Fun with Weather Maps!
(no, really… stop laughing)
AOSC 200
Tim Canty

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

Topics for today:

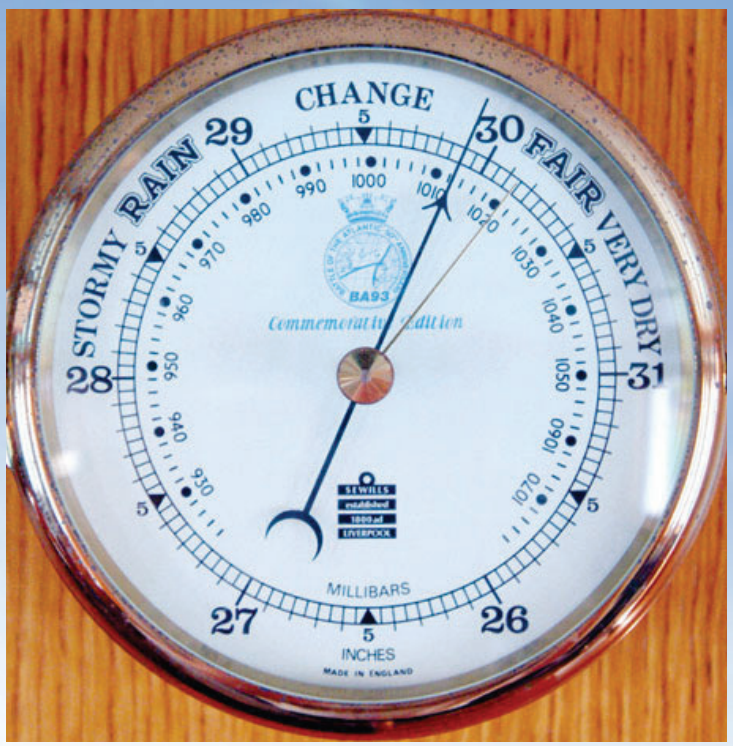
- **Observations**
- **Station Model**
- **Temperature Maps**
- **Pressure Maps**
- **Fronts**

Lecture 03

Sep 3 2019

Pressure: Aneroid Barometer

Low Pressure



High Pressure

Fig 5-3b *Meteorology: Understanding the Atmosphere*

Wind Speed and Direction

A wind vane points in the direction the wind is coming from

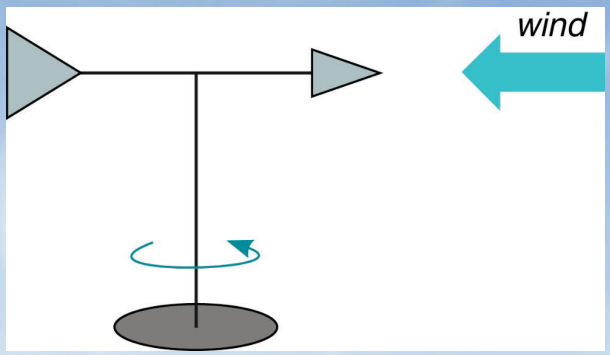


Fig 1-10 *Weather: A Concise Introduction*

A westerly wind means winds are coming from the west

Can also use degrees from North.

(can you spot the mistake in the figure?)

