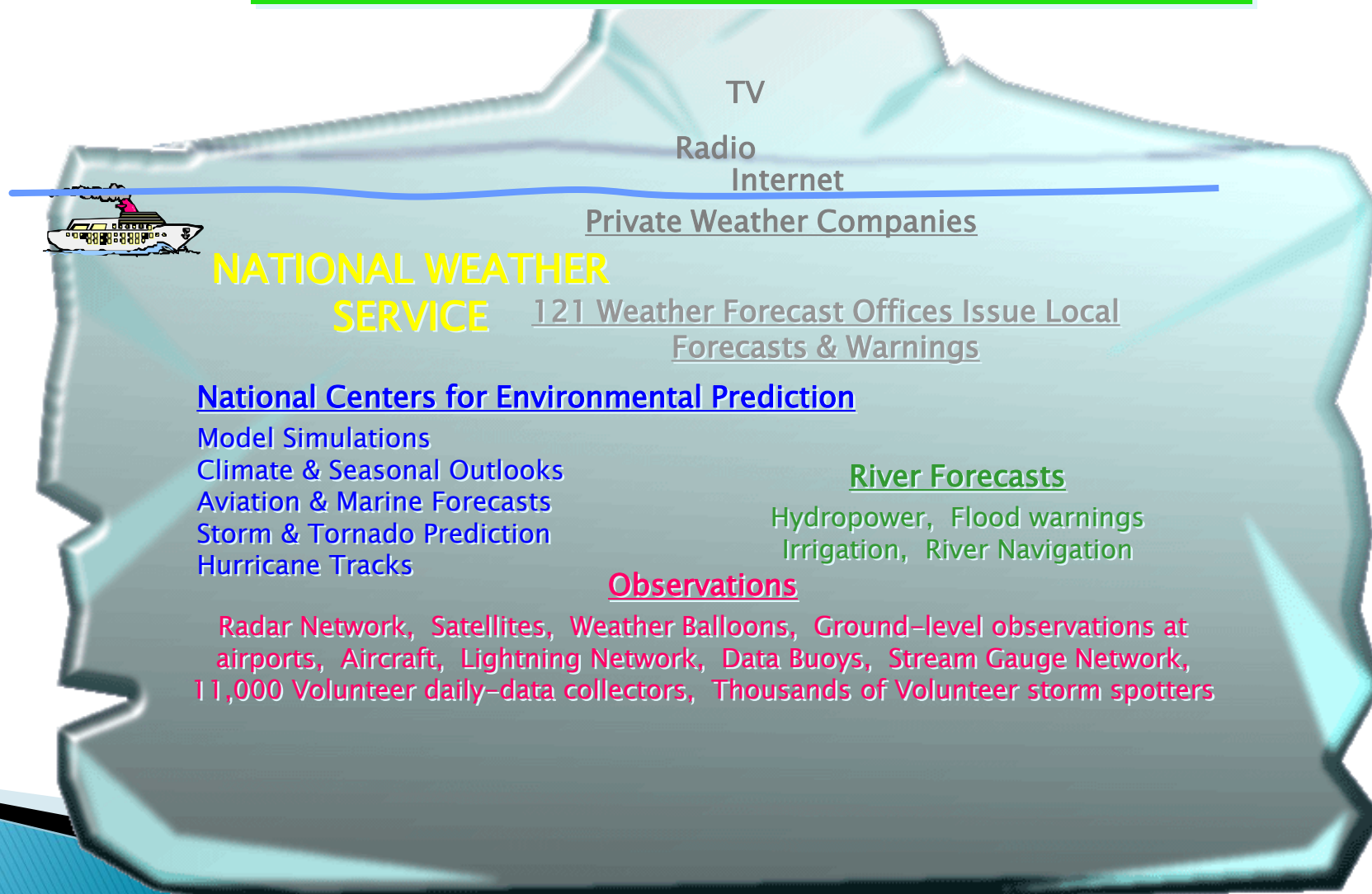


Overview of NWS Operations



How We Do It

The average person only sees the tip of the iceberg



How We Do It

Private Sector Partners Are Essential To Our Success



► How do you receive weather warnings?

65% Television

17% Radio

10% When the storm hits

--source: *USA Today* web survey,
May 2000





Local NWS Operations



What do we do?

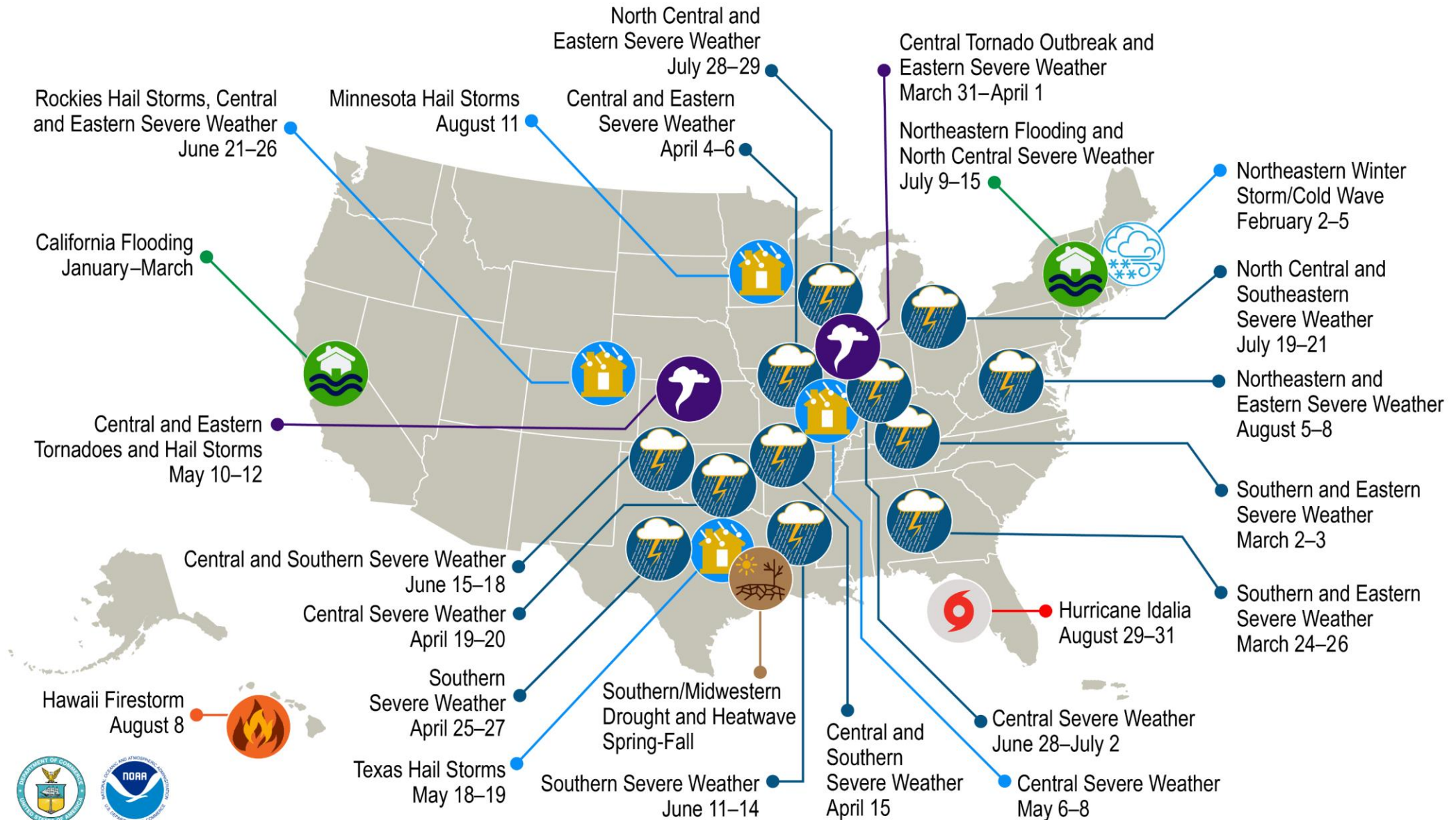
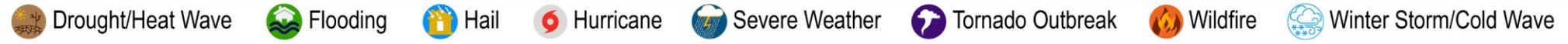
- Issue local forecasts and warnings
- Sole entity responsible for issuing watches, warnings, and advisories
- Create aviation forecasts for FAA, airports, airlines, private pilots, etc.
- Maintain internal and external equipment
- Conduct community outreach
- Provide expert advice to emergency operations centers (DSS)
- Train volunteer observers and public



Billion Dollar US Disasters Since 1980



U.S. 2023 Billion-Dollar Weather and Climate Disasters

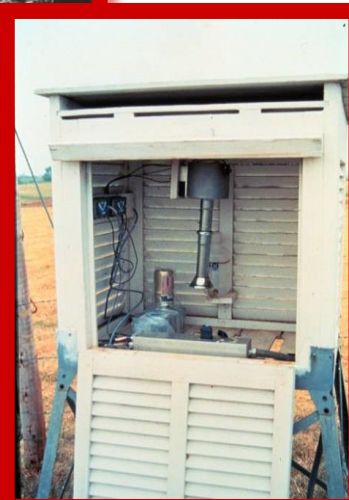
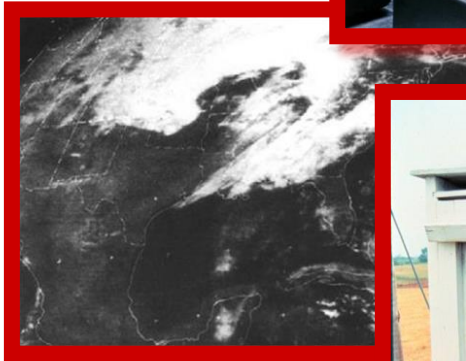
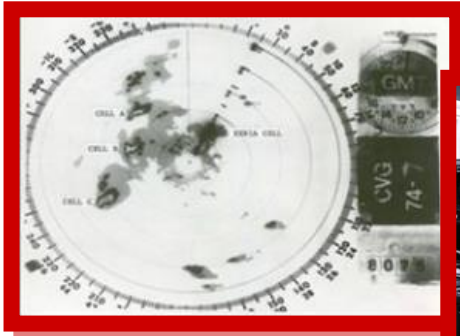


This map denotes the approximate location for each of the **24 separate billion-dollar weather and climate disasters** that impacted the United States through September 2023.

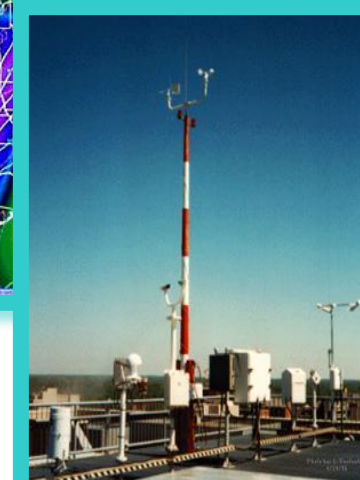
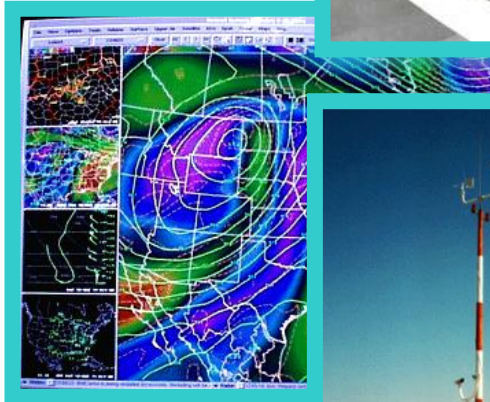
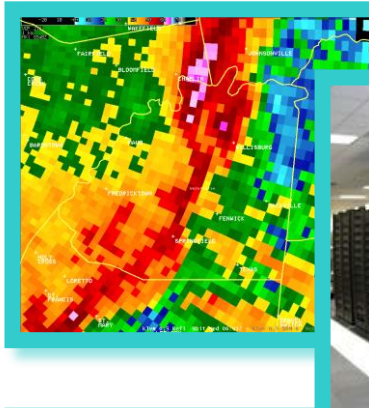
NWS Modernization

Enabled Successes

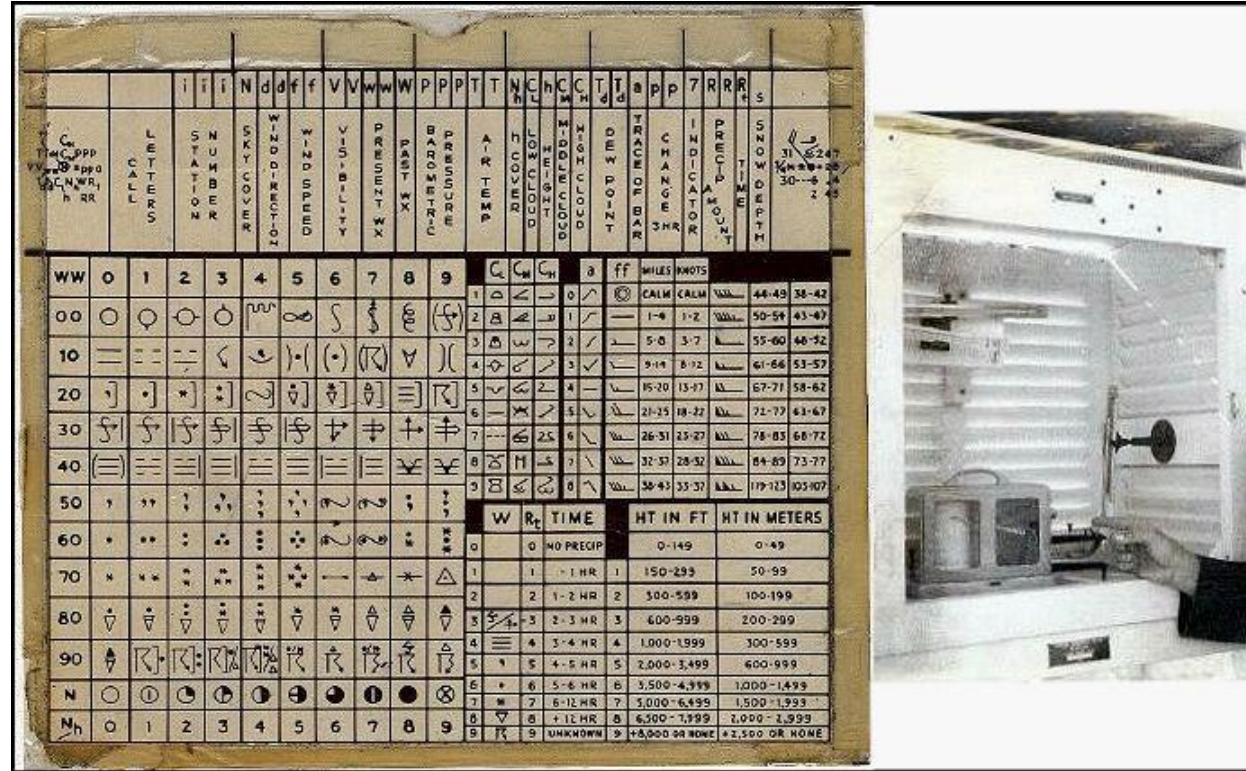
1970s...



1990s-Present



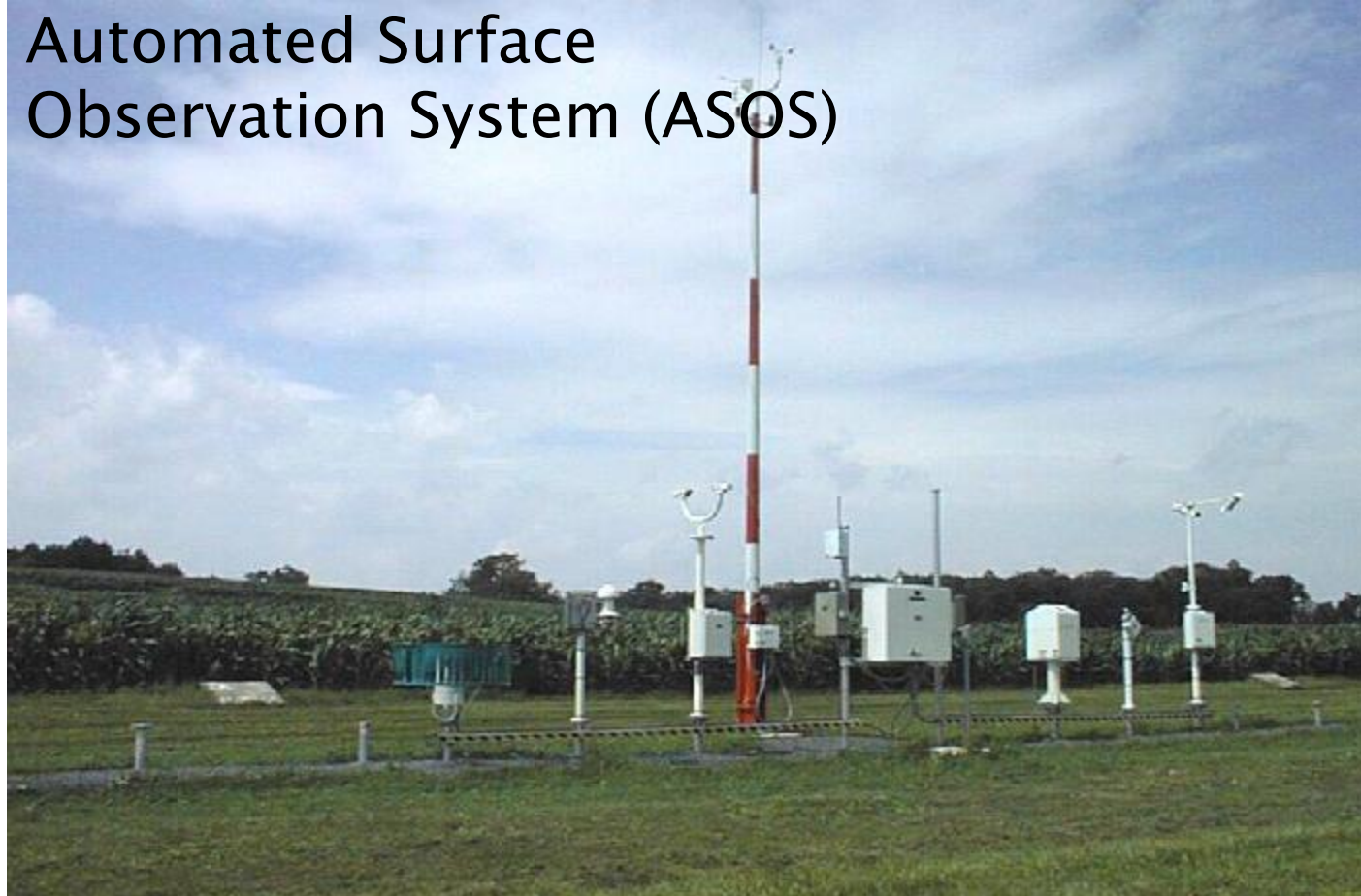
Technology Old- Surface Observations



Manual observations every hour, and when conditions changed enough to warrant a special observation.

Technology New– Surface Observations

Automated Surface Observation System (ASOS)



Completely automated and takes observations every minute (if needed). Additionally, there are hundreds and hundreds of stations!

