Remote Sensing Observations
AOSC 200

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Class Web Site: http://www.atmos.umd.edu/~tcanty/aosc200

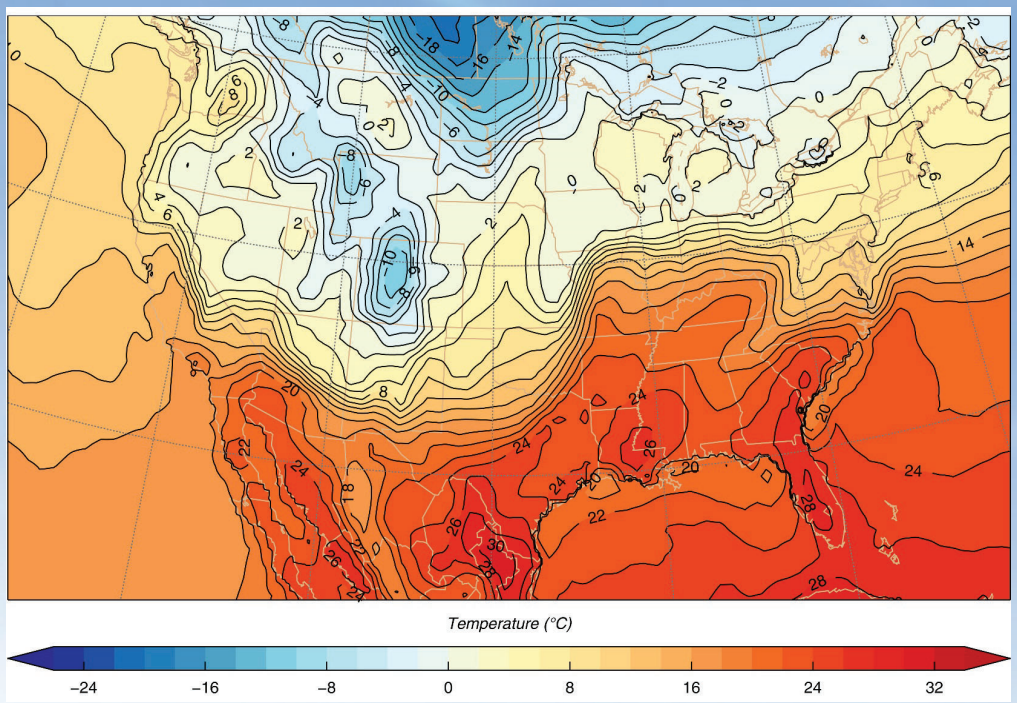
Topics for today:

- **Maps**
- **Radar**
- **Satellite Observations**

Lecture 04

Sep 5 2019

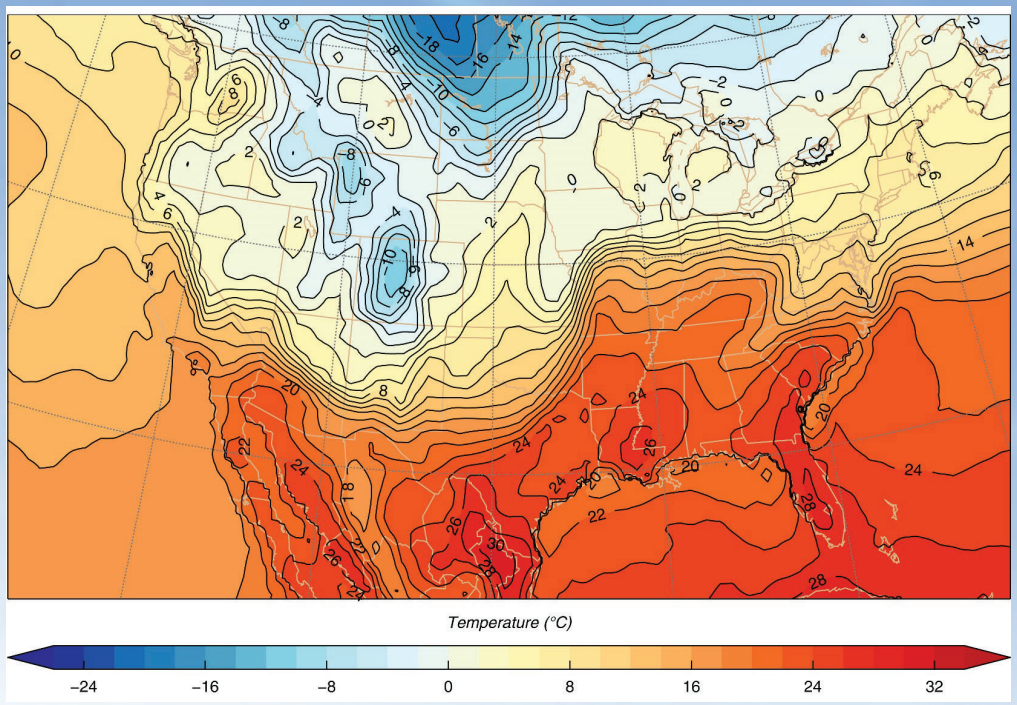
Temperature Maps



Temperature maps are often colored based on how warm (red) or cold (blue) the surface temperatures are

Fig 2-2 *Weather: A Concise Introduction*

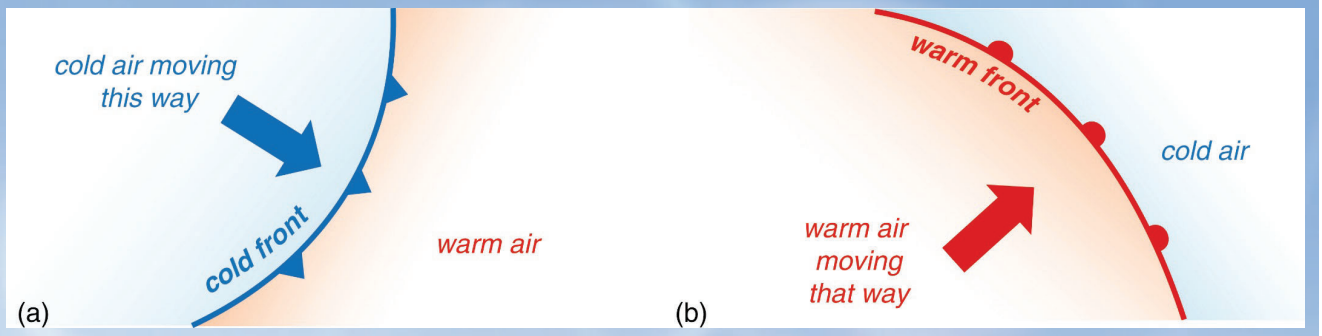
Temperature Maps



The black lines indicate “isotherms” or lines of constant temperature. These maps help us identify the air masses that are controlling surface conditions and the temperature frontal boundaries between them

Fig 2-2 *Weather: A Concise Introduction*

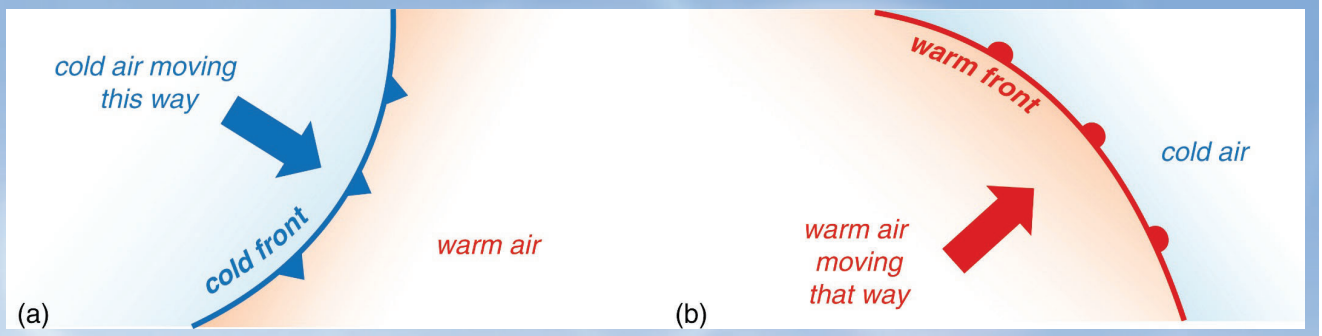
Temperature Fronts



A cold front is a region where cold air is replacing warm air. It’s indicated by a blue line with blue triangles pointing in the direction the air mass is moving.

