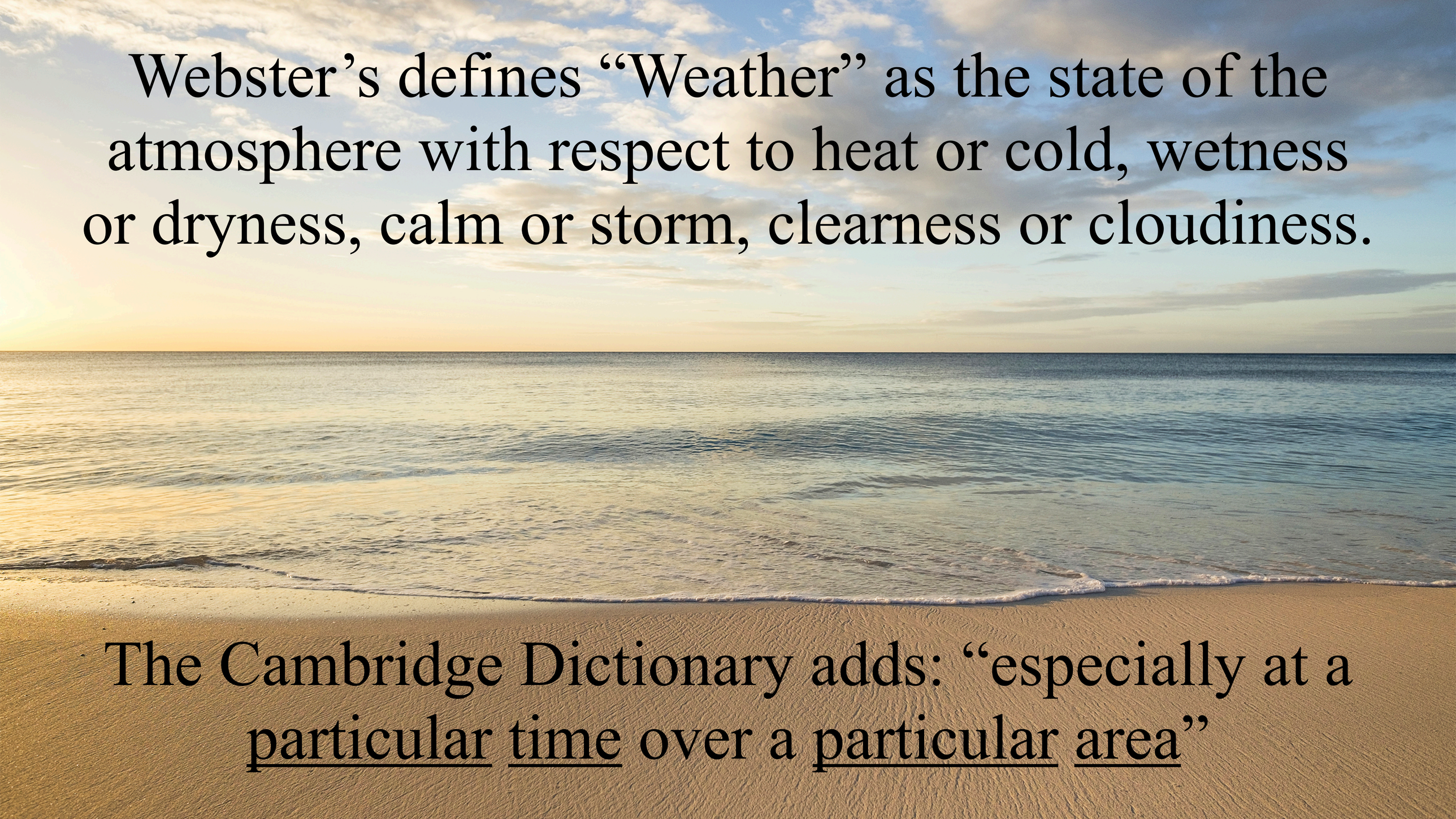
Weather or Not...

Part 1: Understanding Weather Better

John Dysinger — AdAgrA 2025

“He answered and said to them, ‘When it is evening you say, ‘It will be fair weather, for the sky is red’; and in the morning, ‘It will be foul weather today, for the sky is red and threatening.’ Hypocrites! You know how to discern the face of the sky, but you cannot discern the signs of the time.”

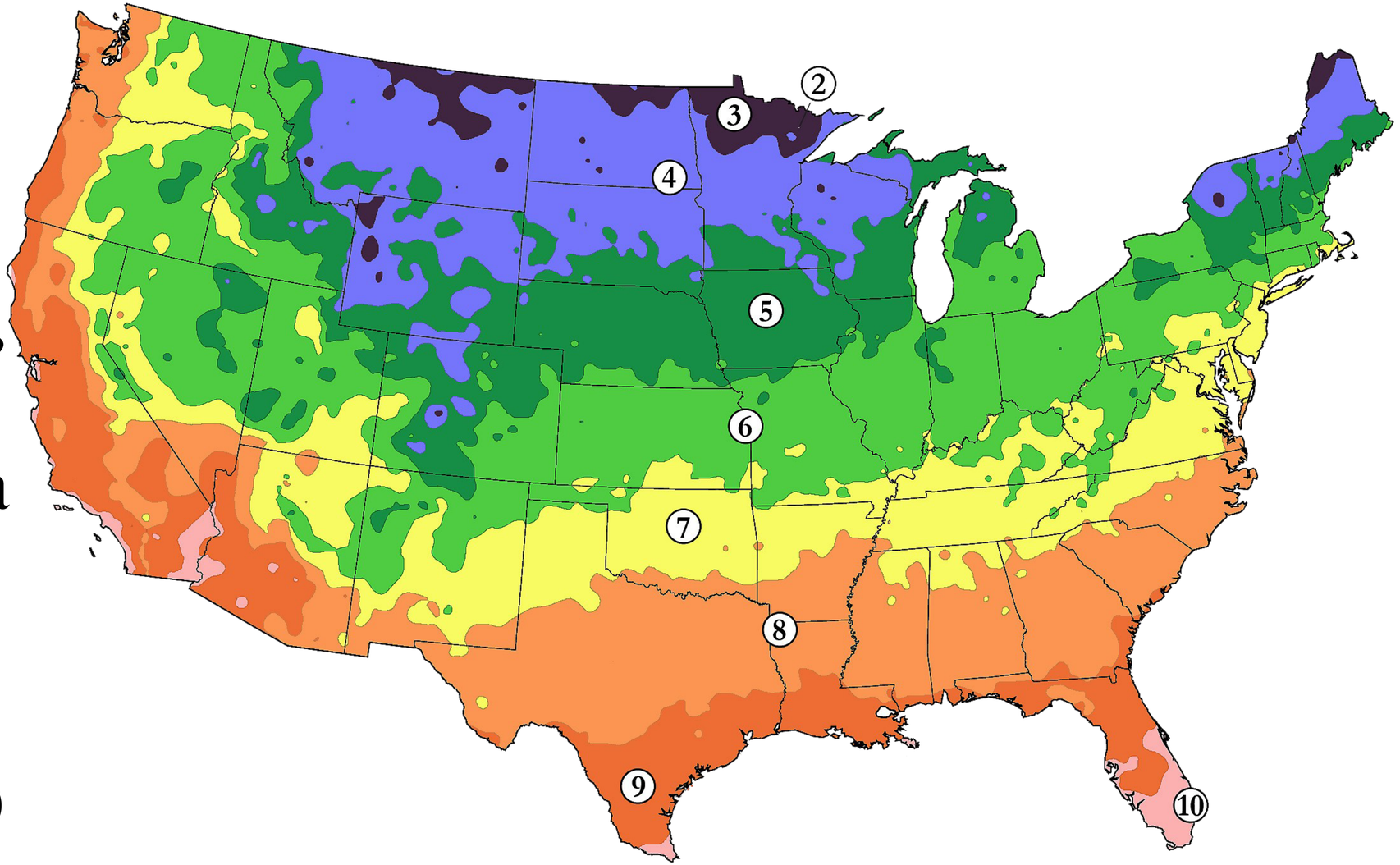
Matthew 16:2,3



Webster's defines "Weather" as the state of the atmosphere with respect to heat or cold, wetness or dryness, calm or storm, clearness or cloudiness.

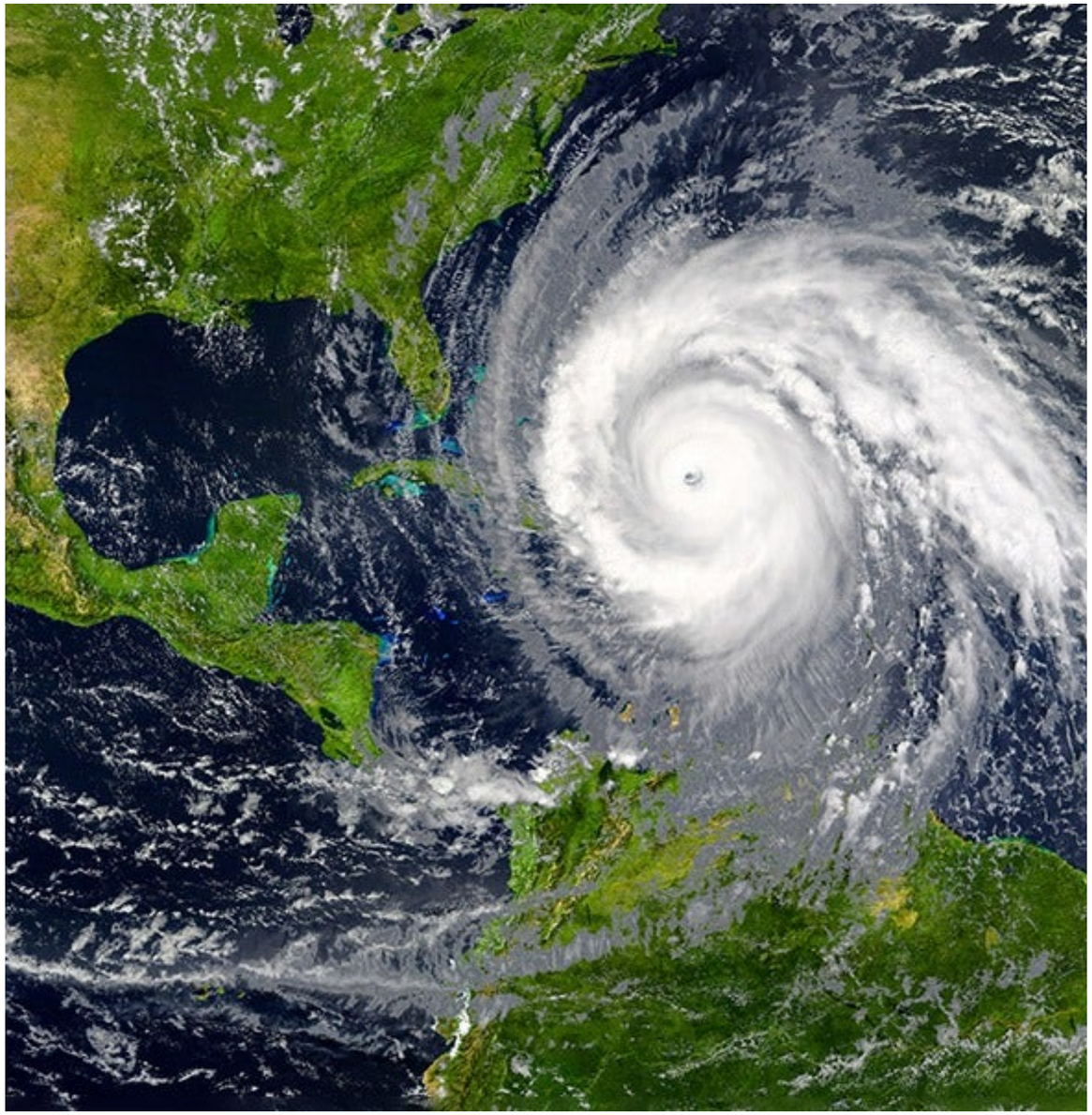
The Cambridge Dictionary adds: "especially at a particular time over a particular area"

“Climate,” in contrast, is the long-term pattern of weather in a particular area. A region’s weather patterns, usually tracked for at least 30 years, are considered its climate.