Technology Old- Radar

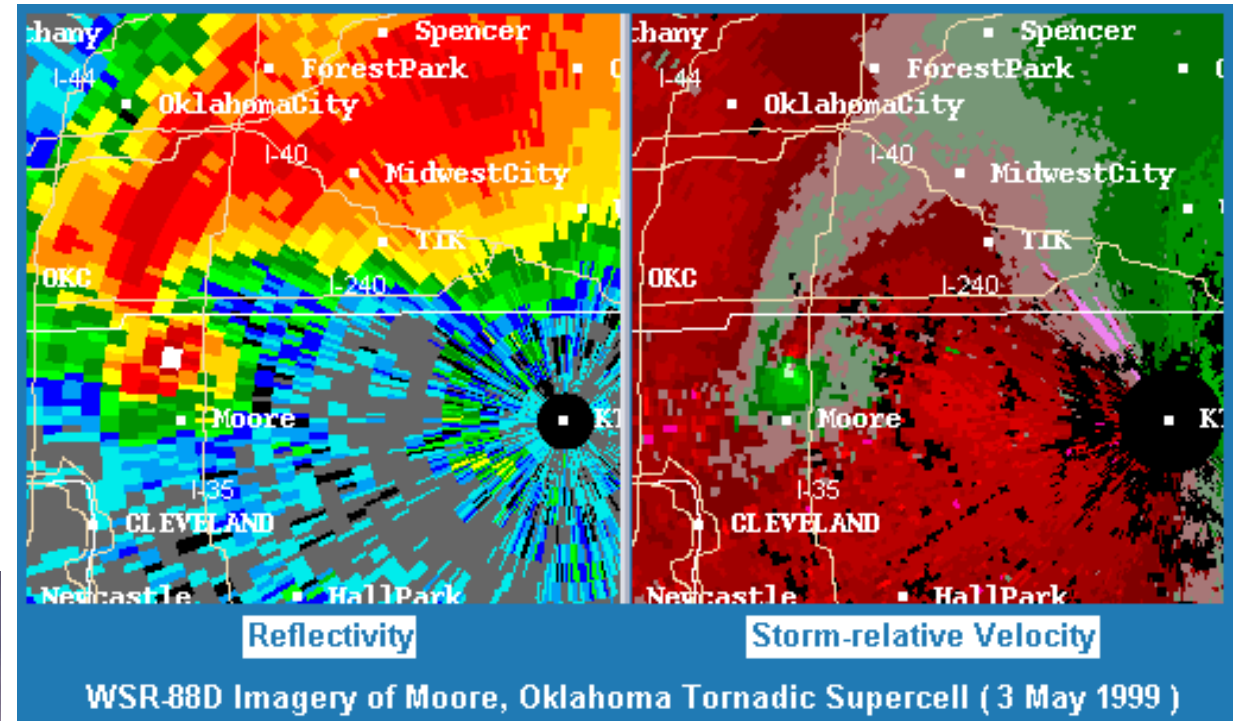


Weather Service Radar – 1957
technology



Radar scope image – from archived film (1965)

Technology New – Radar

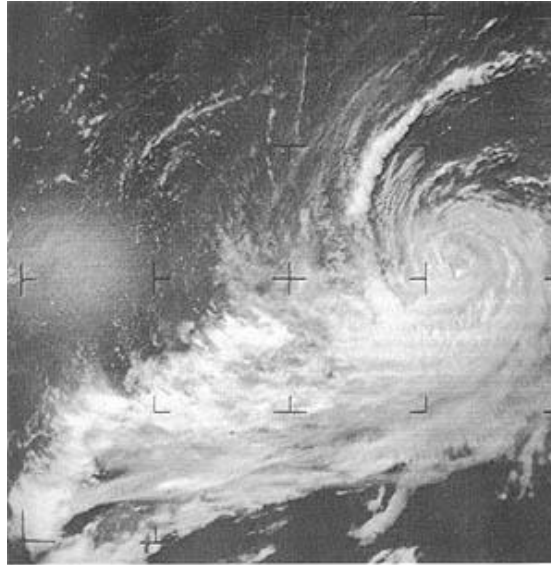


WSR-88D – Doppler Radar

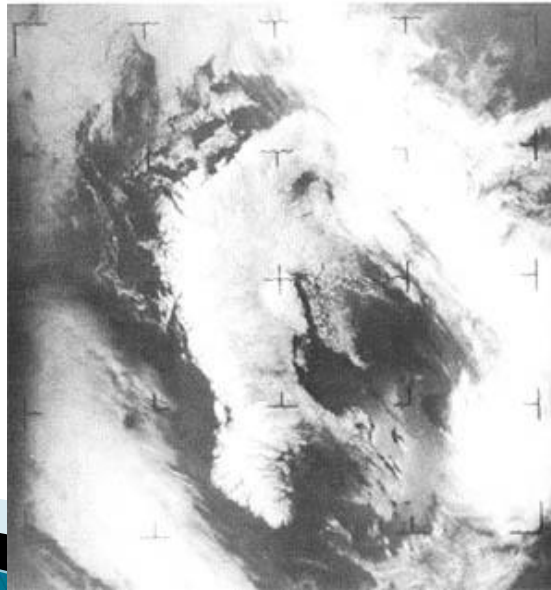
What's in the Radome?



Technology Old – Satellite

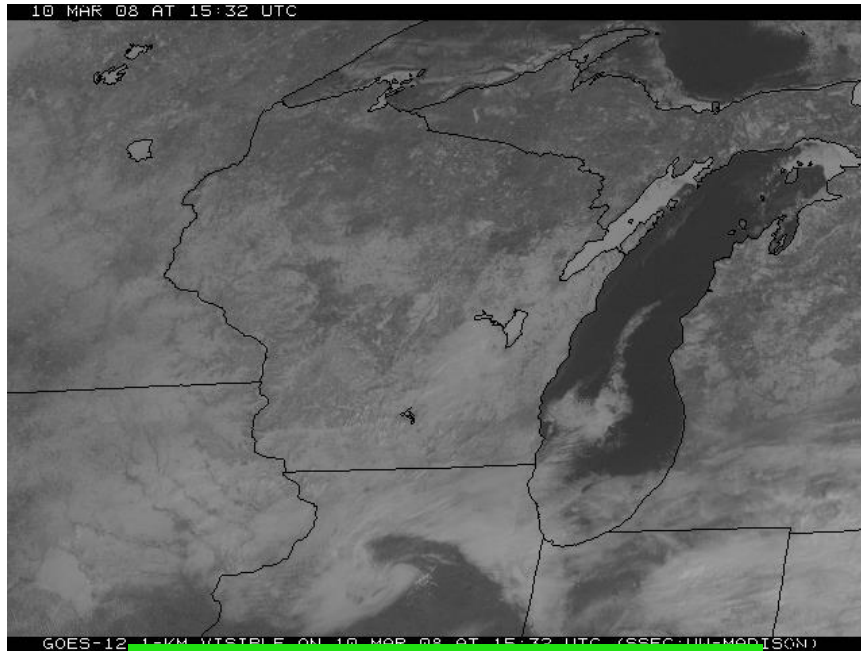


ESSA Imagery from
September 1,
1966: Hurricane
Faith
approximately
300 miles off Cape
Hatteras.

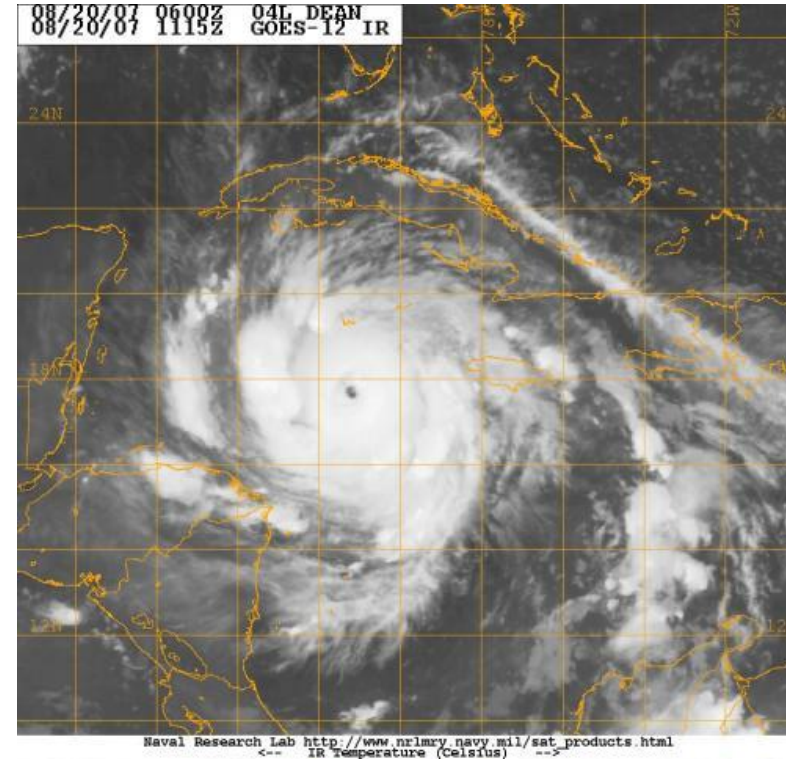


Lower picture of
Scandinavia in a
generally cloud-
free picture.

Technology New – Satellite

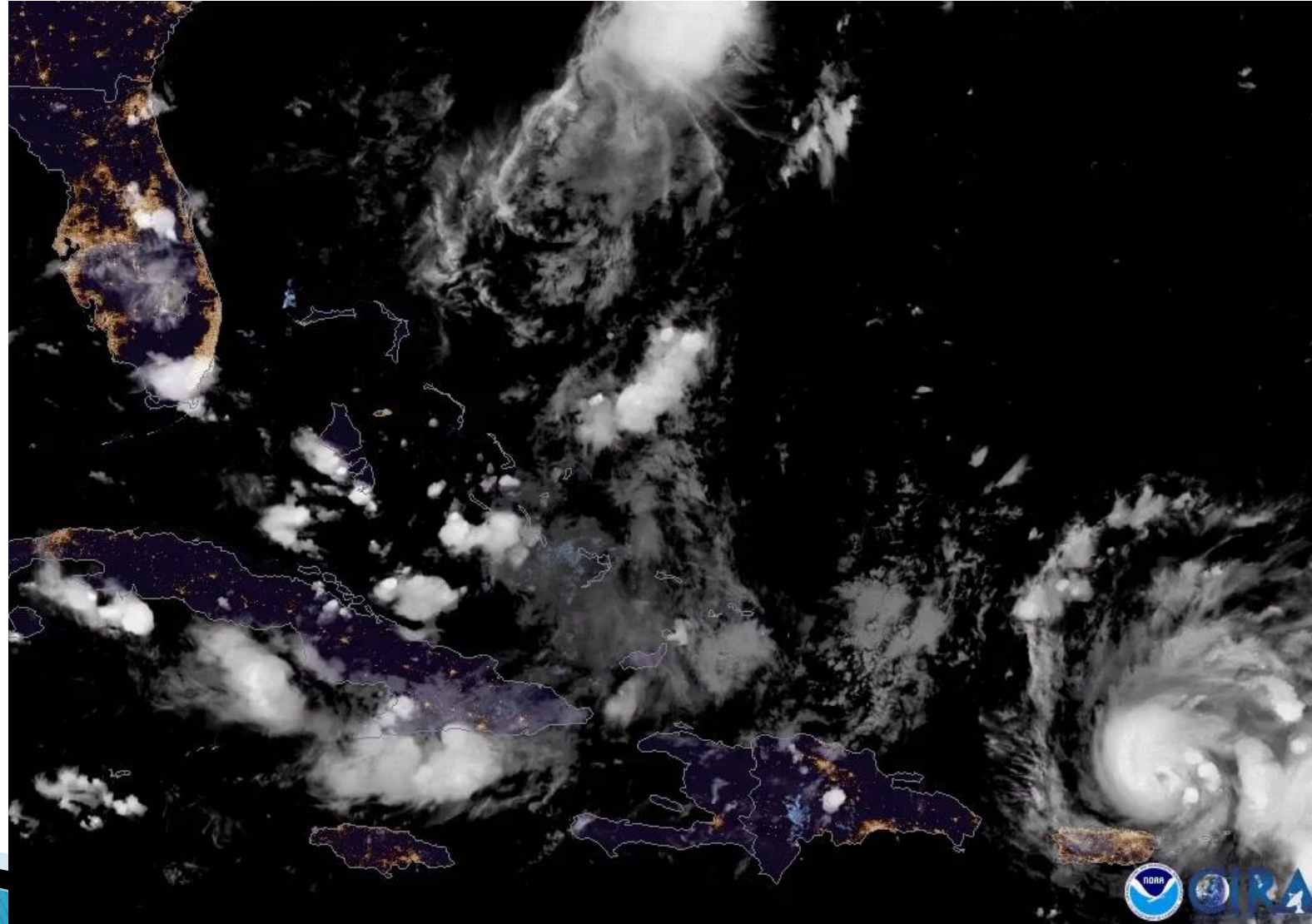


Visible GOES satellite image
(March 10, 2008)

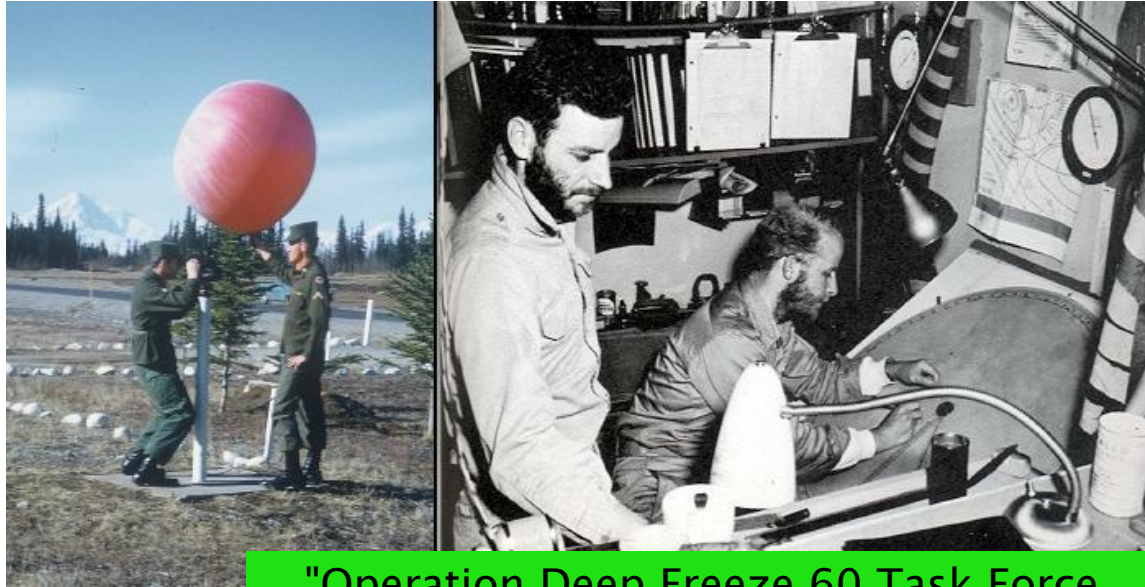


Infrared imagery – Hurricane Dean
(August 20, 2007)

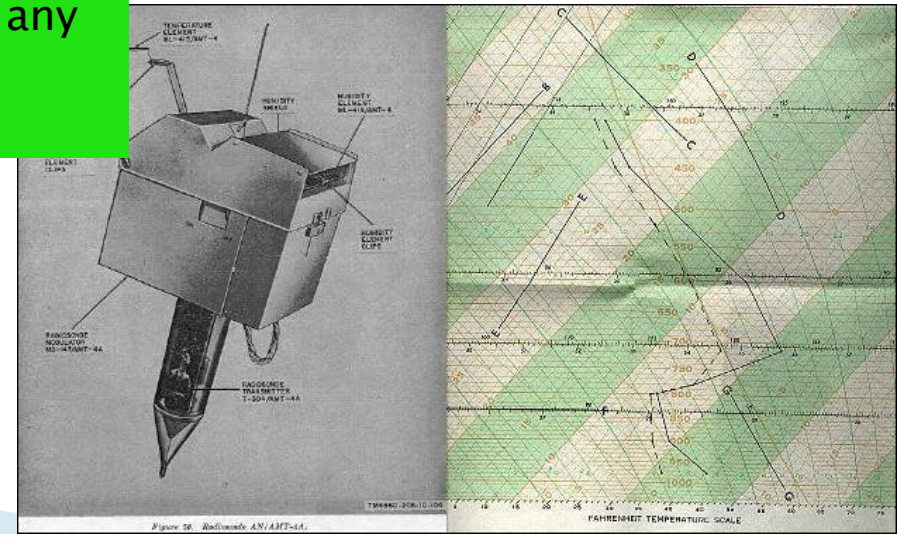
Technology Newest – Satellite



Technology Old- Upper Air



"Operation Deep Freeze 60 Task Force 43" yearbook since I could not find any similar picture of Ft. Monmouth personnel.