Fig 2-3 *Weather: A Concise Introduction*

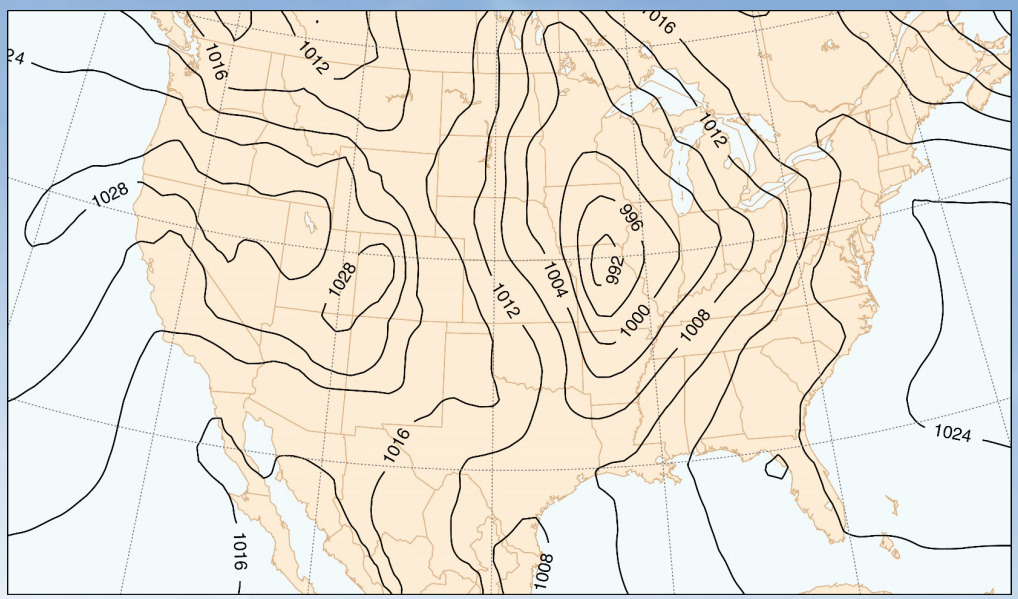
Temperature Fronts



A warm front is a region where warm air is replacing cold air. It's indicated by a red line with red half circles pointing in the direction the air mass is moving.

Fig 2-3 *Weather: A Concise Introduction*

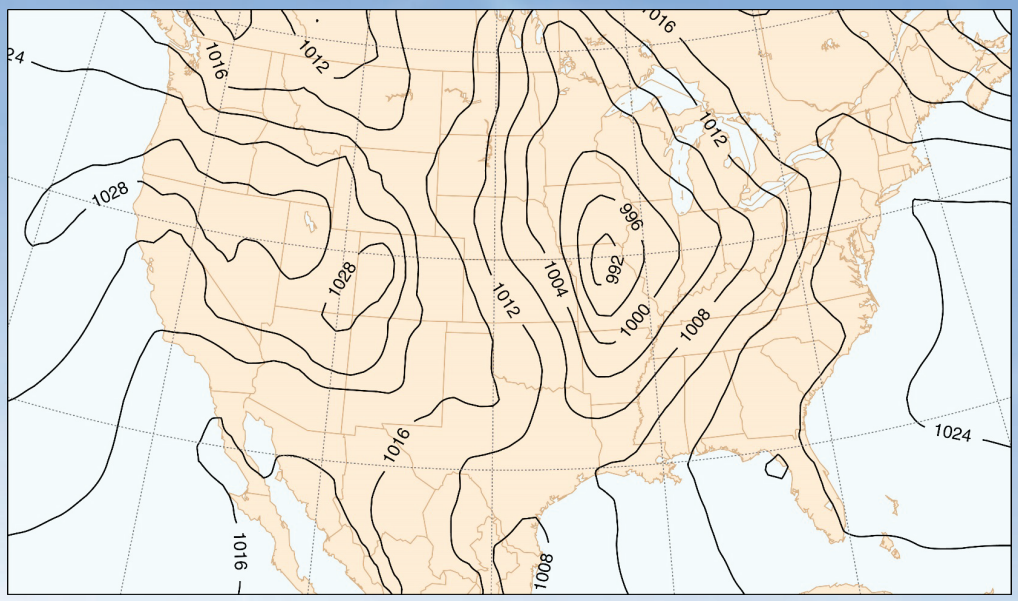
Pressure Maps



The black lines indicate "isobars" or lines of constant pressure. These maps help us identify regions of high pressure ("H") and low pressure ("L"). They also give some indication of surface wind speed and direction. The numbers are the <u>actual</u> pressure (no conversion needed)

Fig 2-4 *Weather: A Concise Introduction*

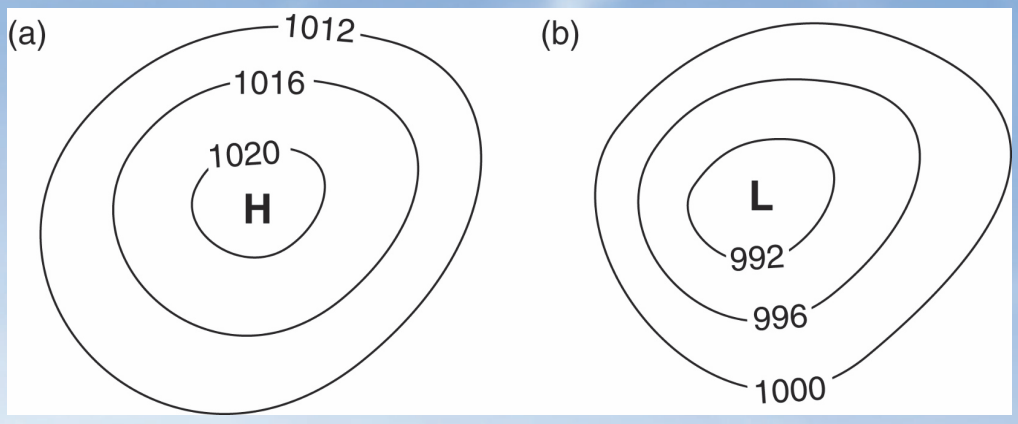
Pressure Maps



Generally, isobars are plotted at 4 hPa intervals
If it helps, consider this like a map of surface height and you'll get an idea of where are is flowing too and how fast it's moving.

Fig 2-4 *Weather: A Concise Introduction*

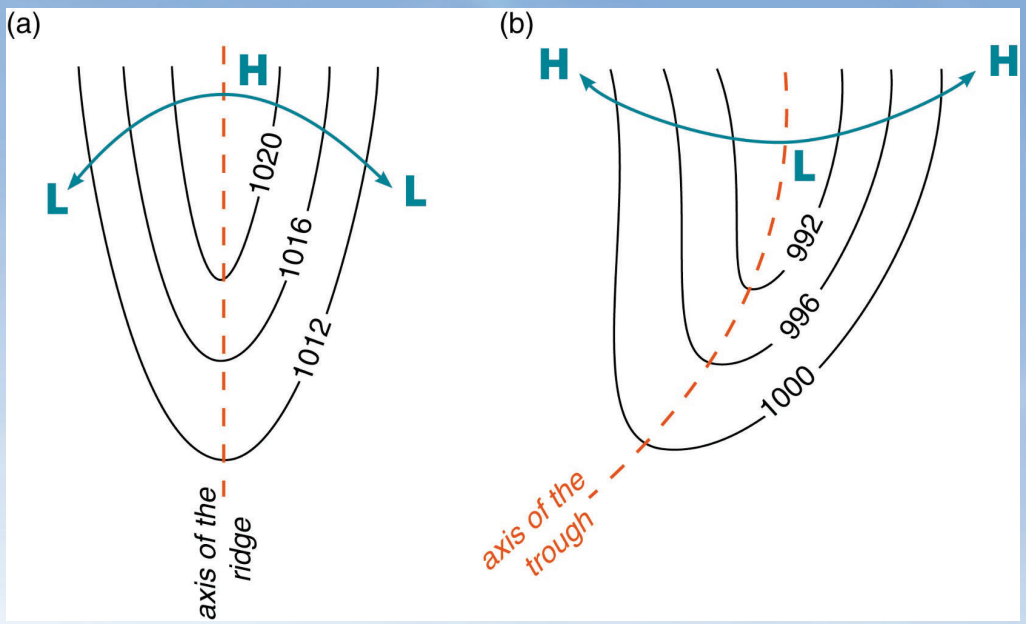
Pressure Maps



Closed contours define regions of high pressure and low pressure.