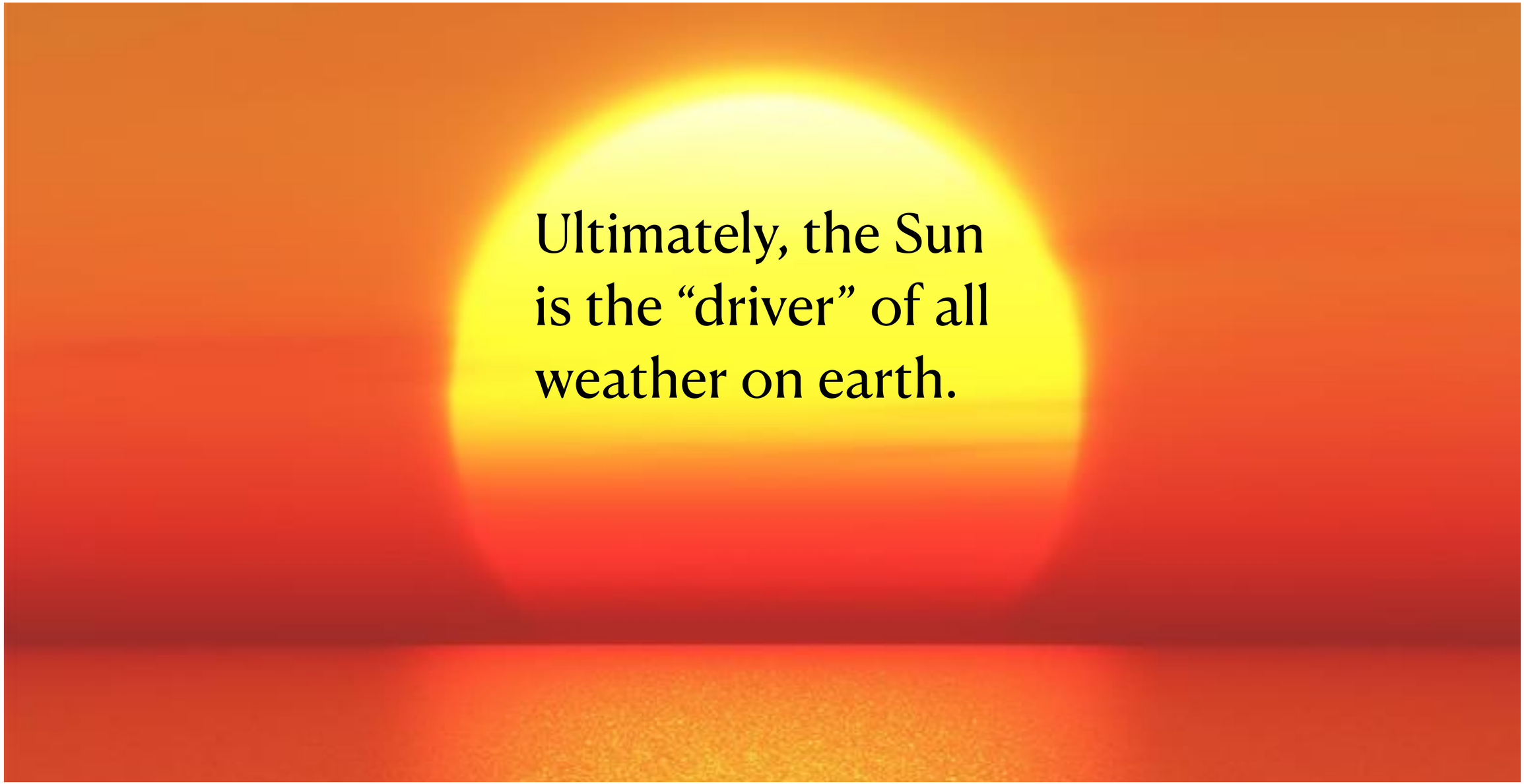


Why Study the Weather?

Everyone on earth is directly effected by the weather, but there's no sector of industry more weather-dependent than agriculture! Good weather = good growing. Bad weather = bad growing! Understanding weather can help you make better decisions on the farm/ garden.



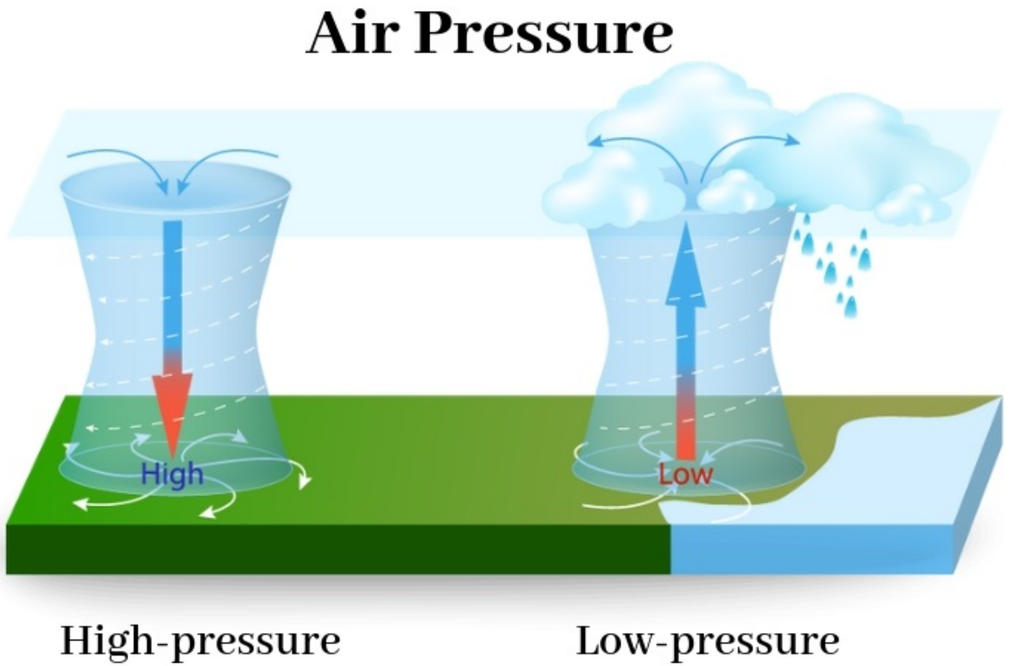
There are six main components of weather: (1) temperature, (2) atmospheric pressure, (3) wind, (4) humidity, (5) precipitation, and (6) cloudiness. Together, these components describe the weather at any given time.


Ultimately, the Sun
is the “driver” of all
weather on earth.

Atmospheric Pressure

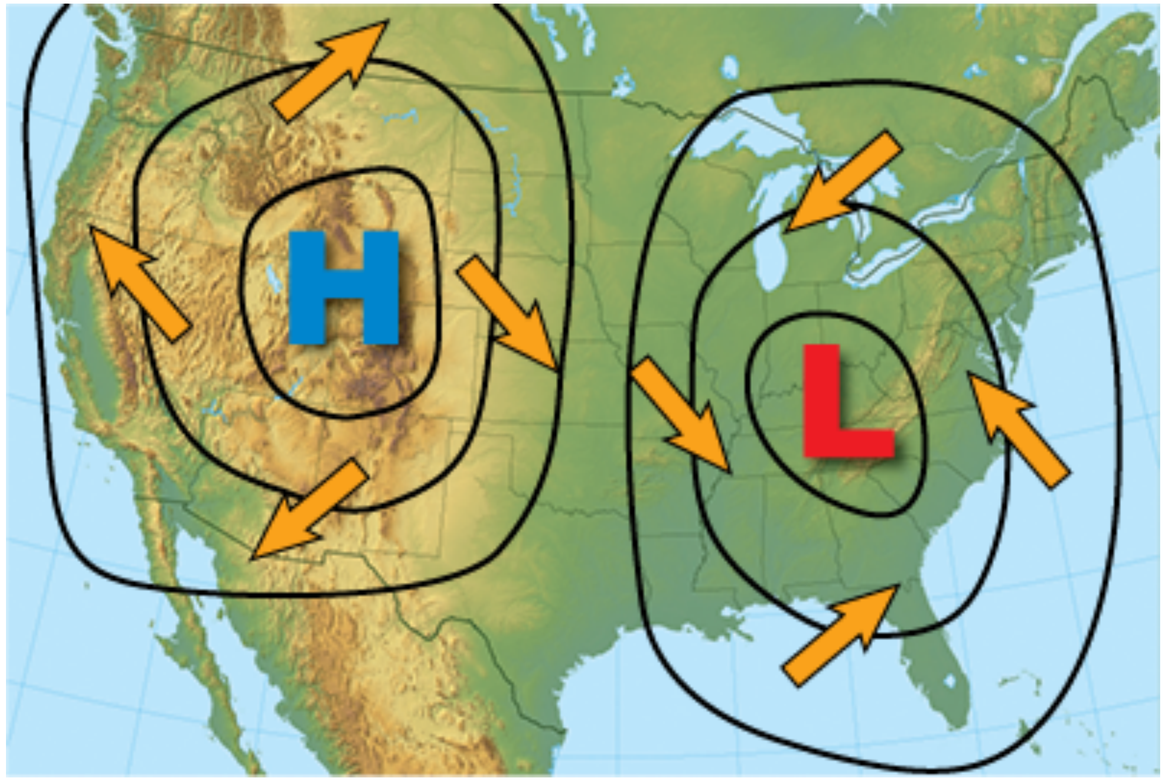
Also known as Air Pressure or Barometric Pressure

- Air has weight.
- Cold air sinks and spins outward clockwise — causing high surface pressure.
- High pressure (H on weather maps) is considered “stable” —with clear, calm, “happy” weather.
- The higher the elevation, the lower the pressure.



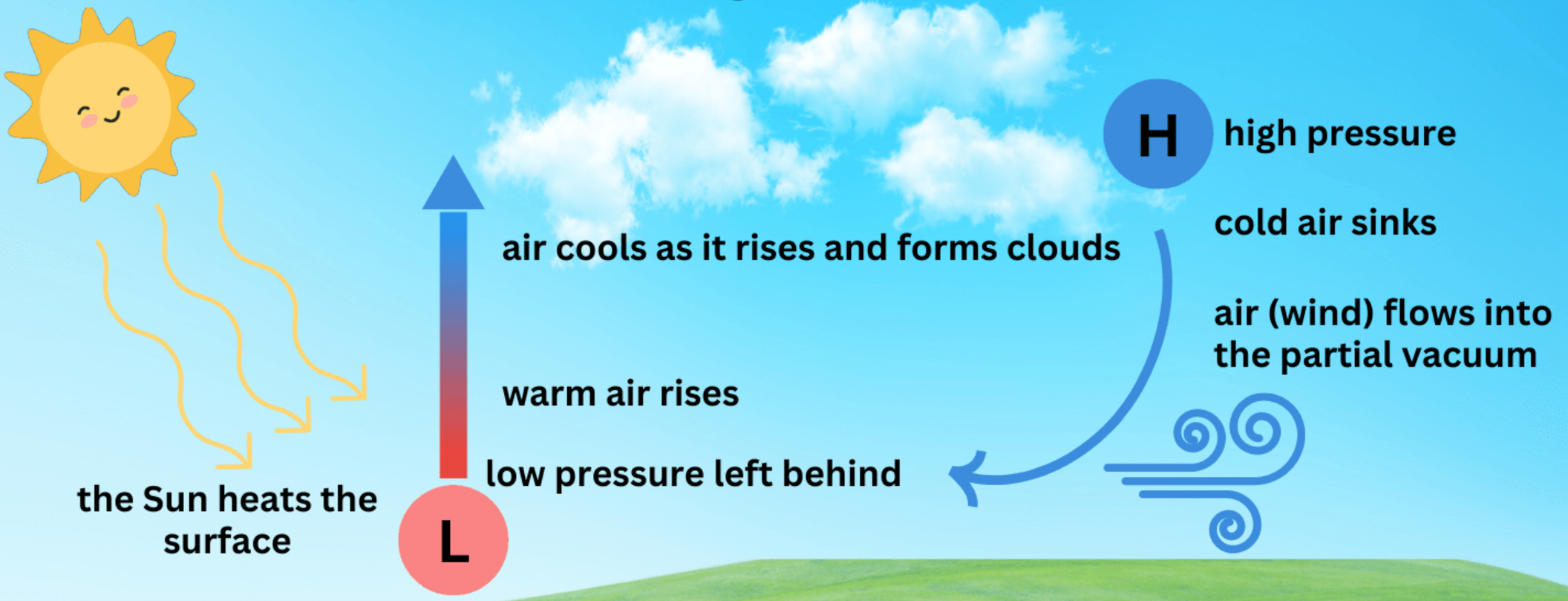
Atmospheric Pressure (cont.)

