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# Weather Apps

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PMUG SIG, JUNE 2022

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# My Qualifications to talk about Weather

- Introduced to weather analysis for two semesters at Air Force Academy
  - Studied weather while training to be a pilot where weather is critical
  - Flew WC-130's for 2 years and had a full time Meteorologist on board with either BS or MS in Meteorology
  - Flew into Typhoons, Cumulonimbus Clouds for cloud seeding, fog (Zero visibility) for fog dispersal
  - Continued interest while doing Search and Rescue in Rocky Mountains
  - Lived on several islands susceptible to hurricanes and typhoons (island person)
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# Weather Apps

- What is weather?
  - Key statistics reported by Apps and collected by NWS
  - Making sense of the information
  - Forecasting is based on Modeling and its data inputs
  - LOTS & LOTS & LOTS OF APPS
  - What is important to you when choosing an App
  - The “Weather Rock” method of forecasting
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# What is Reported by Apps (if good)

- Basic Temperature (High, Low, Hourly)
  - Basic Condition (Sunny, Cloudy, Foggy, Rainy, Thunderstorms, etc)
  - Air Quality (index goes from 0 - great, to 500 - stay inside or die)
  - Humidity (Amount of moisture in the air where 100 is rain/fog)
  - UV Index (from 1 - good, to 11 - extreme risk)
  - Wind speed and direction
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# What is Reported by Apps (if good)

- Percent chance of precipitation and type
  - Cloud Cover
  - Visibility
  - Pollen count
  - Satellite or Radar images
  - Sunrise/Sunset
  - Historical Data
-

# Air Quality Index

## AQI Basics for Ozone and Particle Pollution

Daily AQI Color	Levels of Concern	Values of Index	Description of Air Quality
Green	Good	0 to 50	Air quality is satisfactory, and air pollution poses little or no risk.
Yellow	Moderate	51 to 100	Air quality is acceptable. However, there may be a risk for some people, particularly those who are unusually sensitive to air pollution.
Orange	Unhealthy for Sensitive Groups	101 to 150	Members of sensitive groups may experience health effects. The general public is less likely to be affected.
Red	Unhealthy	151 to 200	Some members of the general public may experience health effects; members of sensitive groups may experience more serious health effects.
Purple	Very Unhealthy	201 to 300	Health alert: The risk of health effects is increased for everyone.
Maroon	Hazardous	301 and higher	Health warning of emergency conditions: everyone is more likely to be affected.

# UV Index

<b>1-2</b> ("Low")	<p>A UV Index reading of 2 or less means low danger from the sun's UV rays for the average person:</p> <ul style="list-style-type: none"><li>▪ Wear sunglasses on bright days. In winter, reflection off snow can nearly double UV strength.</li><li>▪ If you burn easily, cover up and use sunscreen of at least SPF-30.</li></ul>
<b>3-5</b> ("Moderate")	<p>A UV Index reading of 3 to 5 means moderate risk of harm from unprotected sun exposure.</p> <ul style="list-style-type: none"><li>▪ Take precautions, such as covering up, wearing a hat and sunglasses, if you will be outside. Use sunscreen of at least SPF-30.</li><li>▪ Stay in shade near midday when the sun is strongest.</li></ul>
<b>6-7</b> ("High")	<p>A UV Index reading of 6 to 7 means high risk of harm from unprotected sun exposure. Protection against sun damage is needed.</p> <ul style="list-style-type: none"><li>▪ Reduce time in the sun between 10 a.m. and 4 p.m.</li><li>▪ Cover up, wear a hat and sunglasses, and use sunscreen with a SPF of at least 30.</li></ul>
<b>8-10</b> ("Very High")	<p>A UV Index reading of 8 to 10 means very high risk of harm from unprotected sun exposure. Protection against sun damage is needed.</p> <ul style="list-style-type: none"><li>▪ Take extra precautions. Wear a wide-brimmed hat and sunglasses, use sunscreen of at least SPF-30, and wear a long-sleeved shirt and pants if practical.</li><li>▪ Minimize sun exposure between 10 a.m. and 4 p.m.</li><li>▪ White sand on the beach will reflect UV rays and can double UV exposure.</li></ul>
<b>11+</b> ("Extreme")	<p>A UV Index reading of 11 or higher means extreme risk of harm from unprotected sun exposure. Try to avoid sun exposure during midday hours, from 10 a.m. to 4 p.m. Apply sunscreen with an SPF of at least 30 liberally every 2 hours.</p> <ul style="list-style-type: none"><li>▪ Take all precautions. Unprotected skin can burn in minutes. Beachgoers should know that white sand and other bright surfaces reflect UV and will increase UV exposure.</li><li>▪ Try to avoid sun exposure between 10 a.m. and 4 p.m.</li><li>▪ Seek shade, cover up, wear a hat and sunglasses, and use sunscreen.</li></ul>

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# What is Reported by NWS

- Same as Apps plus:
  - Pressure at Sea Level (extrapolated from barometer reading at location)
    - 29.92 inches of mercury or 1013.25 millibars - High & Low Pressure systems
  - Dewpoint - the temperature at which the humidity is 100% and clouds can form
  - Visibility - usually stated in miles
  - Fronts - Air masses moving across the land
    - Warm front, cold front, stationary front, occluded front
-



# NWS Forecasts:

## Current conditions at Prescott, Love Field (KPRC)

Lat: 34.64917°N Lon: 112.42222°W Elev: 5043ft.



Clear  
**72°F**  
22°C

**Humidity** 12%  
**Wind Speed** WSW 6 MPH  
**Barometer** 29.86 in (1011.18 mb)  
**Dewpoint** 18°F (-8°C)  
**Visibility** 10.00 mi  
**Last update** 30 May 11:05 AM MST

**More Information:**  
[Local Forecast Office](#)  
[More Local Wx](#)  
[3 Day History](#)  
[Mobile Weather](#)  
[Hourly Weather Forecast](#)

## Extended Forecast for Prescott AZ

**Memorial Day**



Sunny and Breezy

**High: 73 °F**

**Tonight**



Mostly Clear

**Low: 47 °F**

**Tuesday**



Sunny

**High: 81 °F**

**Tuesday Night**



Clear

**Low: 48 °F**

**Wednesday**



Sunny

**High: 86 °F**

**Wednesday Night**



Clear

**Low: 54 °F**

**Thursday**



Sunny

**High: 88 °F**

**Thursday Night**



Mostly Clear

**Low: 56 °F**

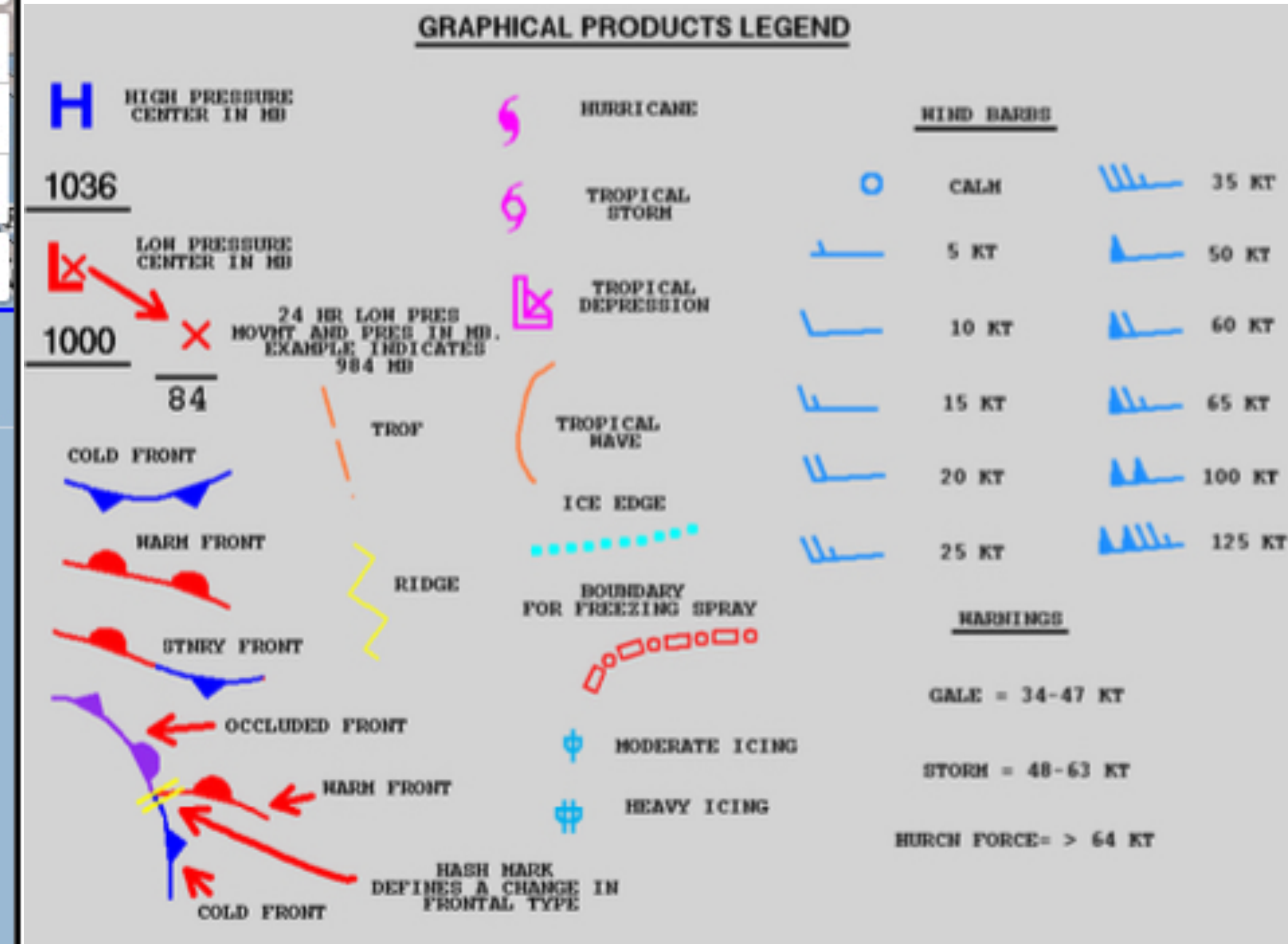
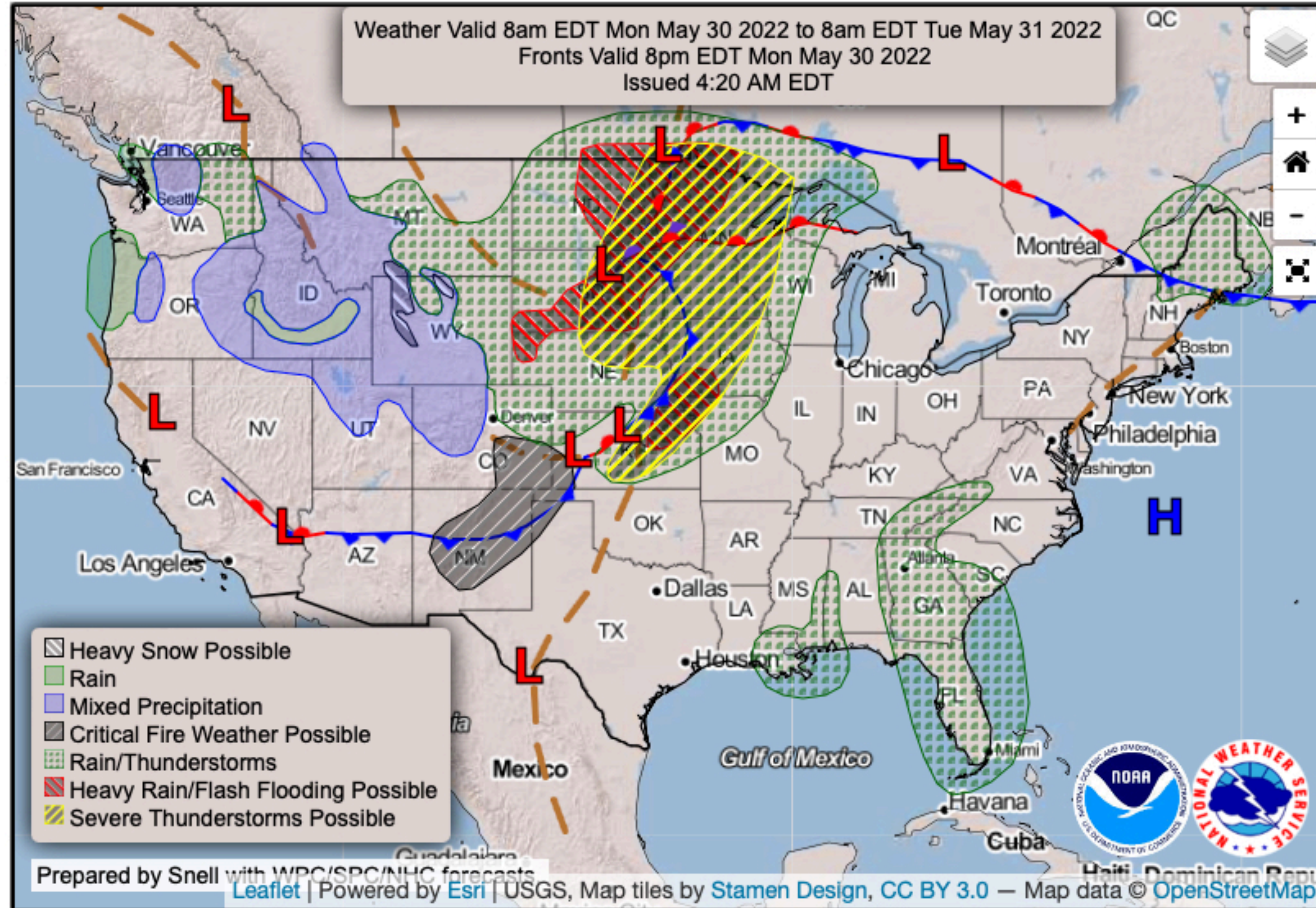
**Friday**