Fig 2-5 *Weather: A Concise Introduction*

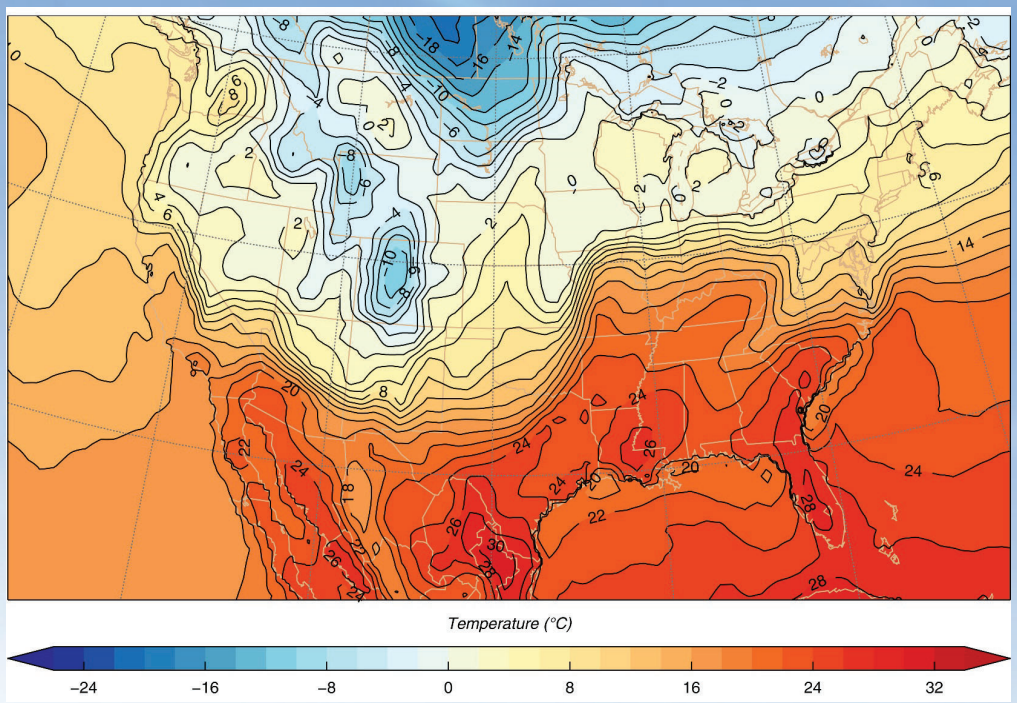
Pressure Maps



Isobars that aren't closed can still help us define regions of increasing ("ridges") and decreasing ("troughs") pressure.

Fig 2-6 *Weather: A Concise Introduction*

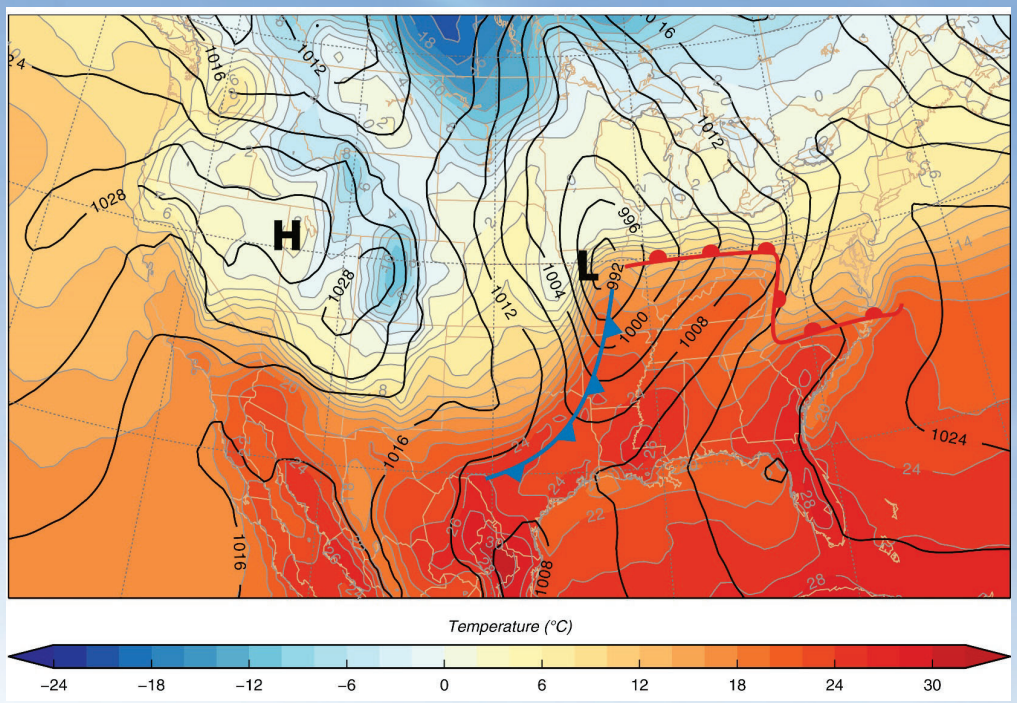
Temperature Maps



We can combine the different ways of looking at surface data to create what you may recognize as a modern weather map

Fig 2-2 *Weather: A Concise Introduction*

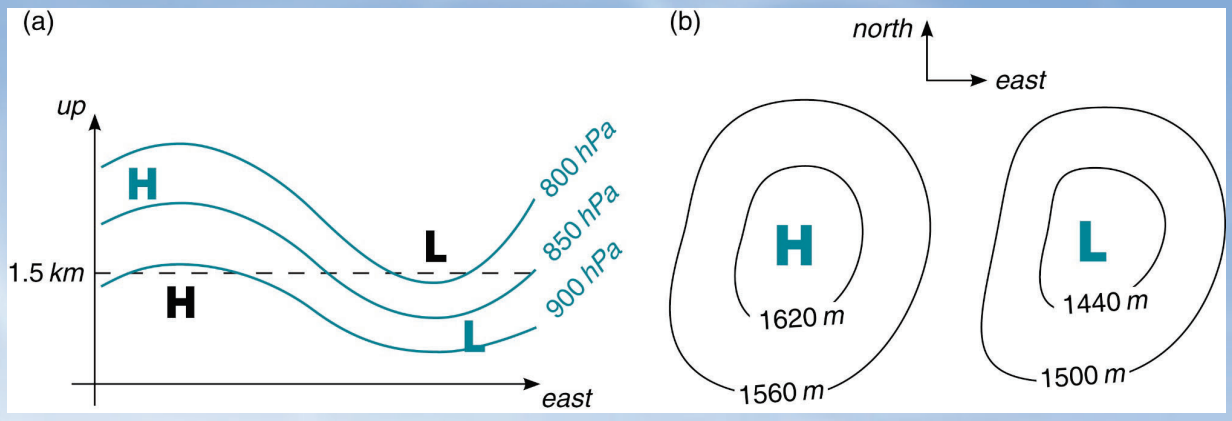
Weather Maps



We can combine the different ways of looking at surface data to create what you may recognize as a modern weather map

Fig 2-2 *Weather: A Concise Introduction*

Upper Level Maps

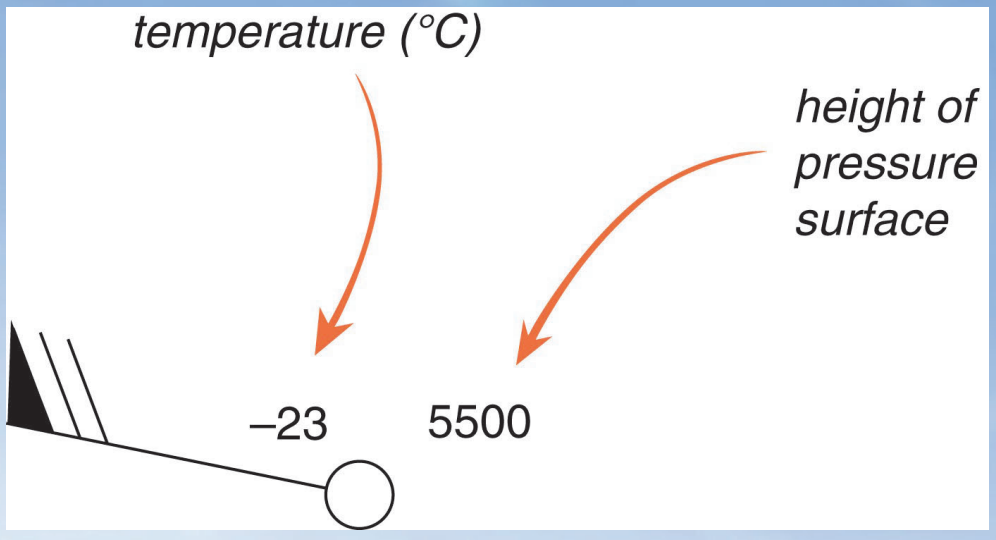


We can look at pressure maps at a some particular altitude but the mathematics becomes very complicated ☹

Instead, we look at altitude of a specific pressure level.
The figures to the right show the height (in meters) of the 850 hPa surface.

