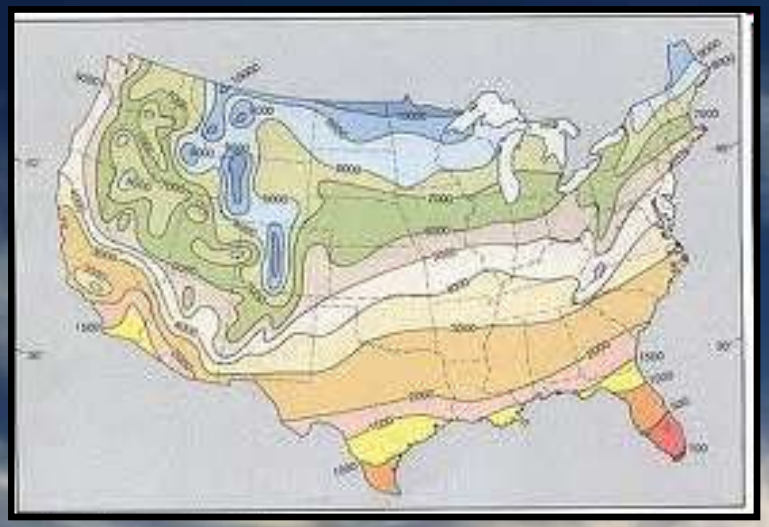
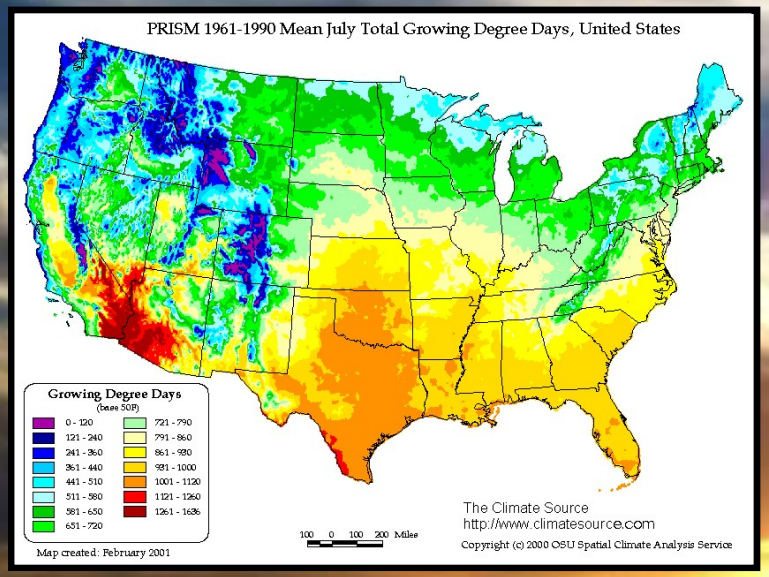
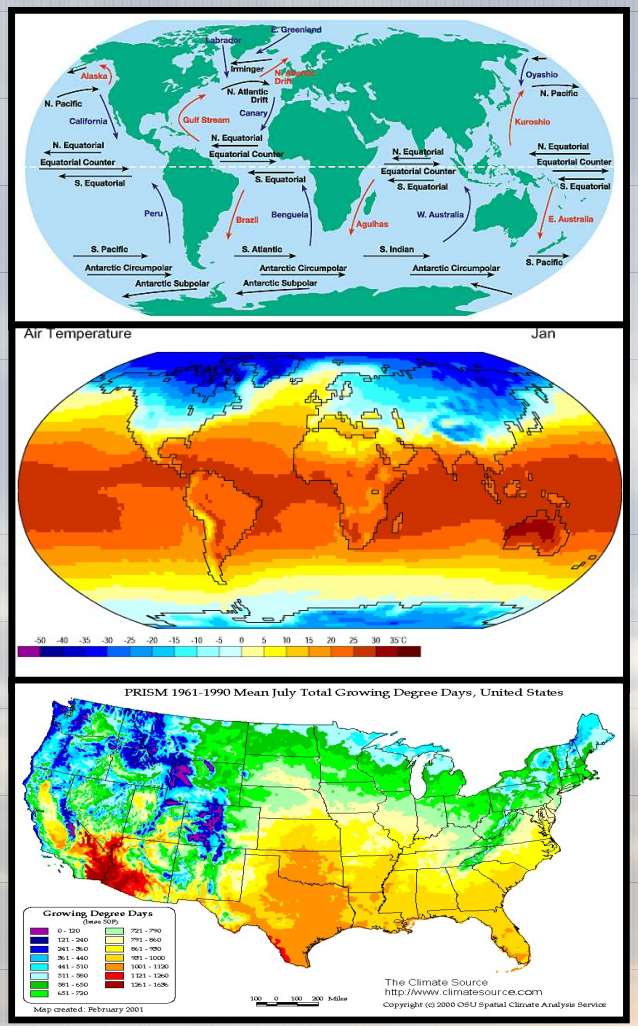




Lecture 6

Air Temperature & Applications

Learning Goals for Part 2 of Chapter 3



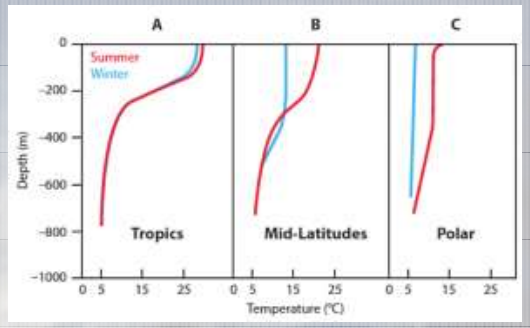
1. Know the other aspects of the Earth that **CONTROL AIR TEMPERATURE**.

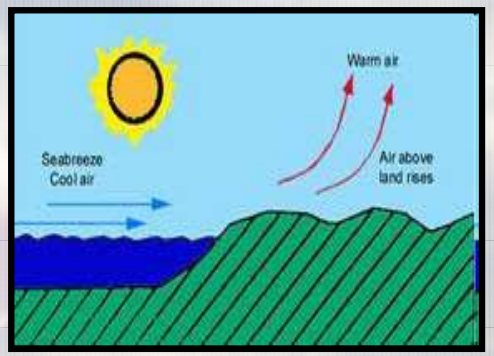
2. Have an understanding of the average **GLOBAL DISTRIBUTION** (pattern) of temperature.

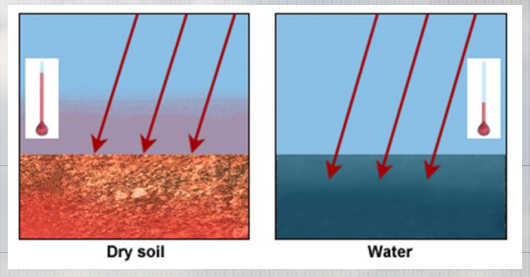
3. Have an understanding of how temperature data can be **APPLIED** to our lives.

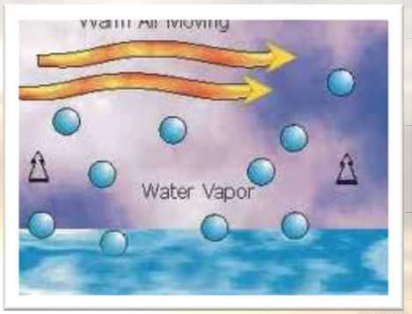
What controls air temperature? Con't

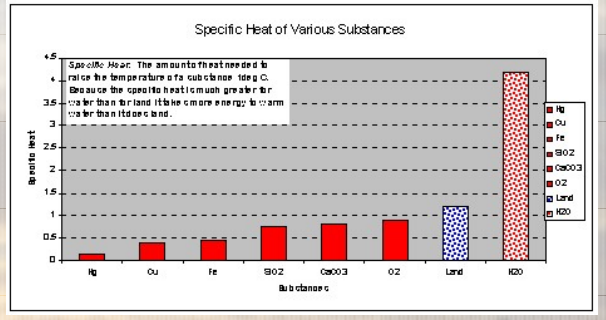
- ✓ Differential Heating of land and water
- Ocean Currents
- Altitude
- Geographic Position
- Cloud cover and albedo