Sunny

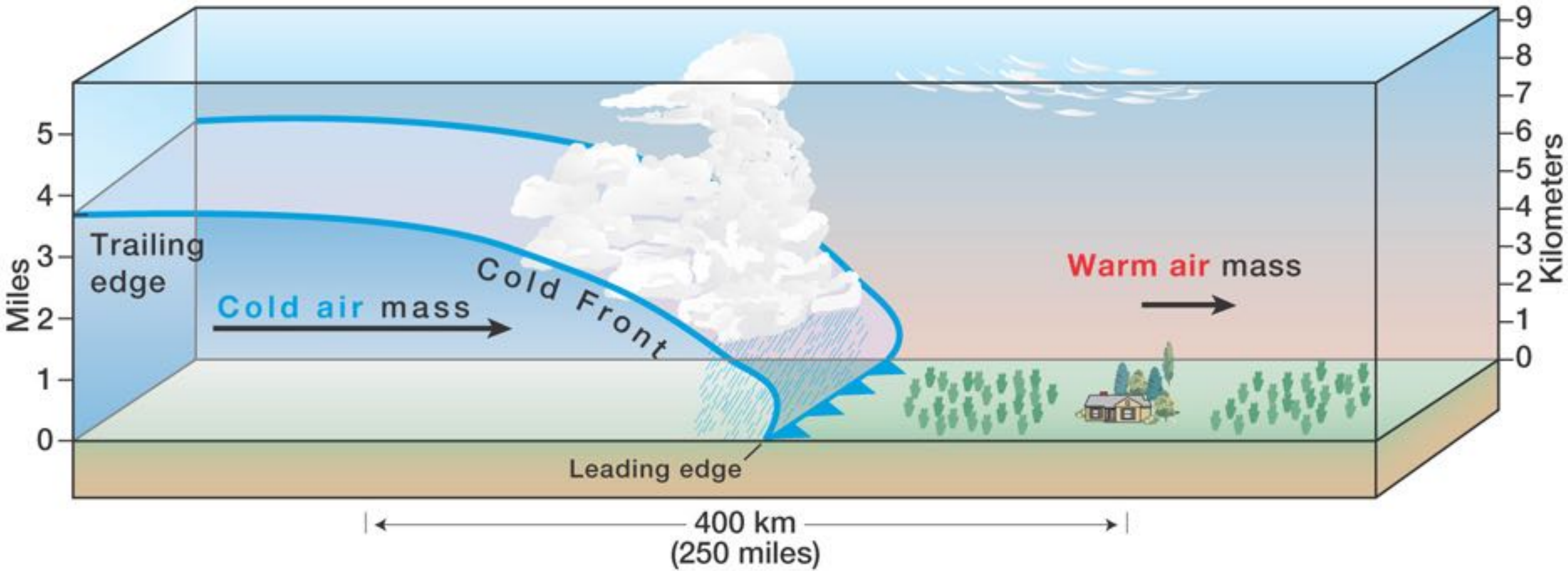
**High: 86 °F**

# NWS Forecasts:



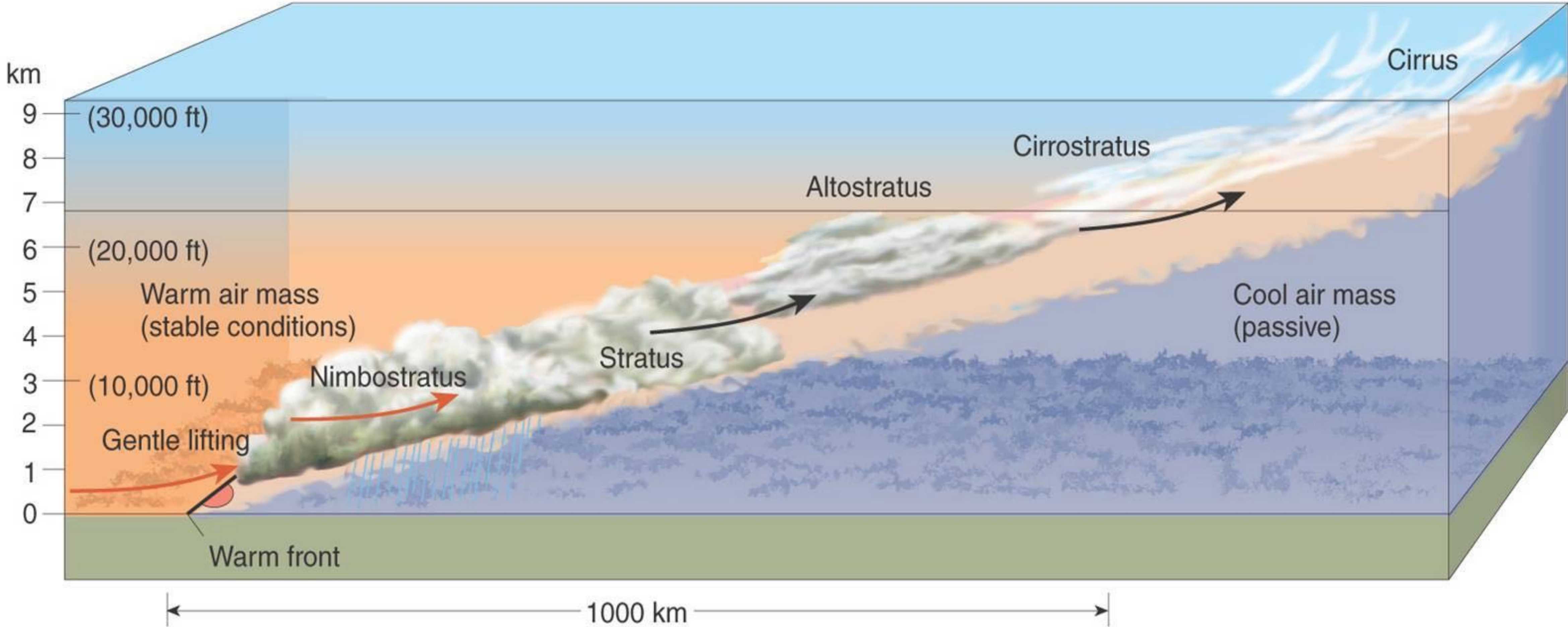
<https://www.wpc.ncep.noaa.gov/NationalForecastChart/map.php#>

# Cold Front



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# Warm Front

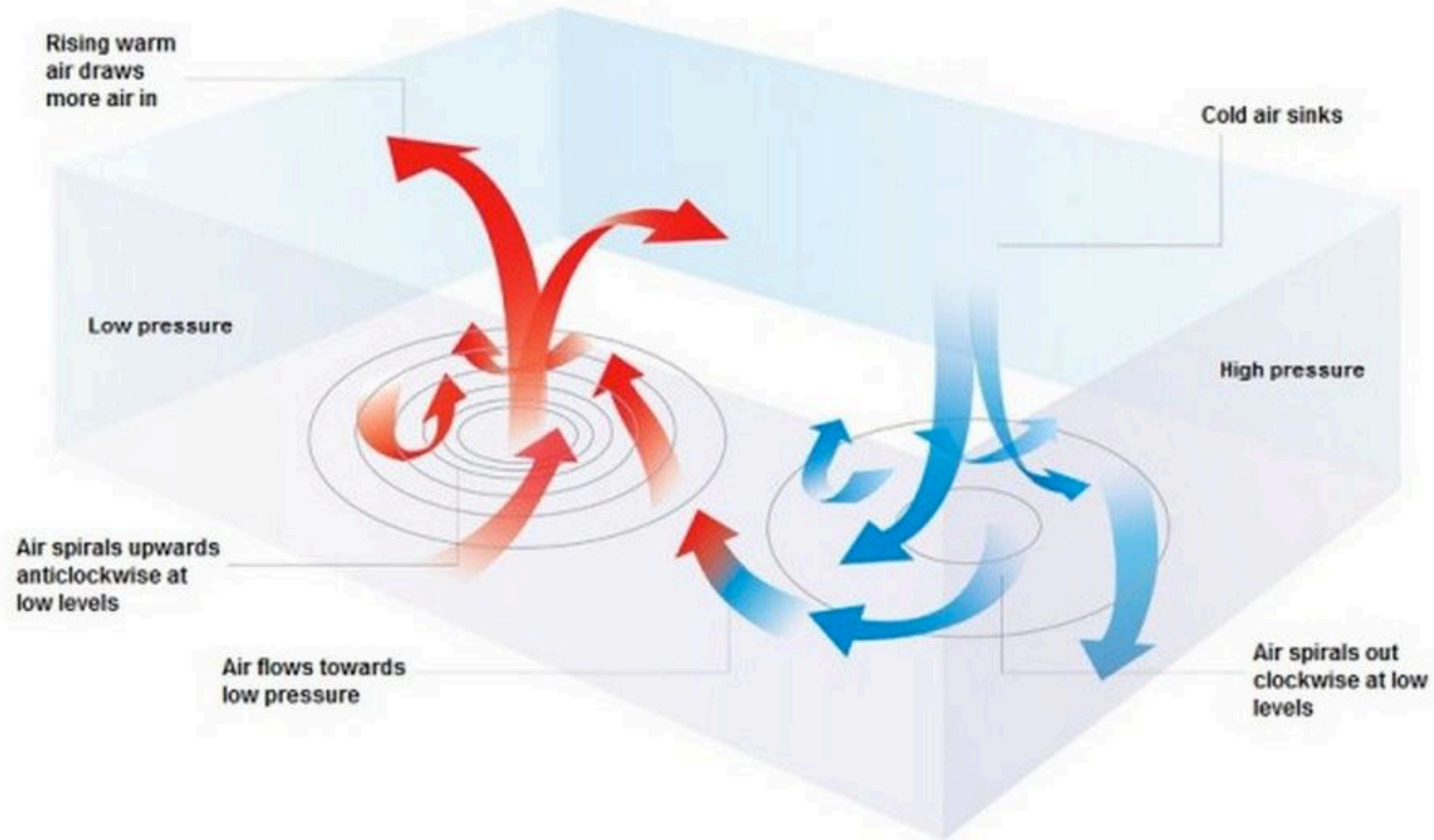


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# NWS Forecasts - So What

- Low pressure means rising air: thunderstorms - Counter Clockwise wind circulation
  - High Pressure means sinking air: stable weather - Clockwise wind circulation
  - High and Low close to each other creates strong wind trough
  - Cold front means lower temperature (duh); the cold air holds less moisture; cold air sinks under warmer air ahead of front; pressure decreases after frontal passage
  - Warm front means higher temperature; the warm air holds more moisture; warm air rises over colder air ahead of front which can bring some form of steady rain; pressure increases after frontal passage
-