Fig 2-8 *Weather: A Concise Introduction*

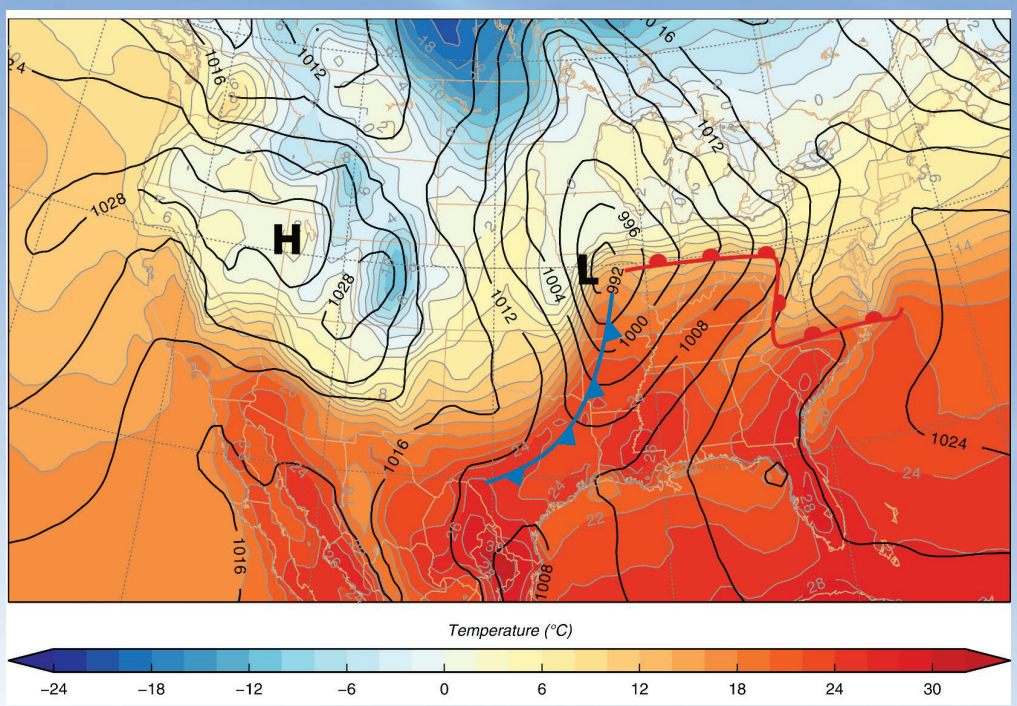
Upper Level Maps



The station model provides slightly different information than at the surface. The height of the pressure surface is in the position where pressure used to be. Maps of this information are called “isobaric” maps

Fig 2-9 *Weather: A Concise Introduction*

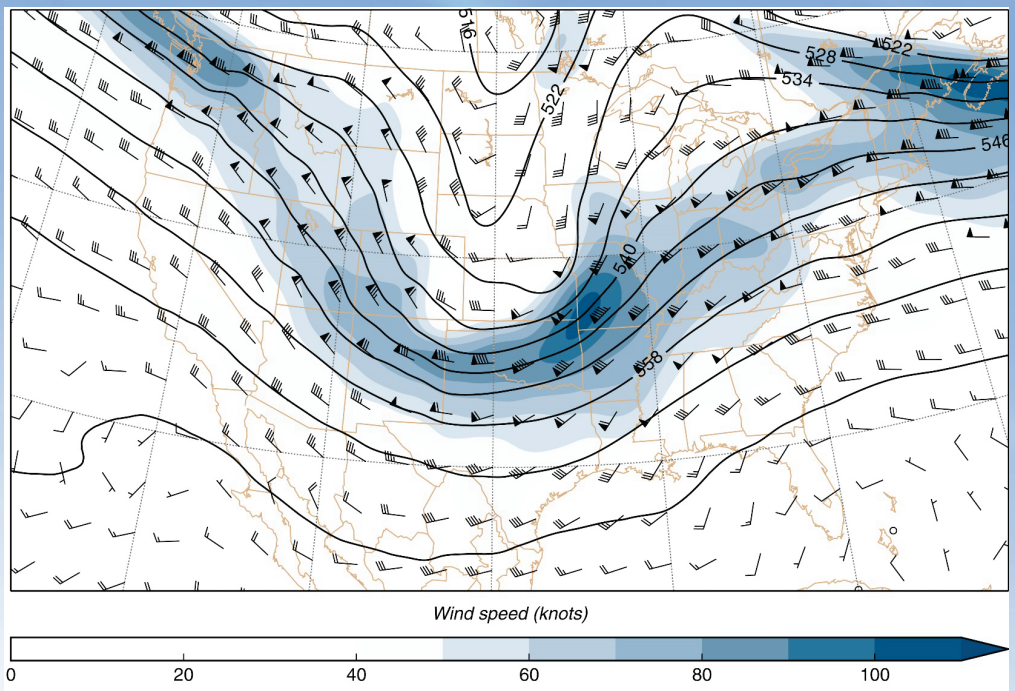
Weather Maps: Surface



We can combine the different ways of looking at surface data to create what you may recognize as a modern weather map

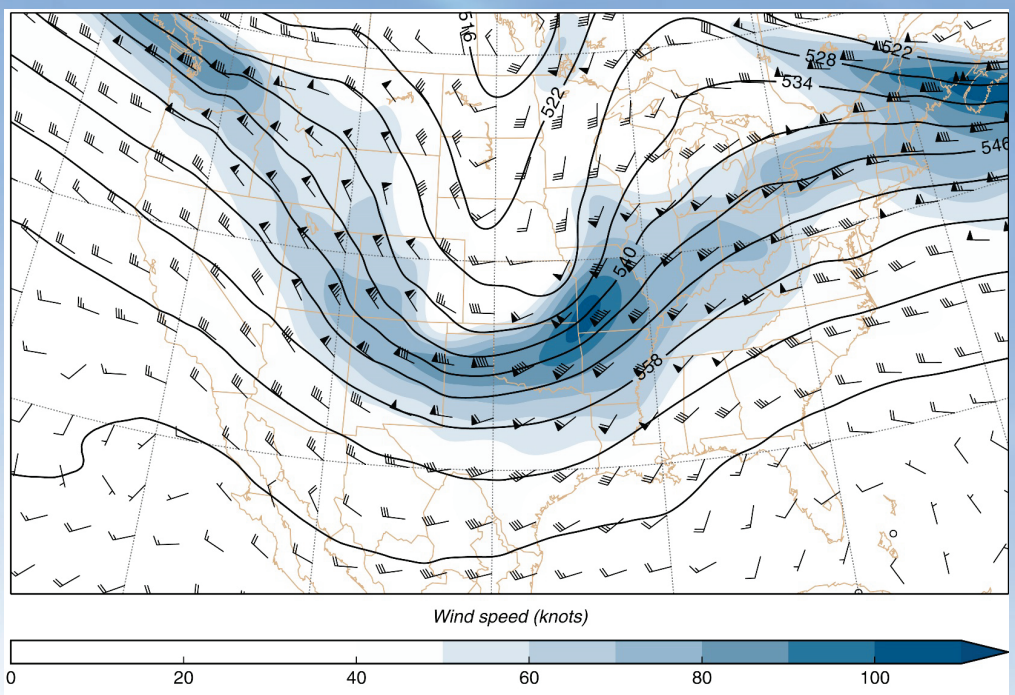
Fig 2-2 *Weather: A Concise Introduction*