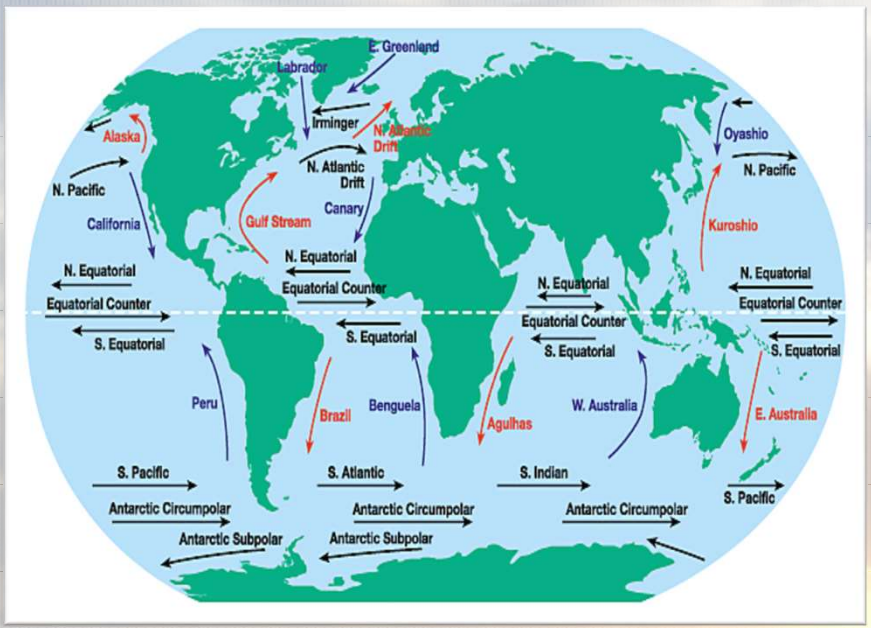












Ocean Currents

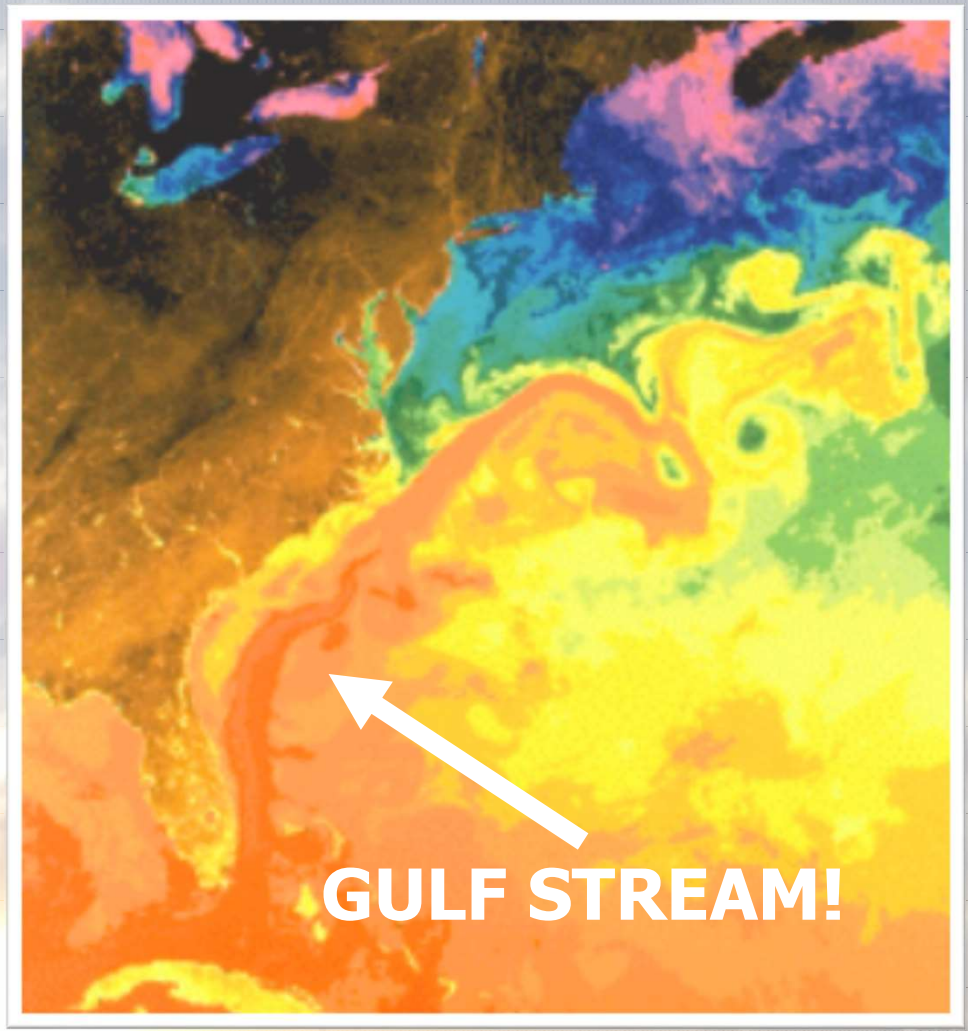
- **Ocean currents are caused by wind**
  - interactions between the atmosphere and ocean
- Energy passes from the atmosphere to the ocean via friction.
  - The **DRAG** exerted be the wind causes it to move

Ocean Currents – Poleward Currents

Have a MODERATING effect !!

- Warm water from the tropics travels up the coast via the Gulf Stream

- It becomes the North Atlantic Drift and helps **keep English and Irish weather mild**.



Altitude

- Cooler temperatures at greater heights

- Atmospheric **pressure** and **density decreases** so that atmosphere absorbs and reflect less radiation.

Geographic Position

- **Leeward:** prevailing winds blow TOWARDS the Ocean

Lacks Ocean Influence, More like Land Temperatures

MORE VARIABLE TEMPERATURES

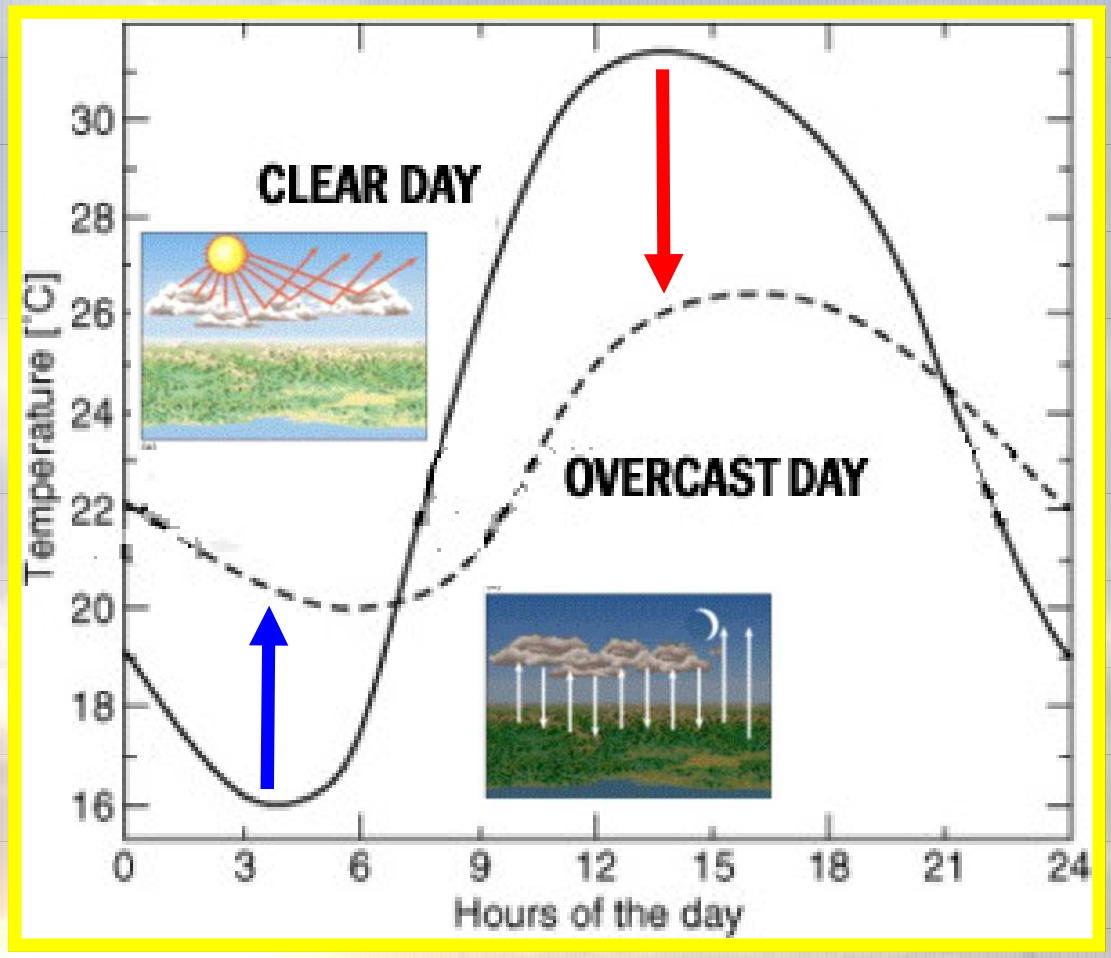
- **Windward:** prevailing winds blow From the Ocean to the SHORE

Moderated by the Ocean air, cool summers-mild winters

LESS VARIABLE TEMPERATURES

Cloud Cover and Albedo

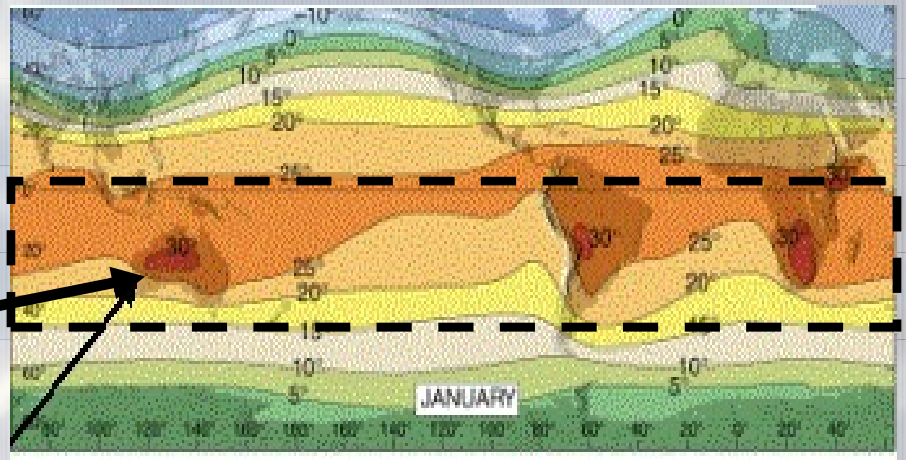
- **Clouds cool during the day**
  - High ALBEDO
  - **Lower Maximum**
- **Clouds warm at night**
  - Trap OUTGOING Longwave radiation
  - **Higher Minimum**