# Pressure Systems



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# Weather Satellites

## Visible satellite imagery...

- is based on the albedo of objects (the fraction of incoming sunlight that is reflected to the satellite).
  - can tell you about the thickness of clouds (thicker clouds have higher albedos and appear brighter than thinner clouds, which have lower albedos).
  - can be used to distinguish between snow cover and clouds, given that surface features such as lakes and rivers can be observed.
  - is ***not*** able to detect clouds (or anything else) during the satellite's local night (visible imagery requires sunlight).
  - is ***not*** useful for determining whether precipitation is present under the observed clouds.
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# Weather Satellites

## Infrared satellite imagery...

- is based on the fact that measuring an object's infrared emission tells you something about its temperature.
- displays the temperature of either cloud tops or the earth's surface (if the sky is clear).
- can be combined with the assumption that temperature decreases with height to determine cloud-top heights. Colder cloud-tops (lower temperatures) mean higher clouds.
- is ***not*** able to give any *direct* indication of cloud thickness or the presence of precipitation (although inferences can be made in some cases).

This is Thermal infrared imagery using emitted IR energy

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# Weather Satellites

## Water Vapor imagery...

- uses infrared radiation; except unlike traditional infrared imagery, it uses wavelengths at which water vapor strongly emits and absorbs infrared radiation.
  - displays the temperature of the effective layer. Warm effective layers mean that the middle to upper troposphere contains very little water vapor (that is, they're "dry"). By comparison, colder effective layers indicate a higher concentration of water vapor and/or ice clouds in the upper troposphere.
  - is ***not*** able to give any measure of the atmospheric water vapor content below the effective layer.
  - ***usually does not*** show the presence of low clouds or water vapor near the surface. These almost always lie below the effective layer.
  - is used to trace air motions in the middle and upper troposphere, even in areas with no clouds.
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# Weather Radar

## Radar imagery...

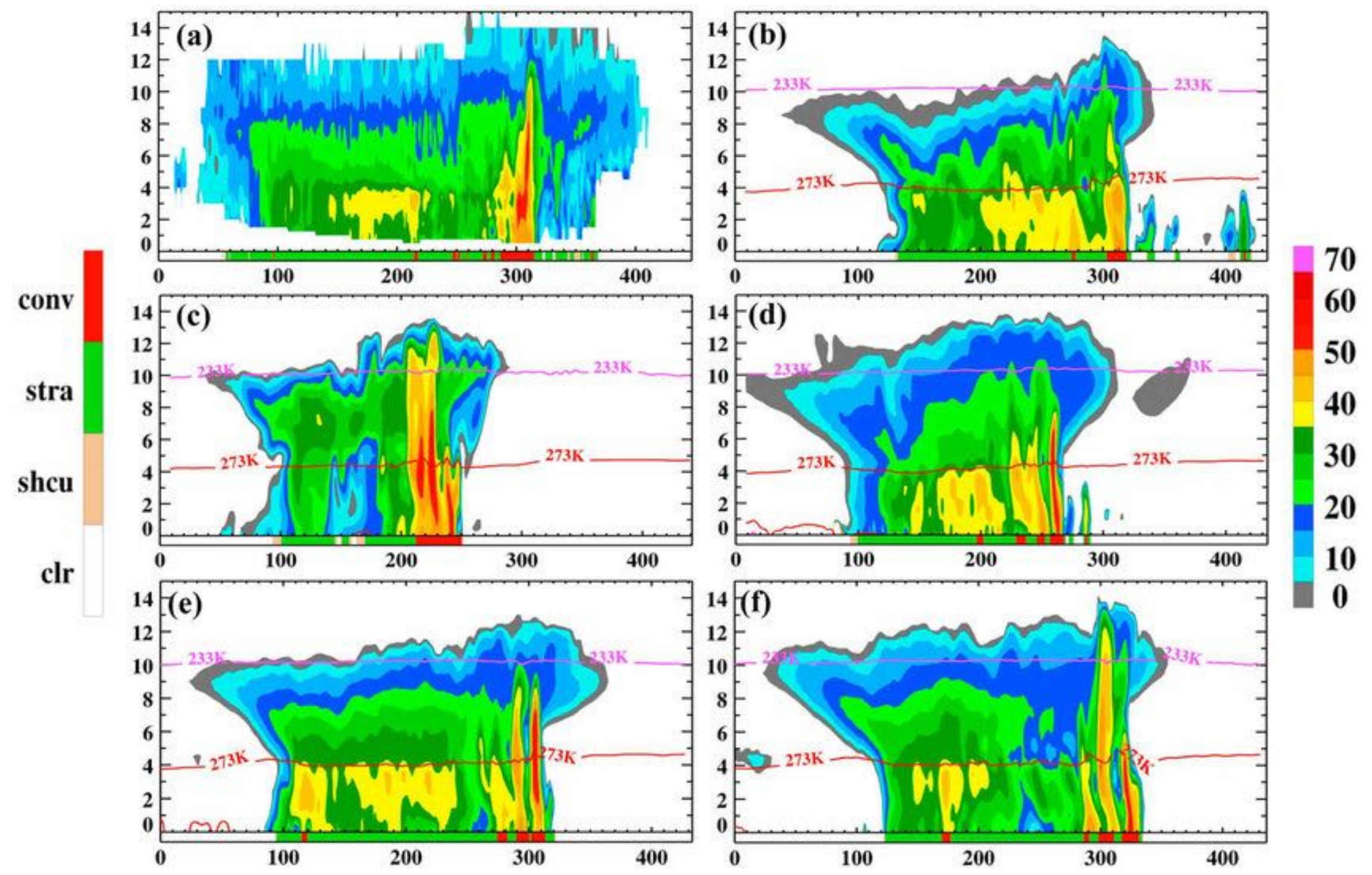
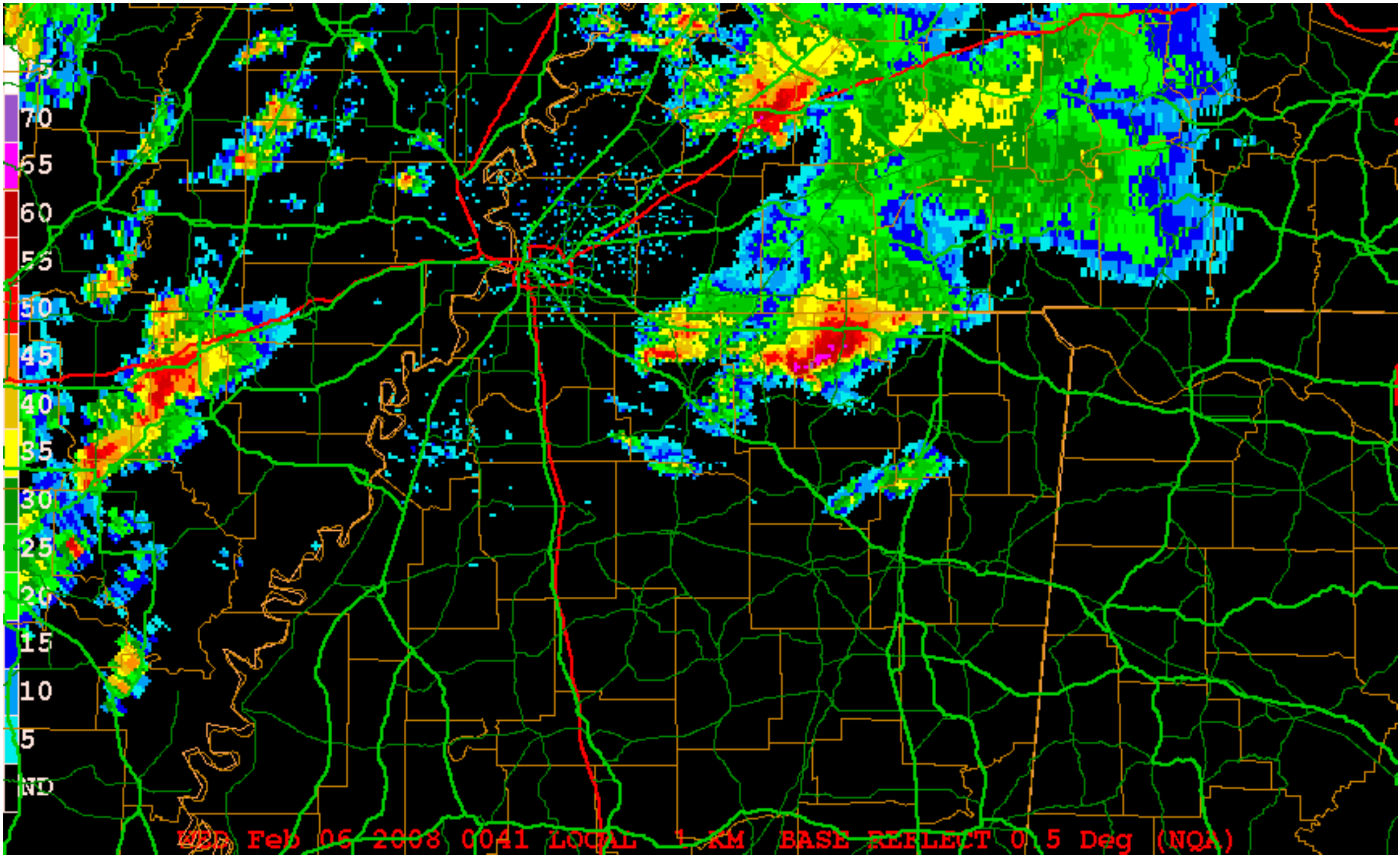
- originates from ground-based sensors (**not** from satellites) that actively emit pulses of radiation.
  - uses the microwave part of the electromagnetic spectrum (**not** the infrared).
  - usually displays the variable "reflectivity" (units dBZ) which is the measure of the amount of signal returned to the radar from the original transmitted pulse.
  - can help forecasters detect areas of precipitation (via reflectivity) as well as potential areas of severe weather via Doppler velocities and dual polarization data.
  - **cannot** tell you anything about cloud top temperature, cloud height, or cloud thickness.
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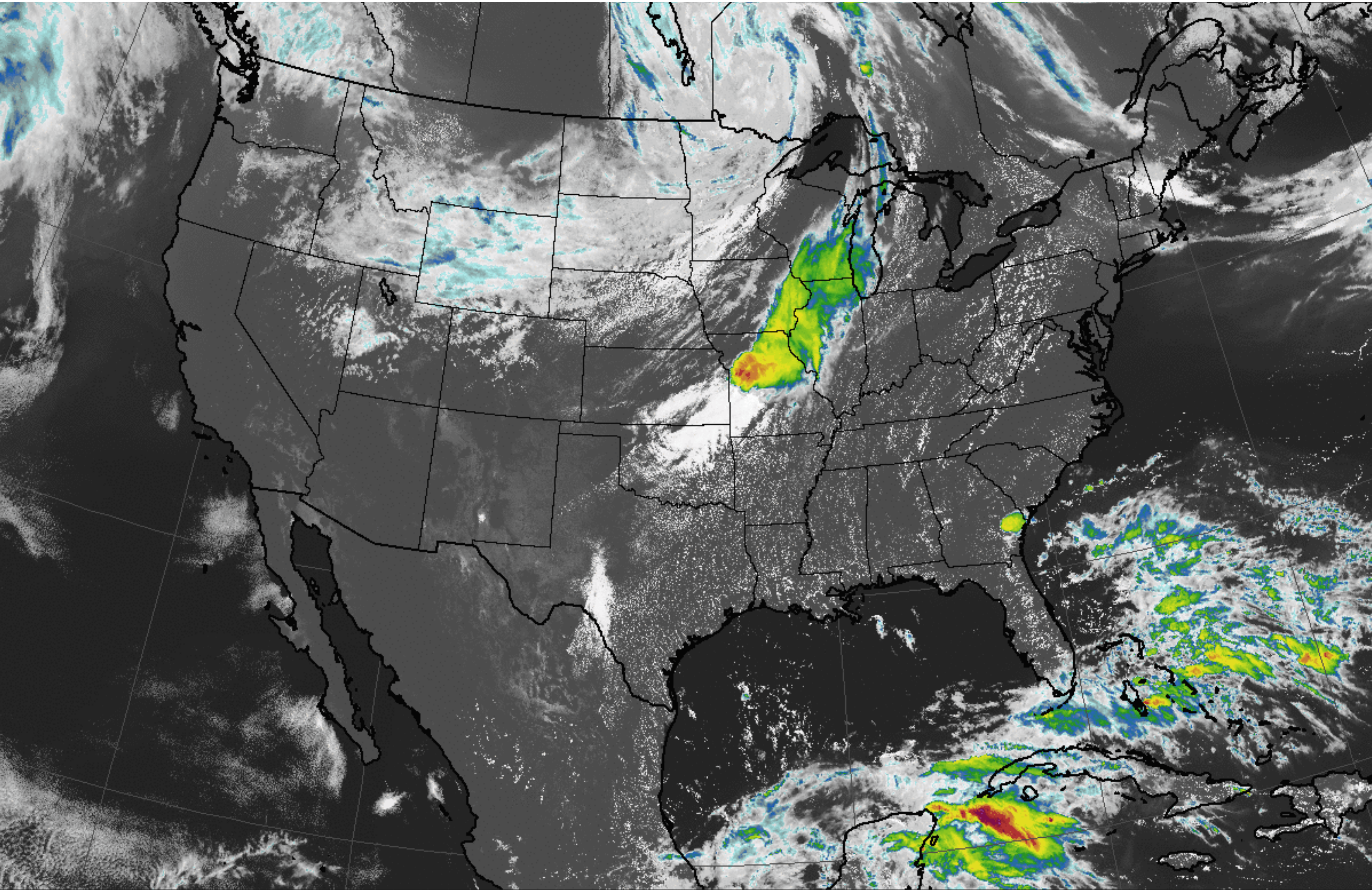
# Ground Doppler Weather Radar