Weather Maps: 500 mb



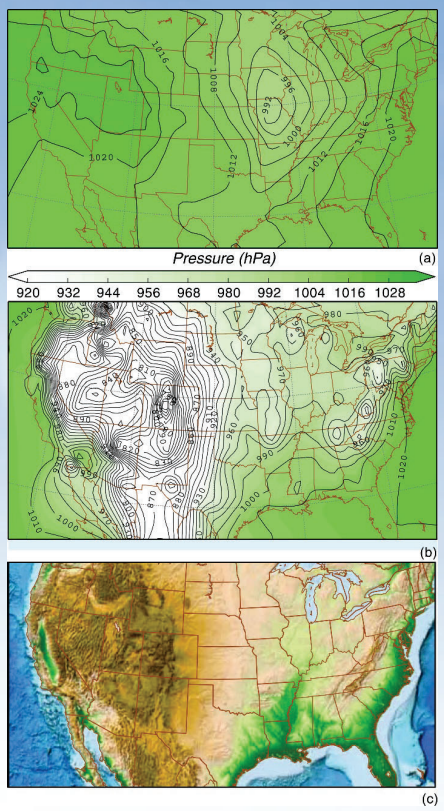
The color contours represent wind speed (in knots). Notice that the fastest winds in the central US are almost above the position of the surface low pressure. Here the black lines are in “decameters”.

Weather Maps: 500 mb



Sometimes this information is plotted as the 1000-500 hPa thickness

Mean Sea Level Pressure



Pressure and altitude are connected: pressure decreases with height

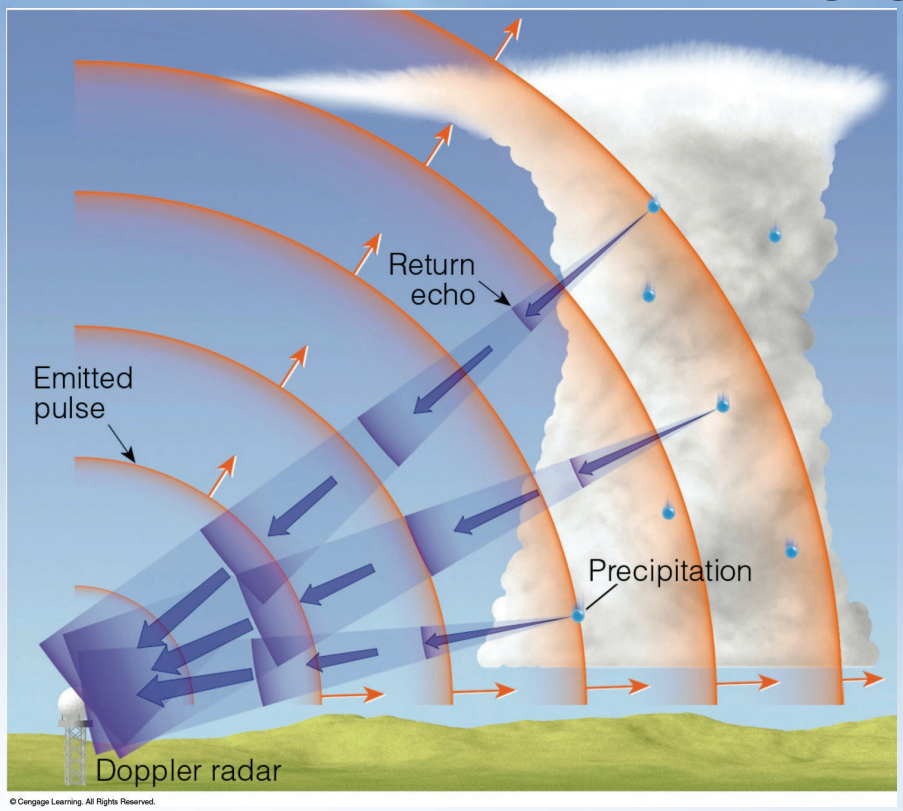
The air pressure at the top of a mountain is lower than at the beach.

If you didn't account for this then your forecasts would assumer there's always a low pressure system over the mountains.

You need to correct for this by determining what the pressure on the top of the mountain would be if you brought it to sea level (~10mbar for every 100m)