- Hot air rises and spins inwards counterclockwise — causing low surface pressure.
- Low pressure (L on weather maps) is considered “unstable” — leading to stormy, wet, “lousy” weather.
- A mercury reading of between 29.80 and 30.20 is considered normal. Anything above that would be high pressure and below would be low pressure.
- The speed at which the pressure drops can indicate the severity of the storm.



What Causes Wind?

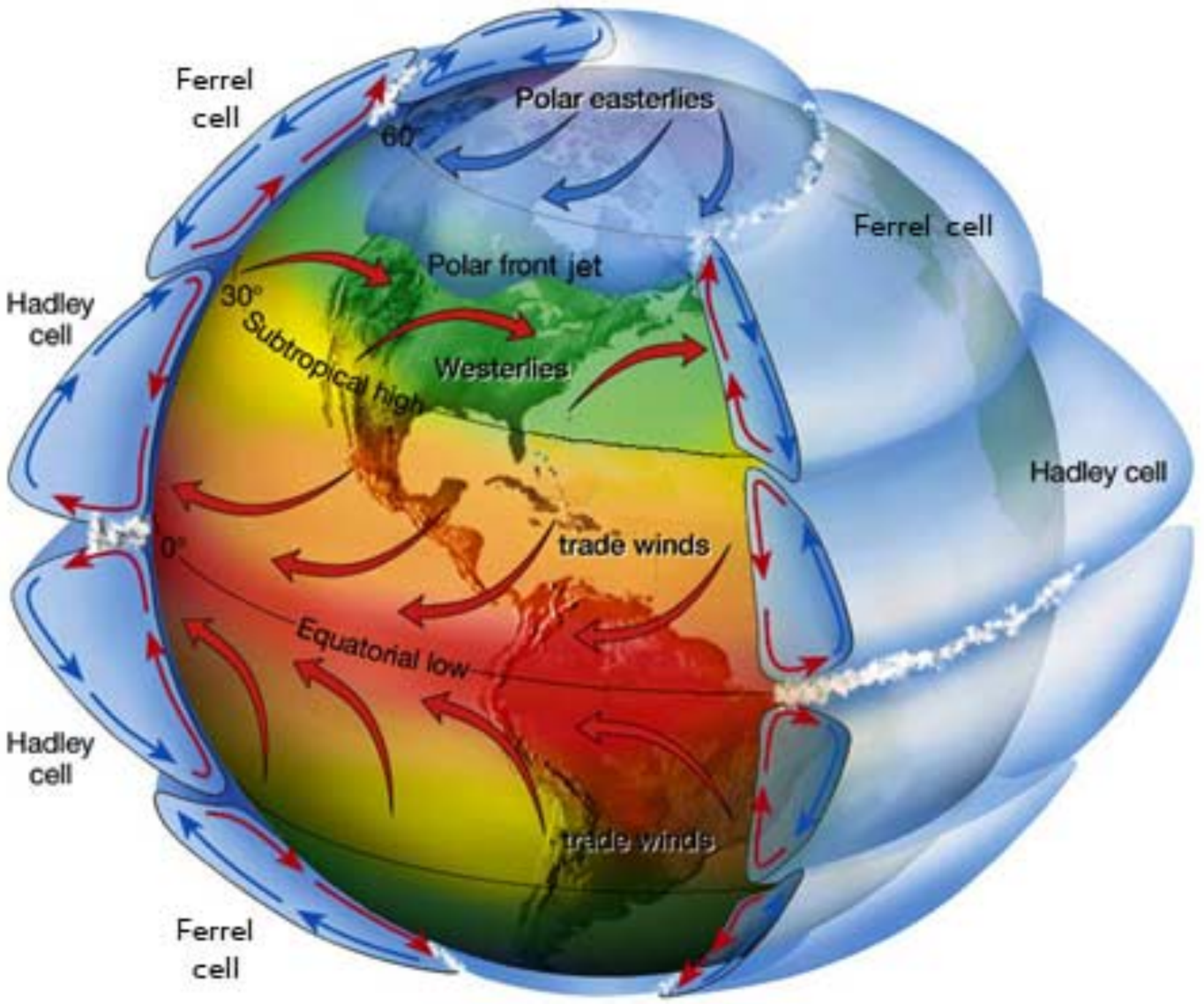
Wind is the movement of air from a region of high pressure to a region of low pressure.

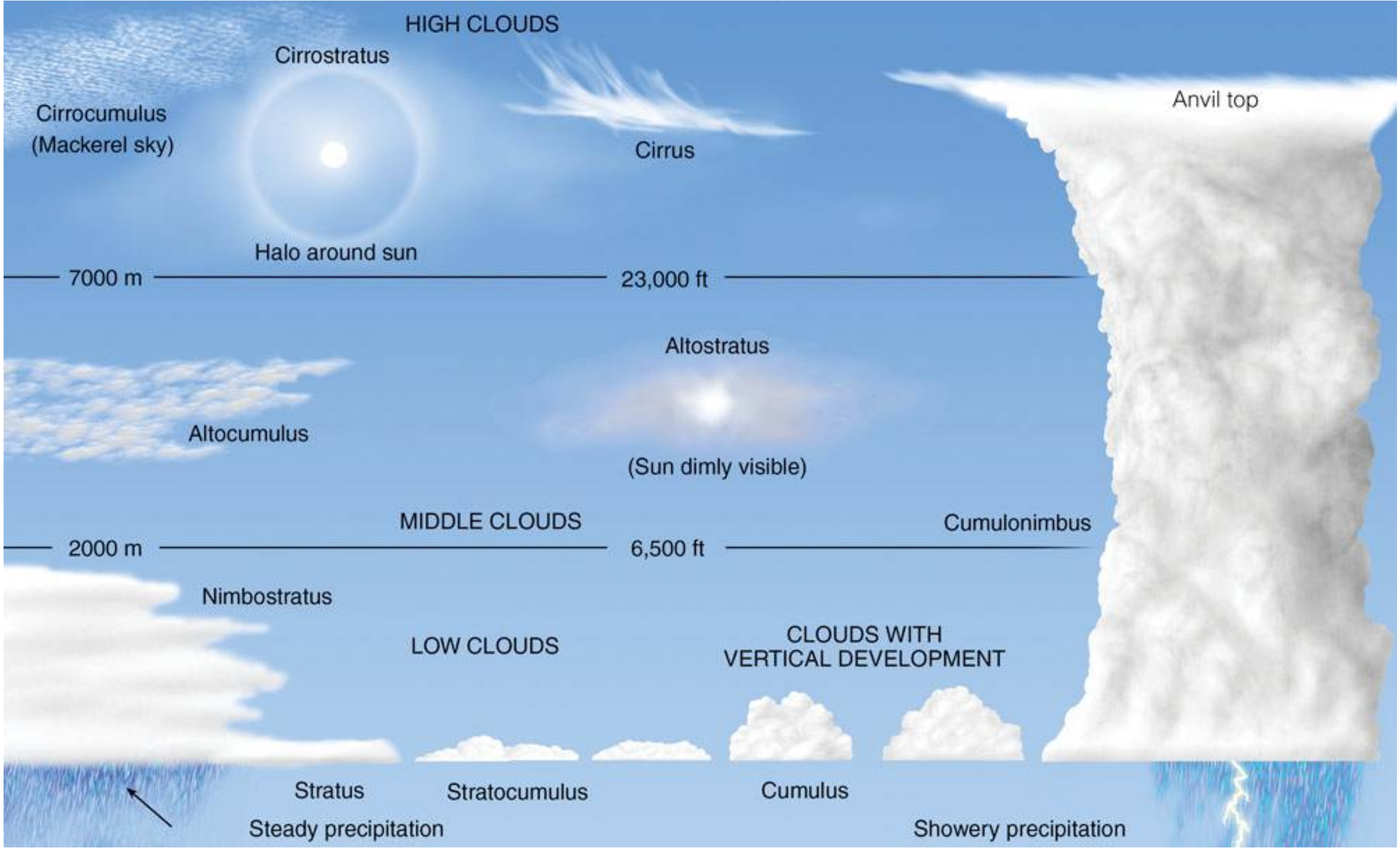


Temperature drives air pressure, so ultimately wind comes from unequal heating of the Earth.

Global Air Circulation

- The Intertropical Convergence Zone (ITCZ) is an area of low pressure at the equator (think hot, muggy, with lots of thunderstorms)
- The area around 30 degrees N and S of the equator are areas of relatively high pressure (where most of the world's deserts are).
- The area above 30 degrees N is where most of us live. It is an area of prevailing westerly winds and mid-latitude cyclones during the winter.
- Winds curve due to the Coriolis Effect.
- The reality is not quite as "pretty" as this picture.
- See earth.nullschool.net for realtime circulation patterns.