- Sites (>120) all over the US
  - Antenna sends out short pulses of microwave energy
  - Reflected by the object and information is determined by calculating time, phase, shape, position and form of raw data from the object
  - Allow us to “see” inside the clouds
  - Can detect the particle type (rain, snow, hail, insects), intensity and motion
  - Can determine the structure of storms and predict severity
-

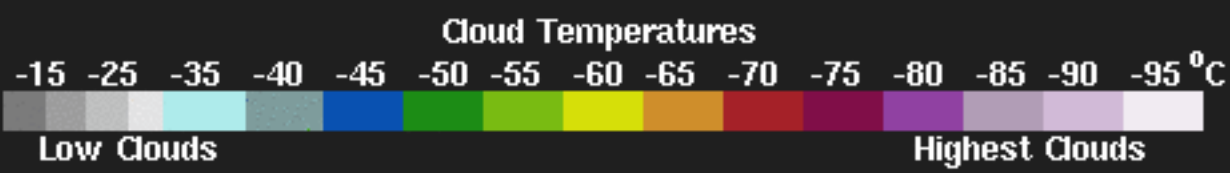
# Ground Doppler Weather Radar



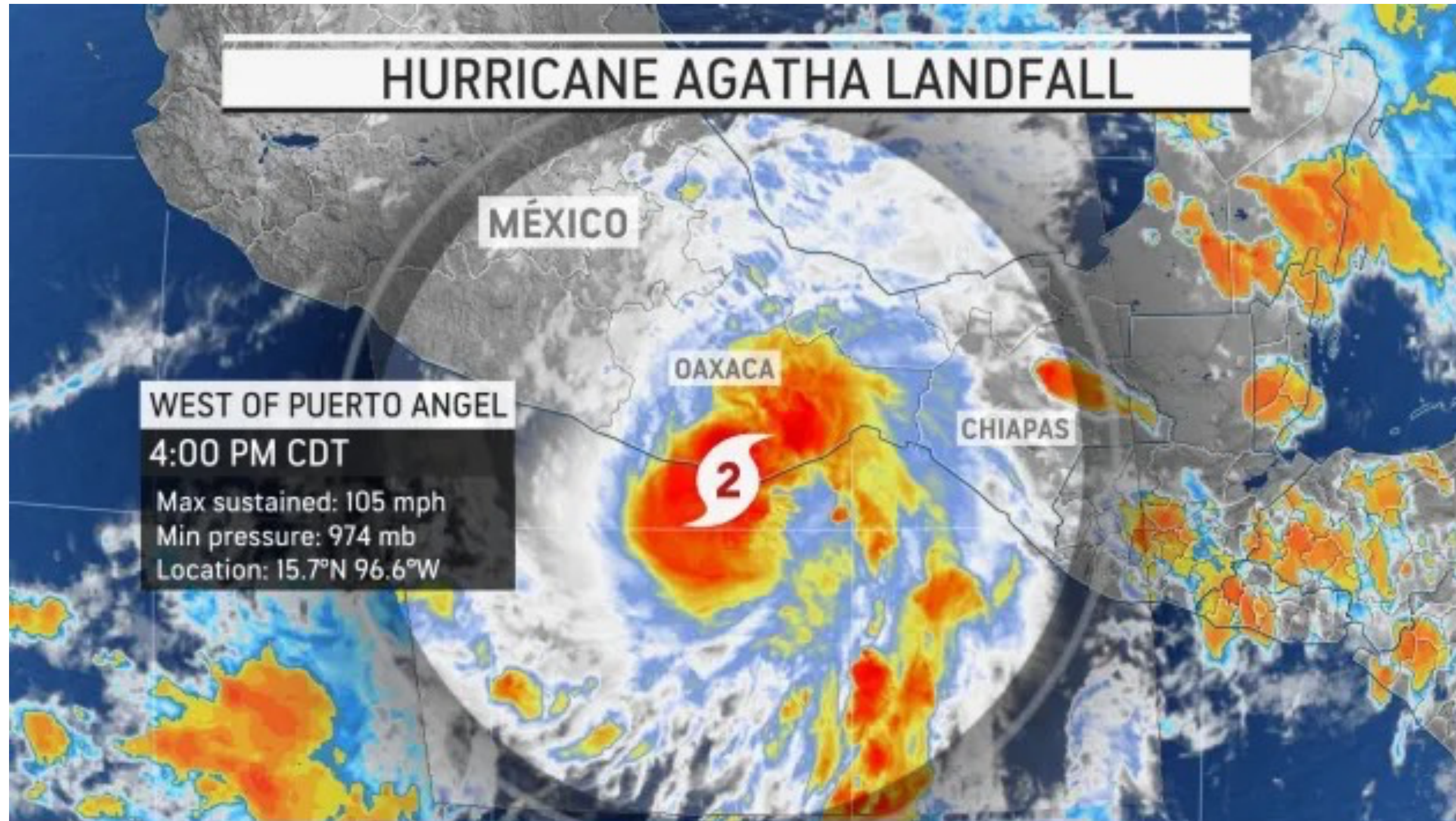
# Visible & MIR Reflective Satellite Imagery