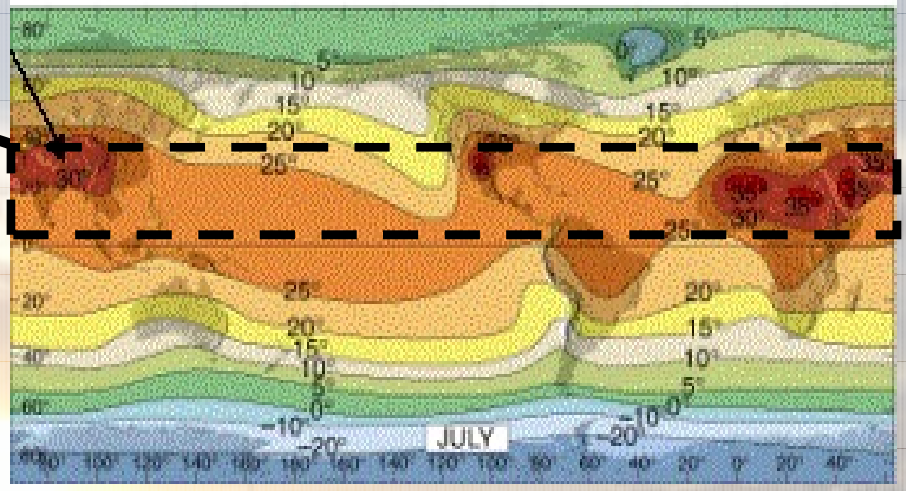
World Distribution of Temperature

- Latitudinal Shifting due to the **seasonal migration of the Sun**.
- "**HOT SPOTS**"
  - Differential heating
- Heating is largely a function of **LATITUDE**

JANUARY

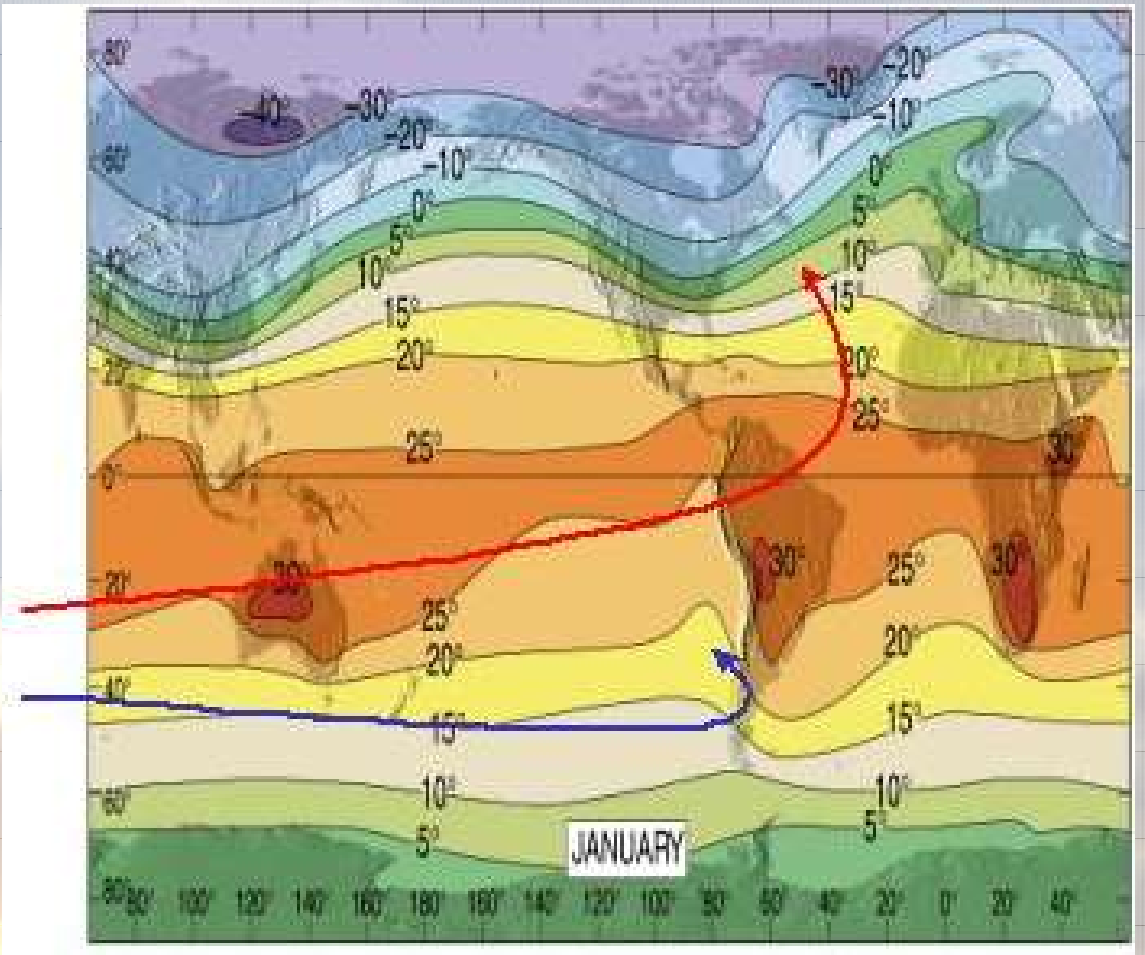


JULY



World Distribution of Temperatures

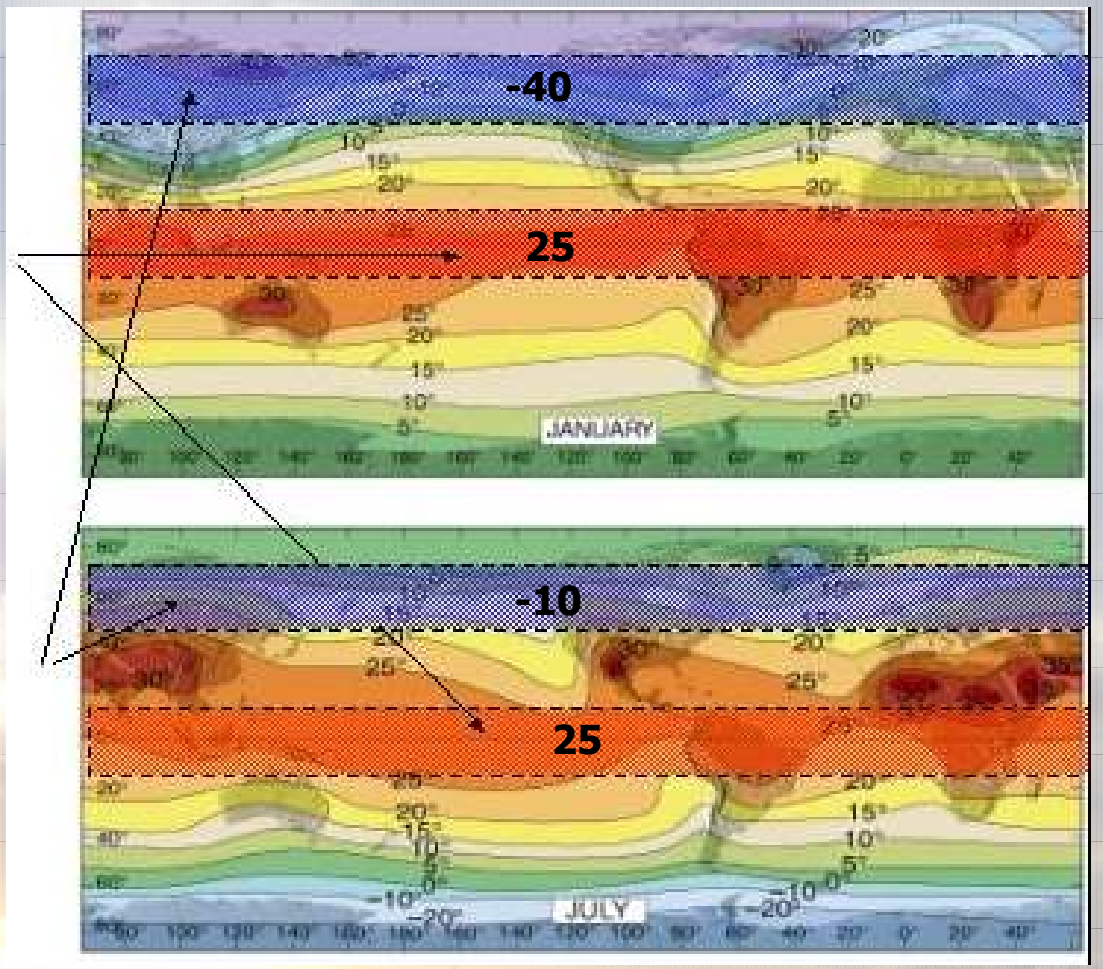
- The hottest and coldest places are over land.
- **Warm ocean currents** moving to the Poles warm the air.
- **Equatorial bound currents** help cool the air.