Technology Newer– Upper Air



Radiosonde launch – image courtesy of NCAR/UCAR/NSF



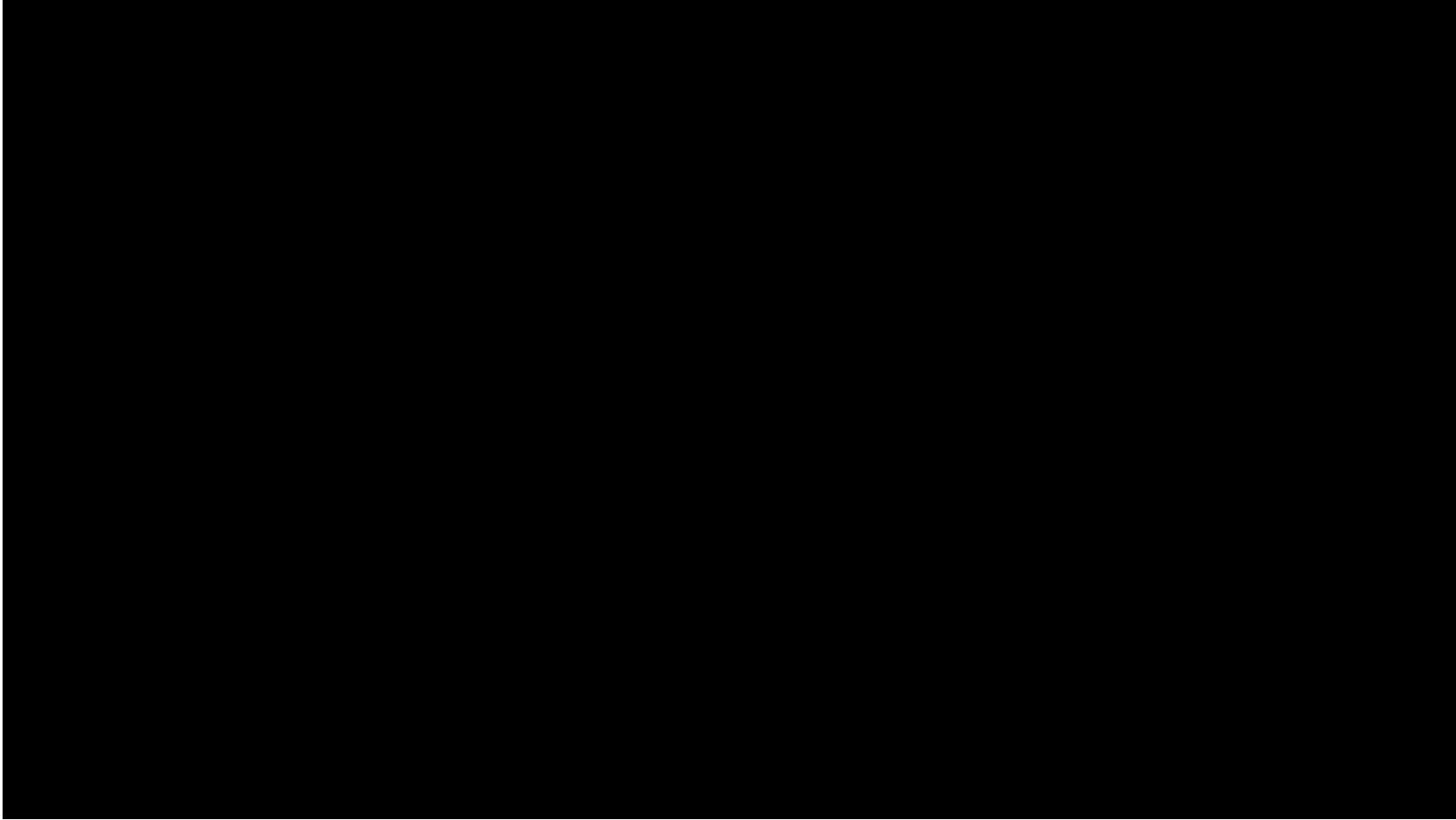
Radiosonde instrument package



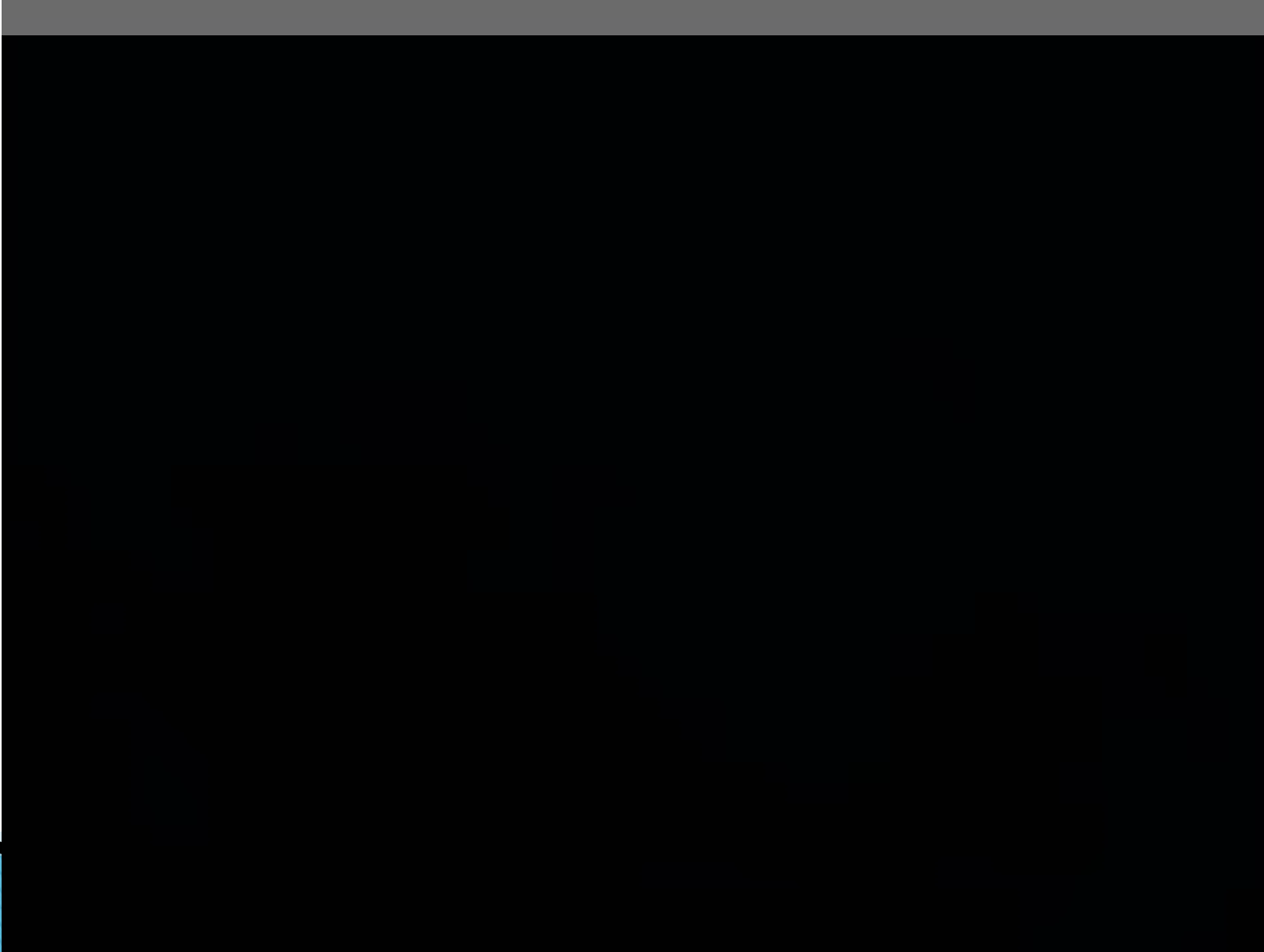
Technology keeps improving the tools

Collecting Data

Weather Balloon Release

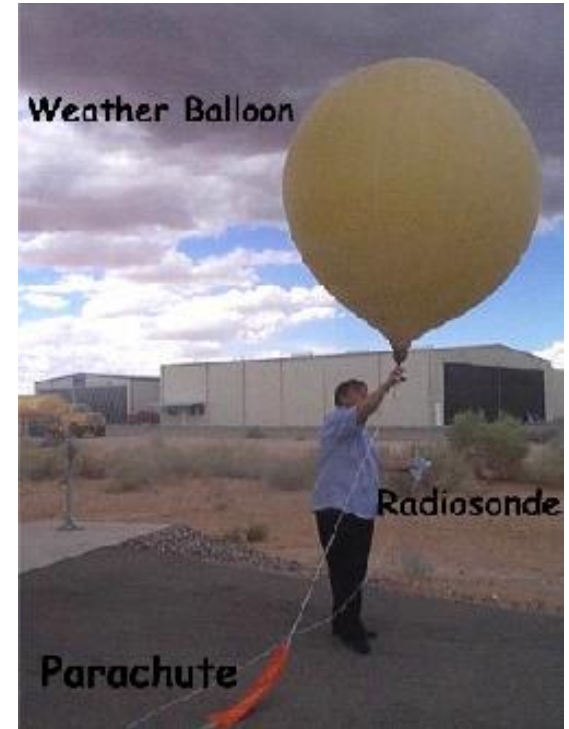


Weather Balloon Popping at 110,000 Feet



Weather Balloons

- Released twice a day, every day
- 92 sites in the US; 900 worldwide
- Filled with hydrogen or helium
- Flight lasts for about 2 hours; can drift as far as 125 miles away; will rise up to 100,000 feet (20 miles)
- Instrument called a radiosonde is attached to measure pressure, temperature, relative humidity, wind speed and direction
- Primary source of data above the ground
- Provides valuable input for computer forecast models, local data for meteorologists to make forecasts and predict storms, and data for research.
- Each radiosonde contains a mailing bag with instructions. About 20% of the 75,000 radiosondes sent up each year in the US are found and returned.

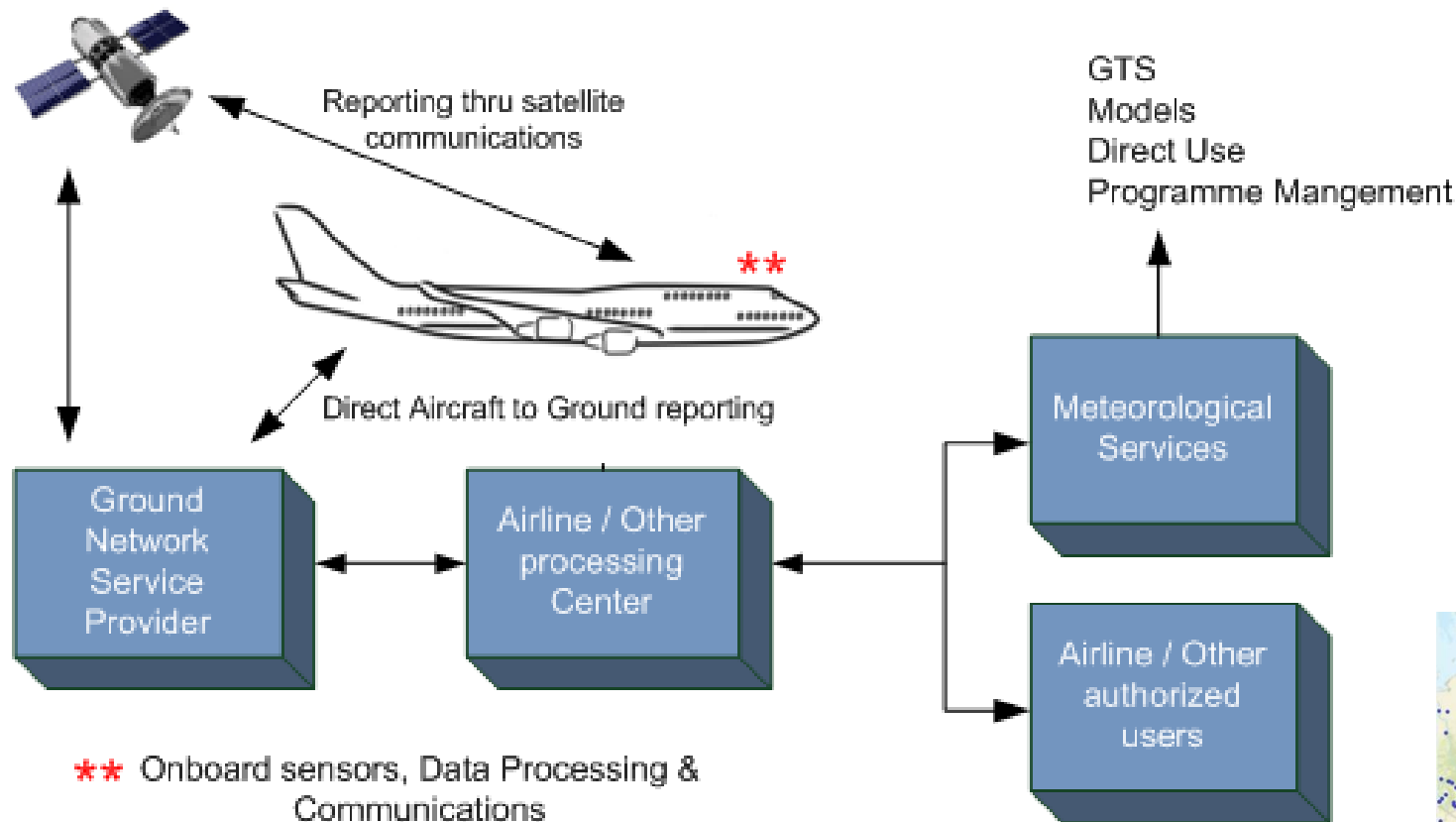


Technology Newest – Upper Air

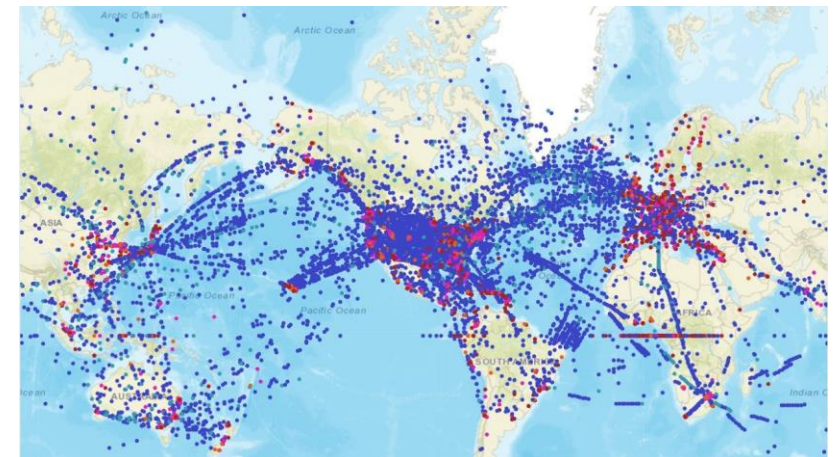
Profilers: These measure wind.
HOWEVER, upgrades can now
Provide MOISTURE
information!



Newest of Newest – AMDAR

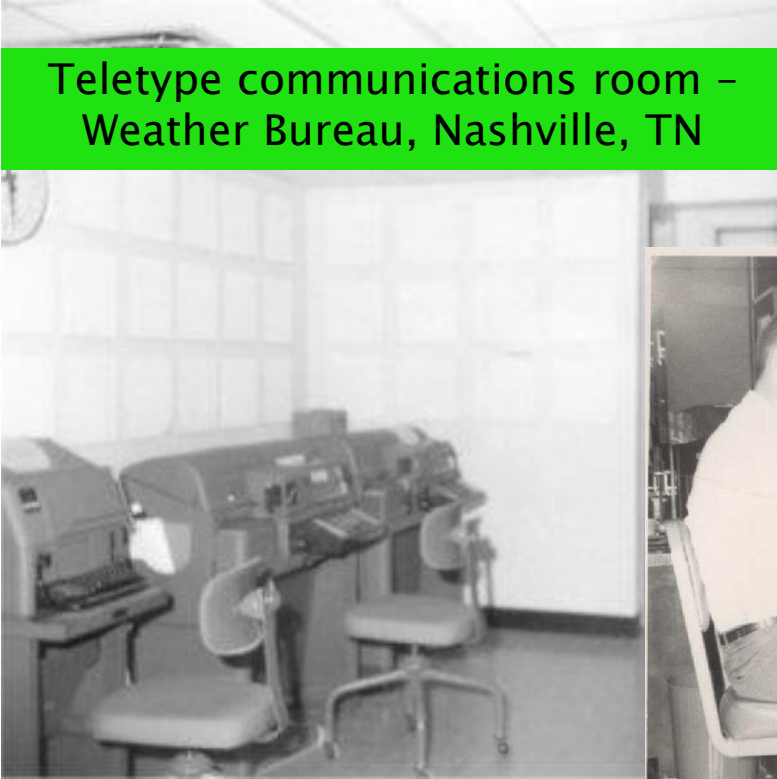


- Critical component of AMDAR is that observations are made on ascent and descent – so vertical profiles
- Provides similar quality and utility as radiosondes – but at higher temporal frequency



Technology Old – Communications

Teletype communications room –
Weather Bureau, Nashville, TN



Operating a
teletype circa
1965.

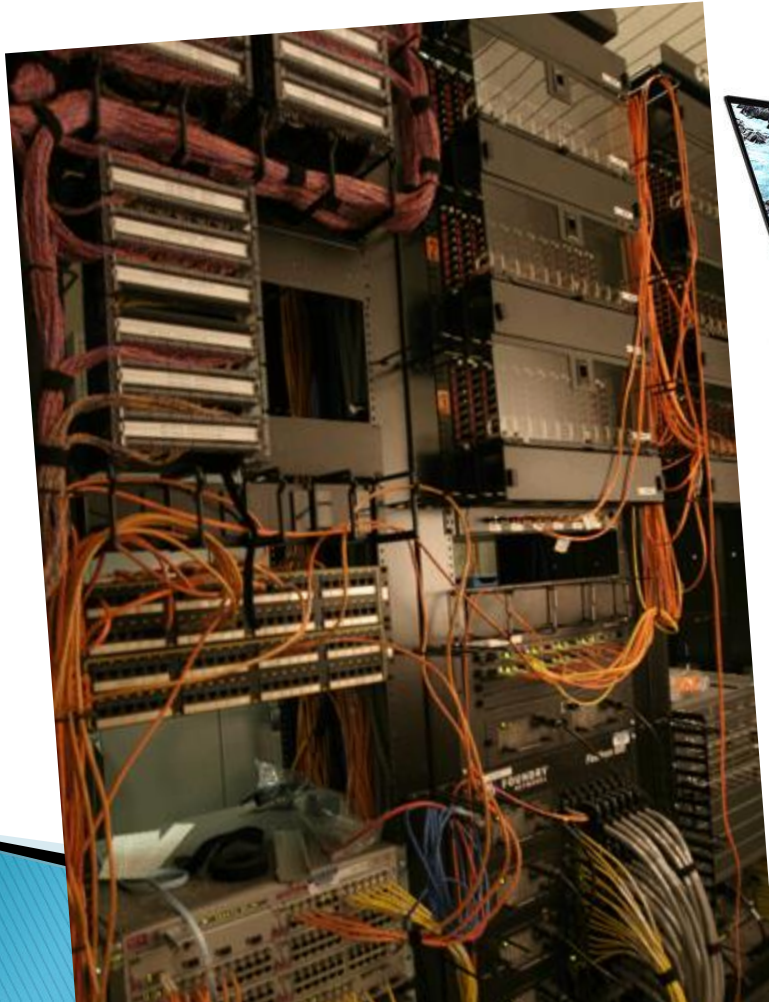


NOAA Weather Radio was
being installed along the
coasts, but was not widely
used across the country until
the 1970s.



Broadcast equipment for KIH-20 Huntsville and KIH-57 Florence. Broadcast segments would be recorded on tapes, which were inserted into tape decks seen here.

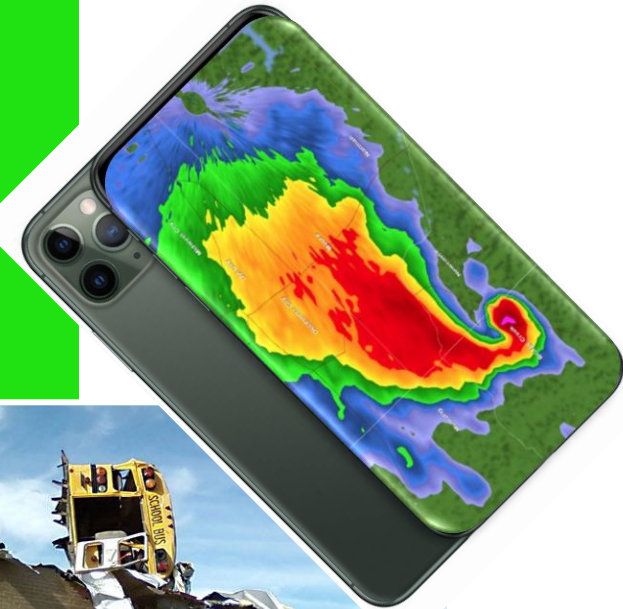
Technology New – Communications



Where We're Headed

Data, Products, and Services to:

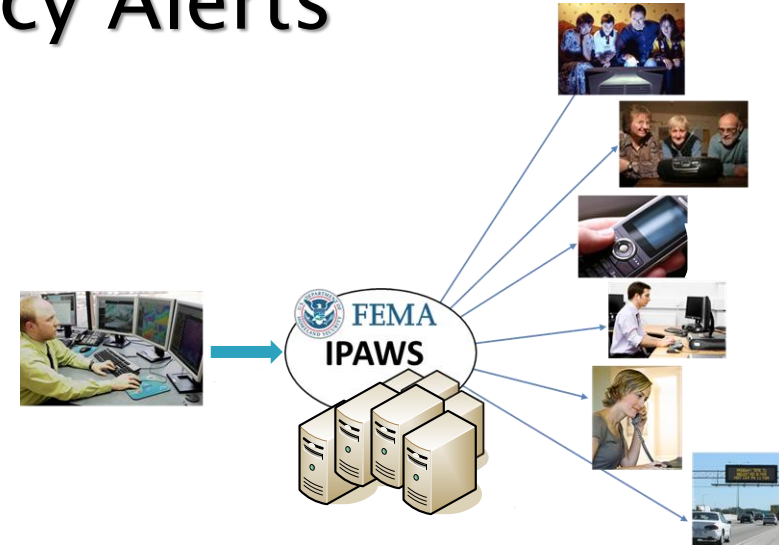
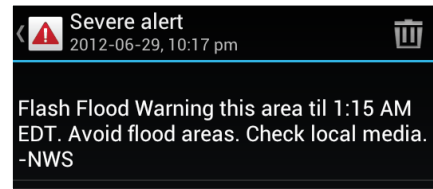
- ▶ *Greatly reduce loss of life and injury*
- ▶ *Enable communities to mitigate property loss well in advance of threatening conditions*
- ▶ *Alert economic sectors to environmental risks with sufficient lead time to limit or avoid impacts*



Where we're Heading Continued... Wireless Emergency Alerts

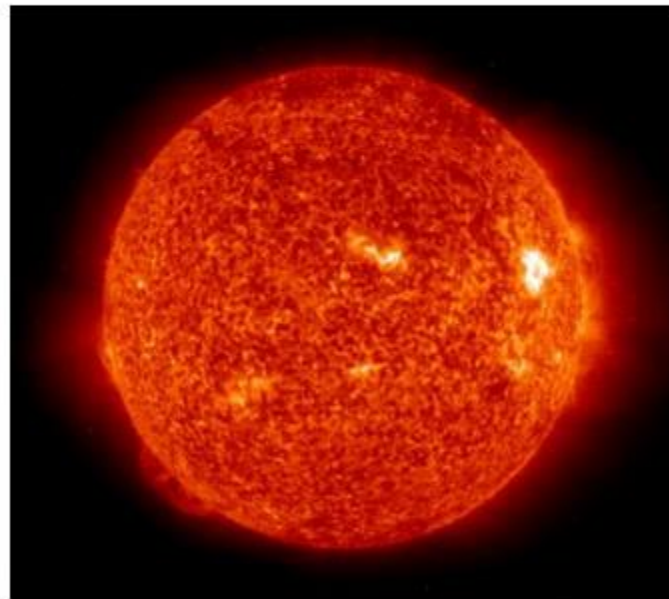
- Available to general public
- Alerts for your current location
- No graphics or full text
- Not subject to network congestion
- Cemented in FCC regulations
- Cell broadcast bleed-over
use false alarm for

| Warning Type |
|----------------------|
| Tsunami Warning |
| Tornado Warning |
| Extreme Wind Warning |
| Hurricane Warning |
| Typhoon Warning |
| Flash Flood Warning |
| Dust Storm Warning |



What Causes the Weather

The **Sun** is where it all starts...