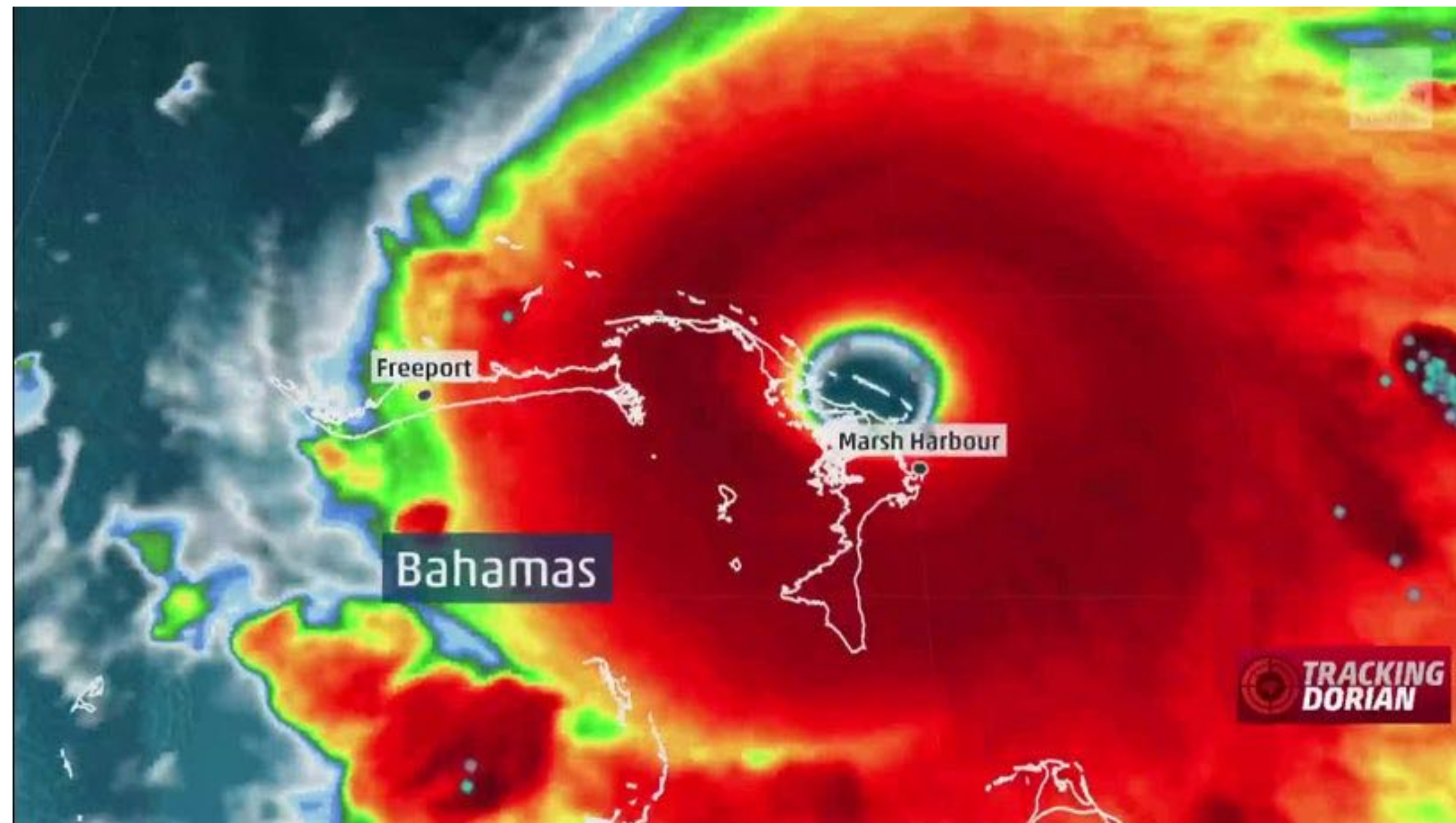
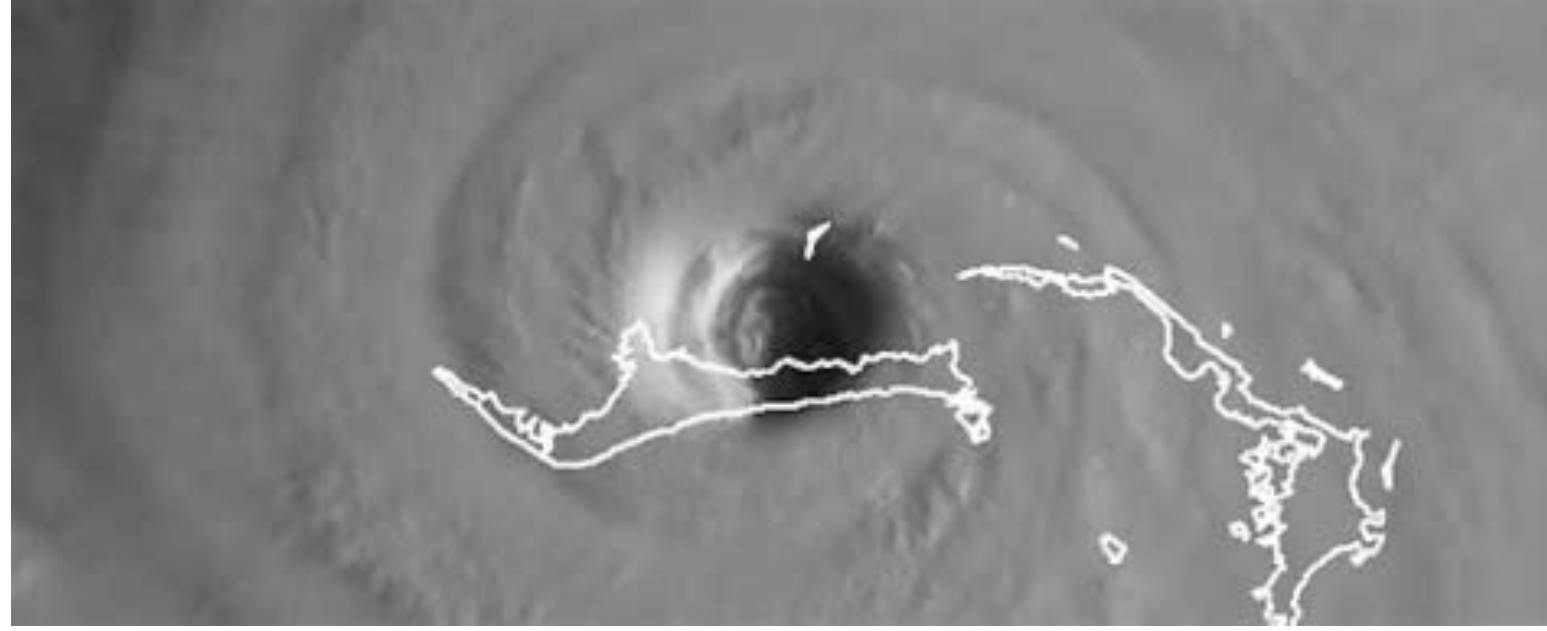
**U.S. Infrared +**  
01:30 PM EDT Tue May 31, 2022 (GMT -0400)  
Source: Geostationary Satellite



# Doppler Radar merged with Satellite

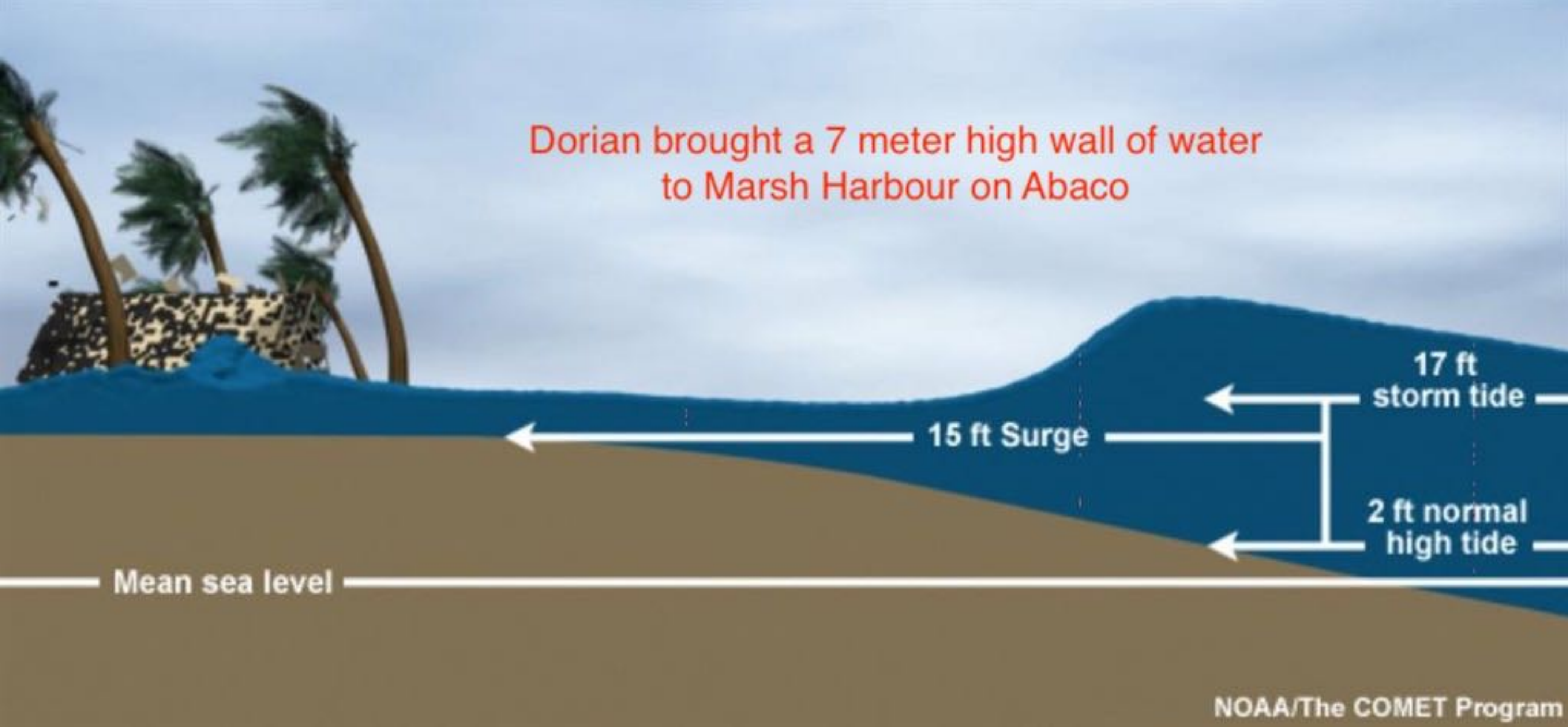


# Hurricane Dorian



- 185mph (gusting to 220mph) winds
- 20+ foot storm surge
- 26.87 in mercury pressure
- Strongest landfall in Atlantic basin
- Worst natural disaster in Bahamas

# What is a Storm Surge?





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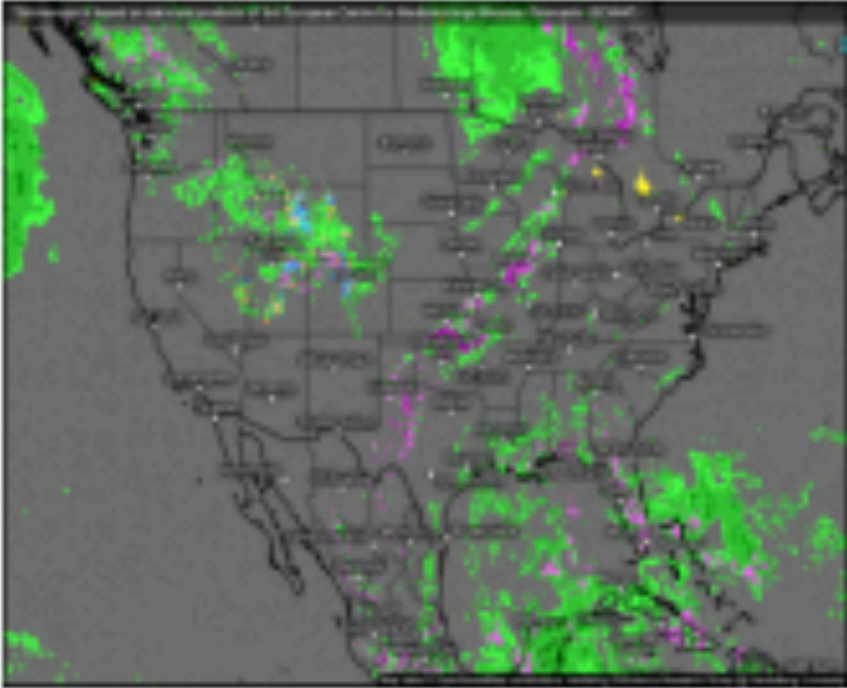
# Weather Forecasting Models

- Where is the nearest NWS office in relation to your location
  - How many observation points are around your location
  - What input layers are used (ground observations, satellite, radar, etc)
  - Models get progressively incorrect the further out in time they go
  - If you have mountains, find the model/app with the best information for your location
  - Which Model are they using
  - Meteorologists STILL run and view the models, and make their own corrections (or guesses)!
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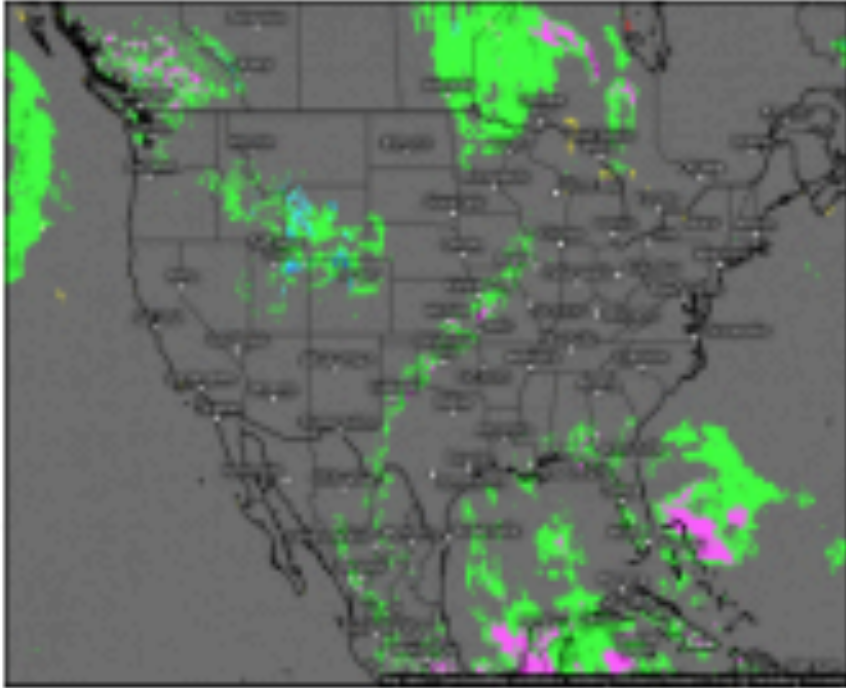
# Weather Forecasting Models