World Distribution of Temperatures

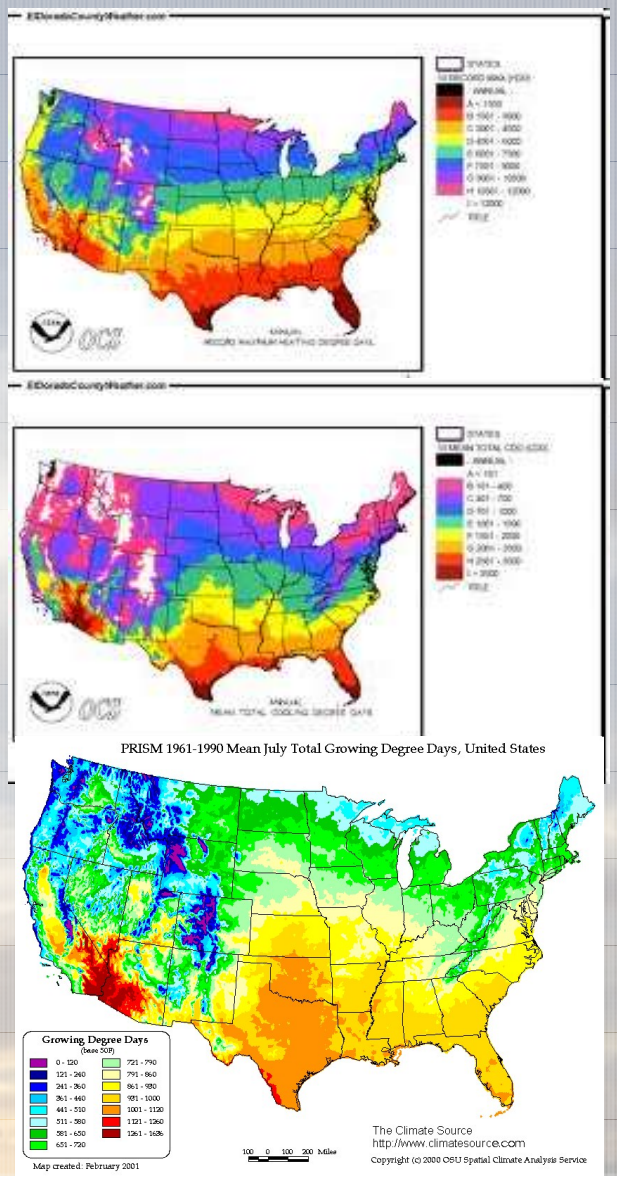
Equatorial temperatures do not fluctuate significantly (there are no seasons).

Middle and higher latitudes have much stronger seasonal signals.



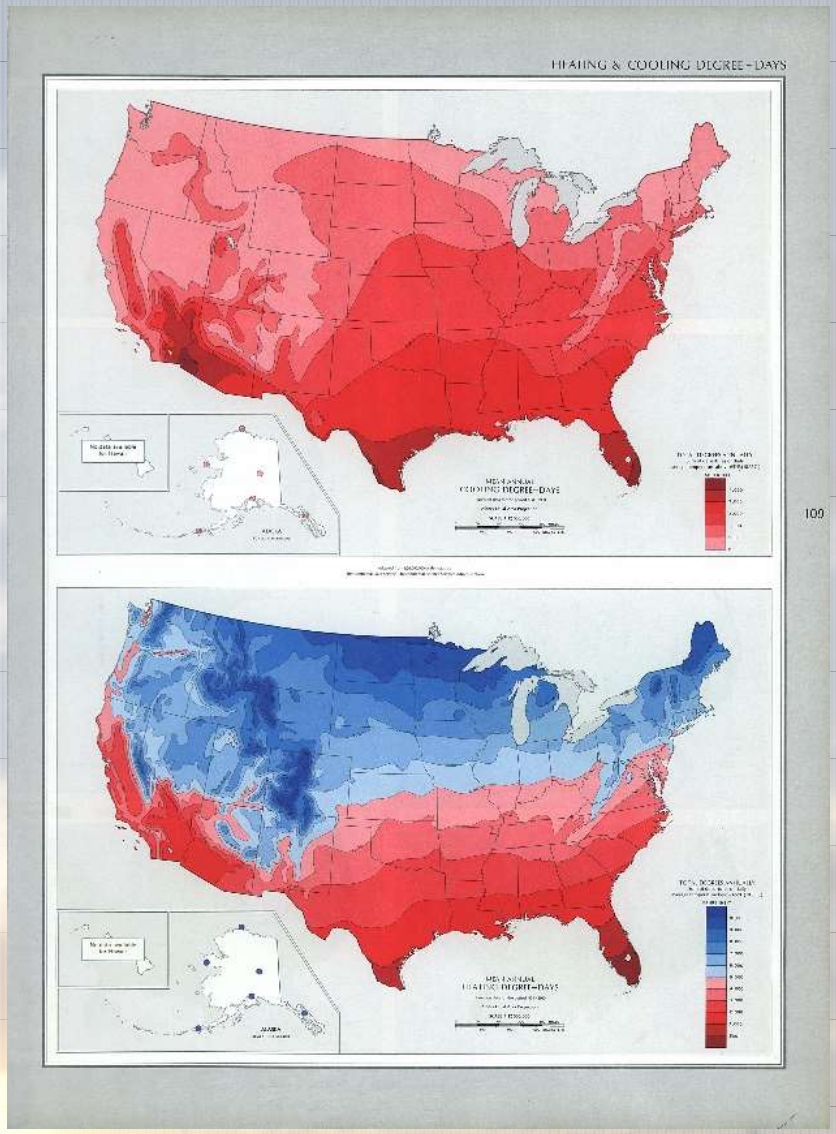
Applications of Temp Data

- **Heating Degree-Days**
  - When you turn the heat on
- **Cooling Degree-Days**
  - When you turn the AC on
- **Growing Degree-Days**
  - When plants can grow
- **Temperature and Comfort**
  - How temperature ACTUALLY feels

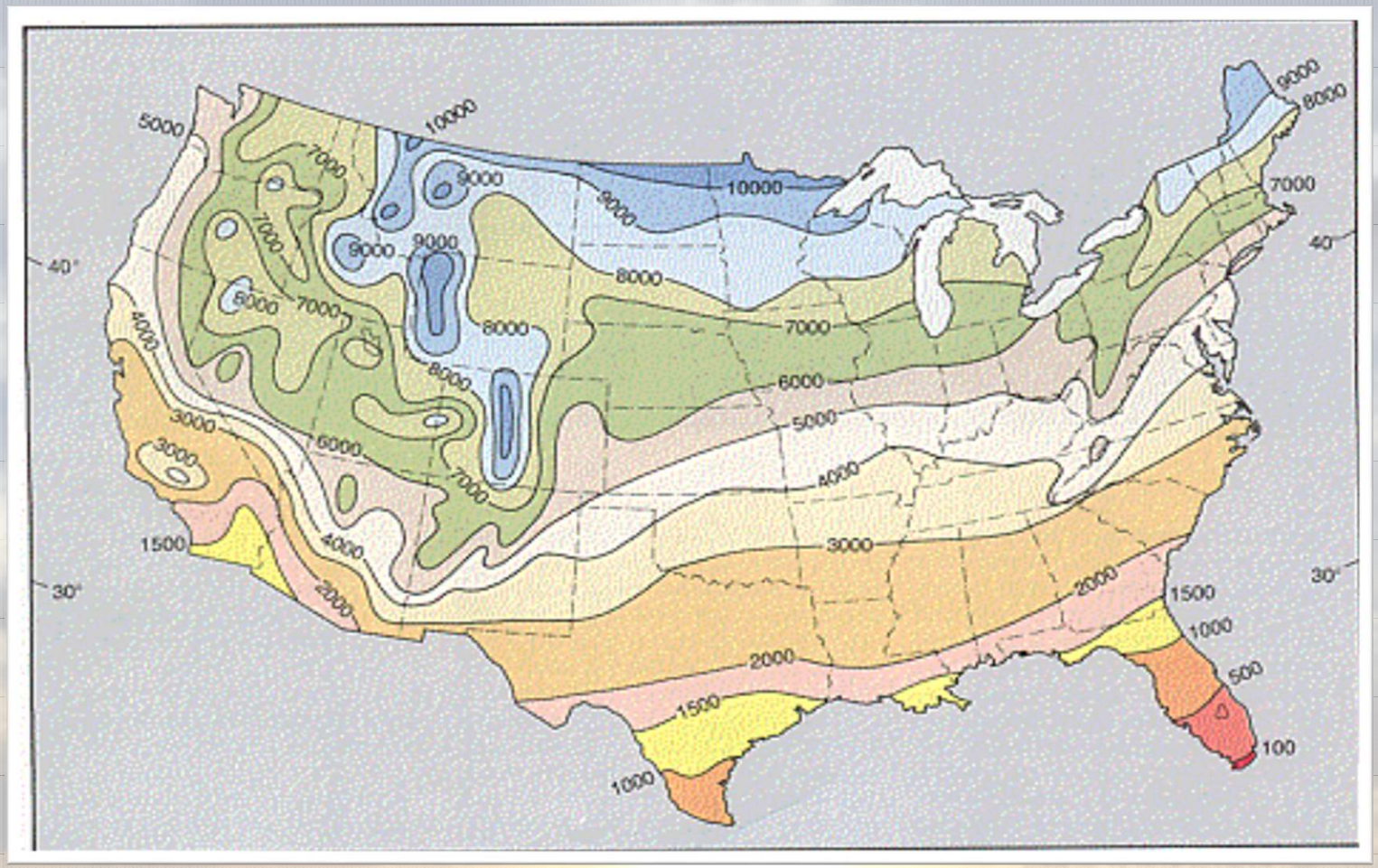


Heating Degree-Days

- Developed by Engineers in the early 20th century
- A way to evaluate energy demand
  - Don't need the "heat" if it is 65F or warmer outside
  - Any degree BELOW 65 counts as a heating degree-day
  - e.g. if it's 50F out….
    - That's **65-50 = 15 heating degree-days**
- **Total it up for the whole year or season**