The Sun Heats the Earth...

The Earth Heats the Air

Incoming Solar Radiation
passes through the atmosphere
and is absorbed by the Earth's
surface.

Outgoing Terrestrial Radiation
is absorbed by the atmosphere.

Cold

Cool

Warm



Uneven Heating of the Earth

Oblique Rays *(Less Radiation Received)*



Vertical Rays *(More Radiation Received)*



Oblique Rays *(Less Radiation Received)*



Equatorial Regions are Warmer *(Higher Sun Angles)*

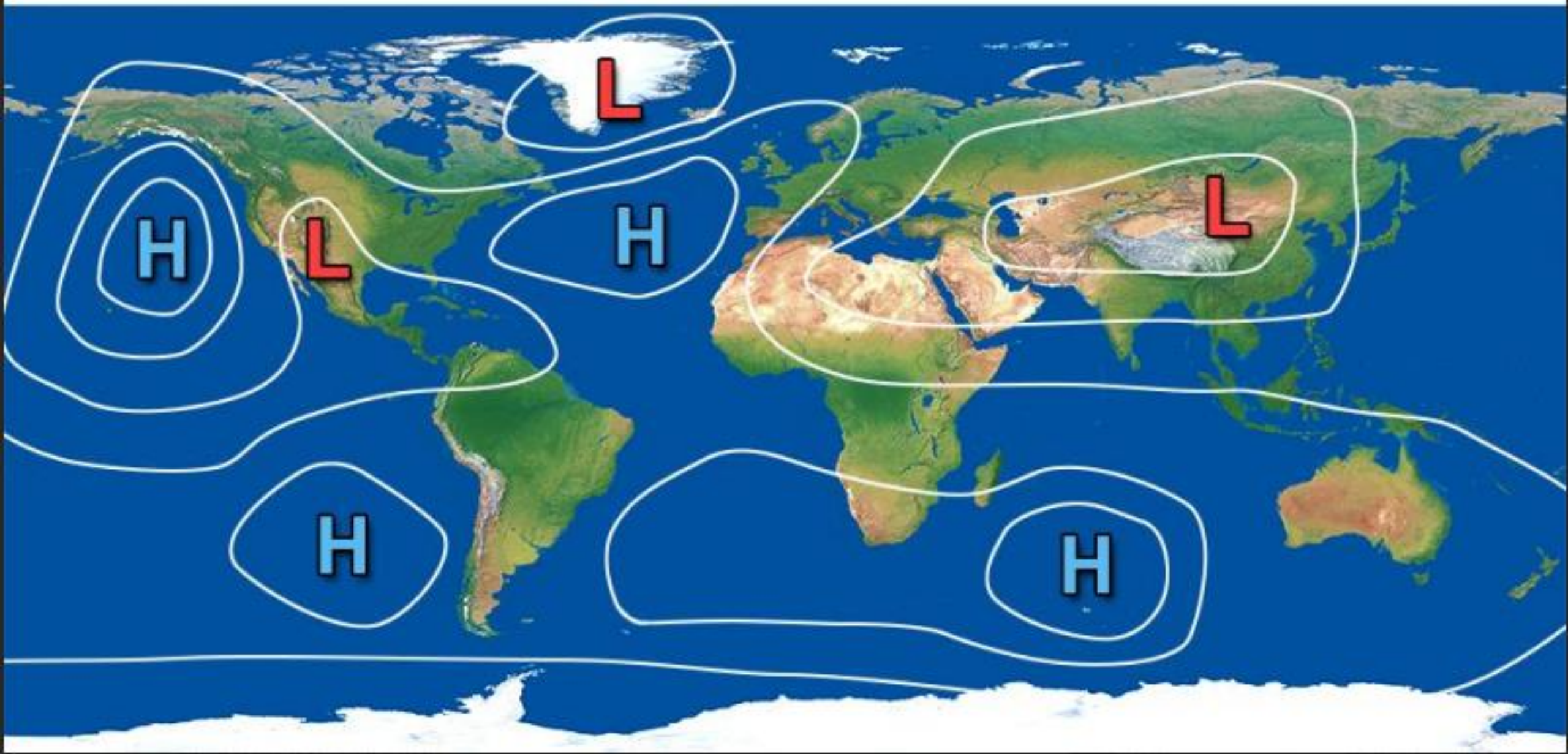
Polar Regions are Colder *(Lower Sun Angles)*

Land & Water Heat Differently

- ✓ Land heats faster and to higher temperatures than water
- ✓ Land also cools faster and to lower temperatures than water



Uneven Heating = Uneven Pressure Distribution



Pressure & Wind

Air moves from High to Low Pressure

Moving air is called "WIND"

H

High Pressure

COOL



L

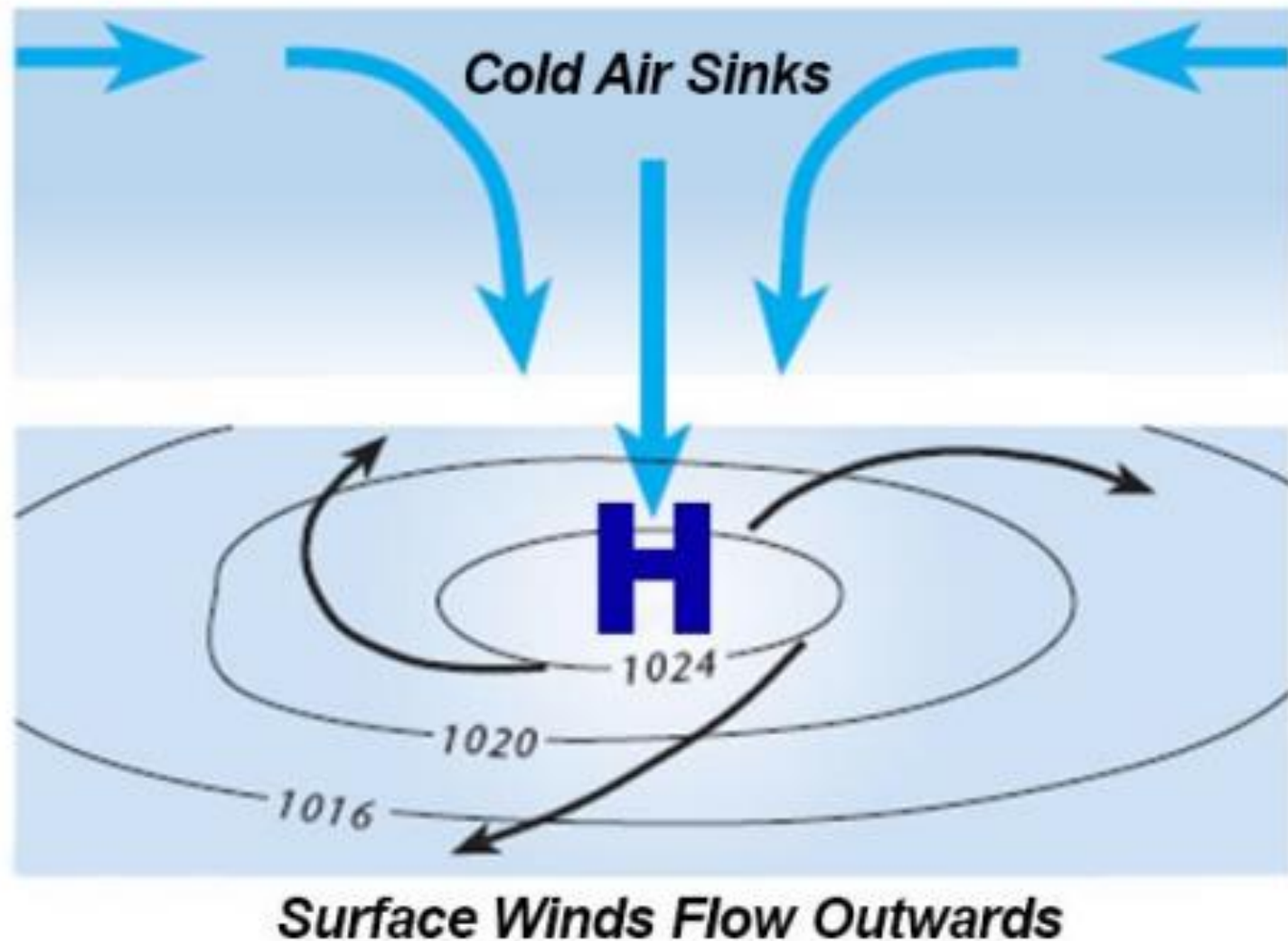
Low Pressure

WARM

High Pressure

H stands for “High Pressure” which brings... Happy Weather!

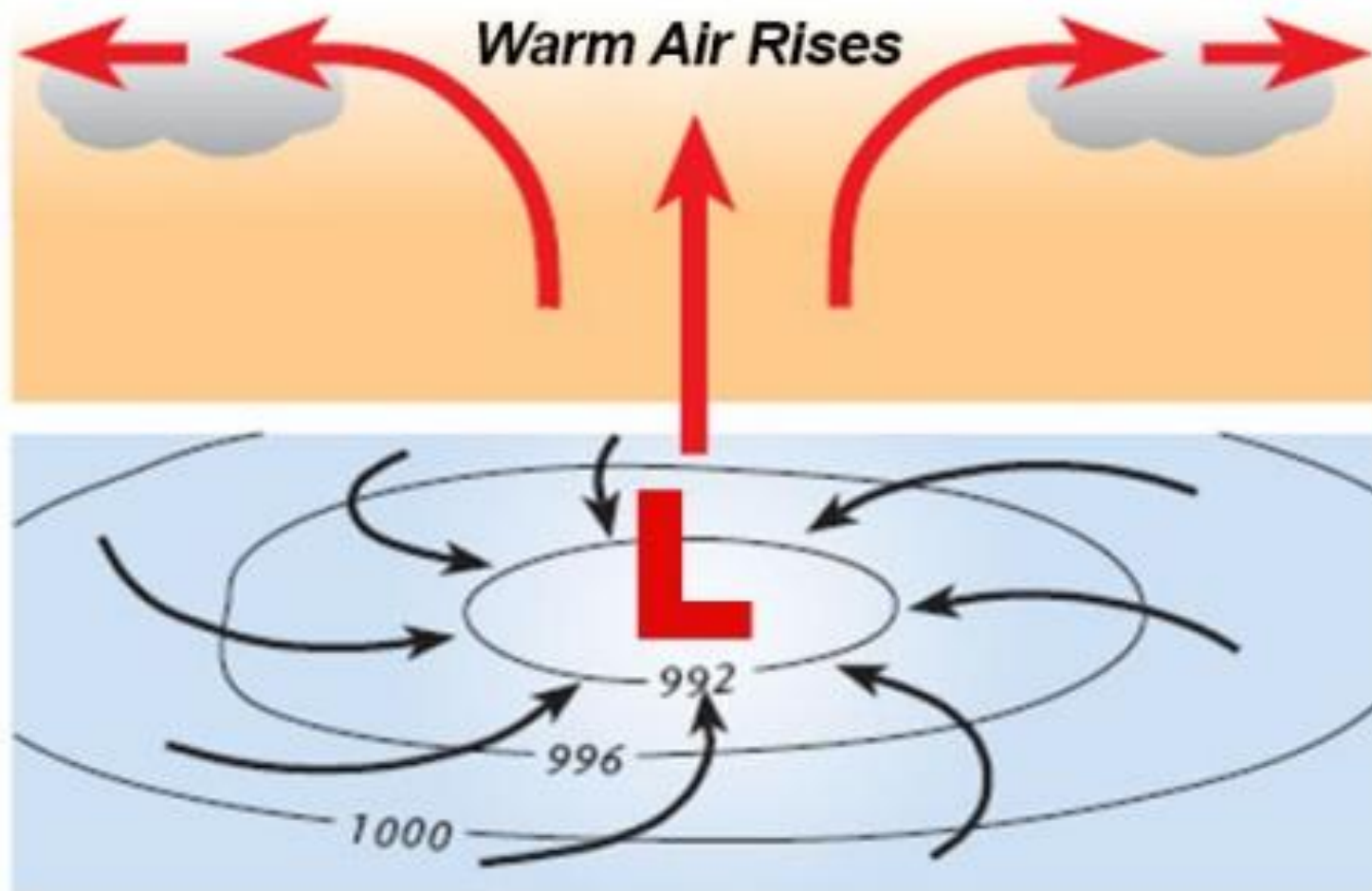
- ✓ Clear Skies
- ✓ Calm Conditions
- ✓ Dry Weather
- ✓ High Day Temps
- ✓ Low Night Temps



Low Pressure

L stands for “Low Pressure” which brings... Lousy Weather!

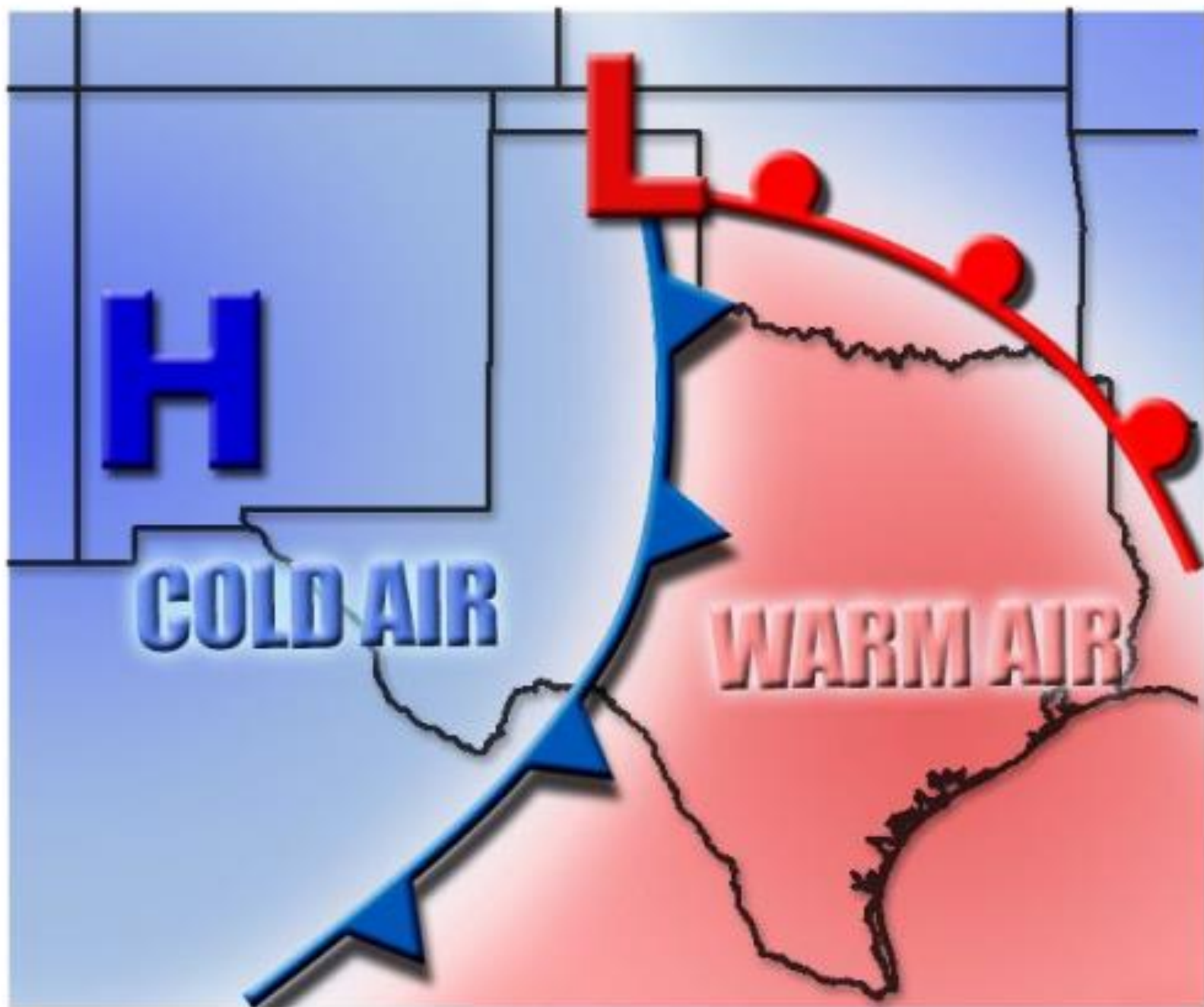
- ✓ Cloudy Skies
- ✓ Windy Conditions
- ✓ Wet Weather
- ✓ Followed by colder weather