## Model charts

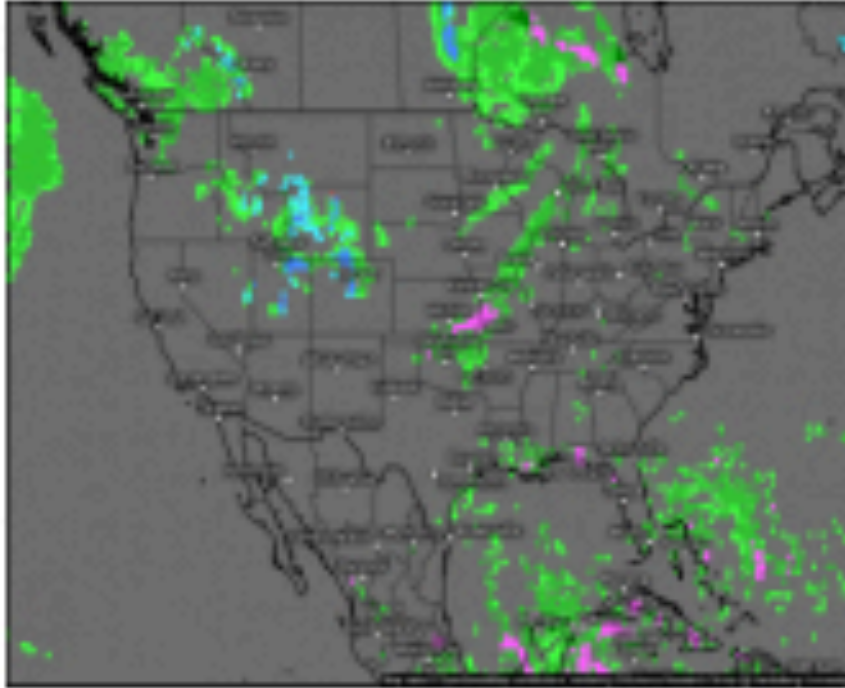
ECMWF



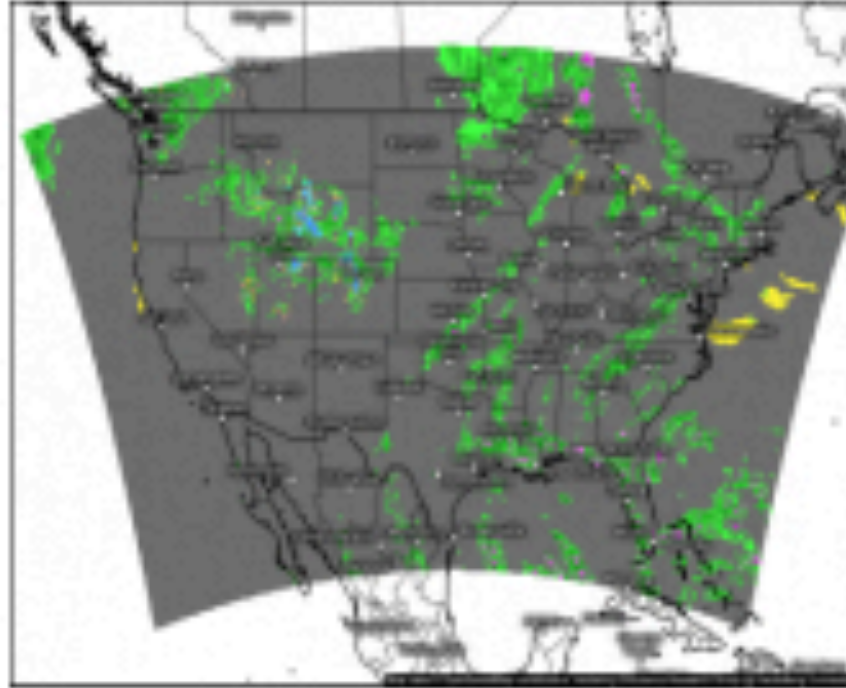
ICON



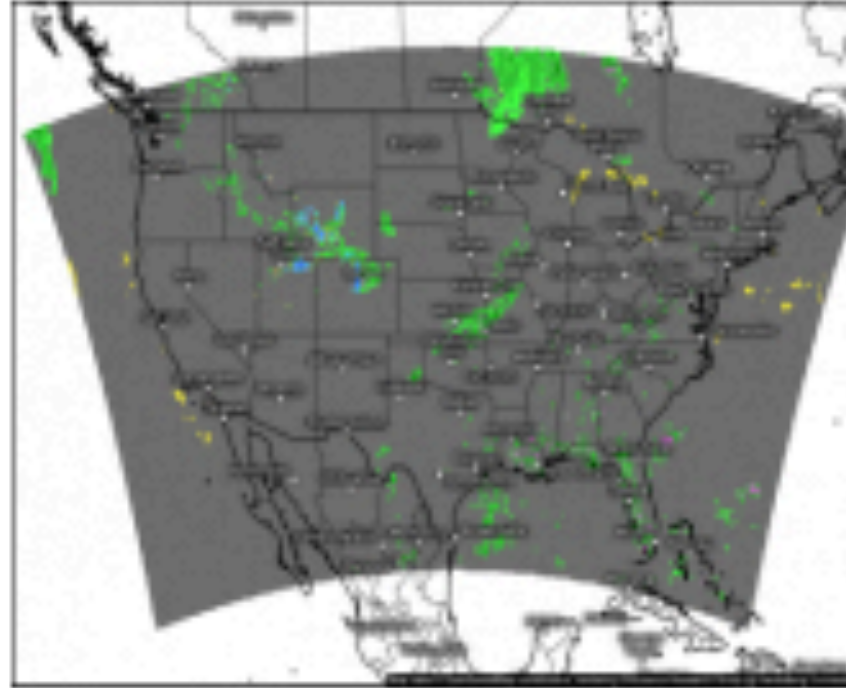
GFS



NAM

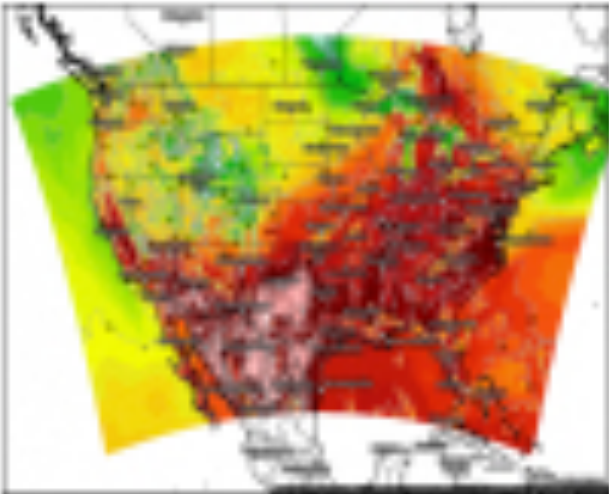


HRRR

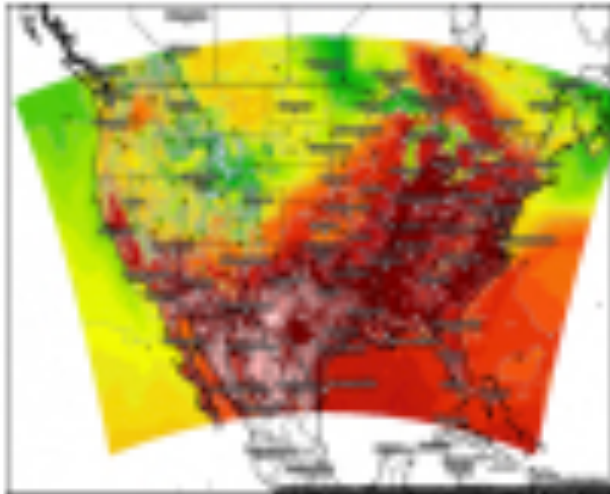


## Local models that cover United States

NAM



HRRR



We have forecast data from several regional models that cover United States. These models have a higher resolution than global models that forecast for the whole world, but the increased computational demands of a high resolution model mean that these forecasts only go a couple days out in time, and are limited to a small area.

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# Weather Forecasting Model Servers

- [Environmental Modeling Center](#)
  - [U.S. Navy](#)
  - [UCAR](#)
  - [Institute of Global Environment and Society](#)
  - [The Ohio State University](#)
  - [University of Michigan](#)
  - [University of Wisconsin](#)
  - [Texas A & M](#)
  - [University of Wyoming](#)
  - [University of Utah](#)
  - UCAR [MM5](#) model
  - Navy's [NOGAPS](#) model
  - Canadian [Global Spectral](#) model
  - United Kingdom [UKMET](#) model
  - European Centre for Medium-Range Weather Forecasting [ECMWF](#) model
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# Weather Apps that I use (in daily use order)

- Forecast Bar (iOS & Mac) - best daily forecasts for my address
  - Windy (iOS) - best wind & temperature, only App to allow use of different models
  - <https://www.wpc.ncep.noaa.gov/NationalForecastChart/map.php#> (iOS & Mac)
  - Weather Mate (iOS) - best historical and almanac data
  - Hurricanes Pro (iOS) - since I used to fly into Typhoons and my father lived in Bahamas
  - Dark Sky (iOS) - Now owned by Apple; is never correct for my address; Very highly rated
  - Apple Weather (iOS) - best information all on one scrolling window
  - Note: most of the above can be used on a Mac via the browser
-

# Forecast Bar Mac




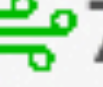






Prescott, AZ ↕  
Clear for the hour.

72°F  
Feels 72°F

High: 78°F  
Low: 59°F

Clear throughout the day.

Last updated: 5/31 @ 10:29

Sunrise	Sunset	Moon Phase
 05:20	 19:38	 Waxing Crescent
Wind Speed	Pressure	Humidity
 7-10 mph	 1008 mb	 14%
From The S	(29.77") rising	Very Dry
Dew Point	UV Index	Cloud Cover
 19°F	 8	 0%
53° Spread	Very High	
Visibility		
 10 mi		

# Forecast Bar iOS

10:38

Prescott, AZ

**70°F**  
Feels 70°F High: 76°F  
Low: 49°F

Sunny for the hour.

05:18 19:36 Tree Low

**TUE** Plentiful sunshine during the day. Clear skies at night. 76°F 49°F

**WED** Sunny skies during the day. A mostly clear sky at night. 81°F 52°F

**THU** Sunny skies during the day. A few clouds overnight. 84°F 56°F

**FRI** Intervals of clouds and sunshine during the day. A few clouds at night. 82°F 54°F

**SAT** Partly cloudy skies during the day. Partly cloudy at night. 80°F 54°F

**SUN** Sunshine and clouds mixed during the day. A mostly clear sky at night. 81°F 57°F

10:38

Prescott, AZ

**70°F**  
Feels 70°F High: 76°F  
Low: 49°F

Sunny for the hour.