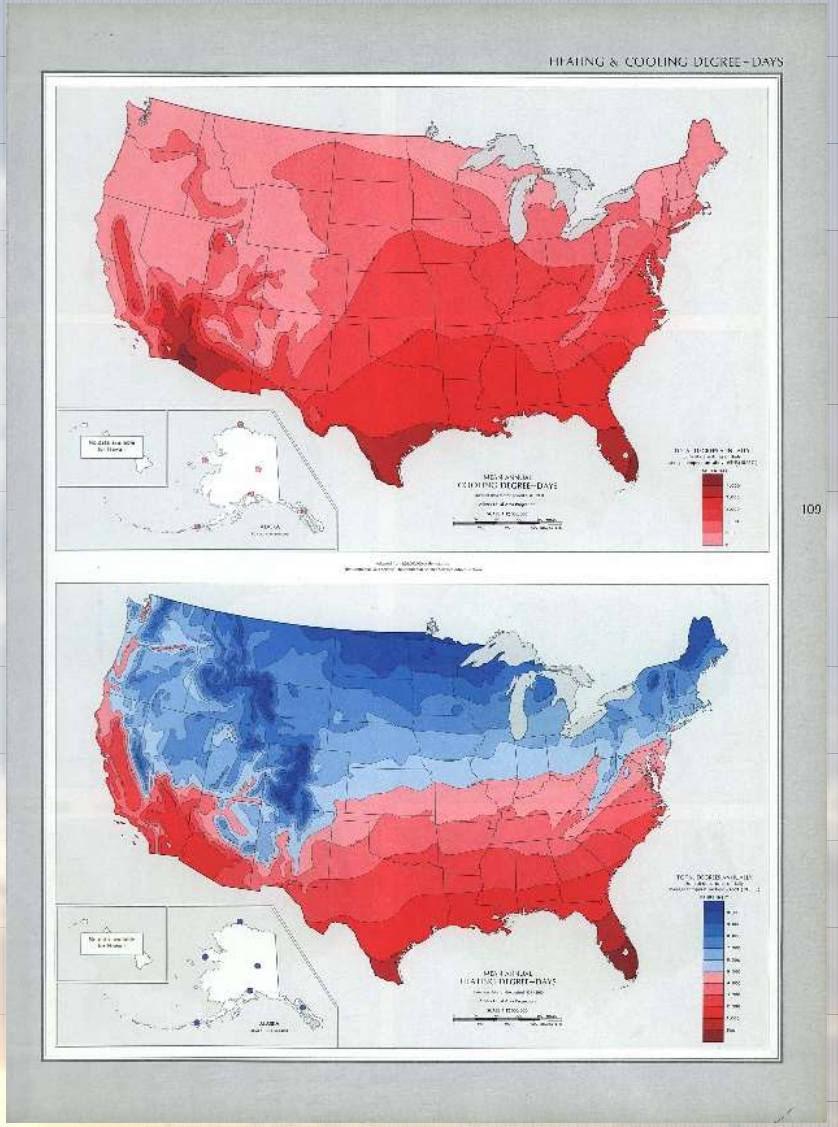
Heating Degree-Days



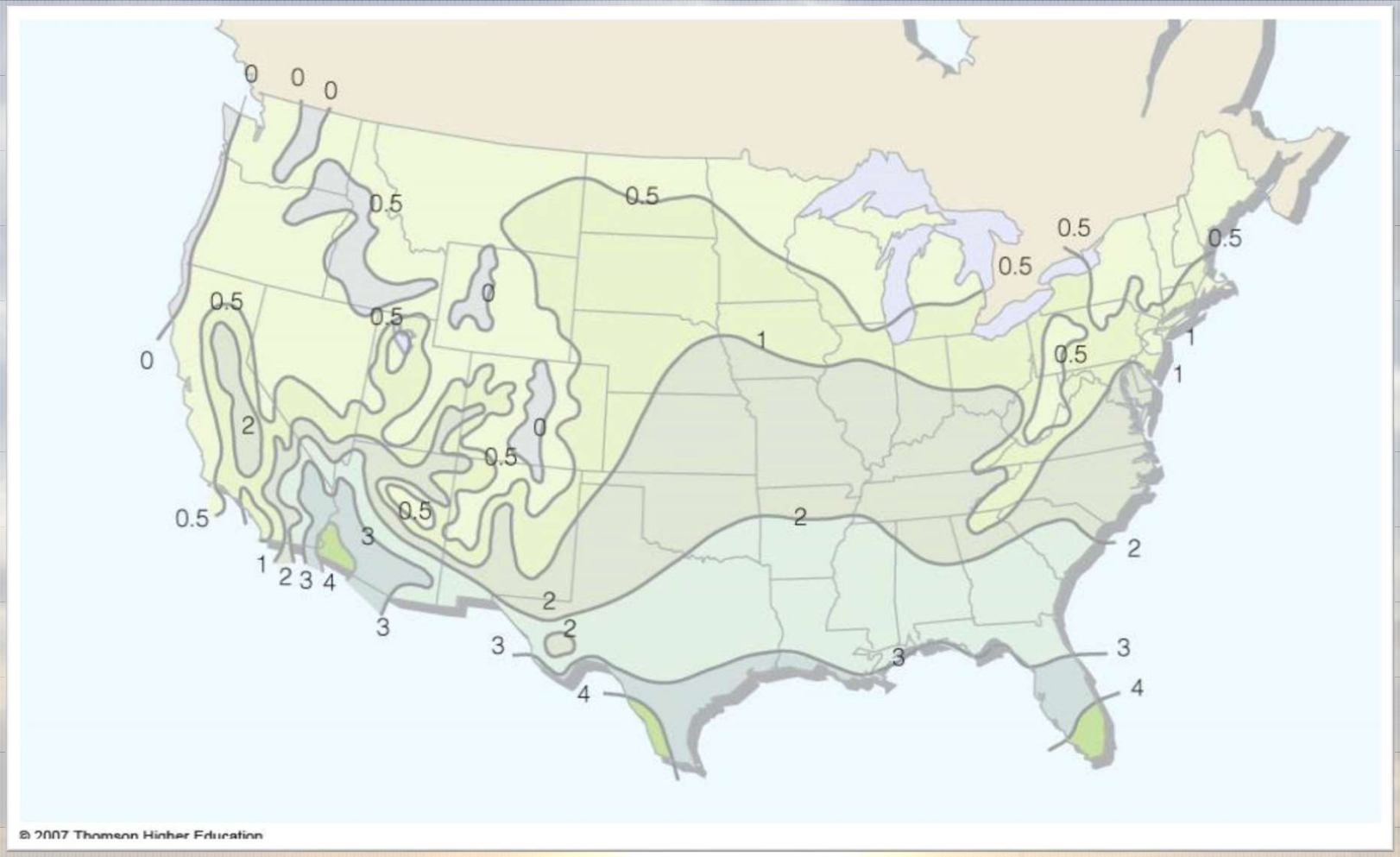
Cooling Degree-Days

- A way to evaluate **energy demand for cooling a building**
  - If its above 65 you need the AC on….
  - Any degree ABOVE 65 counts as a Cooling degree-day
  - e.g. if it's 85F out….
    - That's **85-65 = 20 cooling degree-days**

- **Total it up for the whole year or season**



Cooling Degree-Days



Growing Degree-Days (GDDs)

- Used by **farmers** to determine the approximate date to harvest their crops.
  - Specific for each **CROP**
  - The number of GDDs for a crop on **any day** is:
    - **the difference between the daily mean temperature and the base temperature of the crop**

Growing Degree-Days (GDDs)