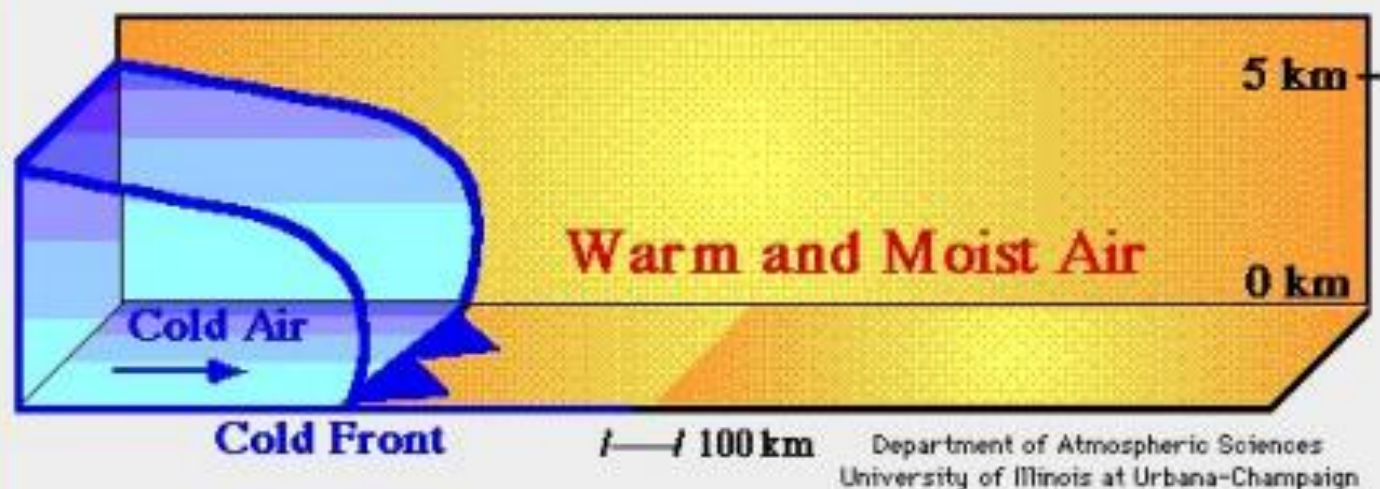
Surface Winds Flow Inwards

Typical Weather Map

High Pressure
Low Pressure
Cold Fronts
Warm Fronts



Warm and Cold Fronts



Cold Front

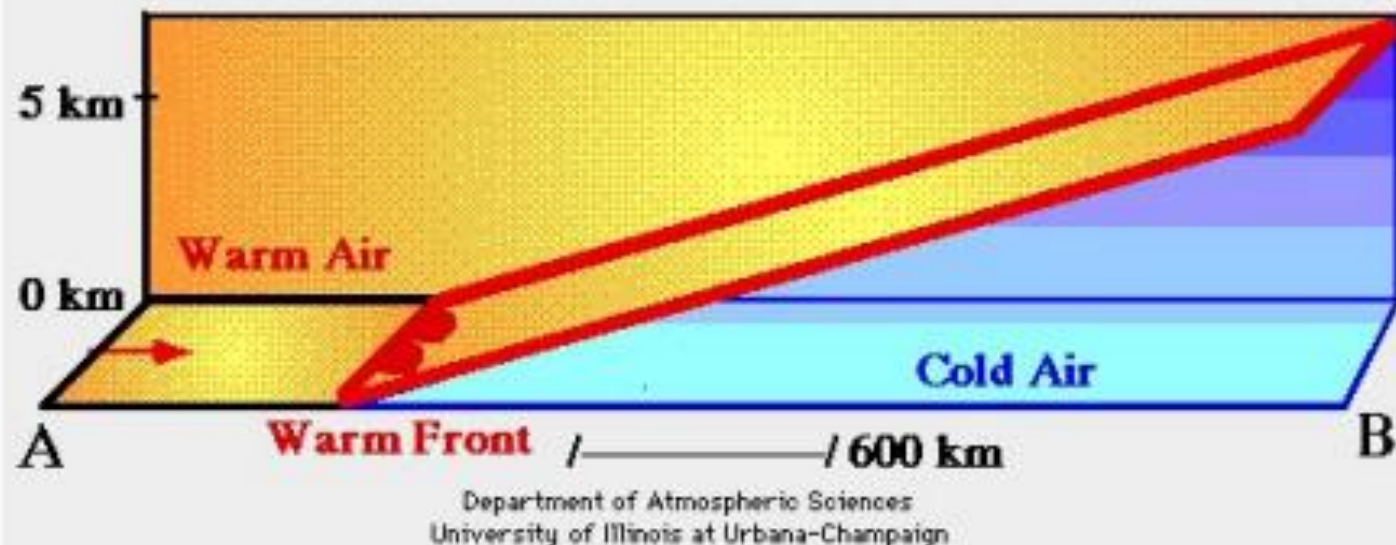
Cold Air Displaces Warm Air
At The Surface