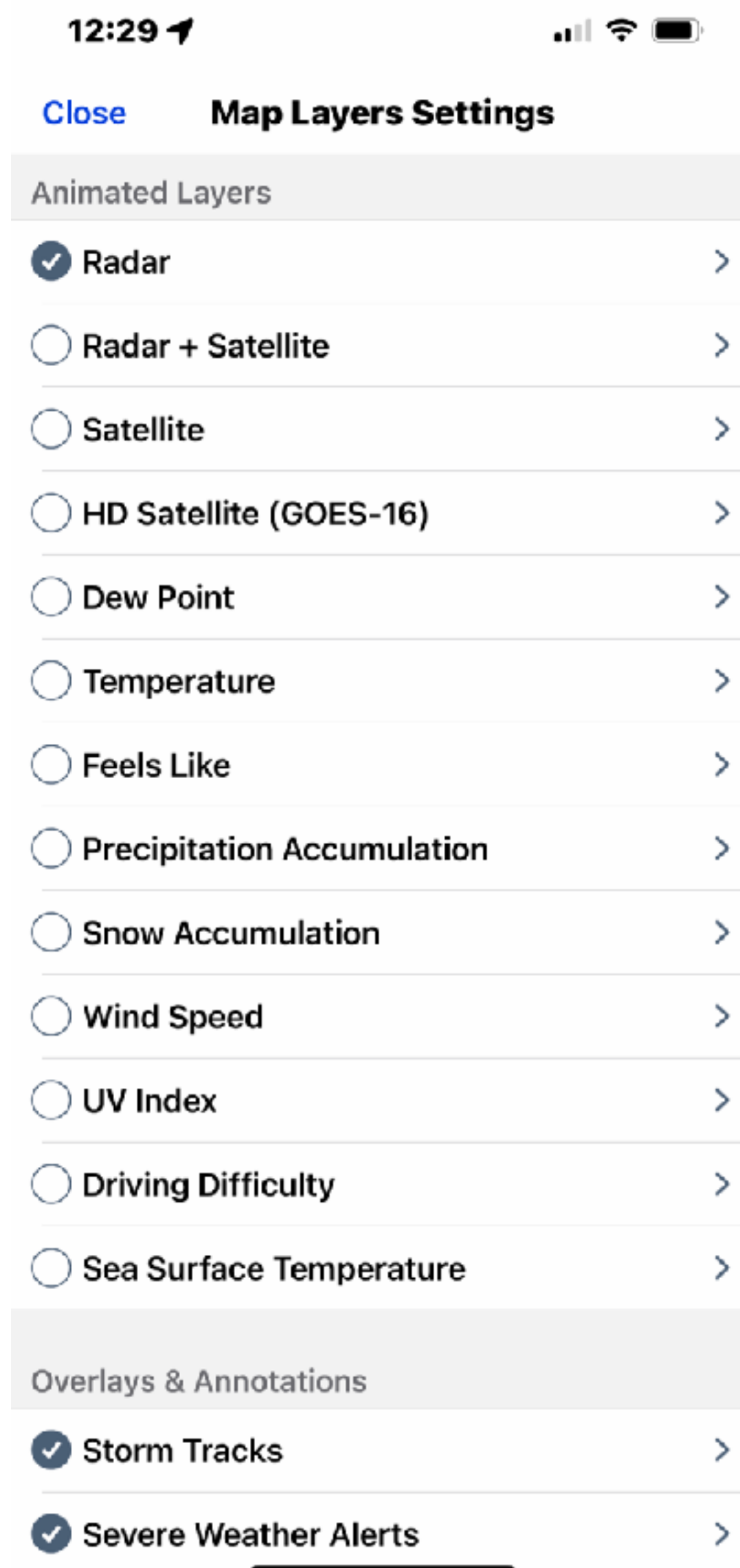
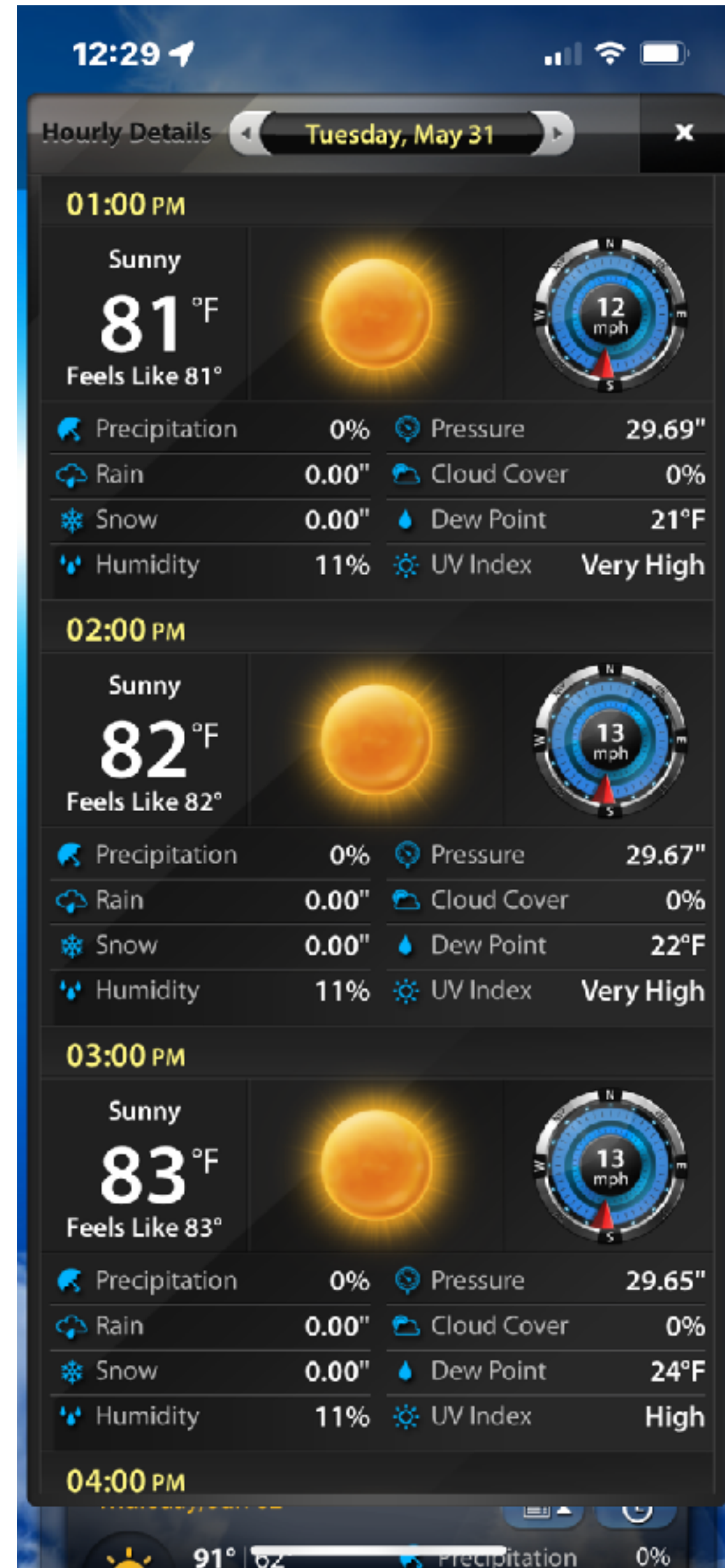
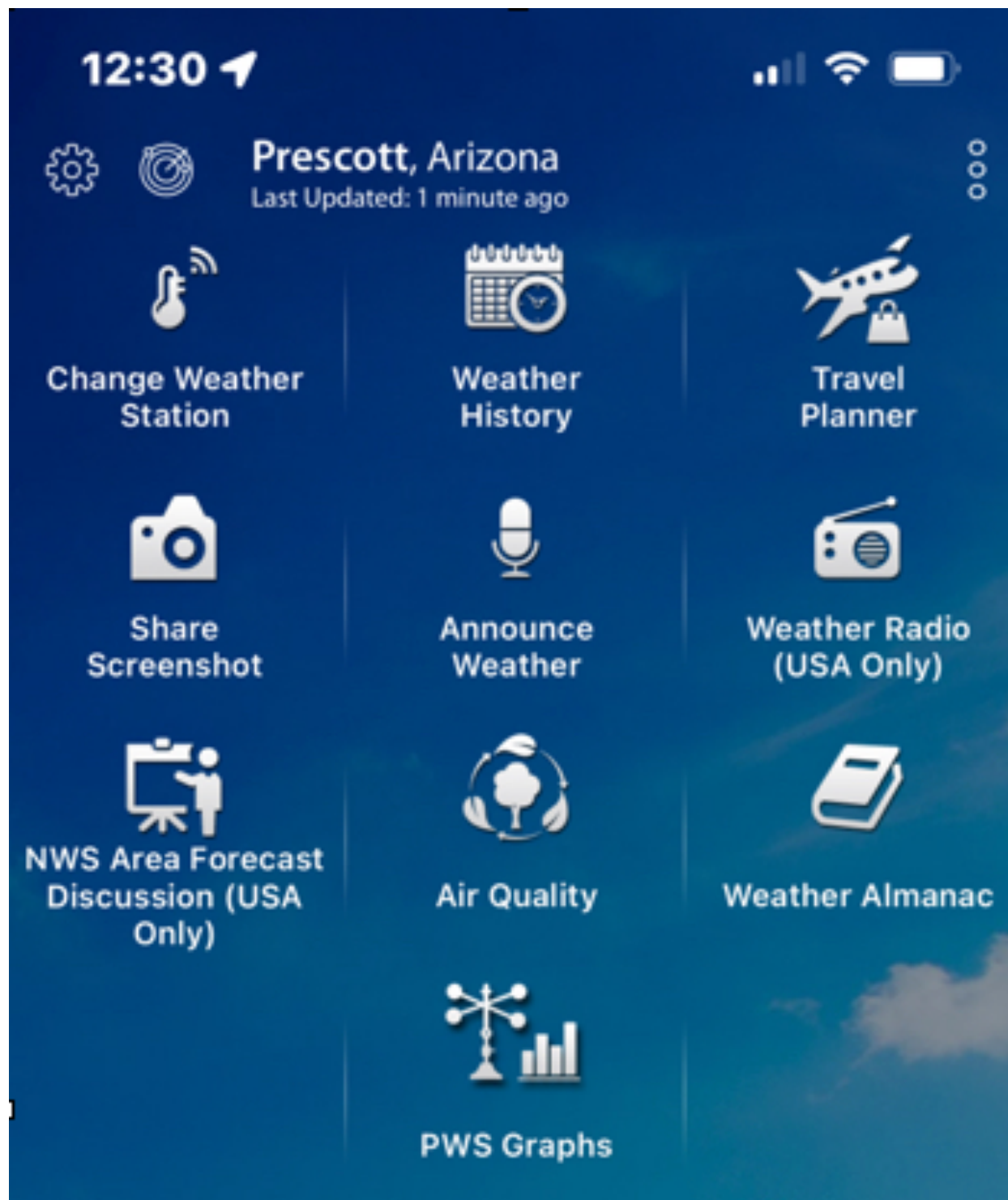
05:18 19:36 Tree Low

11:00	12:00	13:00	14:00	15:00
Sunny	Sunny	Sunny	Sunny	Sunny
<b>72°</b>	<b>73°</b>	<b>74°</b>	<b>75°</b>	<b>75°</b>
0%	0%	0%	0%	0%
13-21mph	13-21mph	13-22mph	12-20mph	12-19mph
Dry, 16%	Dry, 15%	Dry, 15%	Dry, 15%	Dry, 15%

**WED** Sunny skies during the day. A mostly clear sky at night. 81°F 52°F

**THU** Sunny skies during the day. A few clouds overnight. 84°F 56°F

# Weather Mate iOS



# Windy iOS

10:39 Prescott

Map locations and temperatures: Flagstaff 55°, Sedona 66°, Prescott 64°, Camp Verde 66°, Wickenburg 71°, Carefree 73°.