- **Example:**

  Sweet Corn Base Temperature = 50 F

  Peas Base Temperature = 40 F

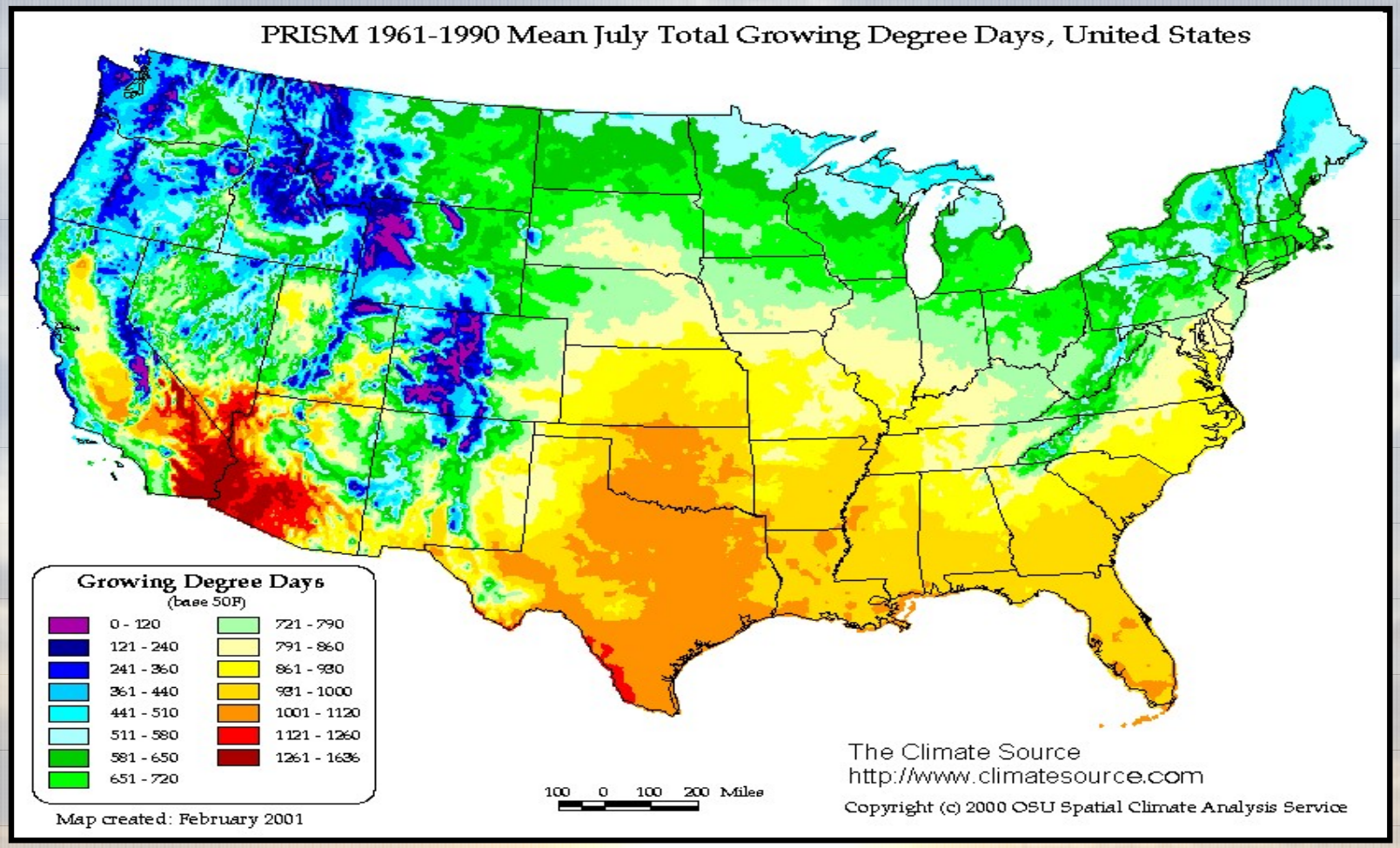
If Mean Daily Temperature = 75 F

Sweet Corn GDDs = 75-50 = 25

Peas GDDs = 75-40 = 35

Thus, if 2000 GDDs are needed to mature a crop, you just keep track of when you reach 2000 GDDs and then harvest!

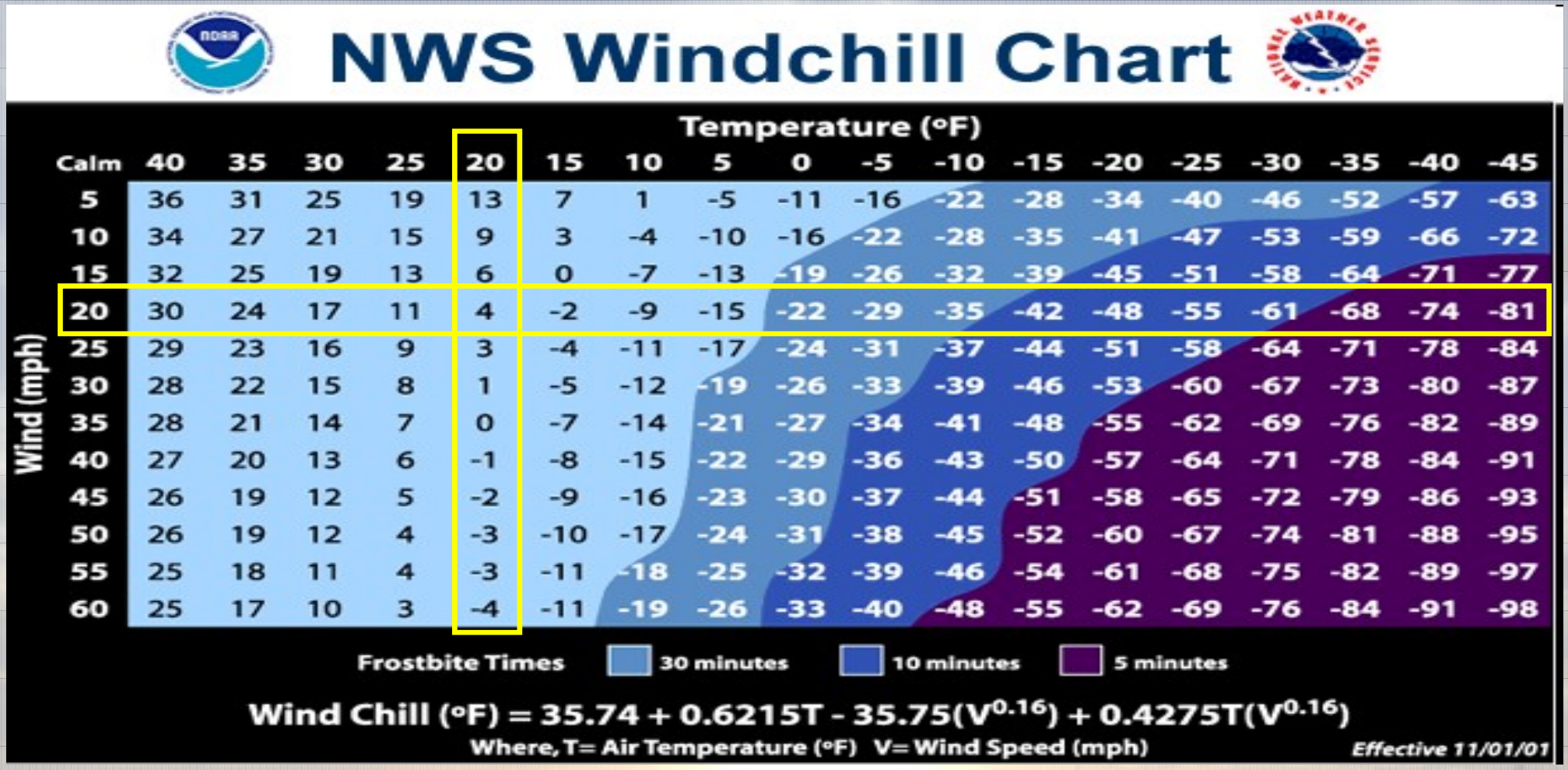
Growing Degree-Days (GDDs)



Temperature and Comfort

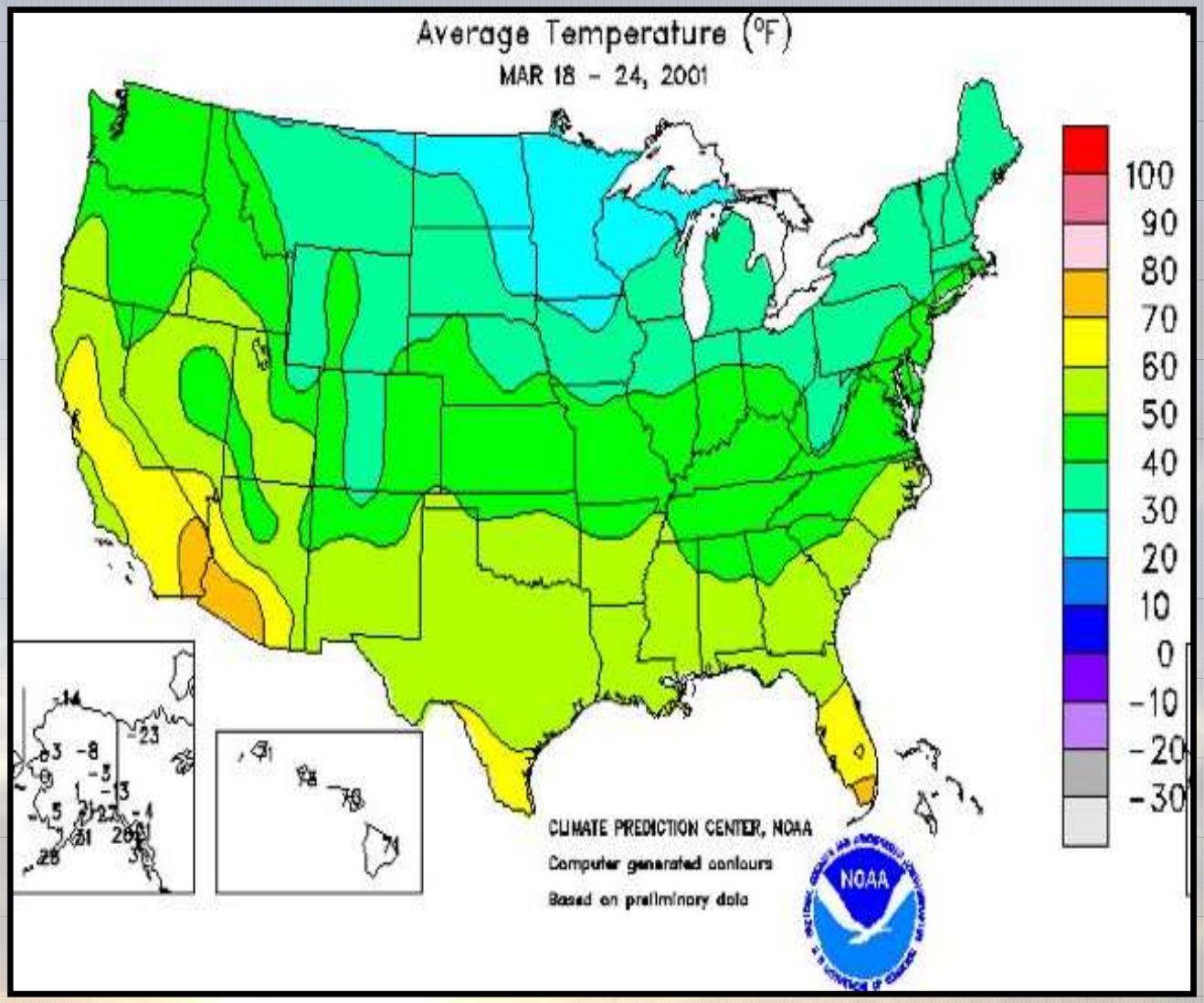
- **How we perceive temperature matters to us humans. It is affected by:**
  - Relative humidity
  - Wind
  - Sunshine
- **Heat Index**
  - When it's humid, evaporation doesn't work as well and we "Feel" hotter
- **Windchill**
  - Wind makes it "Feel" colder than it actually is