Fig 2.2.1 *Weather: A Concise Introduction*

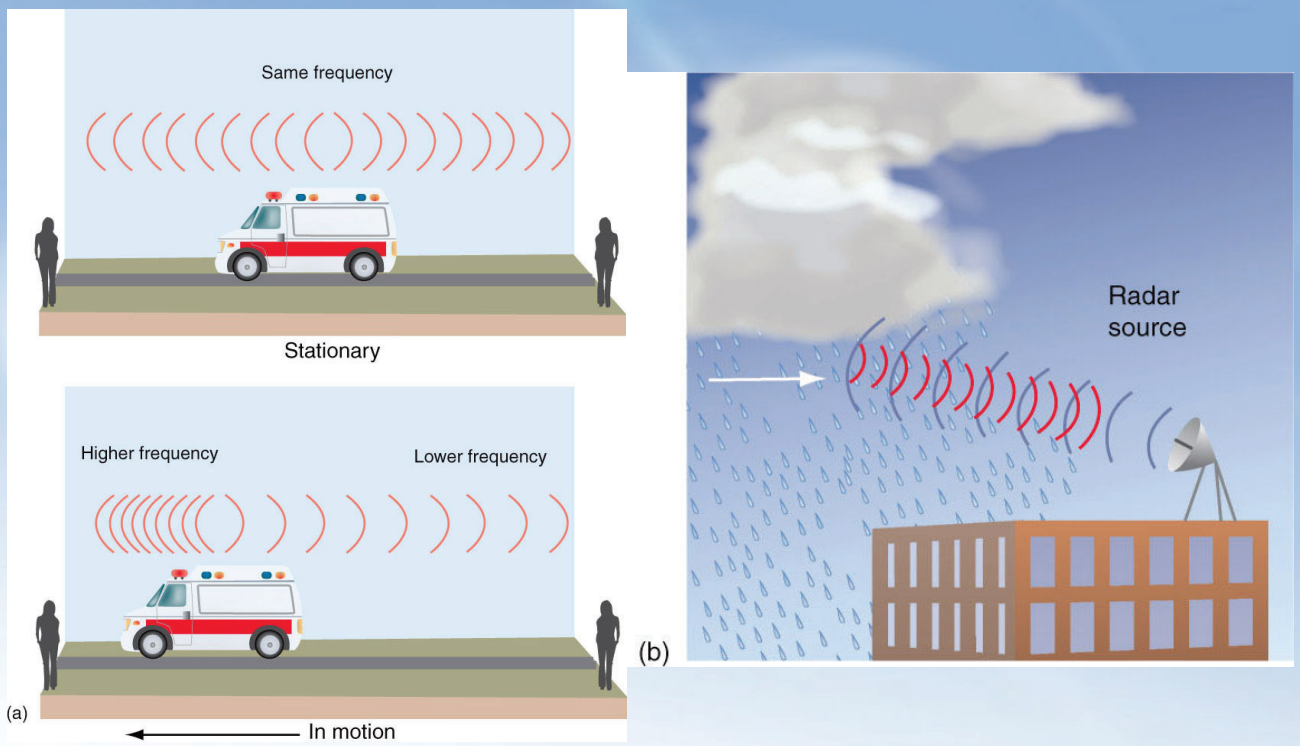
RADAR: RAdio Detection and Ranging



RADAR measures the time it takes for the signal to return

Fig 5.45: ***Essentials of Meteorology***

RADAR: RAdio Detection and Ranging
Doppler



Doppler RADAR measures changes in the return signal

Fig 5-22 *Meteorology: Understanding the Atmosphere*

RADAR Coverage: United States

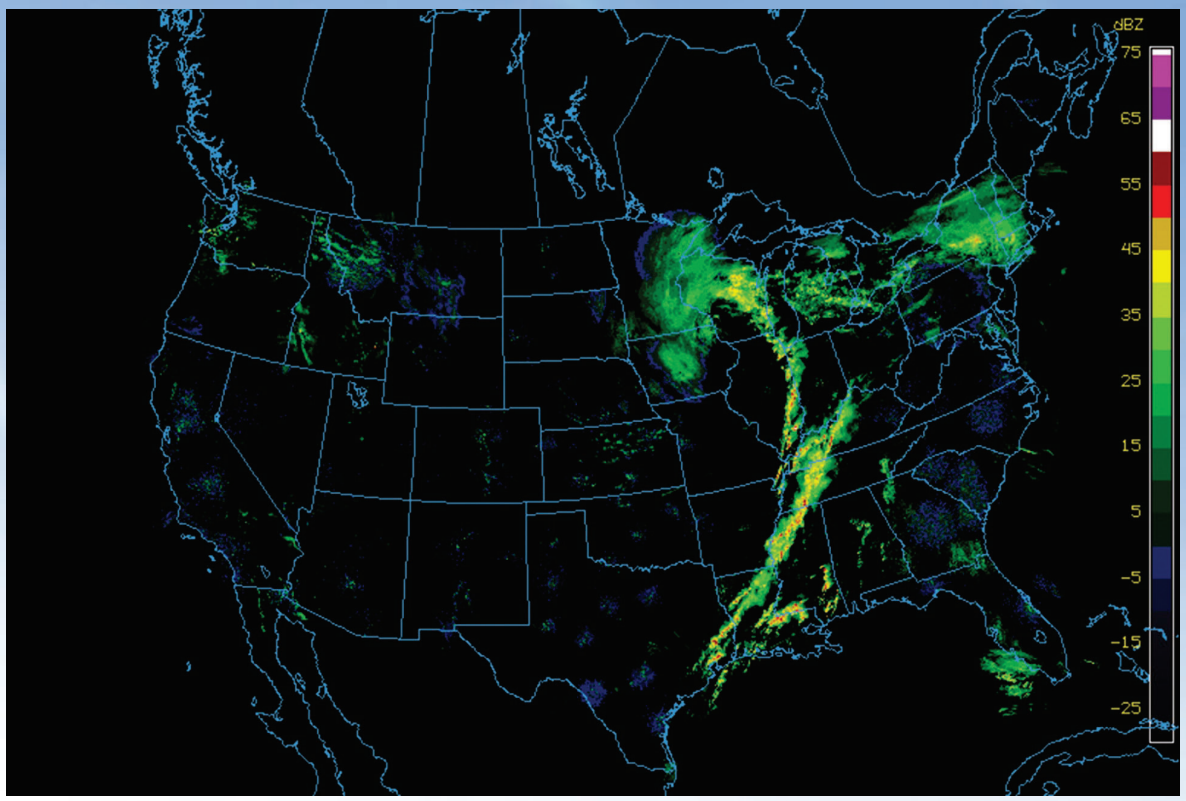
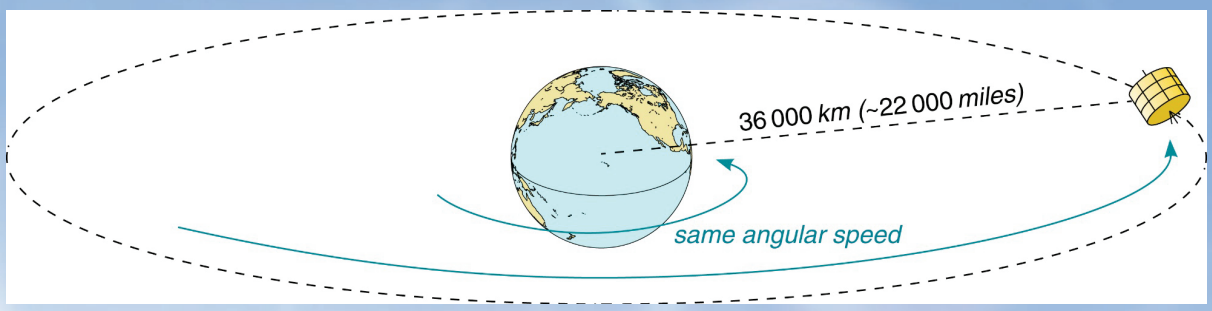


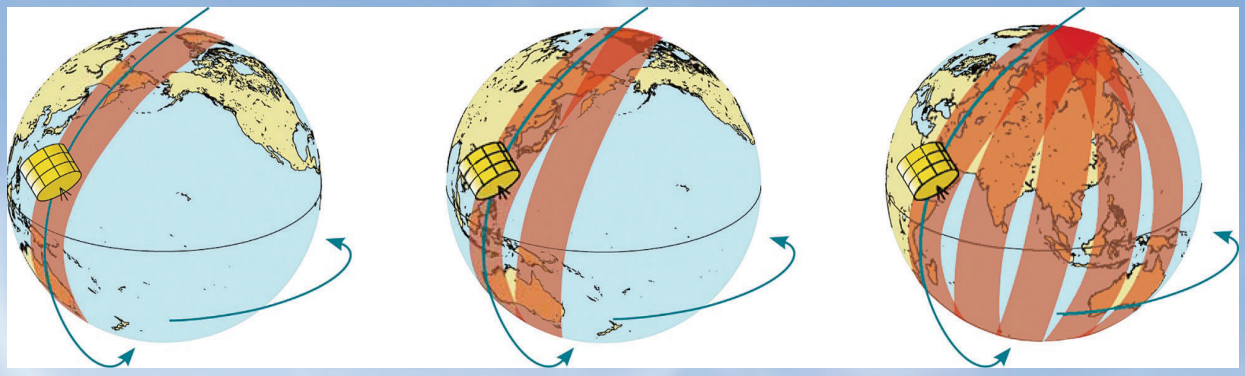
Fig 2-12 *Weather: A Concise Introduction*



Geostationary satellites: Orbits the Earth at the same angular speed as the Earth. They are "parked" in orbit over Earth and stay over the same location.

Provide a lot of information at all times but only at one location and have difficulty seeing the polar regions…

Fig 2-19 *Weather: A Concise Introduction*



Polar orbiting satellites: Travel over the poles. Orbits wrap around the Earth. Need to travel quickly to provide cover the globe. Can be very high resolution because they orbit closer to the surface than geostationary satellites

Problems: Data gaps in time and space.

Fig 2-24 *Weather: A Concise Introduction*

Satellite Imagery: Visible

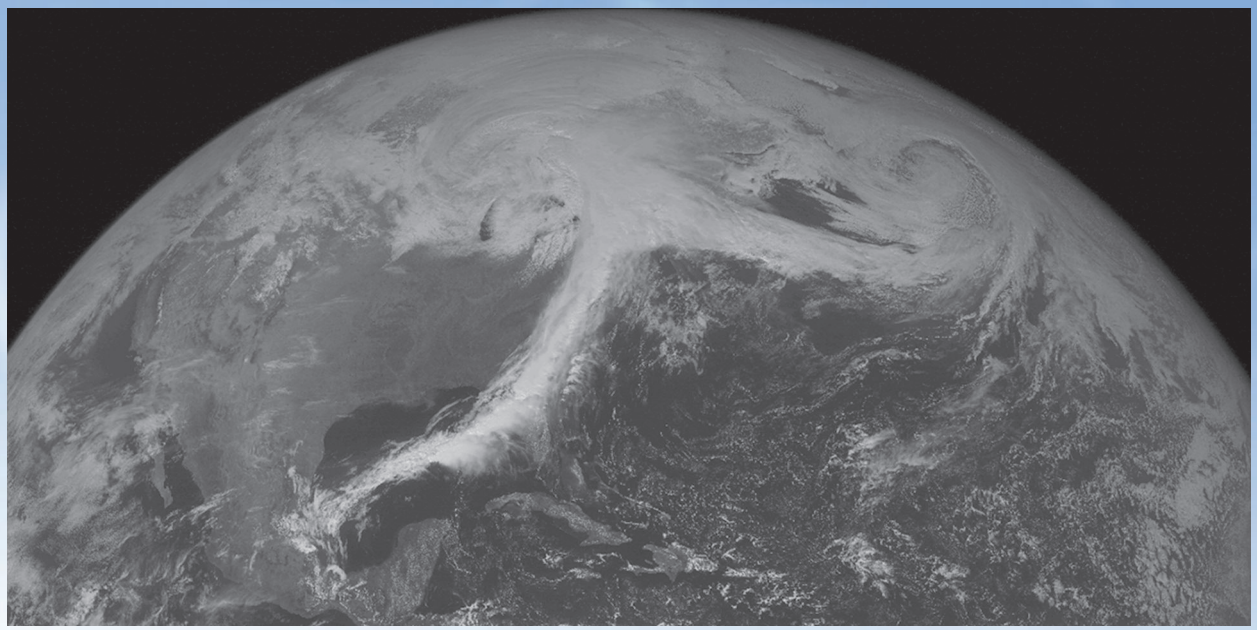
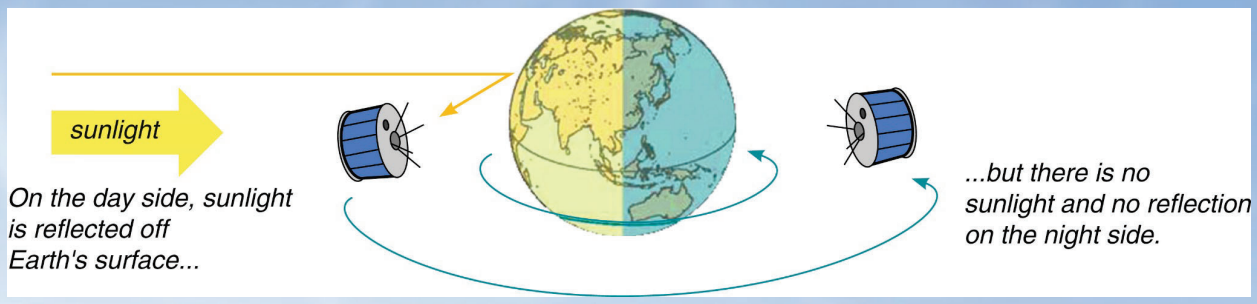