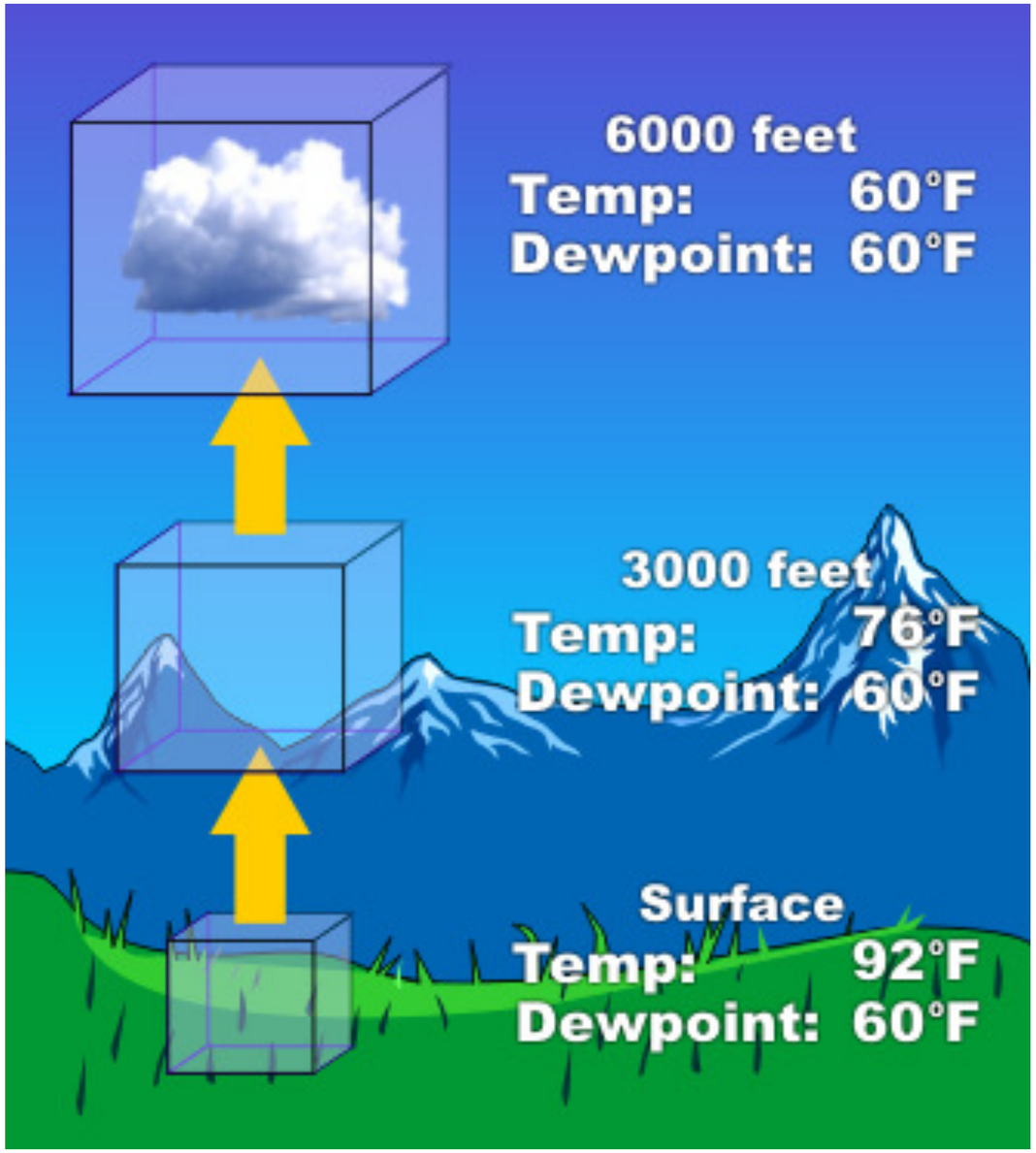



HIGH CLOUDS
Cirrostratus
Cirrocumulus
(Mackerel sky)
Cirrus
Anvil top
Halo around sun
7000 m
23,000 ft
Altostratus
Altocumulus
(Sun dimly visible)
MIDDLE CLOUDS
Cumulonimbus
2000 m
6,500 ft
Nimbostratus
LOW CLOUDS
CLOUDS WITH
VERTICAL DEVELOPMENT
Stratus
Stratocumulus
Cumulus
Steady precipitation
Showery precipitation

How Clouds Form:

A. Through Convection

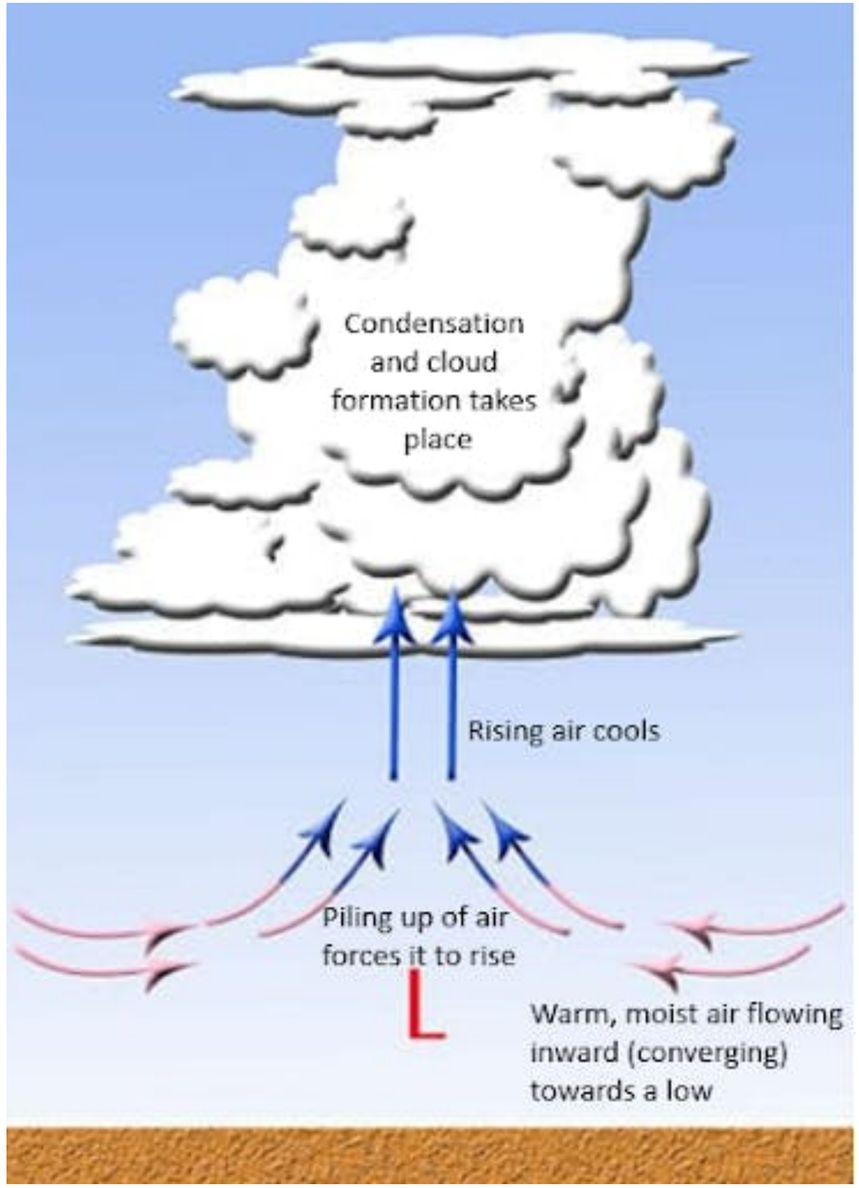
1. The sun heats the surface of the earth (or water).
2. Warm air rises from the heated surface (convection). The rising warm air is called a thermal.
3. The temperature of the air cools as it rises.
4. When the temperature of the air cools to the dewpoint (100% relative humidity), cumulus clouds form.
5. The warmer the thermals, the higher they can rise — sometimes leading to cumulonimbus clouds.



How Clouds Form (cont.)

B. Through Convergence

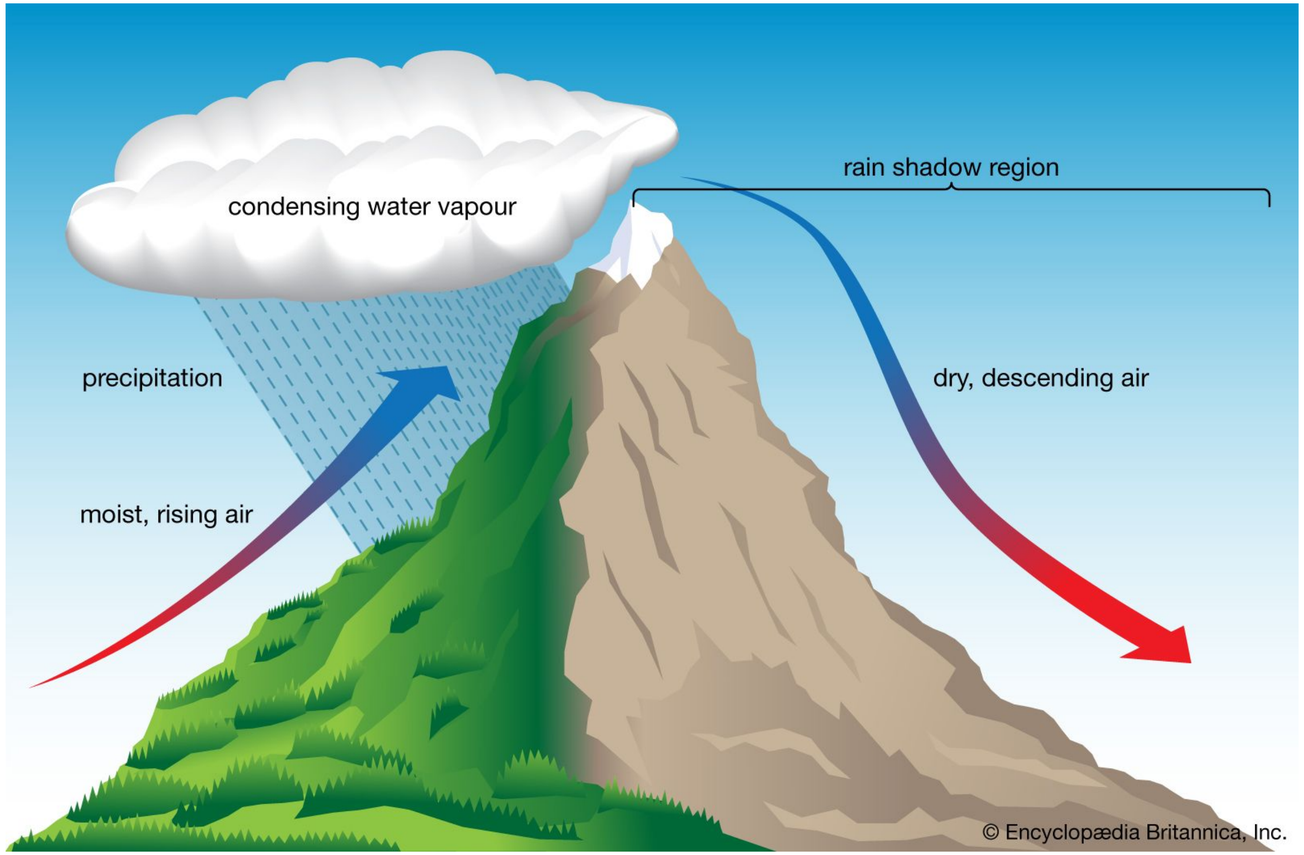
1. Convergence occurs when surface air currents move toward a center of low pressure.
2. When these currents converge, there is only one way to go: Up.
3. As the air rises, it cools and condenses when the dew point is reached.
4. The Intertropical Convergence Zone is a perfect example of this.



How Clouds Form (cont.)

C. Physical (or Orographic) Lifting

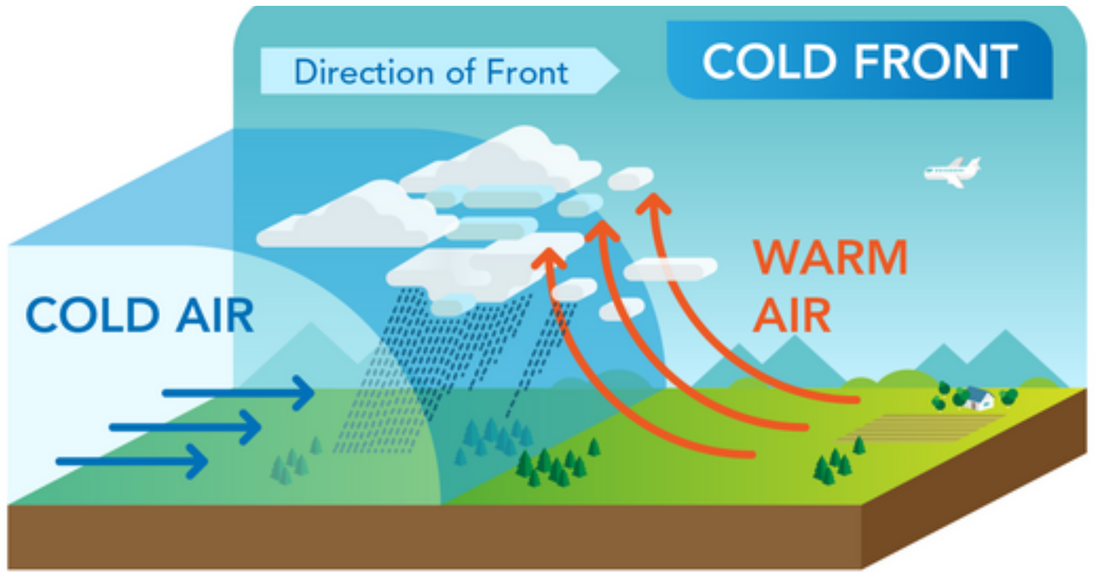
- As moving air encounters a physical barrier (like a mountain), it has to go over it.
- As the air rises, it cools and condenses, often causing rain on the windward side of the mountain.
- The leeward side of the mountain gets less rain and is often very dry (called the rain shadow effect).
- This is very evident in the Western US.