Temperature and Comfort

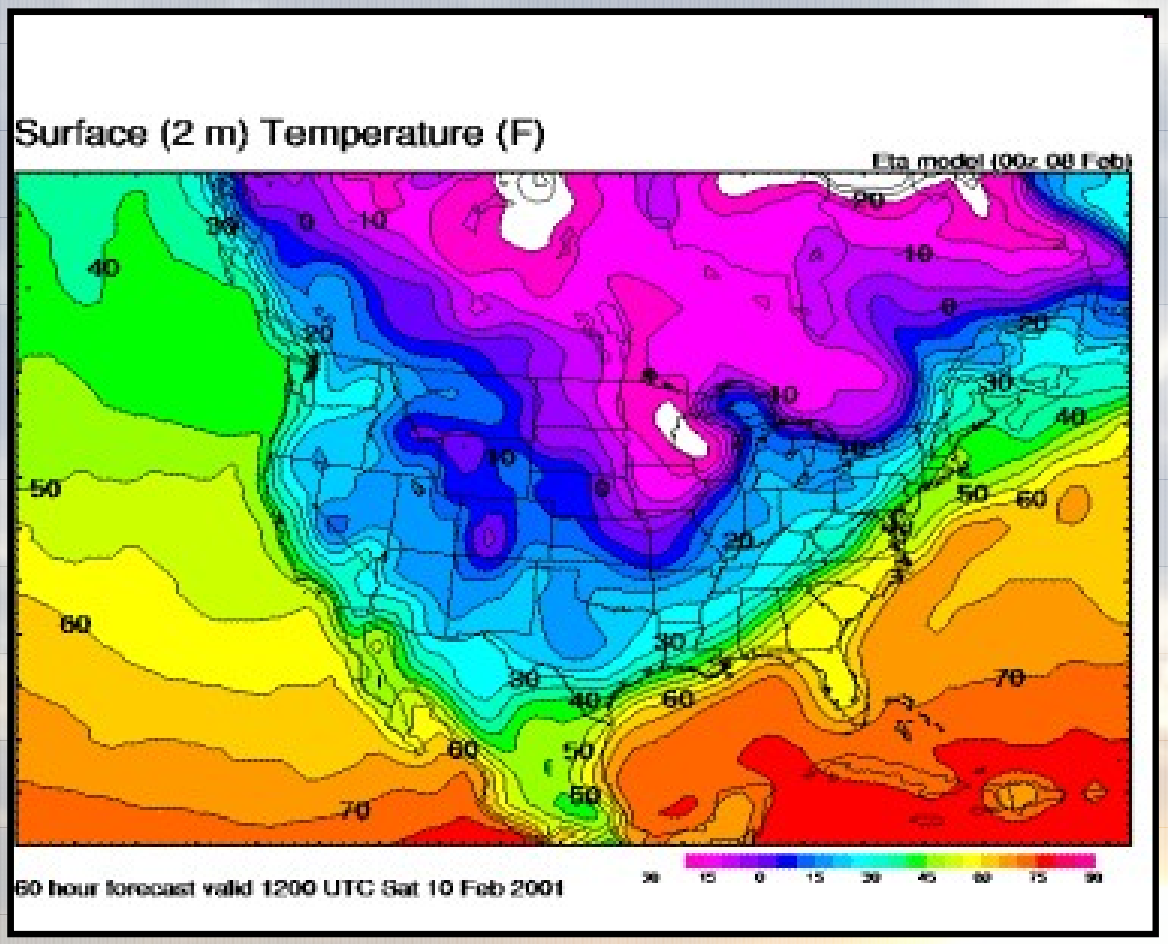


Isotherms

- We use **Isotherms** the distribution of temperature over a large area.
  - **They are lines that connect points on a map that have the same temperature**

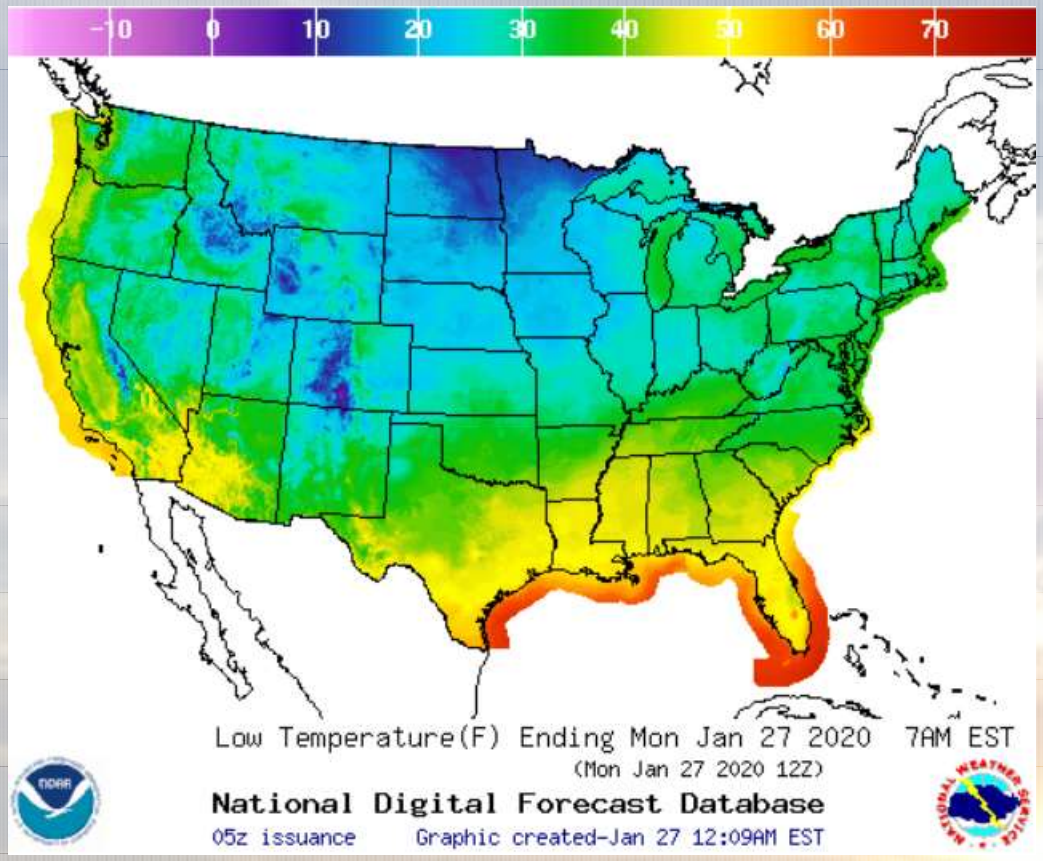


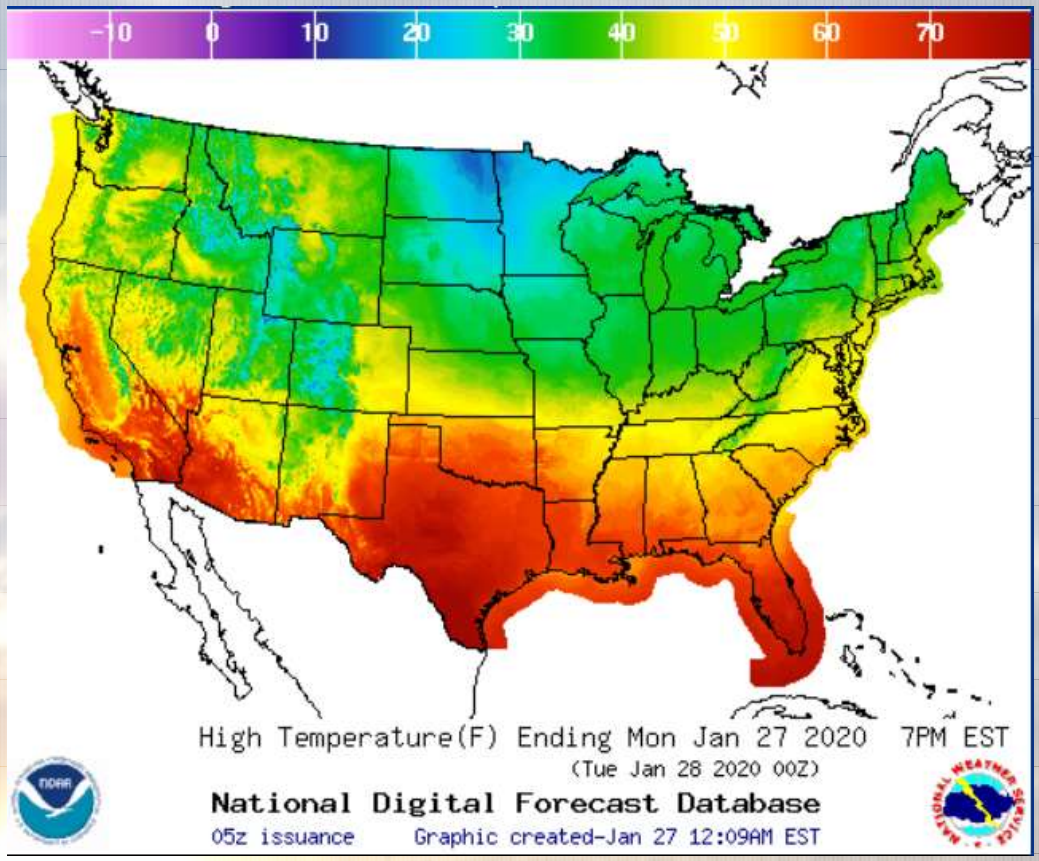
Isotherms – Why do we care??