Fig 2-13 *Weather: A Concise Introduction*

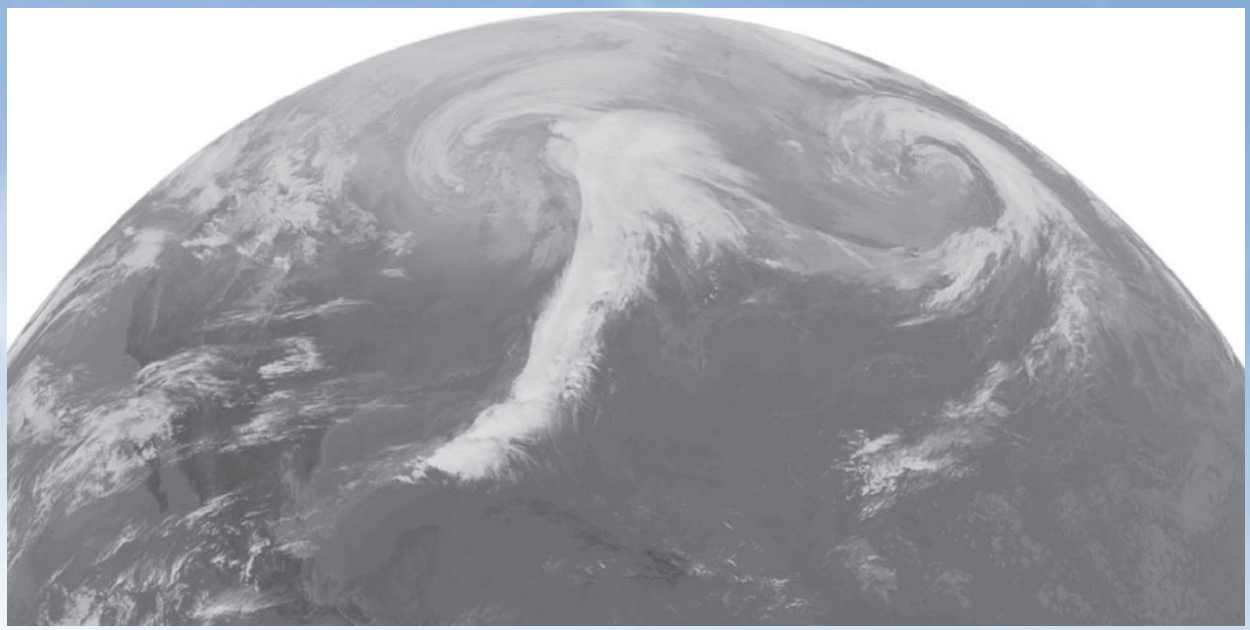
Satellite Imagery: Visible



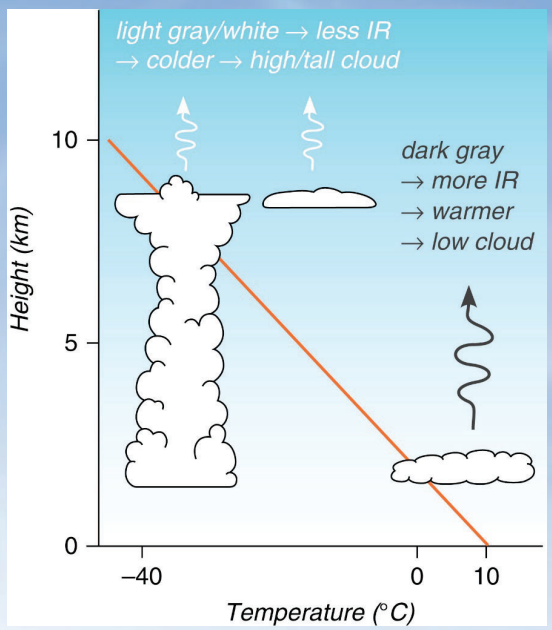
What's the main limitation of the visible image?
You need light to see anything!

Fig 2-14 *Weather: A Concise Introduction*

Satellite Imagery: Infrared (heat)

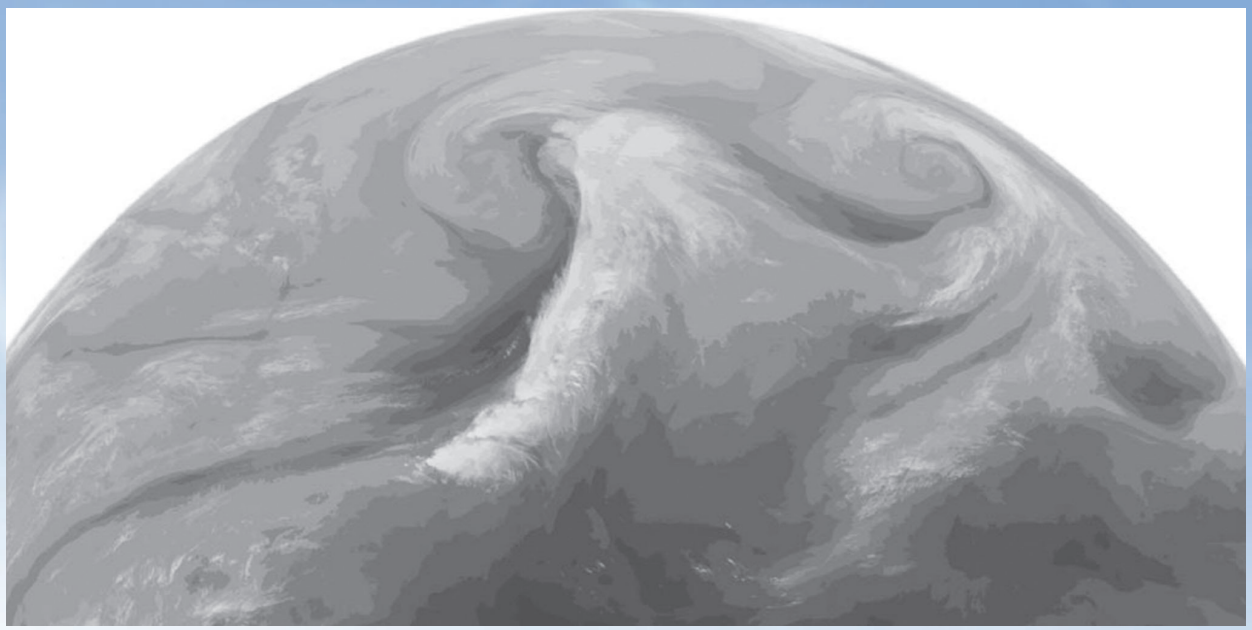


Satellite Imagery: Infrared (heat)



This is a "false color" image. The lighter the color, the colder the temperature.
What does this tell us about clouds?
Can you think of a limitation of the infrared image?