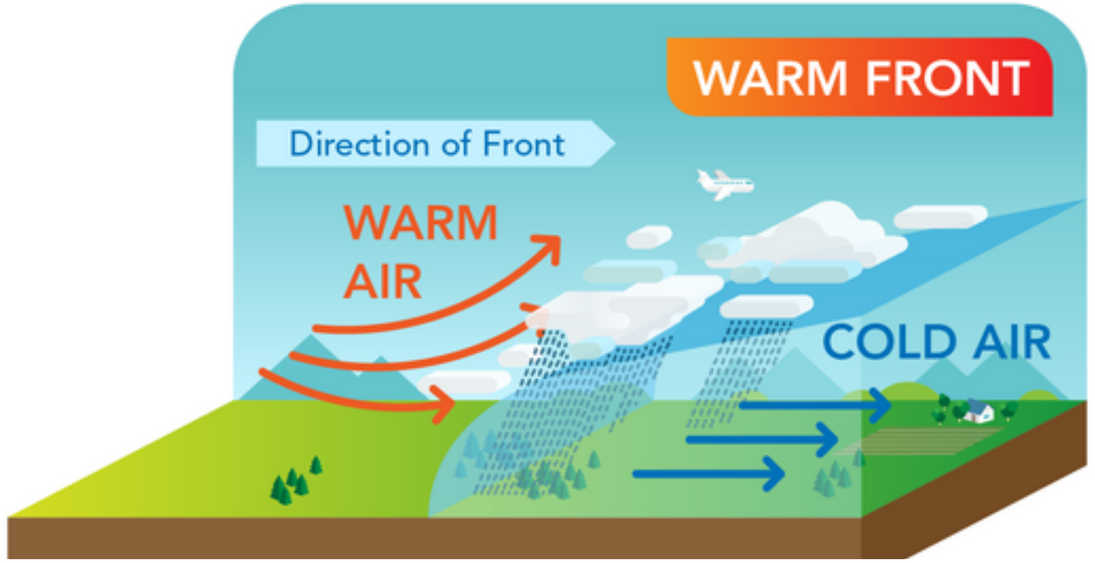


How Clouds Form (cont.)

D. Through Frontal Lifting

- Cold Fronts are usually taller and more powerful, causing dramatic lifting and often strong storms along the front (usually cumulonimbus).
- Warm Fronts are usually more sloped and the warm air slides up over the cold air — causing the classic cloud progression (cirrus, cirrostratus, altostratus, stratus, nimbostratus) and often extended, gentle rain.





What About Red Sky at Night...?

- Red sky at night means that the evening light is shining on clouds — which means a front is likely almost past — with good weather to come.

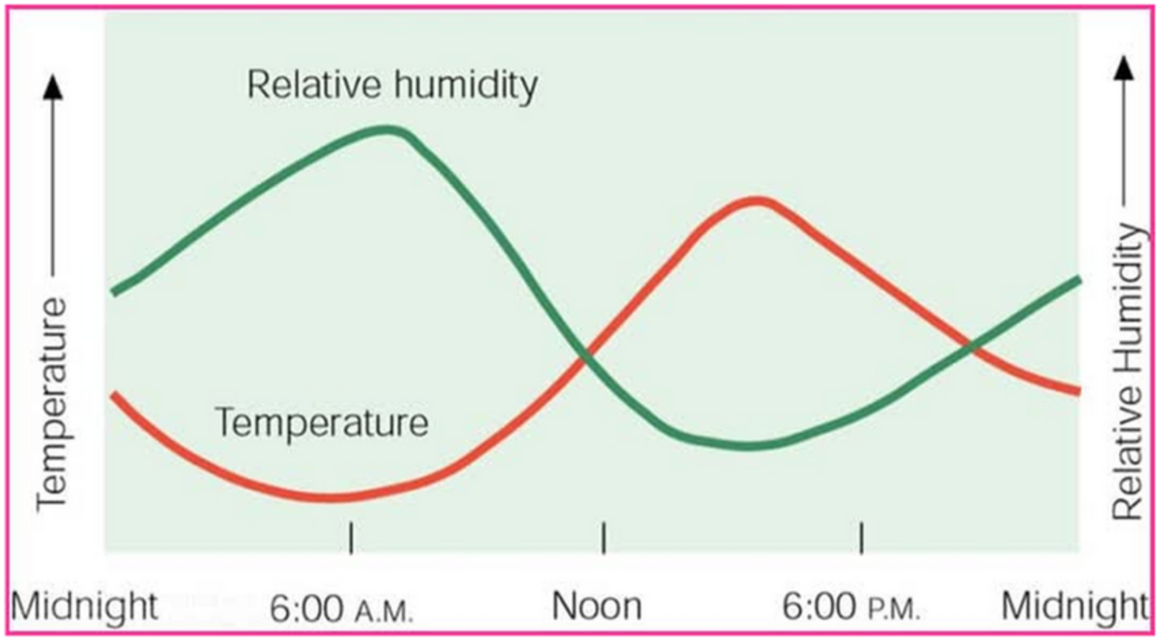
Or

- The sun is shining through dust or pollution particles — indicating a high pressure system (fair weather) that is holding the particles down.
- Red sky in the morning would indicate clouds (and a possible front) approaching from the west.

Measuring Humidity:

Relative Humidity

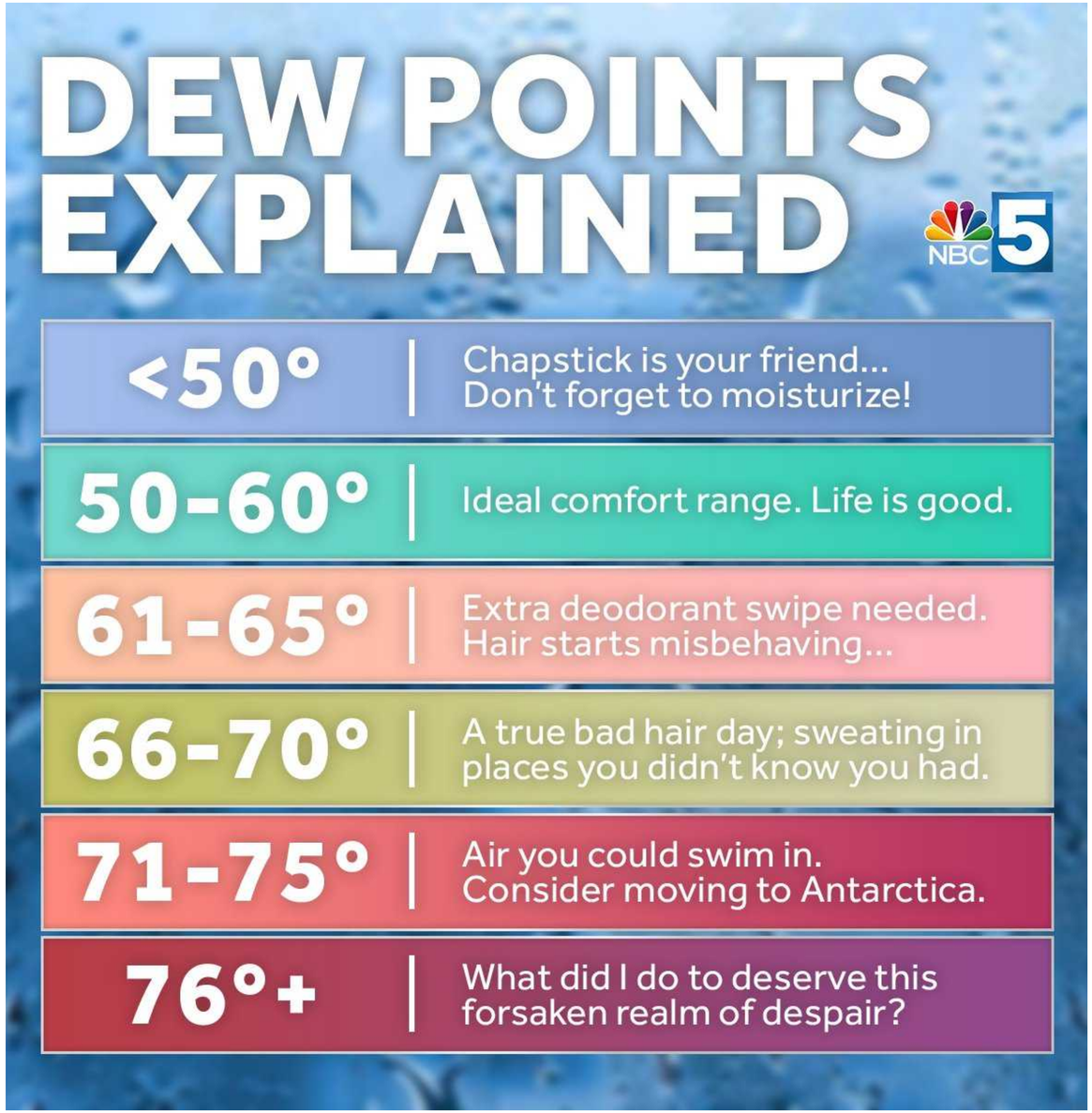
- Relative humidity (RH) is a relative number — meaning it changes significantly with the temperature (usually lower in the daytime and higher at night)
- RH measures the amount of water vapor in the air compared to how much the air could hold at any given temperature.
- Warm air can hold more moisture than cold air, so the relative humidity could be lower, but the humidity “feel” is much hotter.