- **Isotherms** make it easier to read and analyze weather maps
- By looking at patterns of **temperature** (and pressure) you can determine weather conditions in the next few days.

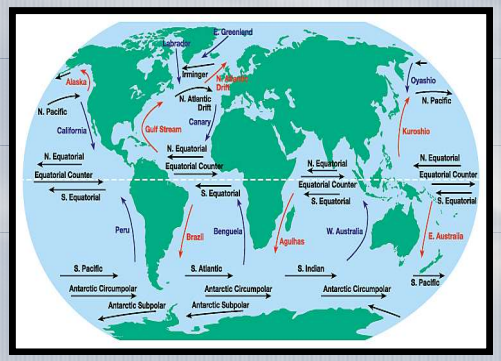
Temperature – Isotherm Maps



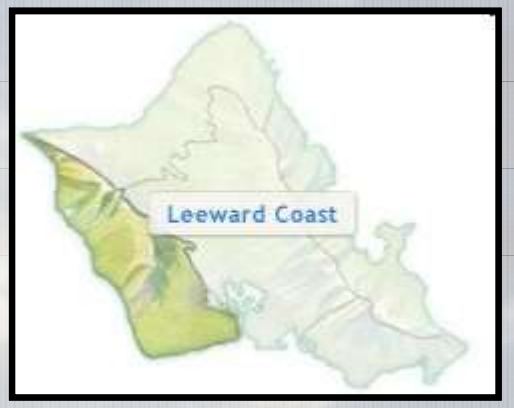


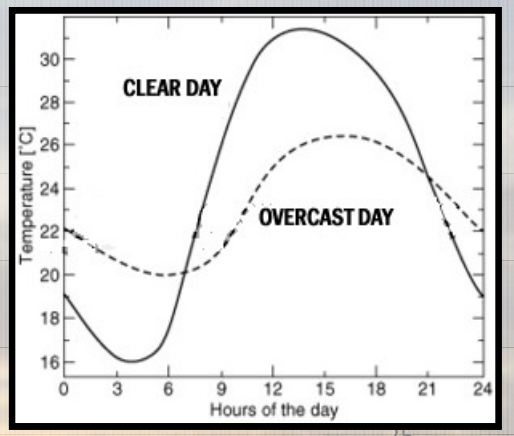
Key Information 1

1. Know the other aspects of the Earth that **CONTROL AIR TEMPERATURE**.



- **Ocean Currents**
  - Move warm water to colder parts of the Earth.
- **Altitude**
  - Temperature decreases with altitude (lapse rate)
- **Geographic Position**
  - Windward and Leeward – keeping track of where the wind blows from
  - Are you coastal or are you land bound?
- **Cloud Cover and Albedo**
  - Reflectivity matters

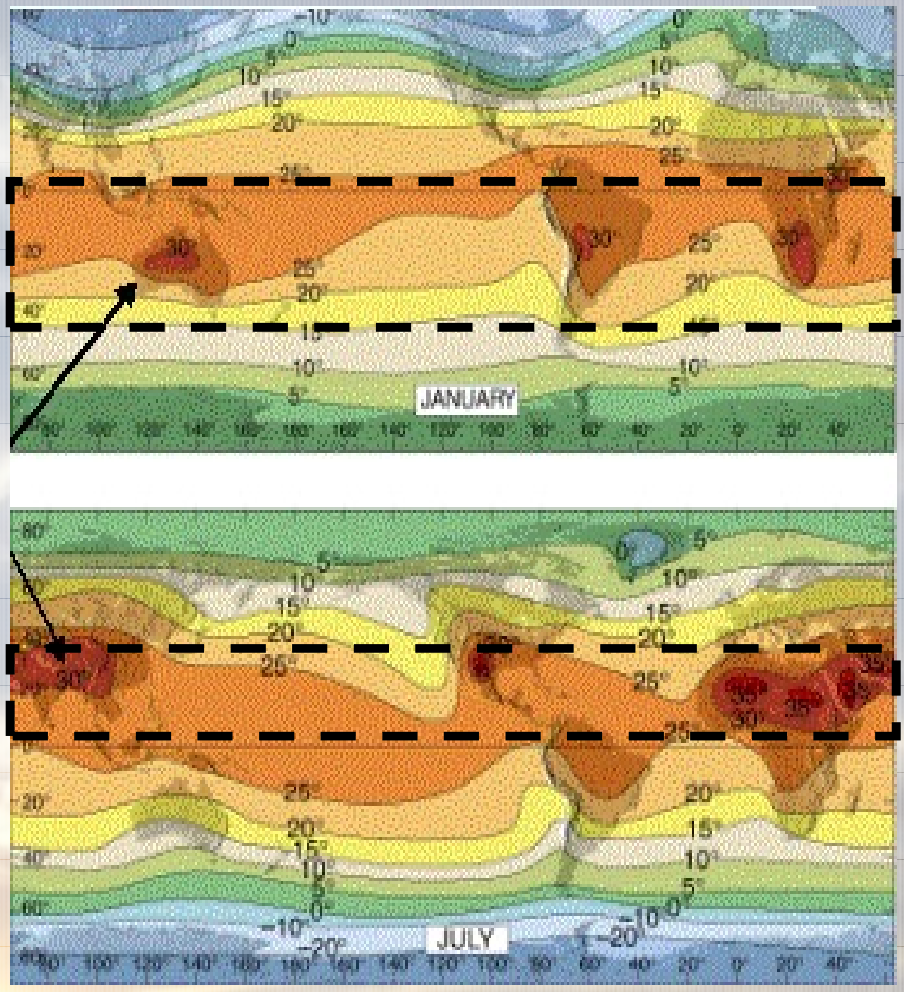




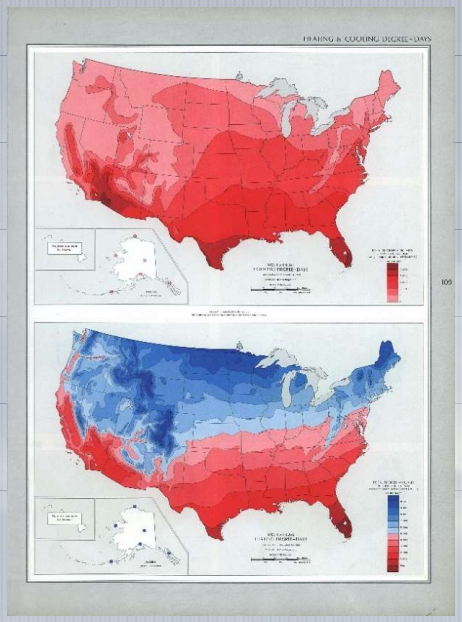
Key Information 2

2. Have an understanding of the average **GLOBAL DISTRIBUTION** (pattern) of temperature.

- **Land vs.Ocean Differences are Clear**
  - Hot spots are over land
  - Land is more variable
  - Ocen temperature are very “straight”
- **Latitudinal Differences**
  - Warmer at the equator and cooler at the poles
- **Seasonal Differences**
  - Area of warmest temperatures shifts to with the sun from the Tropic of Cancer (NH Summer) to the Tropic of Capricorn (NH Winter).
- **Can clearly see the impact of Ocean Currents**
  - Diagonal lines in the Northern Pacific and Northern Atlantic show warmer temperatures than otherwise would be the case.



Key Information 3



3. Have an understanding of how temperature data can be **APPLIED** to our lives.

- **Heating Degree-Days**
  - When you turn the heat on (base 65 F)
- **Cooling Degree-Days**
  - When you turn the AC on (base 65 F)
- **Growing Degree-Days**
  - When plants can grow (base is crop dependent)
- **Temperature and Comfort**
  - How temperature ACTUALLY feels

NWS Windchill Chart

Temperature (°F)

Wind (mph)	Calm	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
5		36	31	25	19	13	7	1	-5	-11	-16	-22	-28	-34	-40	-46	-52	-57	-63
10		34	27	21	15	9	3	-4	-10	-16	-22	-28	-35	-41	-47	-53	-59	-66	-72
15		32	25	19	13	6	0	-7	-13	-19	-26	-32	-39	-45	-51	-58	-64	-71	-77
20		30	24	17	11	4	-2	-9	-15	-22	-29	-35	-42	-48	-55	-61	-68	-74	-81
25		29	23	16	9	3	-4	-11	-17	-24	-31	-37	-44	-51	-58	-64	-71	-78	-84
30		28	22	15	8	1	-5	-12	-19	-26	-33	-39	-46	-53	-60	-67	-73	-80	-87
35		28	21	14	7	0	-7	-14	-21	-27	-34	-41	-48	-55	-62	-69	-76	-82	-89
40		27	20	13	6	-1	-8	-15	-22	-29	-36	-43	-50	-57	-64	-71	-78	-84	-91
45		26	19	12	5	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79	-86	-93
50		26	19	12	4	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81	-88	-95
55		25	18	11	4	-3	-11	-18	-25	-32	-39	-46	-54	-61	-68	-75	-82	-89	-97
60		25	17	10	3	-4	-11	-19	-26	-33	-40	-48	-55	-62	-69	-76	-84	-91	-98

Frostbite Times: 30 minutes | 10 minutes | 5 minutes

$$\text{Wind Chill (°F)} = 35.74 + 0.6215T - 35.75(V^{0.16}) + 0.4275T(V^{0.16})$$

Where, T= Air Temperature (°F) V= Wind Speed (mph)

Effective 11/01/01