Moves More Rapidly

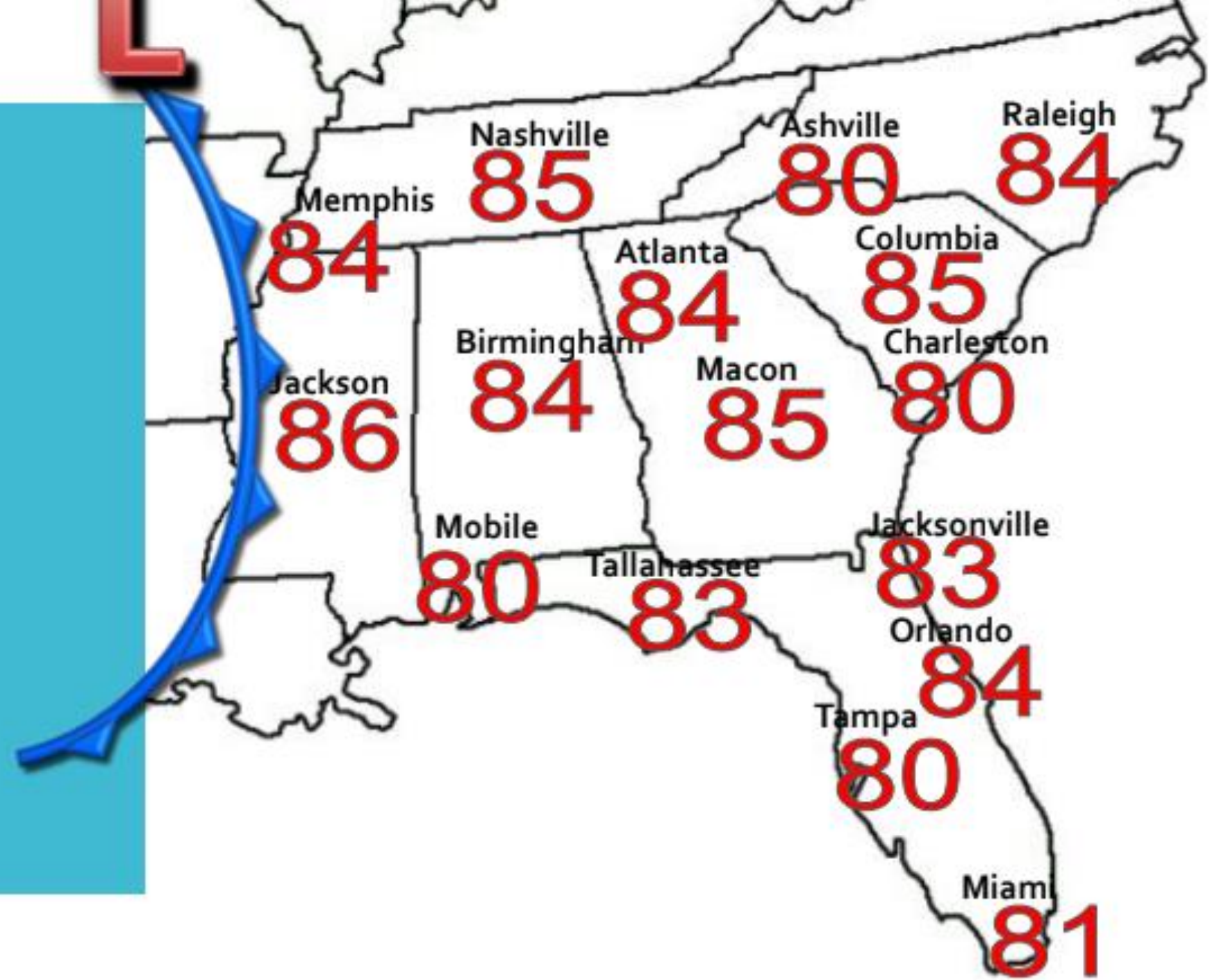
Warm Front

Warm Air Displaces Cold Air
At The Surface

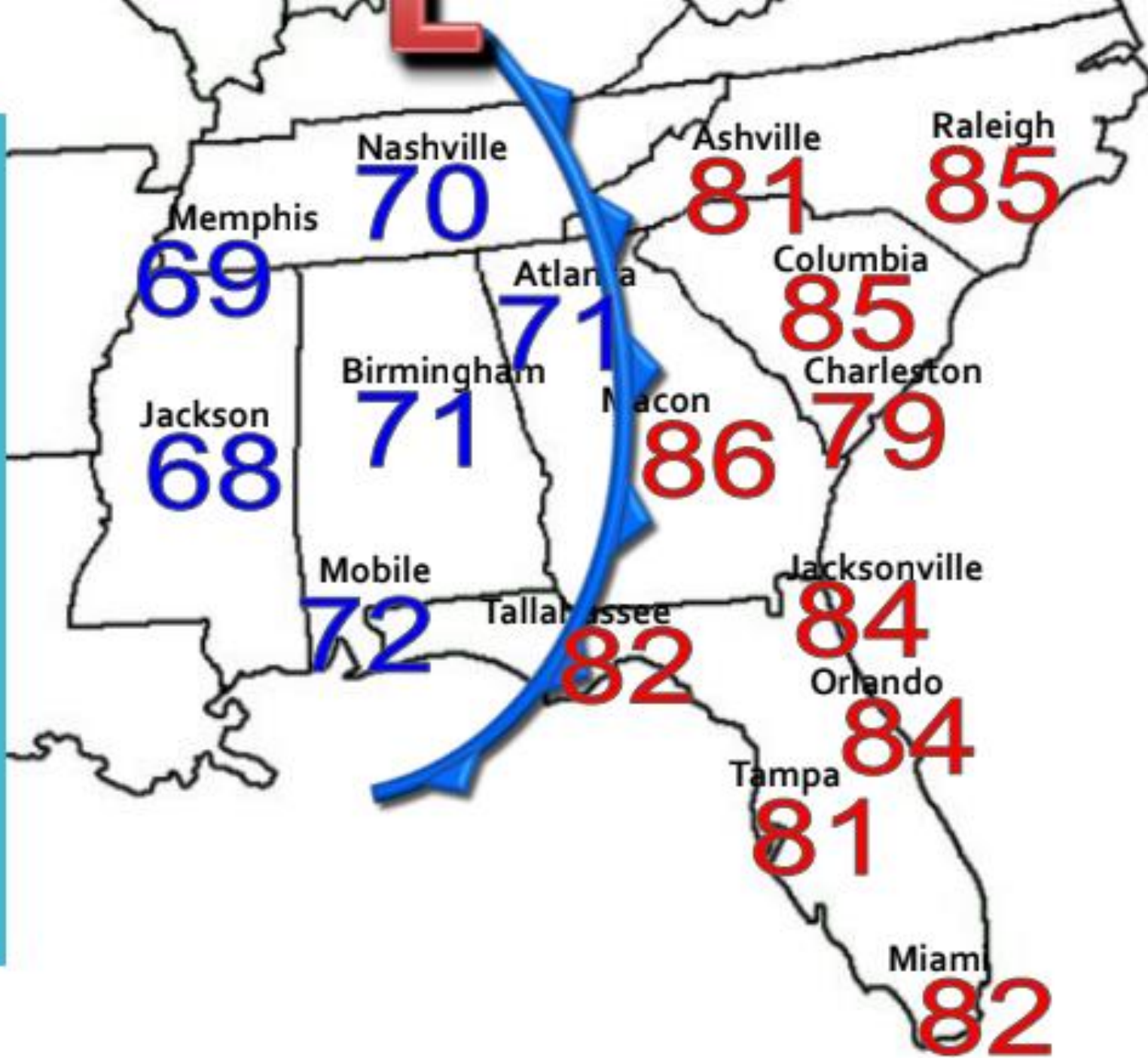
Moves More Slowly



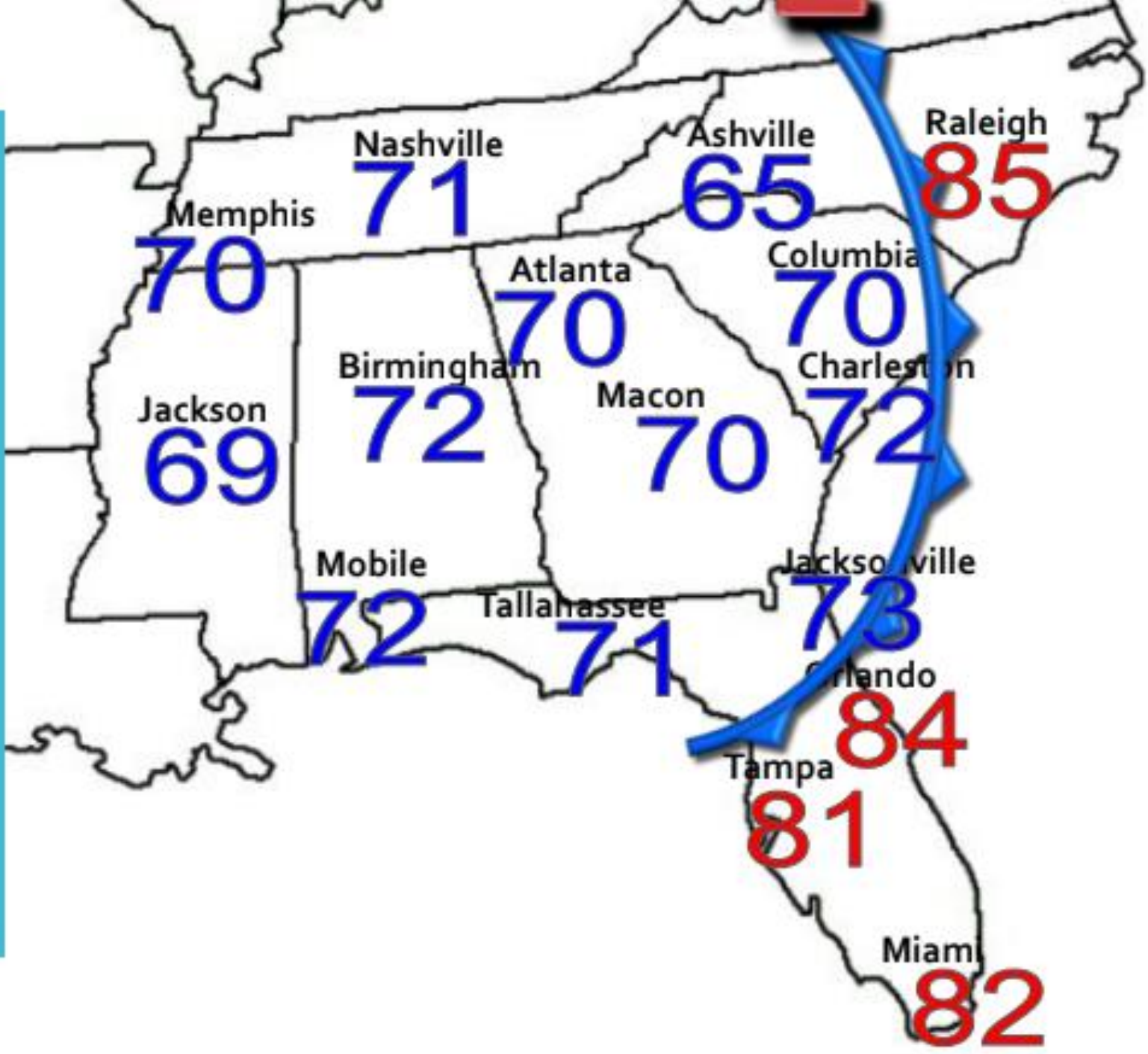
Monday



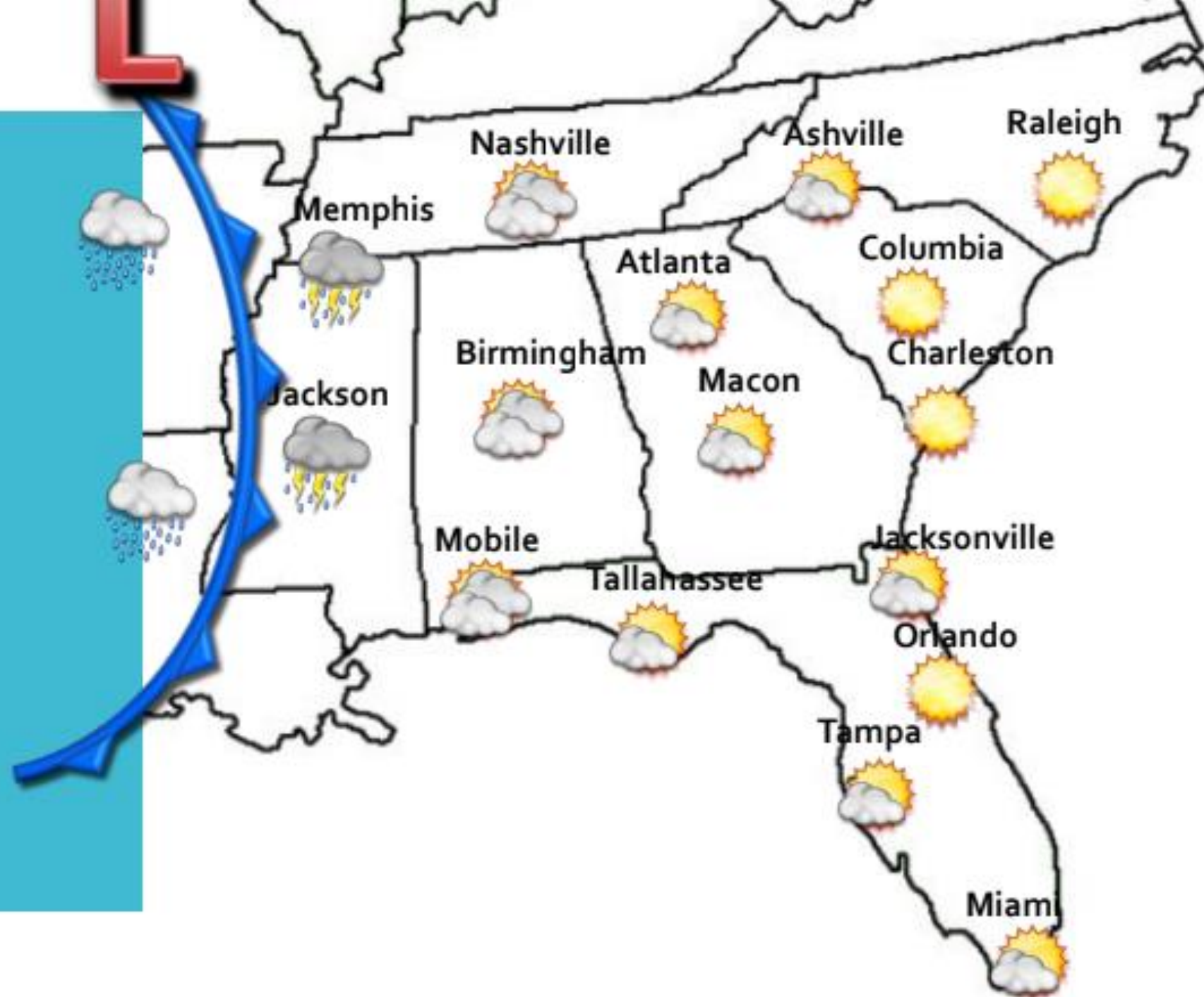
Tuesday



Wednesday



Monday



Tuesday

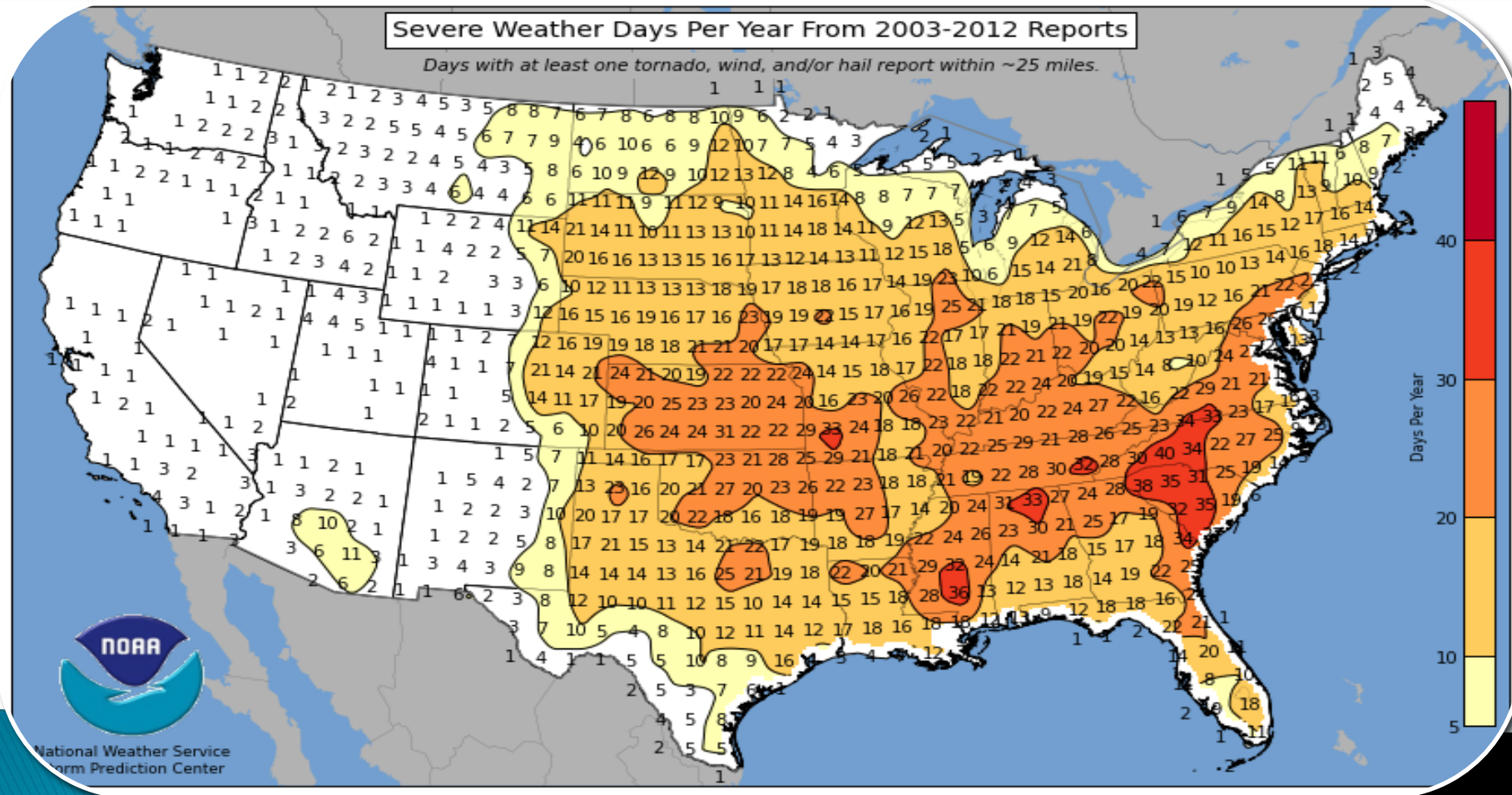


Wednesday



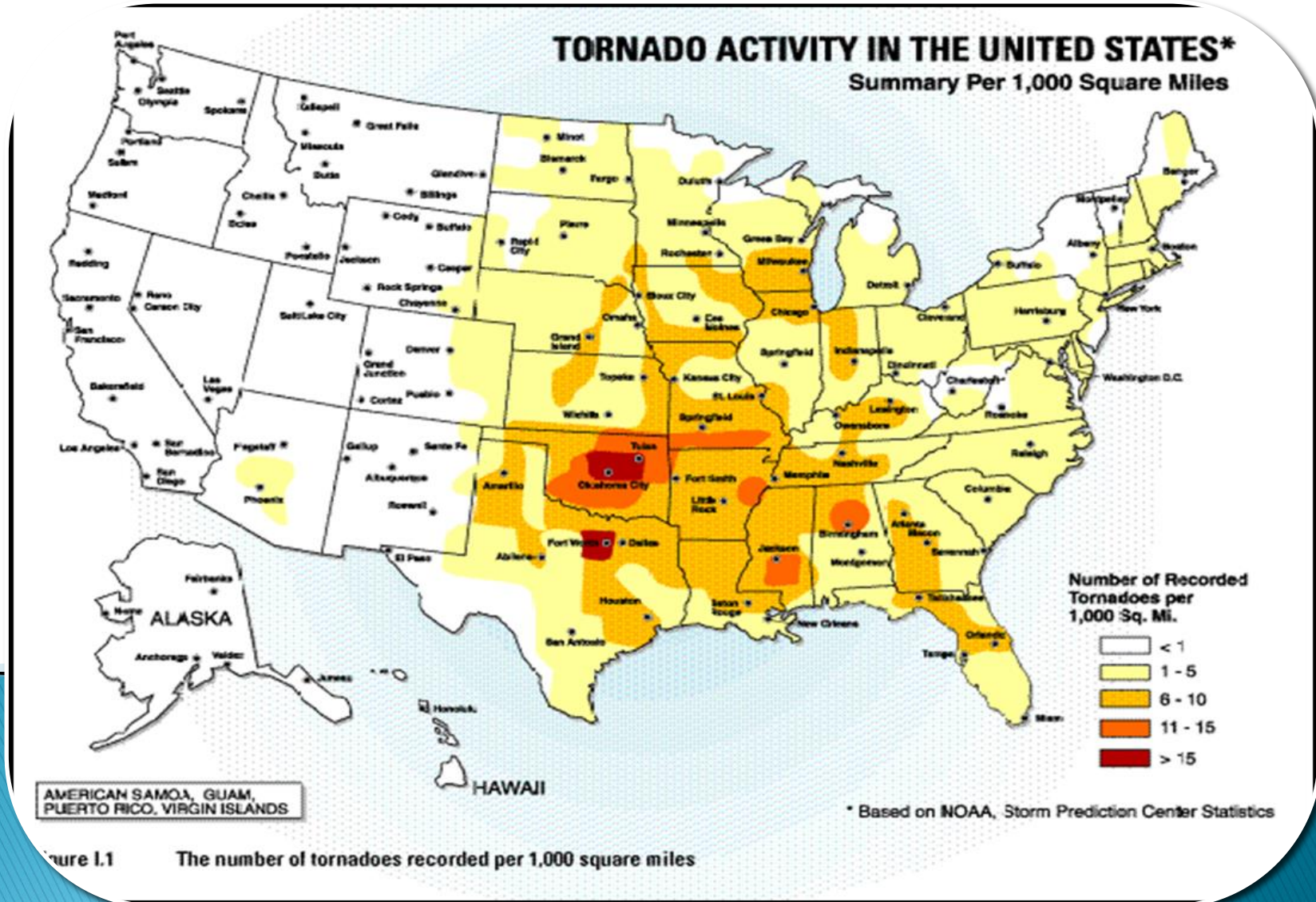


Climatology



Middle TN has 20-30 days of severe weather every year!

What do you think of when you hear “Tornado Alley”?

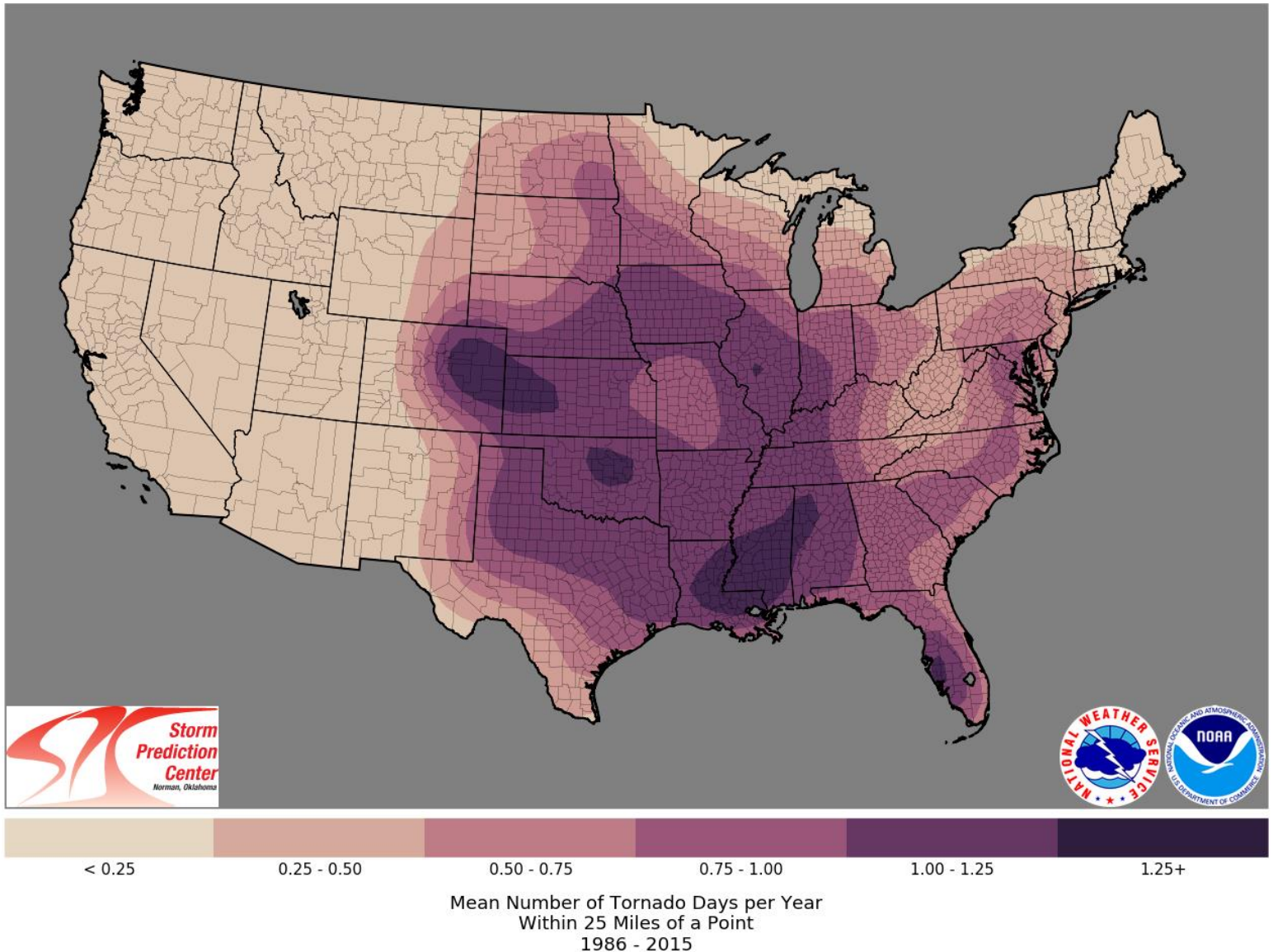




Climatology



But where is the real
“tornado alley”?

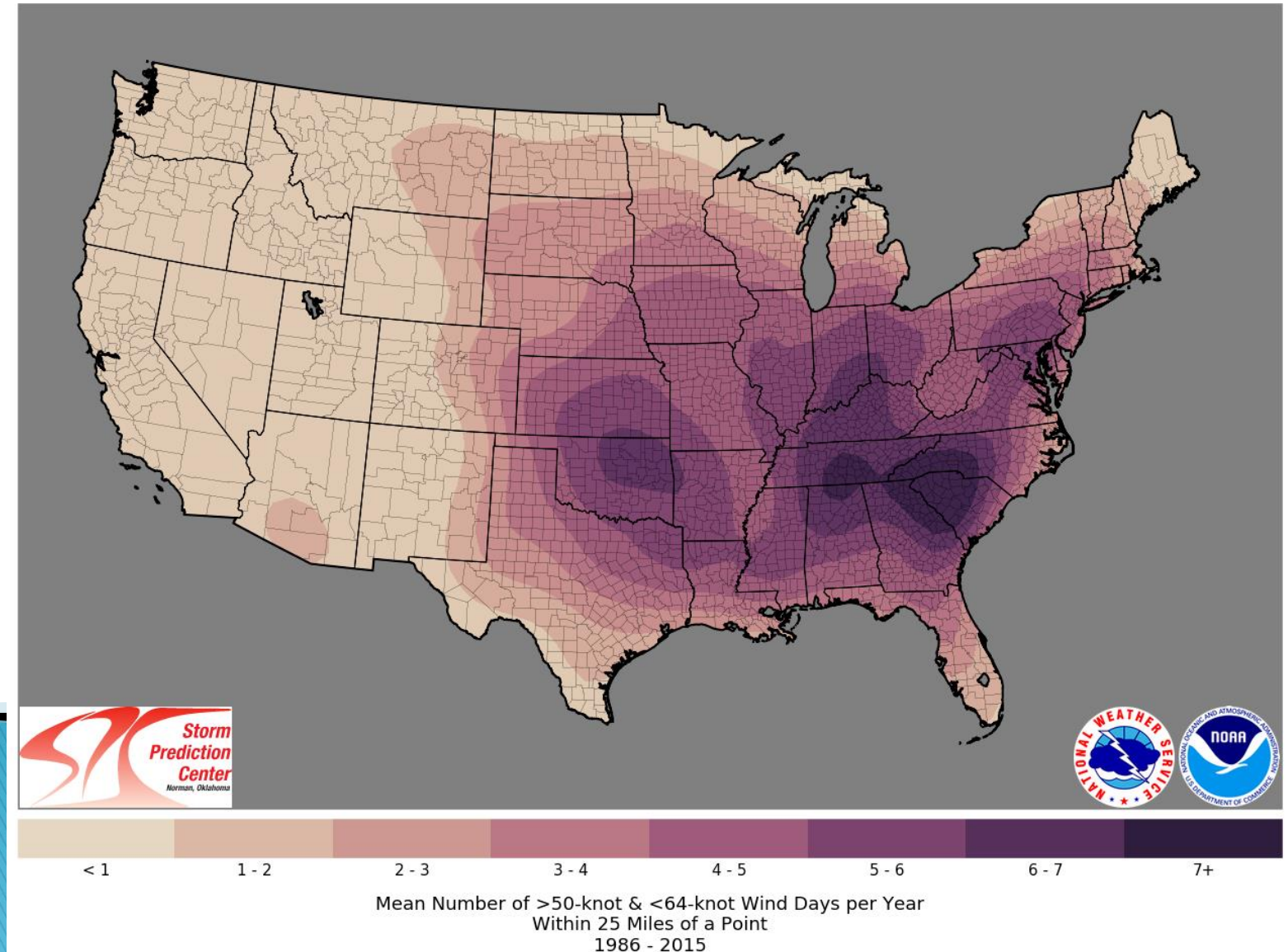


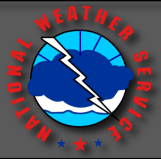


Climatology

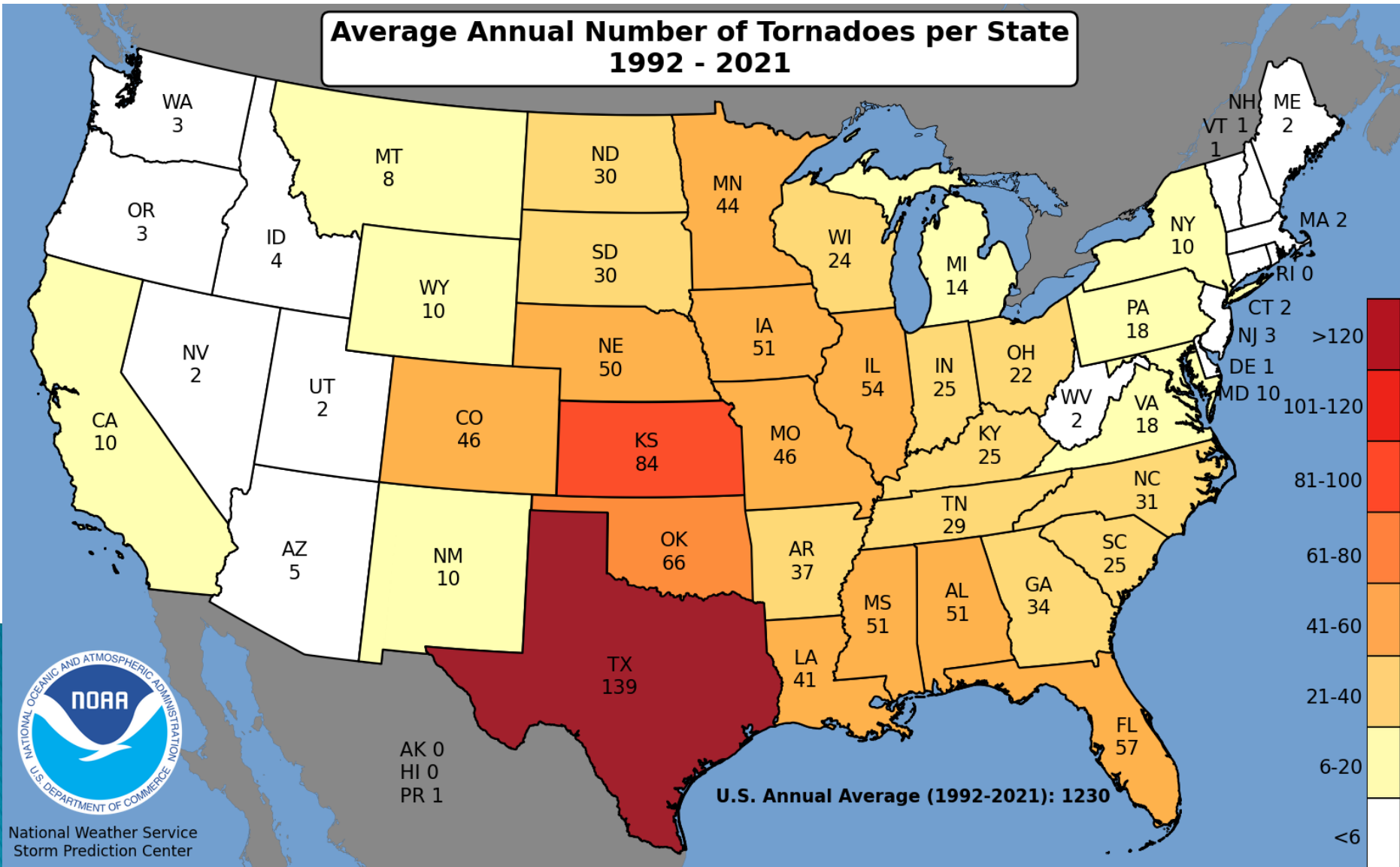


How about
damaging winds?