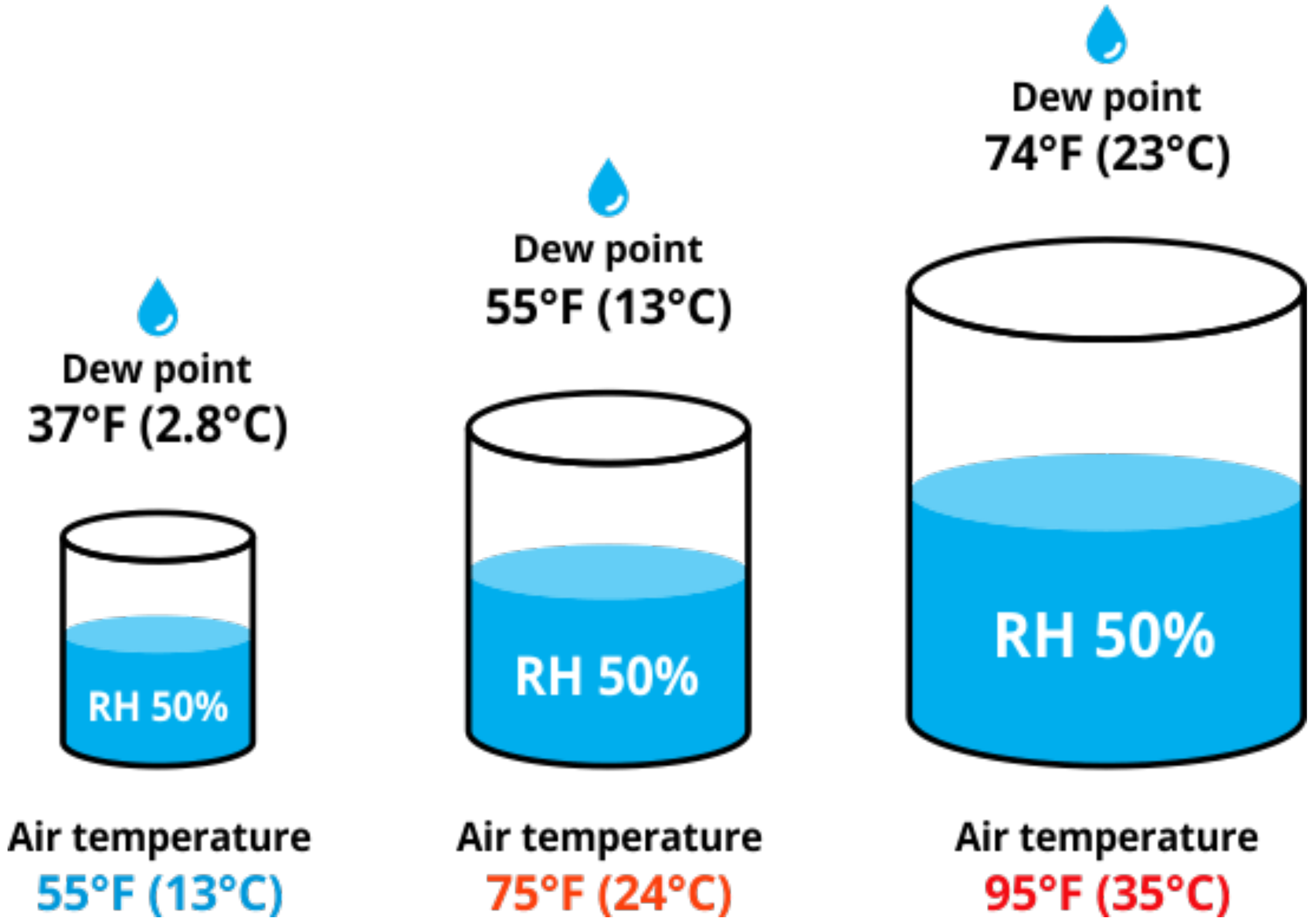


Why You Should Look at Dew Points

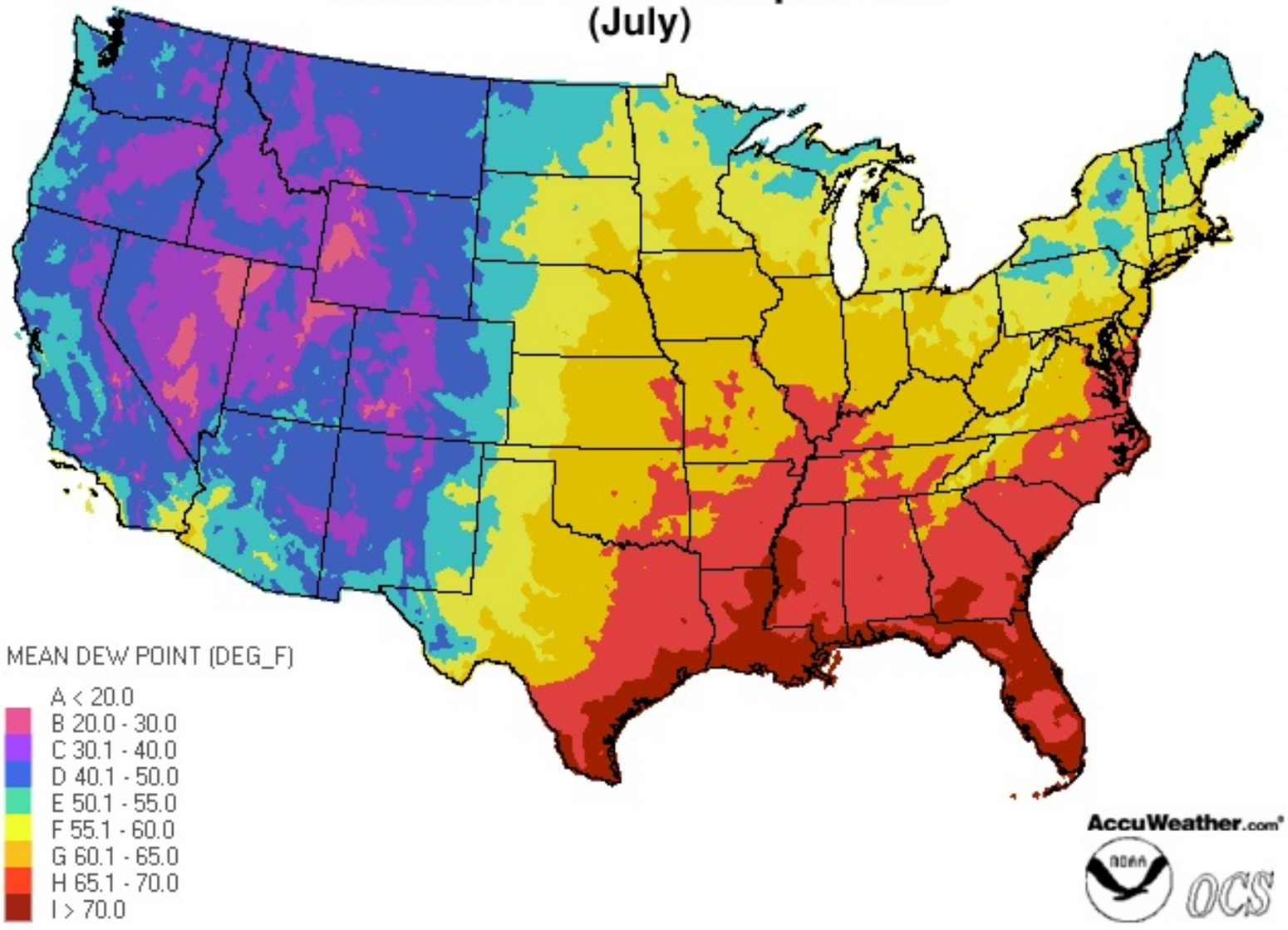
Instead of Relative Humidity

- The Dew Point remains more constant and tells the temperature that the air will reach it's saturation point (or 100% RH).
- Knowing the dew point can easily tell you if the weather is going to feel muggy or dry (see chart).
- The Dew point can never be higher than the temperature.




Dew point
37°F (2.8°C)
RH 50%
Air temperature
55°F (13°C)
Dew point
55°F (13°C)
RH 50%
Air temperature
75°F (24°C)
Dew point
74°F (23°C)
RH 50%
Air temperature
95°F (35°C)

Mean Dew Point Temperature
(July)

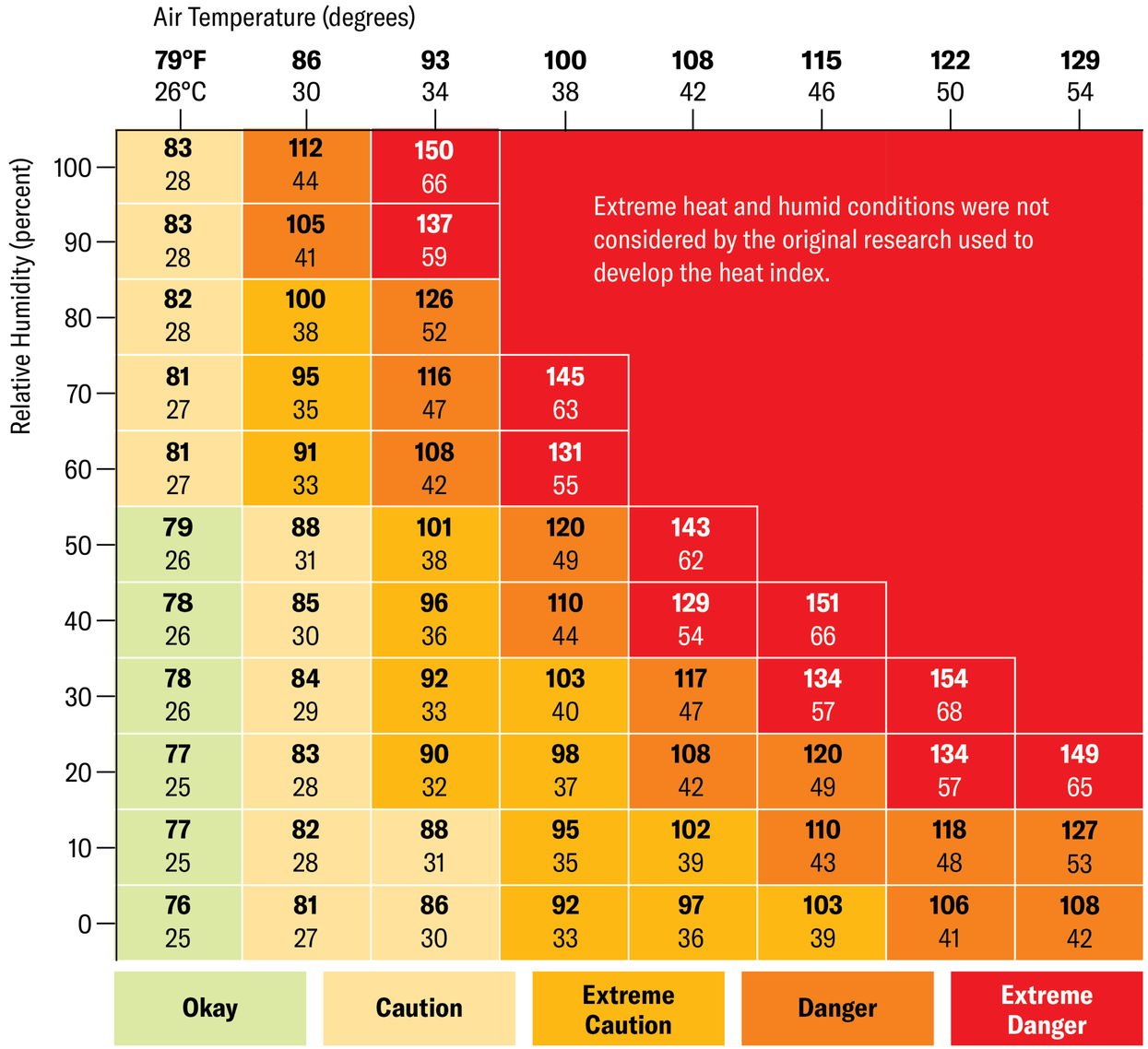


AccuWeather.com®

NOAA OCS

Heat Index

The heat index is calculated with a complex equation that factors in the air temperature and relative humidity, and it is meant to effectively convey what the temperature will feel like. But it makes assumptions about a person's age, weight and level of activity and assumes that they are in the shade. The temperature can feel hotter in the sun or during strenuous activity.



Weather or Not...

Part 2: “Controlling” Weather Better

John Dysinger — AdAgrA 2025

Controlling the Weather

(In a very small way)

- Remember that weather consists of six main components: (1) temperature, (2) atmospheric pressure, (3) wind, (4) humidity, (5) precipitation, and (6) cloudiness.
- I don't know any practical way to control atmospheric pressure or cloudiness. The other variables have some degree of control.