Current conditions: 70° 13mph

Forecast (TUE to SUN): 75°, 82°, 84°, 82°, 79°, 81°

TUESDAY 31		WEDNESDAY 1	
Hours	2 5 8 11 14 17 20 23 2	2 5 8 11 14 17 20 23 2	
Temperature °F	55° 52° 65° 72° 75° 74° 66° 60° 59°	52° 49° 66° 76°	
Rain in			
Wind mph	2 3 6 10 11 10 4 4 4	3 3 2 7	
Wind gusts mph	11 9 16 26 28 27 24 11 10		
Wind dir.	↗ ↗ ↗ ↗ ↗ ↗ ↗ ↗ ↗	↘ ↘ ↘ ↘ ↘ ↘ ↘ ↘ ↘	

1 hour forecast | Display as: Basic | Fcst model: ECMWF

10:39 Prescott

Current conditions: 69° 6mph

Forecast (TUE to SUN): 75°, 82°, 84°, 82°, 79°, 81°

TUESDAY 31		WEDNESDAY 1	
Hours	2 5 8 11 14 17 20 23 2	2 5 8 11 14 17 20 23 2	
Temperature °F	55° 52° 65° 72° 75° 74° 66° 60° 59°	52° 49° 66° 76°	
Rain in			
Wind mph	2 3 6 10 11 10 4 4 4	3 3 2 7	
Wind gusts mph	11 9 16 26 28 27 24 11 10		
Wind dir.	↗ ↗ ↗ ↗ ↗ ↗ ↗ ↗ ↗	↘ ↘ ↘ ↘ ↘ ↘ ↘ ↘ ↘	

1 hour forecast | Display as: Basic | Fcst model: ECMWF

Basic | Waves | Wind | Meteog. | Airgram

ECMWF | GFS | ICON | MBLUE | NAM | HRRR

Compare forecasts

10:39 Prescott

### Compare forecasts

Model	Day	Hours	Temperature °F	Wind mph	Wind dir.	Rain in
GFS 22km	Tuesday 31	11 14 17 20 23	72° 75° 74° 60° 54°	16 17 17 7 4	↗ ↗ ↗ ↗ ↘	
	Wednesday 1	2 5 8 11 14 17 20 23 2	52° 49° 66° 76°	3 3 2 7	↘ ↘ ↘ ↘ ↘	
ECMWF 9km	Tuesday 31	11 14 17 20 23	72° 75° 74° 66° 60°	10 11 10 4 4	↗ ↗ ↗ ↗ ↗	
	Wednesday 1	2 5 8 11 14 17 20 23 2	59° 55° 66° 77°	4 2 2 3	↘ ↘ ↘ ↘ ↘	
ICON 13km	Tuesday 31	11 14 17 20 23	72° 75° 73° 62° 56°	12 12 11 4 2	↗ ↗ ↗ ↗ ↗	
	Wednesday 1	2 5 8 11 14 17 20 23 2	53° 53° 64° 75°	1 1 2 4	↘ ↘ ↘ ↘ ↘	
METEOBLUE	Tuesday 31	11 14 17 20 23	71° 74° 73° 65° 61°	12 13 12 6 4	↗ ↗ ↗ ↗ ↗	
	Wednesday 1	2 5 8 11 14 17 20 23 2	55° 52° 66° 75°	3 2 3 4	↘ ↘ ↘ ↘ ↘	
NAM 5km	Tuesday 31	11 14 17 20 23				
	Wednesday 1	2 5 8 11 14 17 20 23 2				



# Dark Sky iOS

11:23

30 Pinnacle Rd, Prescott, AZ

**81°**  
Feels 81°

Next Hour: No precipitation.

<b>NOW</b>	Partly Cloudy	81°
<b>1 PM</b>	Mostly Cloudy	81°
<b>3 PM</b>		84°
<b>5 PM</b>		76°
<b>7 PM</b>		74°
<b>9 PM</b>		75°
<b>11 PM</b>	Partly Cloudy	71°
<b>1 AM</b>		65°
<b>3 AM</b>	Clear	62°

Forecast Map Notifications Report

11:26

30 Pinnacle Rd, Prescott, AZ

**3 AM** Clear 62°

**5 AM** 59°

**7 AM** 67°

**9 AM** 75°

TEMP (°F) FEELS-LIKE (°F) PRECIP PROB (%)

Rain: 0.14 in  
Sunset in 8¼ hours (7:48 PM)

<b>TODAY</b>	39%	58° - 85°
<b>MON</b>	46%	59° - 86°
<b>TUE</b>	27%	61° - 92°
<b>WED</b>	45%	64° - 94°
<b>THU</b>	32%	63° - 90°
<b>FRI</b>	23%	61° - 93°
<b>SAT</b>		63° - 93°

Forecast Map Notifications Report

11:29

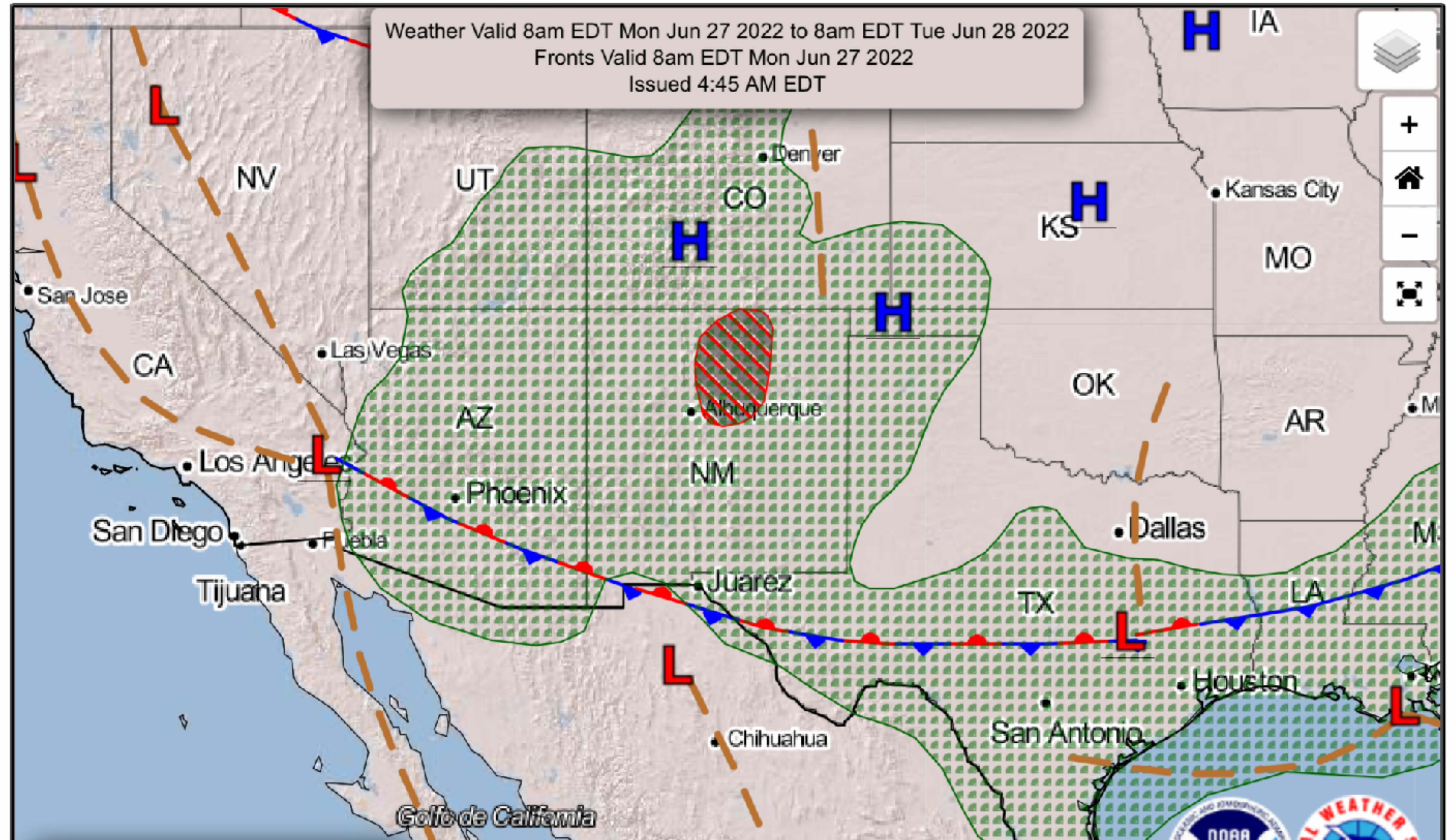
PRECIP TEMP (°F)

SUN 11:28 AM

9 AM 10 AM 11 AM 12 PM

Forecast Map Notifications Report

Sun Jun 26, 2022 Mon Jun 27, 2022 Tue Jun 28, 2022



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# MANY Weather App Topics

- Severe weather including flooding, hurricanes, tornadoes, blizzards, lightning, etc.
  - Wind apps for sailing, parasailing, soaring, parachuting, flying, etc.
  - River water levels, flow, speeds, rafting ratings, lake weather, fishing weather, etc,
  - Tide charts, surf charts, wind, currents, marine weather, sailing weather,
  - Moon phases, sun spot & corona forecasts, astronomy weather, sun rise & set, etc.
  - Local TV channels' weather forecasts
  - Allergy, smog, dust storms, etc.
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# Some Top Rated Weather Apps

- RadarScope - Professional weather radar NOT for the common person
  - My Hurricane Tracker - Hurricane & tornado tracker
  - Ventusky: 3D Weather Maps - “the most advanced weather app”
  - The Weather Channel
  - WeatherBug - Local radar, live map, alerts
  - Weather Underground - Radar and severe storm tracker
  - CARROT weather - Local forecasts & live maps (if you like to be insulted or laugh at the insults)
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# Some Top Rated Weather Apps

- Yahoo Weather
  - Storm Tracker/Shield/Radar
  - AccuWeather - Live local forecast & radar
  - Cloudy - Weather Forecast - Accurate local weather alerts
  - Weather Live - Local forecast & rain alerts
  - Weathertron - Weather for the minimalist
  - MANY, MANY, MANY OTHERS!!!
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# How to choose a Weather App

- What information are you concerned about? (umbrella, clothing, temperature, wind???)
  - What weather data do you want in order to understand what is happening?
  - How many ratings and how many stars? (but what do they know??)
  - How much do you want to pay? (most are subscription based)
  - What privacy information do they collect?
    - WeatherBug collects Health & Fitness??
    - Weather Underground collect Search History???
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# How to choose a Weather App

- I suggest you try a monthly subscription for several apps
  - Look how closely they forecast weather at your home/neighborhood
  - Chose the most accurate and best for information then pay for a yearly subscription
  - IF you live on a hill, or in a valley, make sure you set location information to Precise (be careful if they track your location and sell it...)
  - If you live in a flat area, turn Precise off (Privacy/Location Services/App) (10 sq mi area)
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# The Weather Rock

- If it is bright and you see a shadow, the weather is sunny
- If it is warm/hot to the touch, it is a warm/hot day
- If it is cool/cold to the touch, it is a cool/cold day
- If it is wet, you should have taken an umbrella out with you
- If it is white, it is snowing and you should have worn your snow boots
- If you can not find it, it is either very foggy, you are in a sandstorm, or it is covered by snow...
- Got you outside at least!