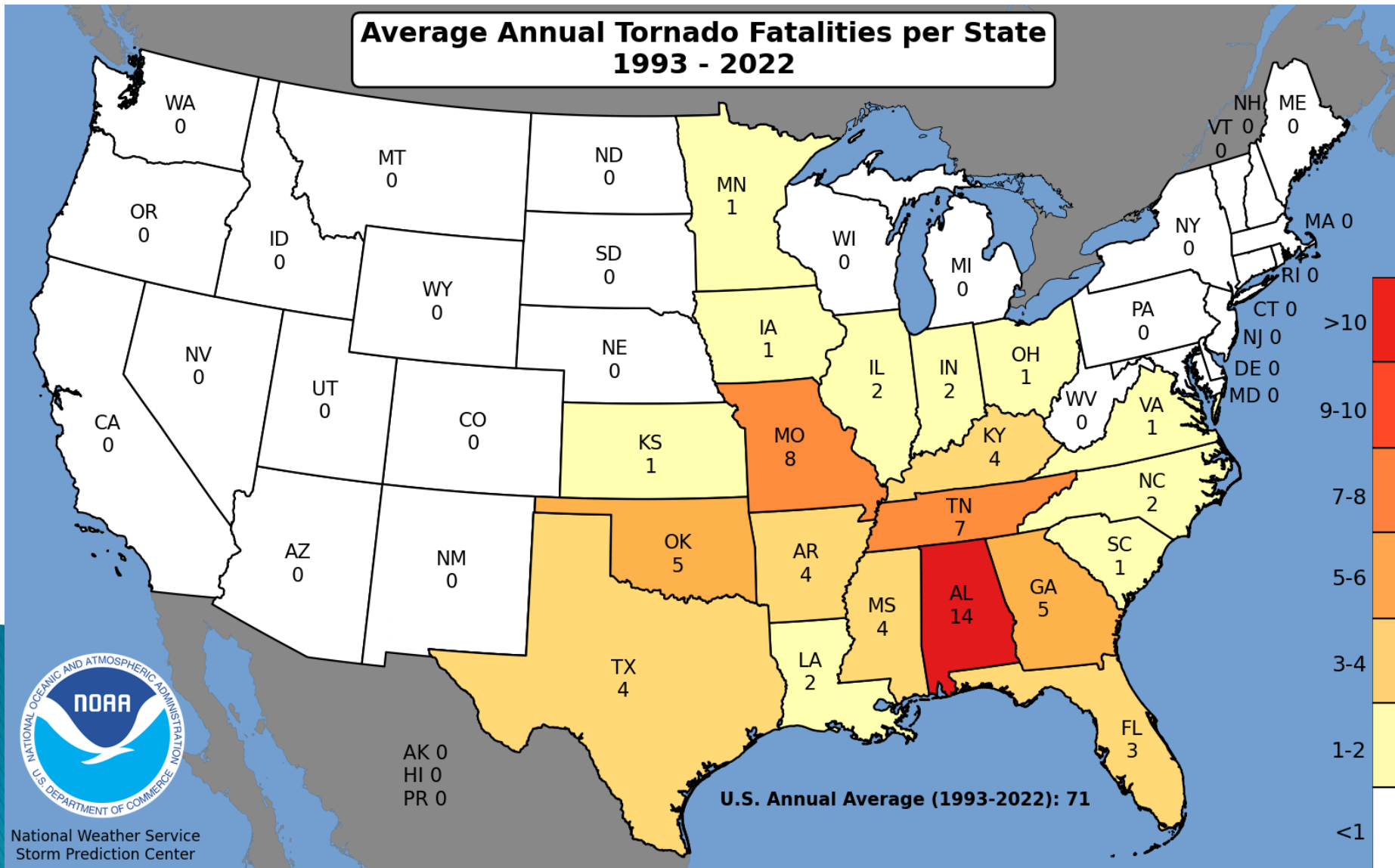
Climatology



National Weather Service
Storm Prediction Center



Climatology



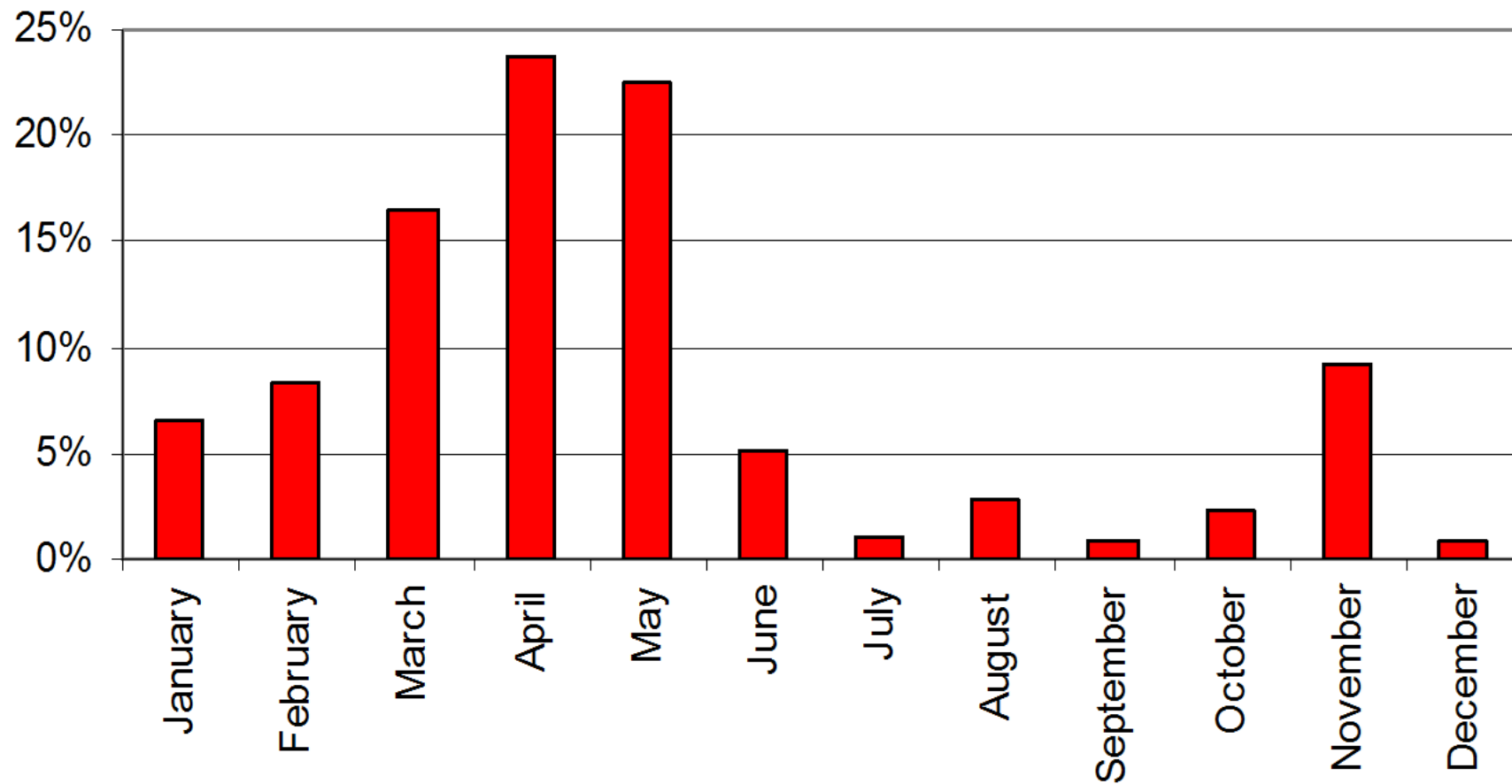
National Weather Service
Storm Prediction Center



Climatology



Tornado Occurrences by Month

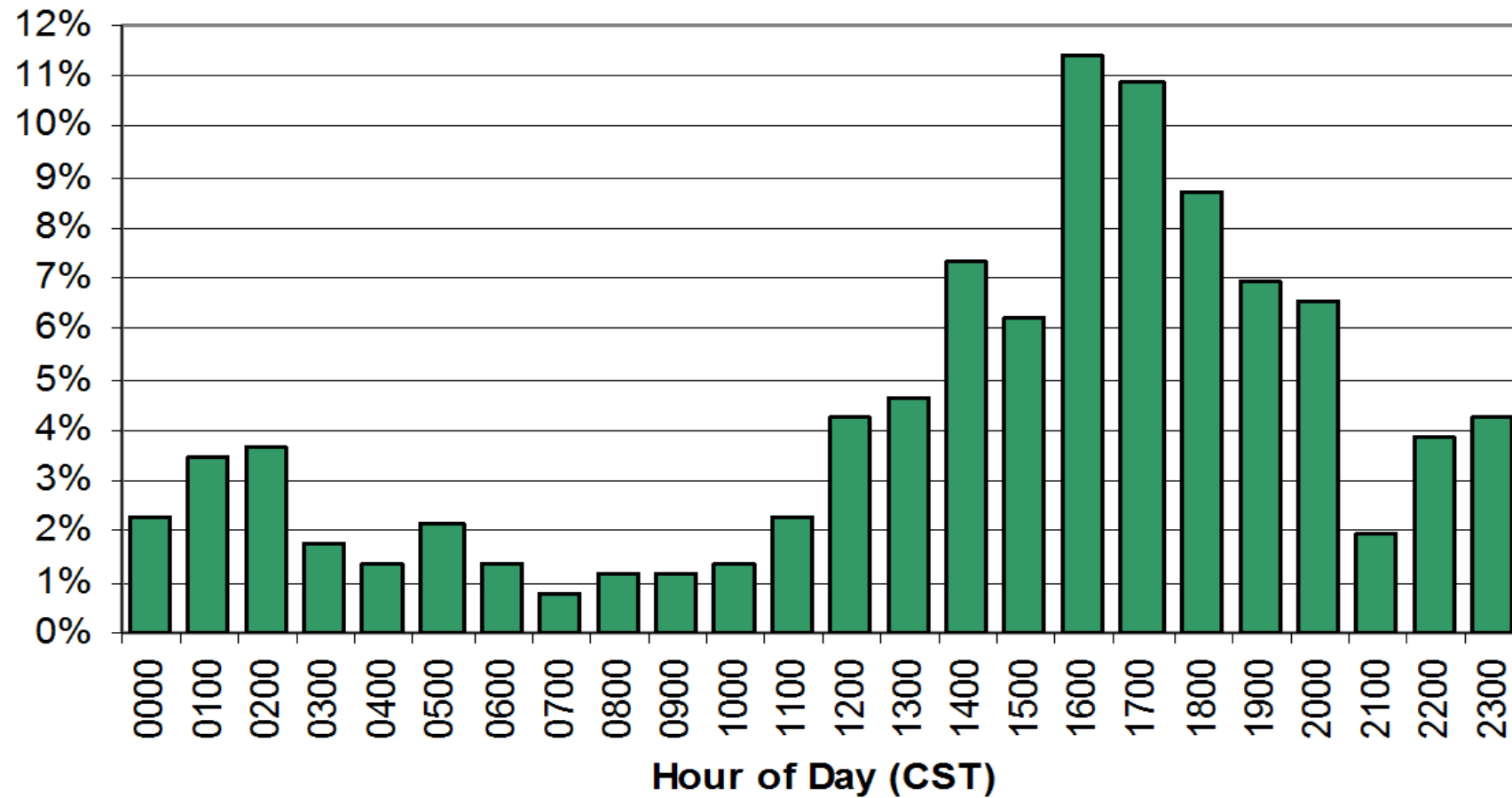




Climatology



Tornado Occurrences by Hour of Day





NWS Products



DISCUSSION

DAY 3 CONVECTIVE OUTLOOK
NWS STORM PREDICTION CENTER NORMAN OK
0227 AM CDT WED JUN 27 2012

VALID 291200Z - 301200Z

...OH VALLEY/CNTRL APPALACHIAN HTNS/MID-ATLANTIC...
A WEST TO NORTHWEST FLOW PATTERN IS FORECAST ON FRIDAY FROM THE UPPER MIDWEST ESEND ACROSS THE GREAT LAKES REGION INTO THE NERN STATES. AT THE SFC...A QUASI-STATIONARY FRONTAL BOUNDARY SHOULD BE IN PLACE FROM NEAR CHICAGO END TO THE MID-ATLANTIC WITH DENPOINTS SOUTH OF THE BOUNDARY FROM THE MID 60S TO AROUND 70 F. THE MOIST BOUNDARY LAYER SHOULD ALLOW FOR MODERATE TO STRONG DESTABILIZATION ACROSS A BROAD CORRIDOR BUT CONVECTIVE DEVELOPMENT SHOULD BE CONFINED TO THE FRONTAL BOUNDARY. FORECAST SOUNDINGS ALONG THE BOUNDARY AT 00Z/SAT IN THE OH VALLEY SHOW MLCAPE VALUES ABOVE 3000 J/KG WITH 40 TO 50 KT OF DEEP LAYER SHEAR SUGGESTING SUPERCELLS WILL BE POSSIBLE. HOWEVER...THE MAGNITUDE OF THE SEVERE THREAT REMAINS UNCERTAIN DUE TO WARM AIR ALOFT AND A LACK OF LARGE-SCALE ASCENT. ANY STORM THAT CAN DEVELOP IN SPITE OF THESE LIMITING FACTORS COULD HAVE AN ISOLATED SEVERE THREAT LATE FRIDAY AFTERNOON.

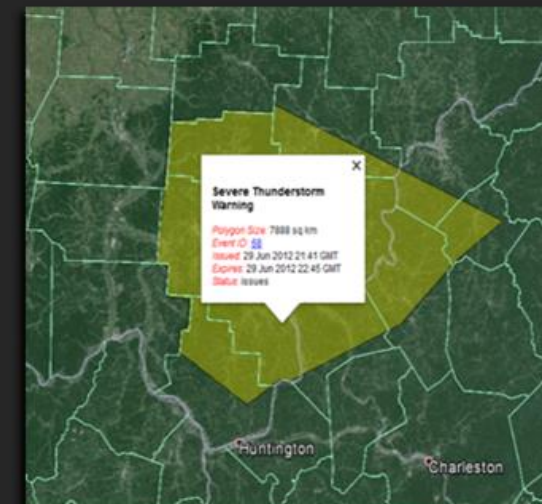
OUTLOOK



WATCH



WARNING



REGIONAL → LOCAL AREA → COUNTIES

ACTION: ask yourself if the forecast mentions possible hazardous weather in your area

ACTION: review your severe weather preparedness plans and monitor the forecast

ACTION: listen for warnings and be prepared to take action if a warning is issued

**TAKE
SHELTER
NOW!**

1 WEEK → 1 to 3 DAYS → HOURS → MINUTES



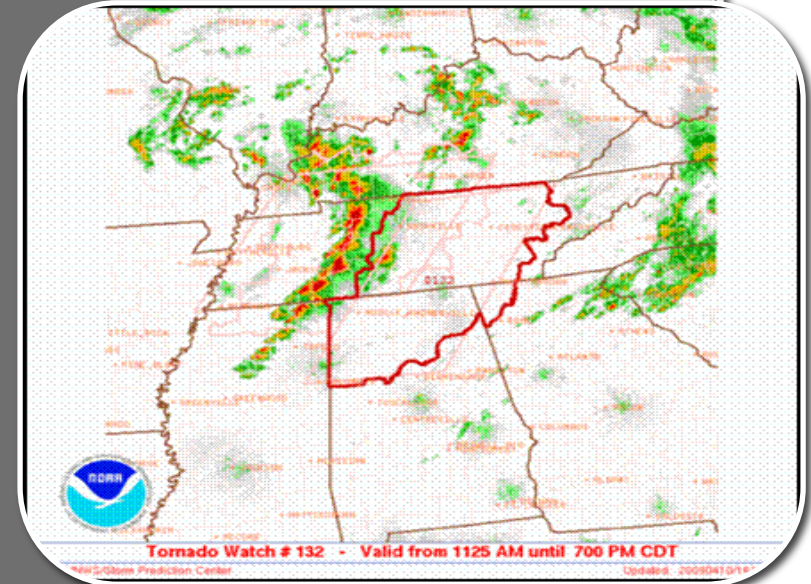
NWS Products



Watches

Tornado/Severe Thunderstorm/Flash Flood

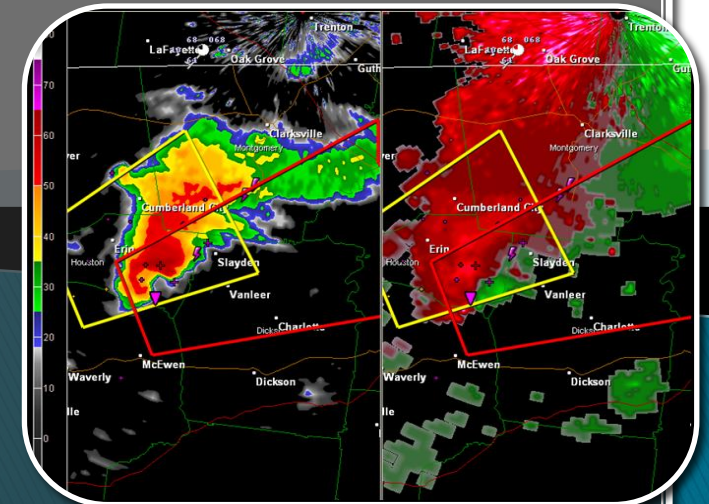
- Conditions are favorable
- Usually last 3 to 6 hours
- Watch the sky, be sure your NOAA Weather Radio is plugged in with fresh batteries



Warnings

Tornado/Severe Thunderstorm/Flash Flood

- Conditions are occurring or about to occur
- Issued by local NWS office, last 30-60 minutes
- Take Shelter if you go under a warning!



Watch vs Warning



What is a Special Weather Statement?

A thunderstorm that contains one or more of the following:

- Large amounts of cloud to ground lightning
- Winds of 30-58 mph
- Hail of 0.25" to 0.88" in diameter (pea to nickel-size)
- Rotation, but not strong enough to warrant Tornado Warning





NWS Products



Severe Thunderstorm Warning

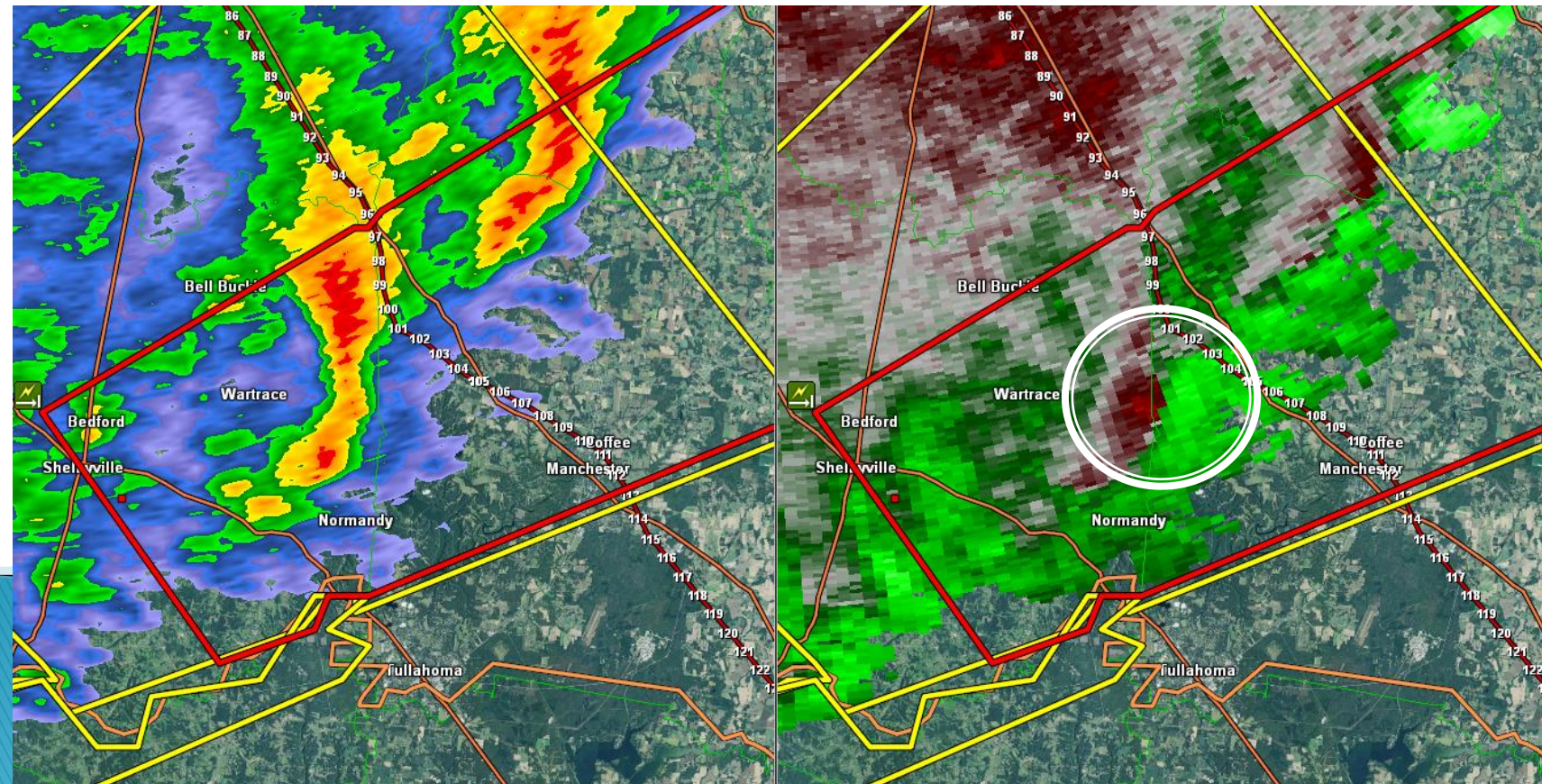
A severe thunderstorm contains one or more of the following:

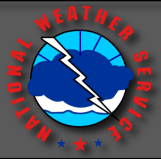
- Winds of 58 mph or higher
- Hail of 1" in diameter or larger (quarter-size)
- Tornado