Controlling Temperature:

Too Cold

- Floating Row Covers
- Add a layer of plastic
- Add a second layer of plastic (with blown air in between the layers)
- Add heat
  - Propane or Natural Gas
  - Alternative fuels (used oil, diesel, wood, etc.)
  - Geothermal options (see ATTRA publication on “Geothermal Greenhouses”)

Controlling Temperature:

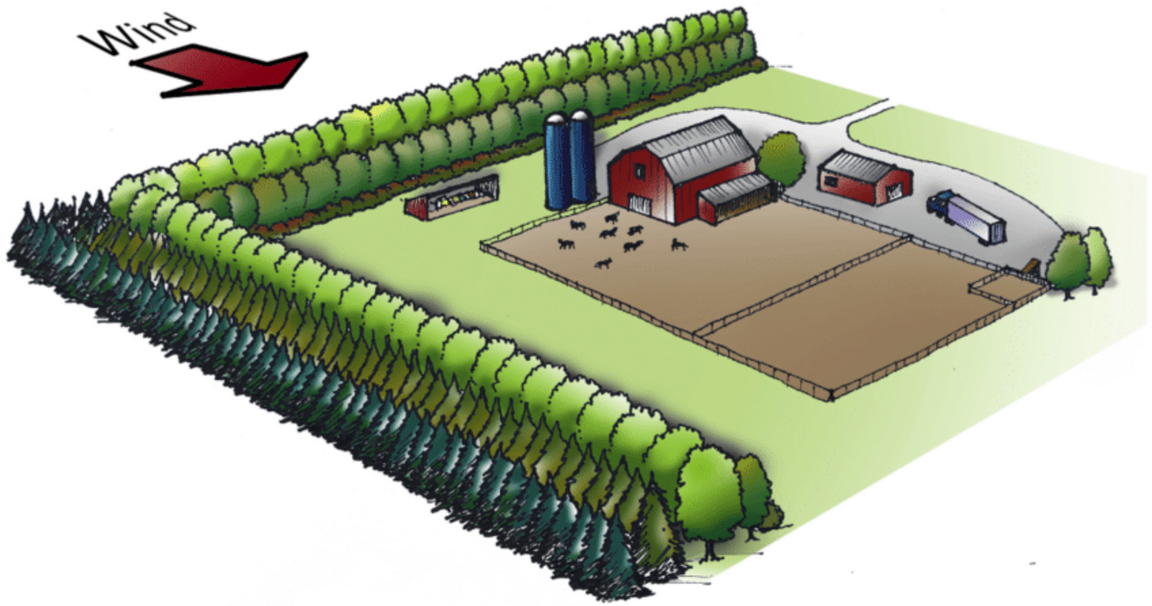
Too Hot

- Shade cloth (I don’t recommend more than 30% shade for most applications)
- Fans (encourage evaporative cooling)
- Cooling walls (if your humidity is lower than 60% RH)
- Misting systems
- Using more heat-resistant varieties (doesn’t control temperature, but helps you handle the heat)

Controlling Wind:

Too Much

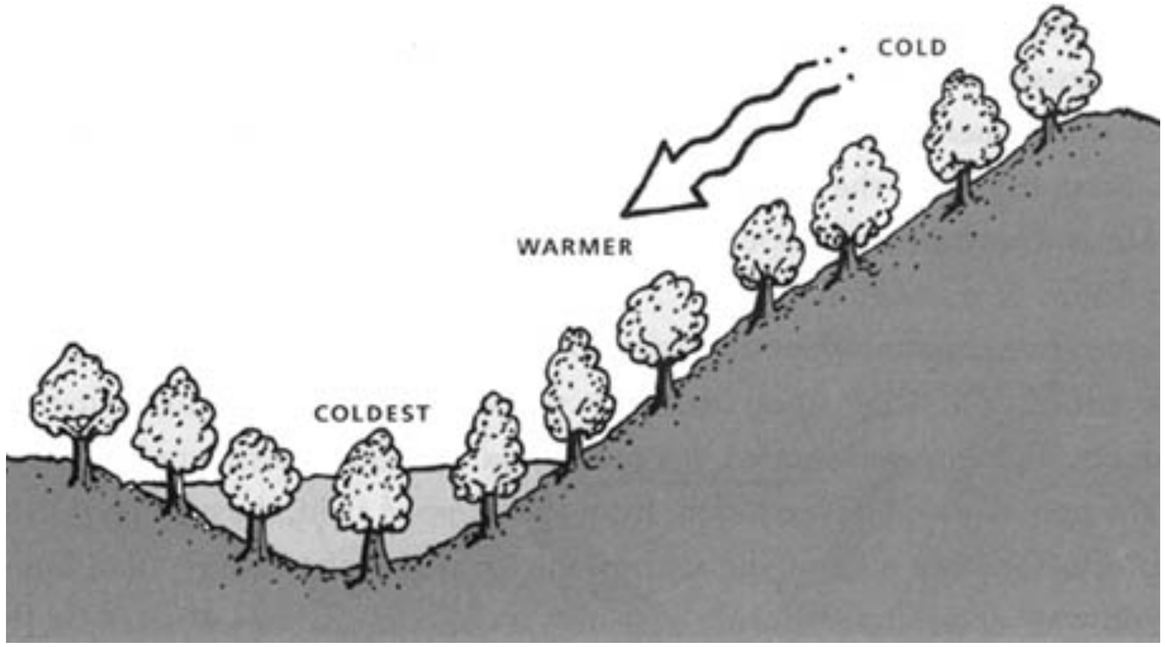
- Try to site your garden/farm so that natural objects (or man-made structures) will block the prevailing winds.
- Erect (or plant) a windbreak (preferably evergreen plants)
- The protected area of a windbreak can be up to 30x its height!
- Our experience with hoophouses suggests that it is best to orient the hoophouses **with** the prevailing wind.



Controlling Wind:

Too Little

- Remember that a little bit of air movement is good! It's one of your first lines off defense against disease.
- Don't place your garden in the lowest spot around — where cold, humidity and disease will sit.
- Instead, place it either on the side or top of a hill — where there is some slope below the garden.
- Also, don't have too much vegetation around the garden to block air flow.



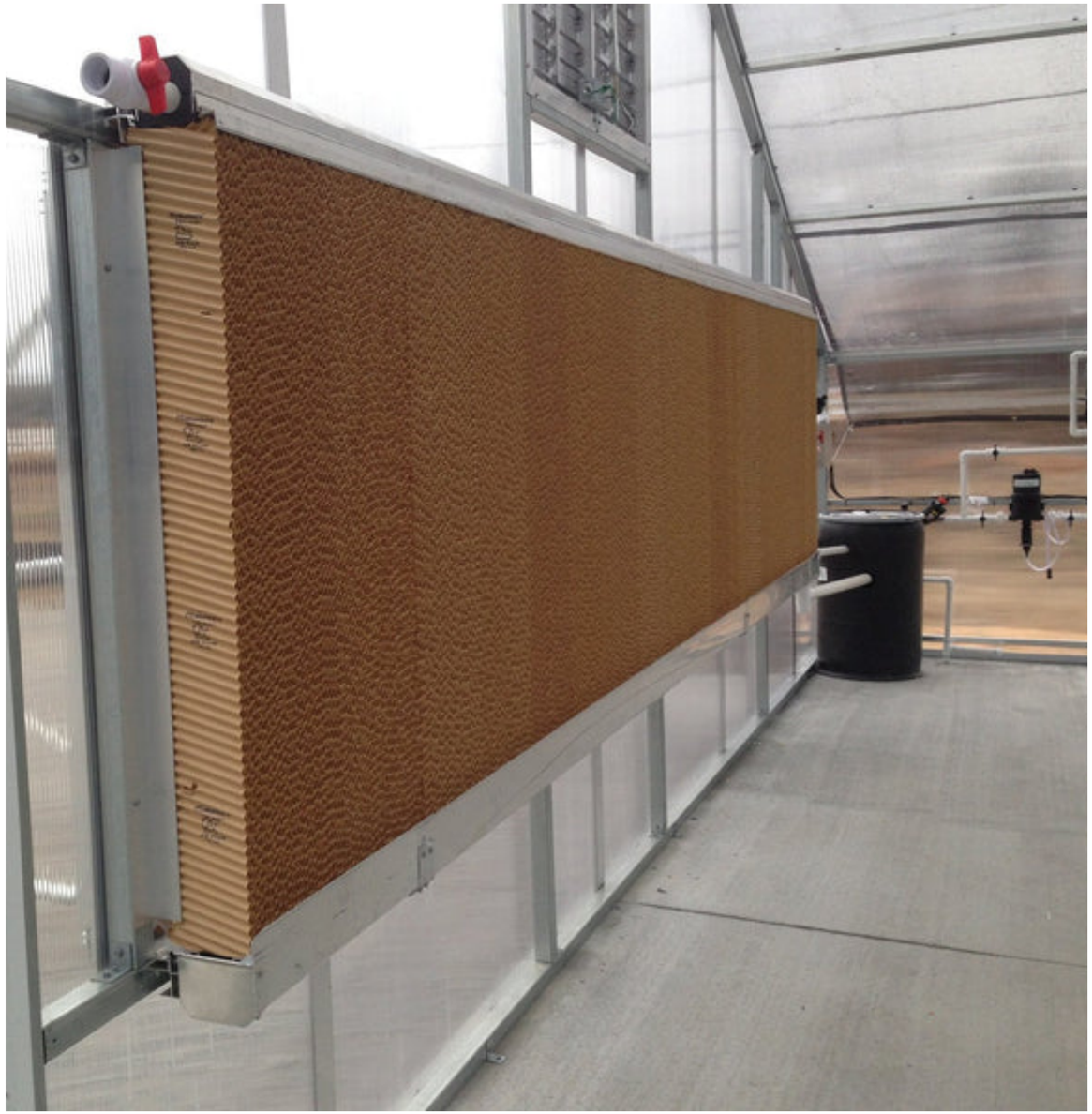
Controlling Humidity:
Too Wet

- It's difficult to **decrease** humidity.
- Using drip irrigation instead of overhead sprinklers can help.
- Fans can help some with evaporation and make it *feel* cooler.
- Power venting — combining ventilation and heat can work.
- There are large, *expensive,* commercial greenhouse dehumidifiers — but they claim to save energy costs significantly.

Controlling Humidity:

Too Dry

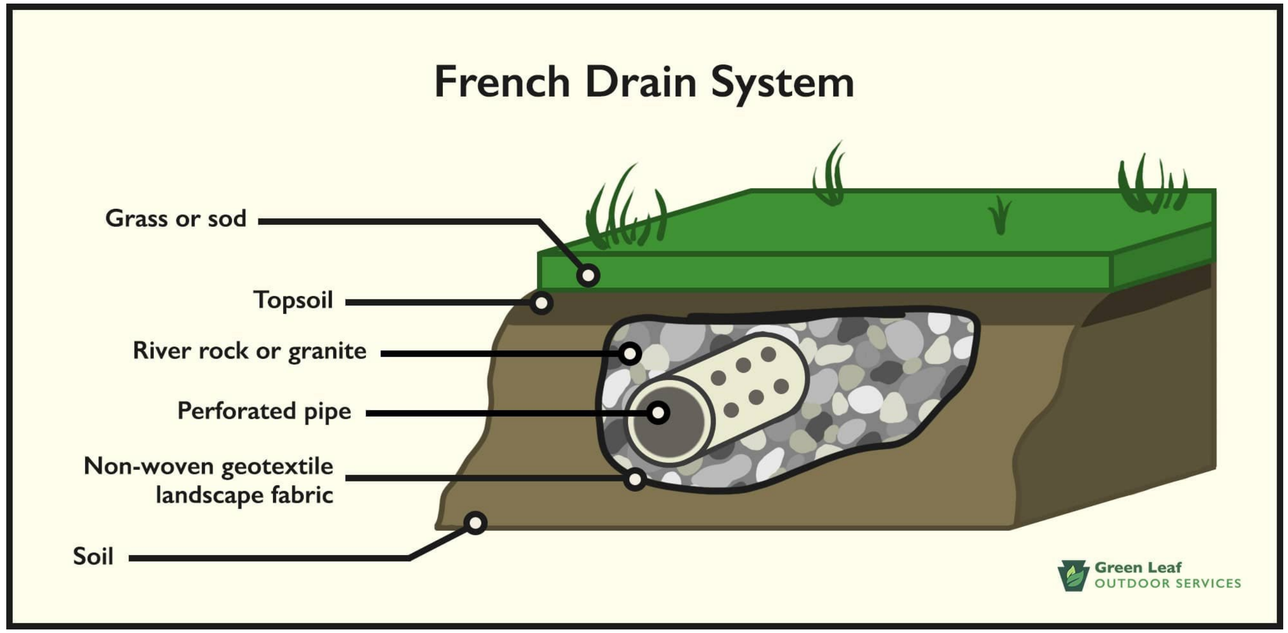
- Plants and soil themselves add humidity to the environment. Make sure soil and plants are receiving adequate water.
- Misting or sprinkling can humidify an environment.
- It is possible to increase humidity by evaporative cooling in a covered structure (if RH is lower than 60%)
- Ideal humidity for most plants is between 50-70% RH.