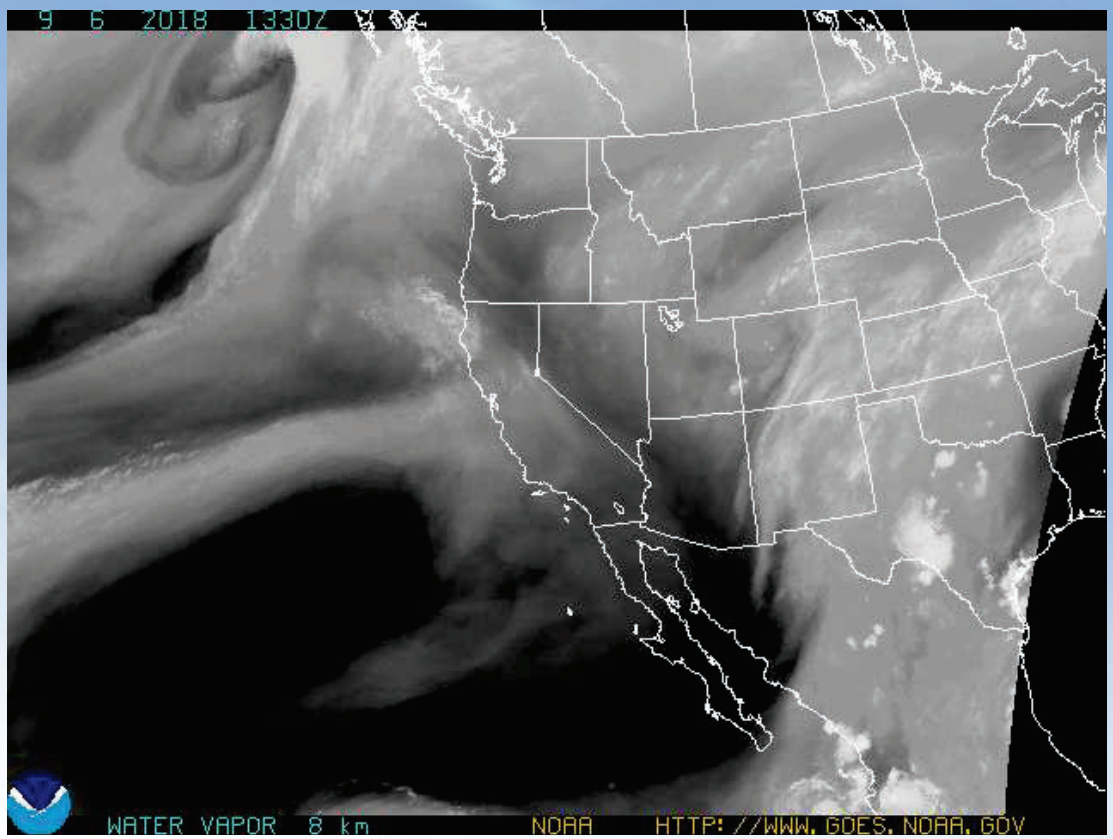
Satellite Imagery: Water Vapor



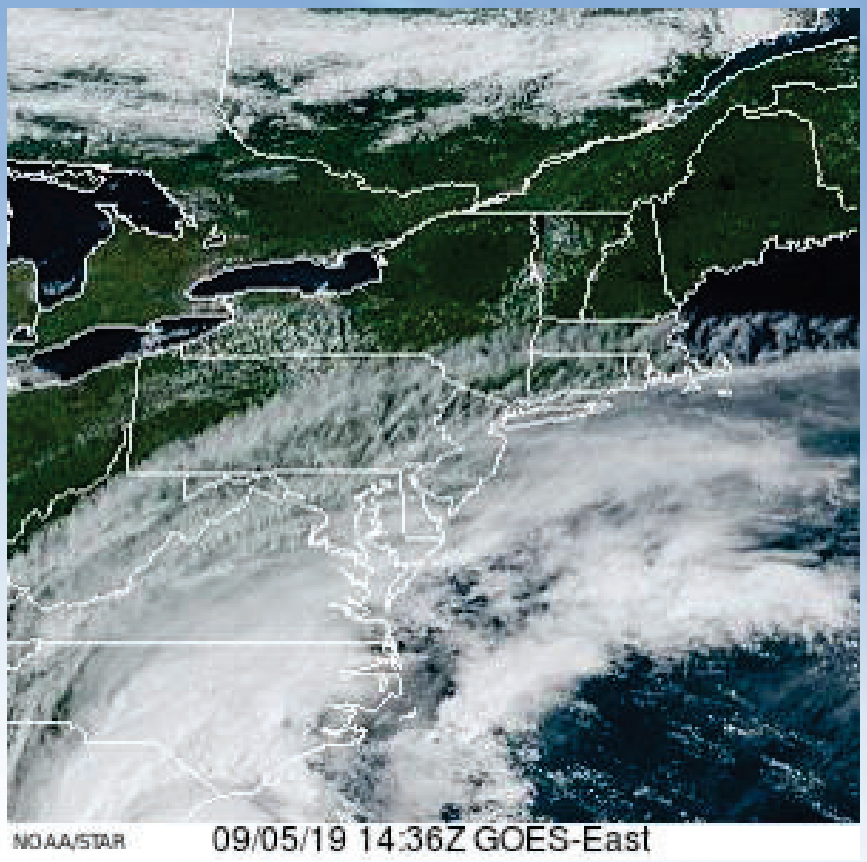
This is a "false color" image. Water vapor absorbs and emits energy. You can tune an instrument to only "see" the wavelengths where water vapor absorbs and emits energy

Fig 2-18 *Weather: A Concise Introduction*

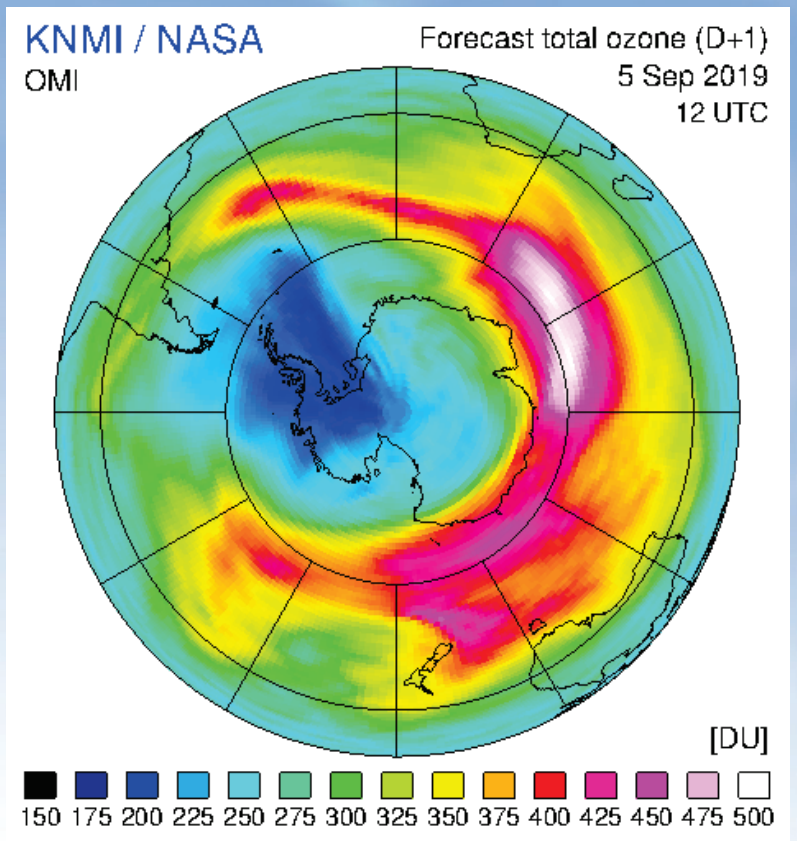
Satellites: NOAA GOES



Satellites: NOAA GOES16



Satellites: OMI Ozone



Ozone Monitoring Instrument