Tornado Warning: Radar Indicated

- Tornado is likely to develop or is already occurring

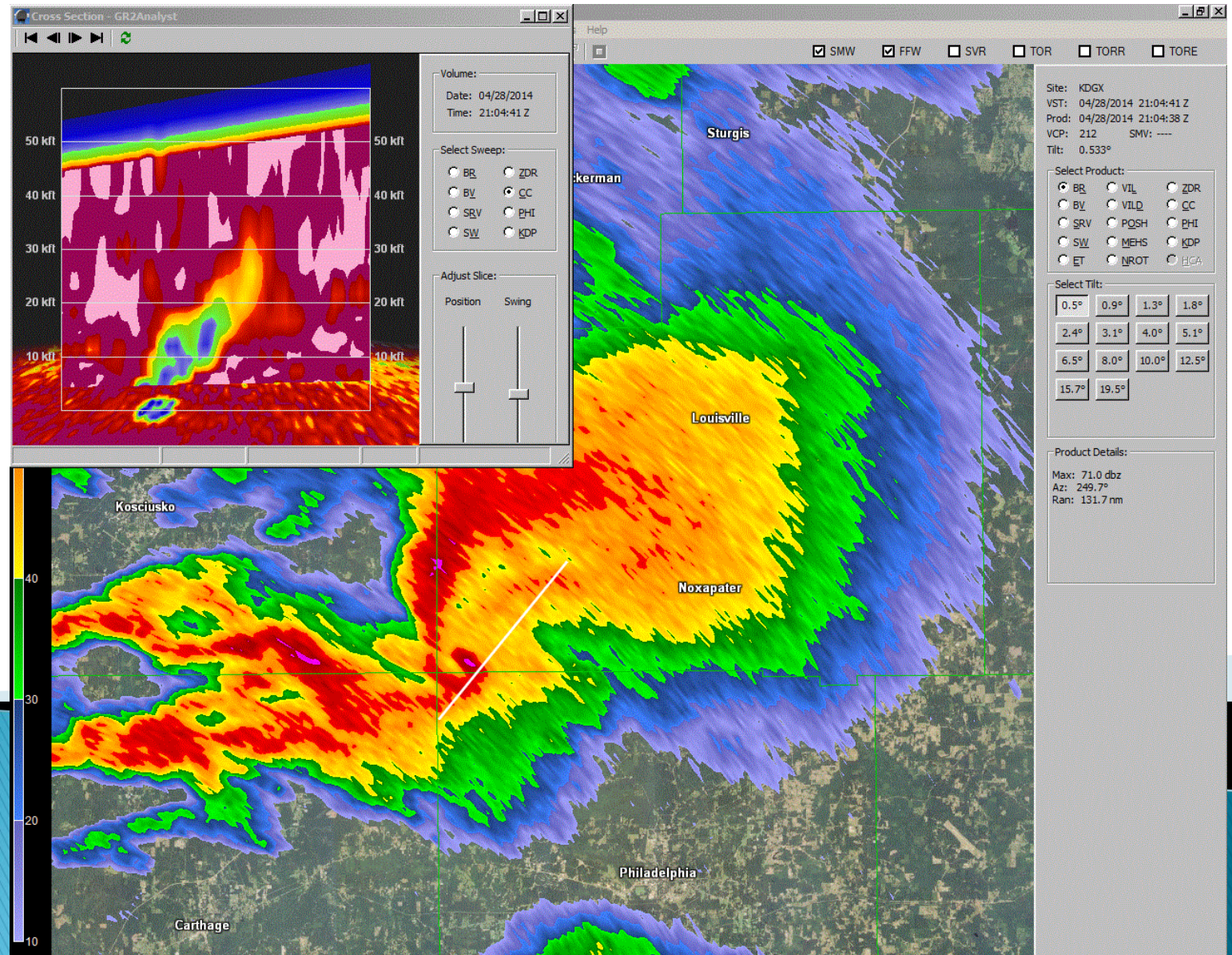




NWS Products



**Tornado
Warning:
Radar Confirmed**





NWS Products

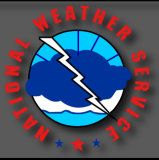


Flood Advisory

Heavy rainfall resulting in:

- Minor ponding on roadways or localized flooding
- Rises on area creeks & rivers





NWS Products



Flash Flood Warning

Heavy rainfall, typically from thunderstorms, resulting in:

- Significant flooding of roadways
- Cars stalling in flood waters
- Flooding of businesses & homes





Weather Safety Rules



Tornadoes

- Seek inside shelter in a basement or interior room on the lowest floor away from windows. *Put as many walls between you and outside as possible.*
- Go to designated shelter in office buildings, hotels, and shopping malls
- Find nearest available shelter in open country



EF Scale: Tornado Classification



Good vs. Bad Shelters

Good



Bad



STAY AWAY FROM WINDOWS!



Weather Safety Rules



Tornadoes: Schools

- Follow school tornado drills
- Go to interior hallways and small rooms away from windows
- Avoid large rooms like gymnasiums and cafeterias





Weather Safety Rules



Tornadoes: Mobile Homes

- Mobile homes are easily damaged and destroyed by tornadoes
- Can very easily be overturned
- If possible, abandon mobile homes for community shelter or sturdier building



Mobile Home vs Well Built
Structure both with EF-2 damage



Weather Safety Rules



Vehicles

- *Automobiles are not safe in tornadoes!*
- Abandon cars and trucks for a storm shelter or sturdy buildings if possible
- If sturdy shelter is not possible, get down in your car and cover your head or seek shelter in low lying ditch





Weather Safety Rules



Damaging Winds

- Take shelter inside a building away from glass
- If caught outdoors, stay away from trees and power lines

MILTON, Tenn. - A man was killed in Rutherford County when a tree fell on him during a thunderstorm.

The storm passed through the area around 6:12 p.m. bringing with it reports of hail and strong winds.

Fire Chief, Larry Farley, said the 64-year-old man was riding a ATV toward his house when a large hickory tree fell on top of him.





Weather Safety Rules



Large Hail

- Take shelter inside a building away from glass
- If in a vehicle, stay inside and wait for hail to end



Quarter to
Ping Pong Ball Hail





Weather Safety Rules



Lightning

- *When thunder roars, go indoors!*

See a flash dash inside!

- Take shelter inside a building or automobile
- Stay away from all wired electronics and plumbing



**When
Thunder
Roars,
Go Indoors!**

STOP all activities.

Seek shelter in a substantial building
or hard-topped vehicle.

Wait 30 minutes after the storm to
resume activities.

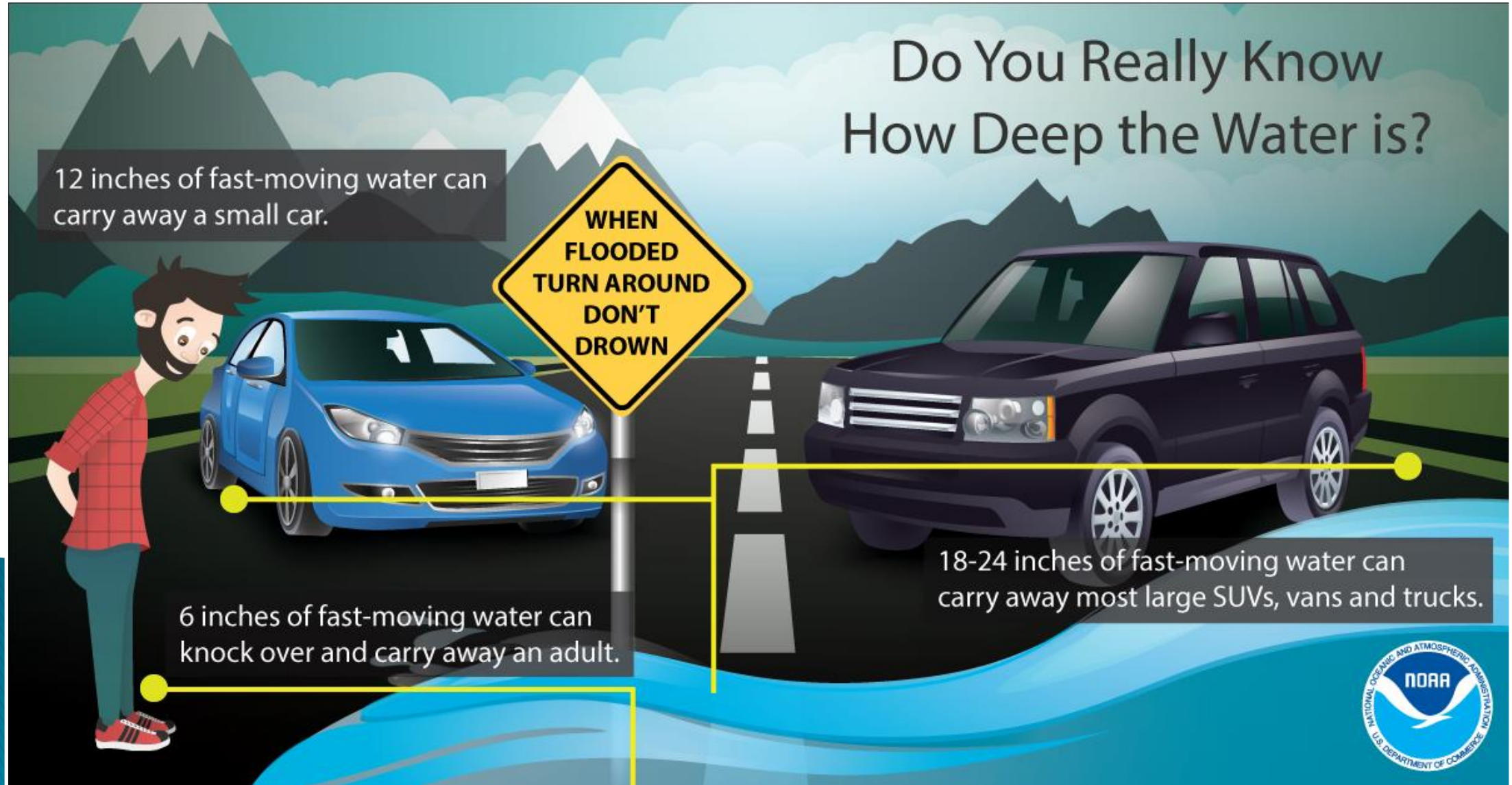


www.lightningsafety.noaa.gov





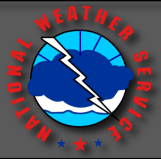
Weather Safety Rules



Flash Flooding

- Never drive around barricades – the water may be deeper than you think
- Don't cross flooded roadways – the road may not be there!



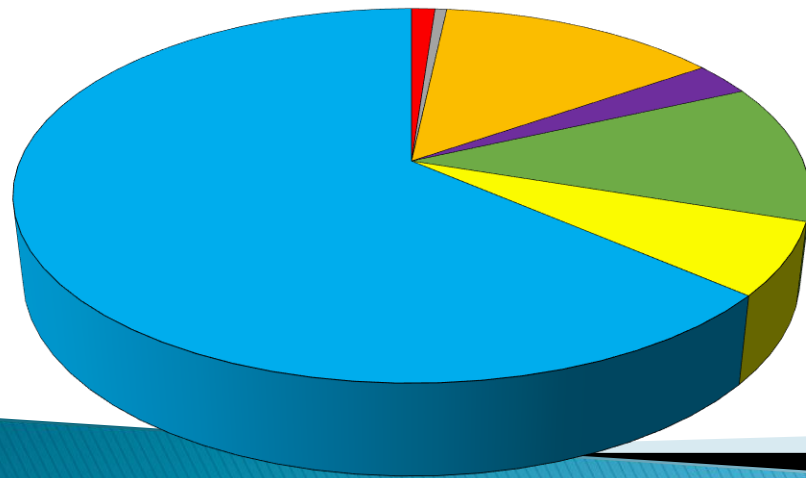


Weather Safety Rules



Flash Flooding: *The #1 weather-related killer*

2015 Flash Flood Fatalities
Activities of Victims



- | | | |
|------------------|---------------|-----------|
| ■ Boating | ■ Business | ■ Camping |
| ■ In Water | ■ Mobile Home | ■ Other |
| ■ Permanent Home | ■ Vehicle | |



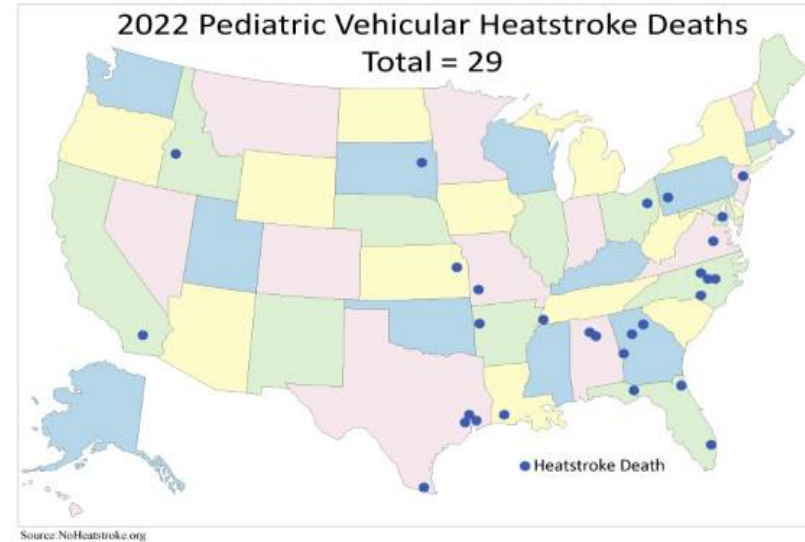



Weather Safety Rules



Heat

- Look before you lock
- Pets in cars / outdoors
- Elderly
- People with chronic health issues
- Pregnant women



| Heat Exhaustion | Heat Stroke |
|--|--|
| ACT FAST <ul style="list-style-type: none">• Move to a cooler area• Loosen clothing• Sip cool water• Seek medical help if symptoms don't improve | ACT FAST CALL 911 <ul style="list-style-type: none">• Move person to a cooler area• Loosen clothing and remove extra layers• Cool with water or ice |
| <i>Dizziness</i> <i>Thirst</i> <i>Heavy Sweating</i> <i>Nausea</i> <i>Weakness</i> | <i>Confusion</i> <i>Dizziness</i> <i>Becomes Unconscious</i> |
|  | |
| <i>Heat exhaustion can lead to heat stroke.</i> | |
| <i>Heat stroke can cause death or permanent disability if emergency treatment is not given.</i> | |

Stay Cool, Stay Hydrated, Stay Informed!



Weather Safety Rules



Cold / Winter

- Prepare: Emergency kit for your car
- Exposure kills: dress in layers and protect skin
- Driving: slow down and leave extra distance between vehicles

ICE & SNOW, TAKE IT SLOW

Each year in the U.S., there are over **1,000 deaths** and **100,000 injuries** due to vehicle crashes during winter weather.

DID YOU KNOW?



Clean off your vehicle before driving.
Flying snow from cars causes accidents.



Keep it slow, and don't use cruise control.
Roads can be slick even if they just look wet.



Leave extra distance between vehicles.
Stay especially far from snow plows.



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DON'T FORGET YOUR PETS



Even with a natural fur coat, **winter can be deadly** for your pets unless proper care is given.



Keep them warm and dry,
and indoors whenever possible.



Provide plenty of food and water.
Dehydration is especially dangerous in winter.



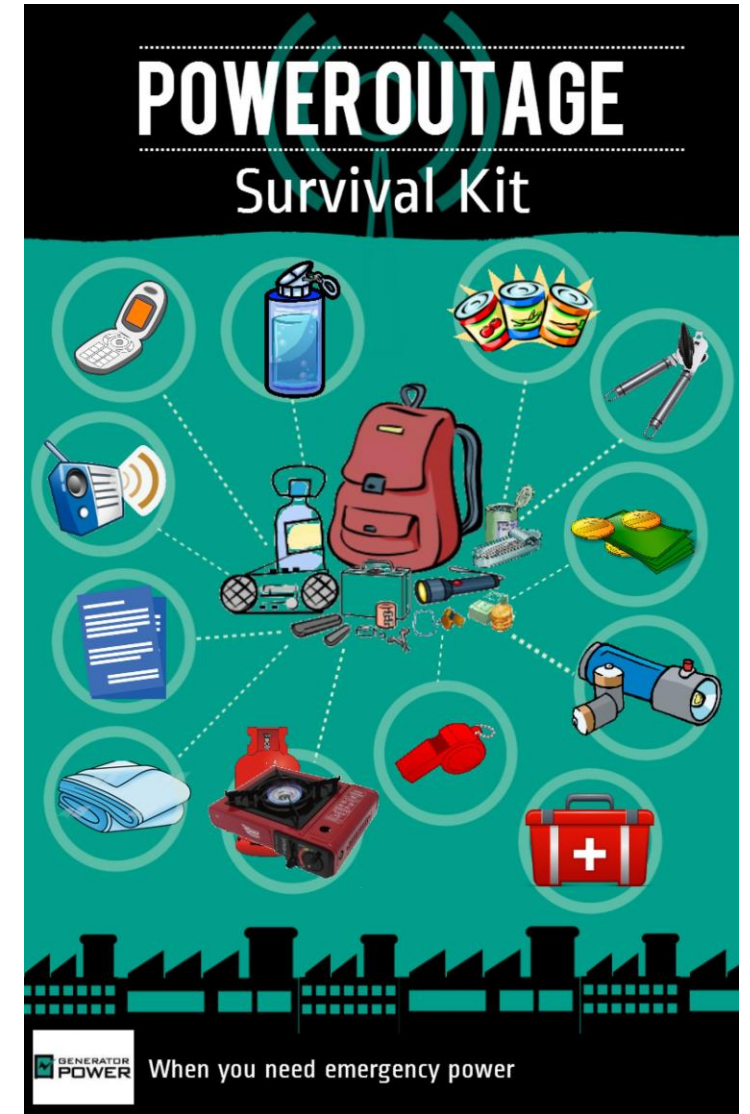
When outside, keep them bundled up.
Limit outside time, and thoroughly clean (including paws) when bringing them in



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Build a Disaster Supply Kit and Go Bag

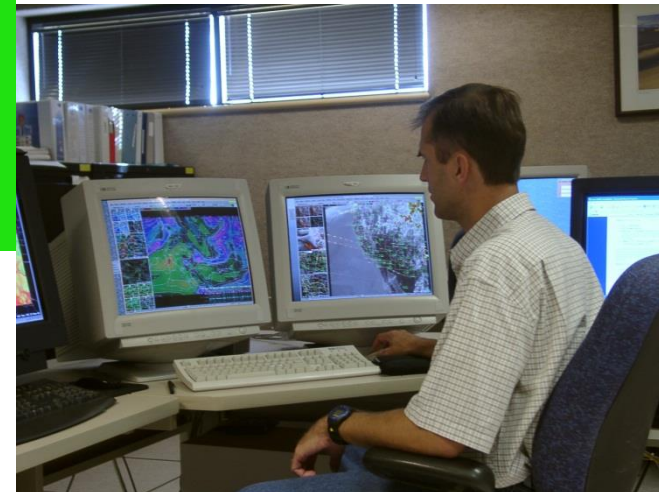


Careers in Meteorology

Educational Requirements: Bachelor of Science in Meteorology or Atmospheric Science (4 years)

What can I do with a degree in Meteorology?

- Operational Meteorologist (forecaster)
- Broadcast Meteorologist (TV or radio)
- Researcher
- Climatologist
- Educator
- Meteorological Consultant
- Atmospheric Modeling
- Marketing
- Instrumentation Design
- Emergency Management
- Air Quality



Careers in Meteorology

Who Employs Meteorologists?

- Government: National Weather Service, Military, Forest Service
- Private Companies: commercial weather companies, media, airlines, insurance companies, large sales companies, universities
- Research: government, universities, private companies

Things to consider:

- 1) Earning a degree in Meteorology/Atmospheric Science is hard work! It requires a lot of calculus and physics.
- 2) Most weather offices are open 24 hours a day, 7 days a week. Most Meteorologists are required to work shiftwork, weekends, and holidays.
- 3) There are more degrees in Meteorology being awarded than there are jobs available. You may not get the job you want right out of college.

Questions?

Thank you for attending!

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