Controlling Precipitation:

Too Much

- Avoid low spots.
- Use French drains if water doesn't drain off quickly.
- Too much precipitation can best be controlled by growing under cover — combined with good drainage.



Controlling Precipitation:

Too Little

- Have a reliable source of irrigation.
  - Overhead irrigation is easier and cheaper (if water volume is sufficient)
  - Drip irrigation is better if water volume is limited (or if you need to control foliar disease).
  - Use permaculture techniques to catch and hold water.

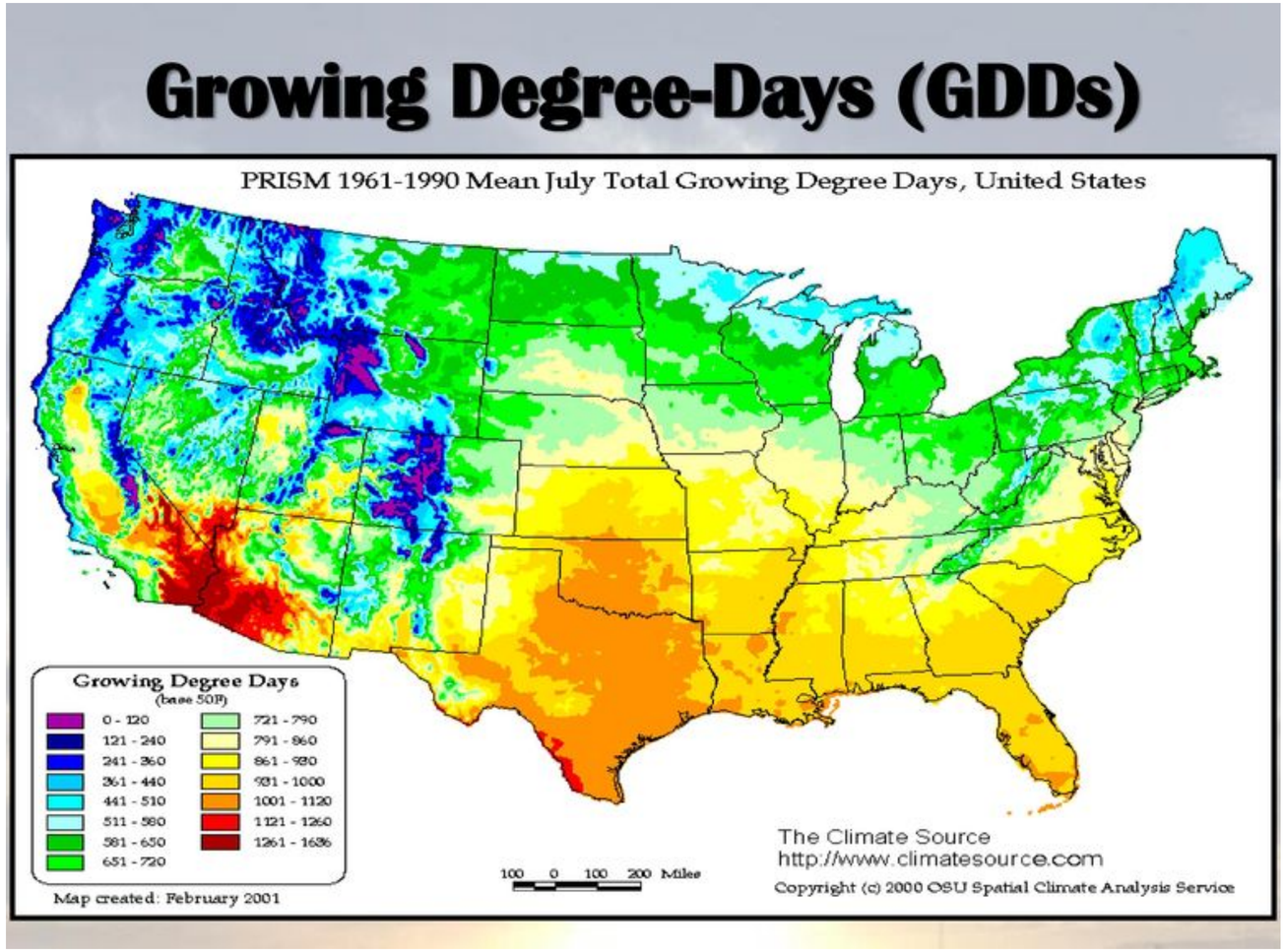
Key Take-Home Points:

Covered structures and a good water supply are two of the best ways to minimize the effects of inclement weather.

Growing Degree Days

(Used widely for Commodity Crops)

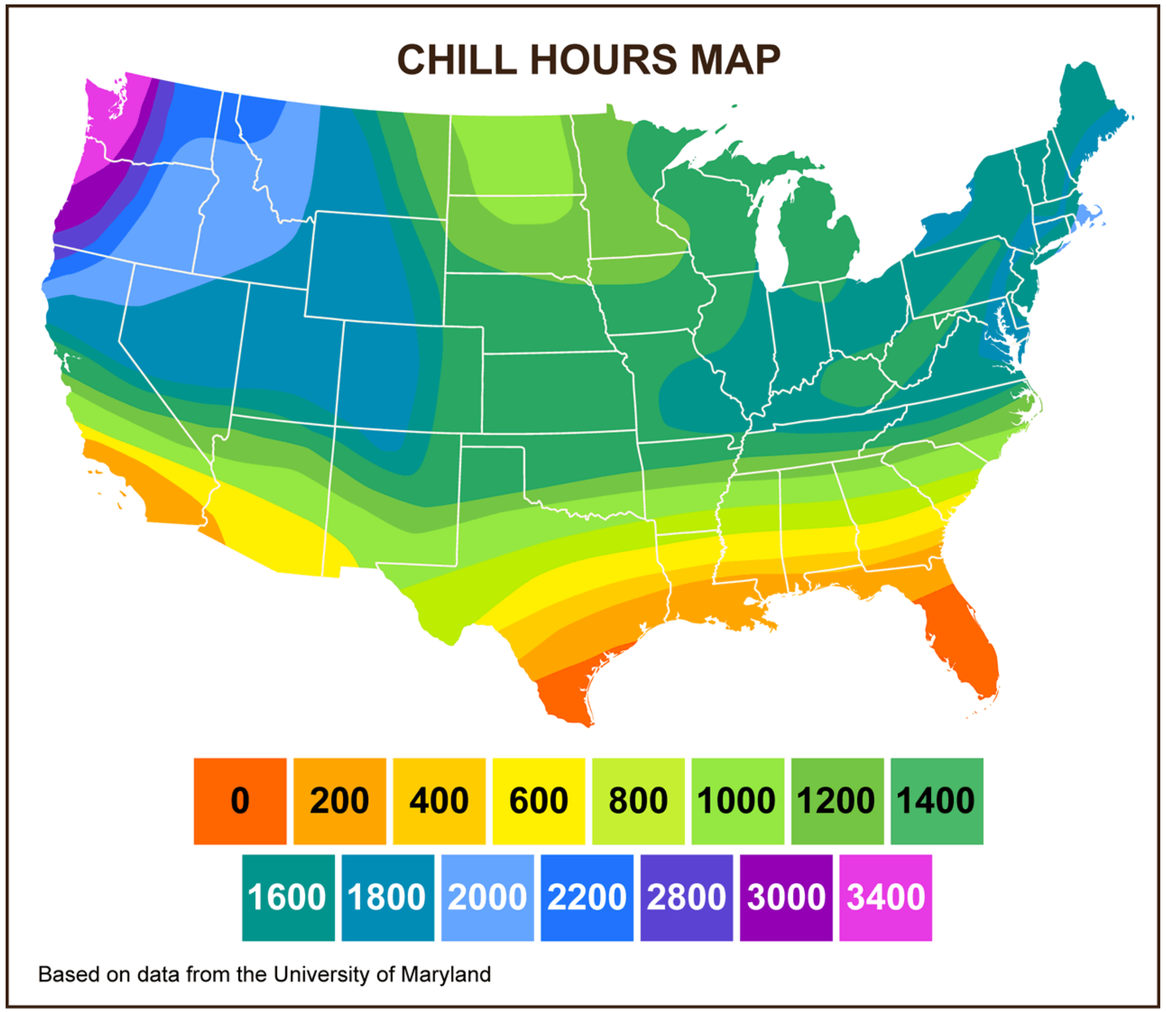
- Growing degree days (GDD), or heat units, are used to estimate the growth and development of certain crops and pests during the growing season.
- To calculate GDDs you add the high and low temperature for the day and divide by 2 to get the mean temperature. The mean temperature minus the base temperature (50 F for corn) gives you the GDD for that day.



Chilling Hours of Crops

(Mainly for Tree Crops and Blueberries)

- There are various ways to calculate chilling hours, but the basic concept is to count the number of chilling hours (usually hours below 45 degrees F) after the the crop has reached dormancy in the fall.
- Some models only count the hours between 32 and 45 degrees F).
- Using a map like this can help you to know what types of plants to grow.



Irrigating for Frost Protection

While Accounting for Low Dew Point

- When dew points are very low, the initiation of frost protection is very critical, because the initial water will actually cool the crop and can cause damage — even when the air temperature is well above freezing.
- Example: I don't want the wet bulb temperature to go below 31° F. The dew point is 20° F. I need to turn on the sprinklers at 37° F

Table 3. Minimum turn-on and turn-off air temperatures (°F) for sprinkler frost protection for a range of wet-bulb and dew-point temperatures (°F)*

Dew-point Temperature	Wet-bulb Temperature (°F)										
°F	22	23	24	25	26	27	28	29	30	31	32
32											32.0
31										31.0	32.7
30									30.0	31.7	33.3
29								29.0	30.6	32.3	34.0
28							28.0	29.6	31.2	32.9	34.6
27						27.0	28.6	30.2	31.8	33.5	35.2
26					26.0	27.6	29.2	30.8	32.4	34.0	35.7
25				25.0	26.5	28.1	29.7	31.3	32.9	34.6	36.3
24			24.0	25.5	27.1	28.6	30.2	31.8	33.5	35.1	36.8
23		23.0	24.5	26.0	27.6	29.1	30.7	32.3	34.0	35.6	37.3
22	22.0	23.5	25.0	26.5	28.1	29.6	31.2	32.8	34.5	36.1	37.8
21	22.5	24.0	25.5	27.0	28.5	30.1	31.7	33.3	34.9	36.6	38.2
20	22.9	24.4	25.9	27.4	29.0	30.6	32.1	33.7	35.4	37.0	38.7
19	23.4	24.9	26.4	27.9	29.4	31.0	32.6	34.2	35.8	37.5	39.1
18	23.8	25.3	26.8	28.3	29.8	31.4	33.0	34.6	36.2	37.9	39.5

*** Select a wet-bulb temperature that is at or above the critical damage temperature for your crop and locate the appropriate column. Then choose the row with the correct dew-point temperature and read the corresponding air temperature from the table to turn your sprinklers on or off. This table assumes a barometric pressure of 1013 millibars (101.3 kPa).**

Recommended Weather Resources

(That I have found helpful)

- MelStrong.org — A college course on weather done in a very engaging and informative way. I loved it!
- “It’s Just Astronomical” YouTube channel — His two part “How Weather Works” series gives a great introduction and overview to the subject.
- earth.nullschool.net — An amazing look at real-time global weather (you can also go back and look at any past date in their database).
- Zoom earth app.