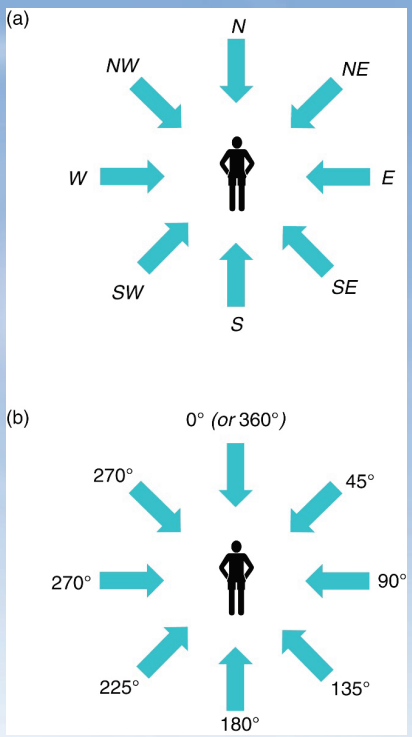


Fig 1-11 *Weather: A Concise Introduction*

Wind Speed and Direction

An anemometer measure wind speed

Fig 5-5 *Meteorology: Understanding the Atmosphere*

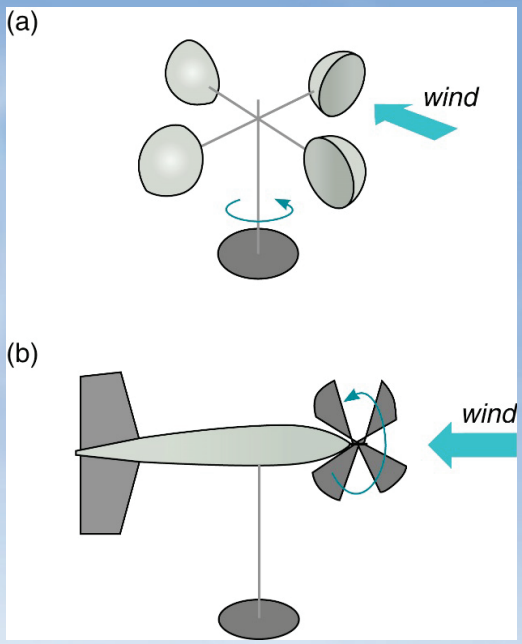
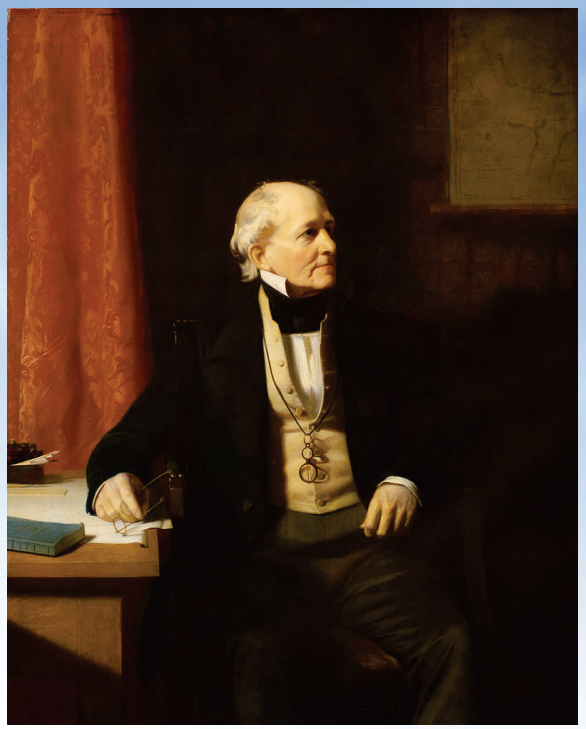


Fig 1-12 *Weather: A Concise Introduction*

Wind Speed and Direction

Beaufort Scale: Devised in 1805 to standardize reporting of wind based on observable conditions. This did not require exact knowledge of wind speed.



Beaufort Scale

Beaufort number	Wind Speed (mph)	Seaman's term		Effects on Land
0	Under 1	Calm		Calm; smoke rises vertically.
1	1-3	Light Air		Smoke drift indicates wind direction; vanes do not move.
2	4-7	Light Breeze		Wind felt on face; leaves rustle; vanes begin to move.
3	8-12	Gentle Breeze		Leaves, small twigs in constant motion; light flags extended.
4	13-18	Moderate Breeze		Dust, leaves and loose paper raised up; small branches move.
5	19-24	Fresh Breeze		Small trees begin to sway.
6	25-31	Strong Breeze		Large branches of trees in motion; whistling heard in wires.
7	32-38	Moderate Gale		Whole trees in motion; resistance felt in walking against the wind.
8	39-46	Fresh Gale		Twigs and small branches broken off trees.
9	47-54	Strong Gale		Slight structural damage occurs; slate blown from roofs.
10	55-63	Whole Gale		Seldom experienced on land; trees broken; structural damage occurs.
11	64-72	Storm		Very rarely experienced on land; usually with widespread damage.
12	73 or higher	Hurricane Force		Violence and destruction.

Rain: rain gauge

Measures total rainfall over a time period but it has to be emptied periodically

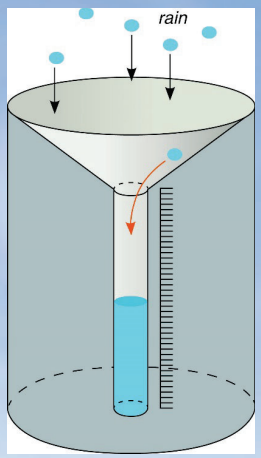
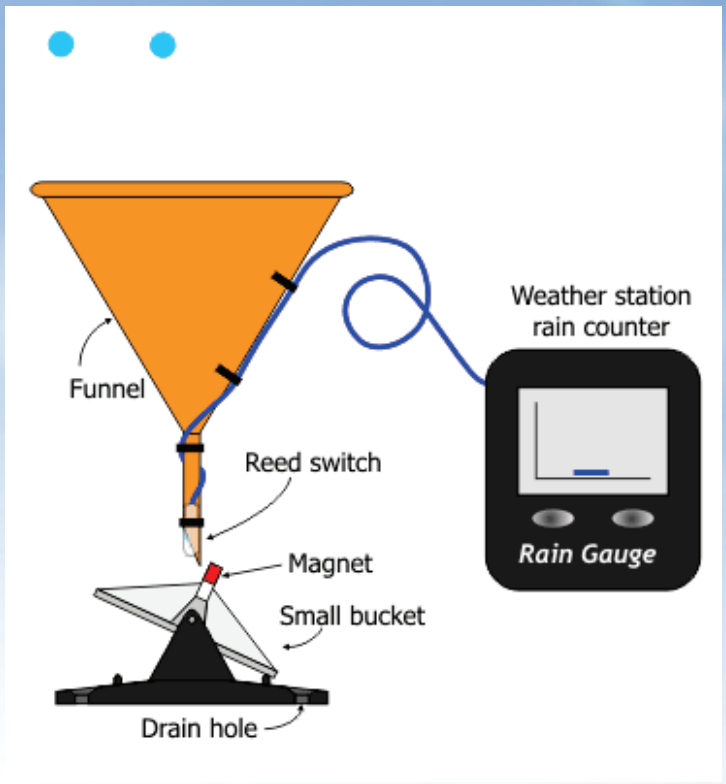


Fig 1-17 *Weather: A Concise Introduction*

Rainfall less than 1mm is reported as a "trace" amount

Rain: tipping bucket rain gauge



After the bucket fills and tips, a small signal is sent and recorded

Meteorological Observations

Automated Surface Observing System (ASOS)

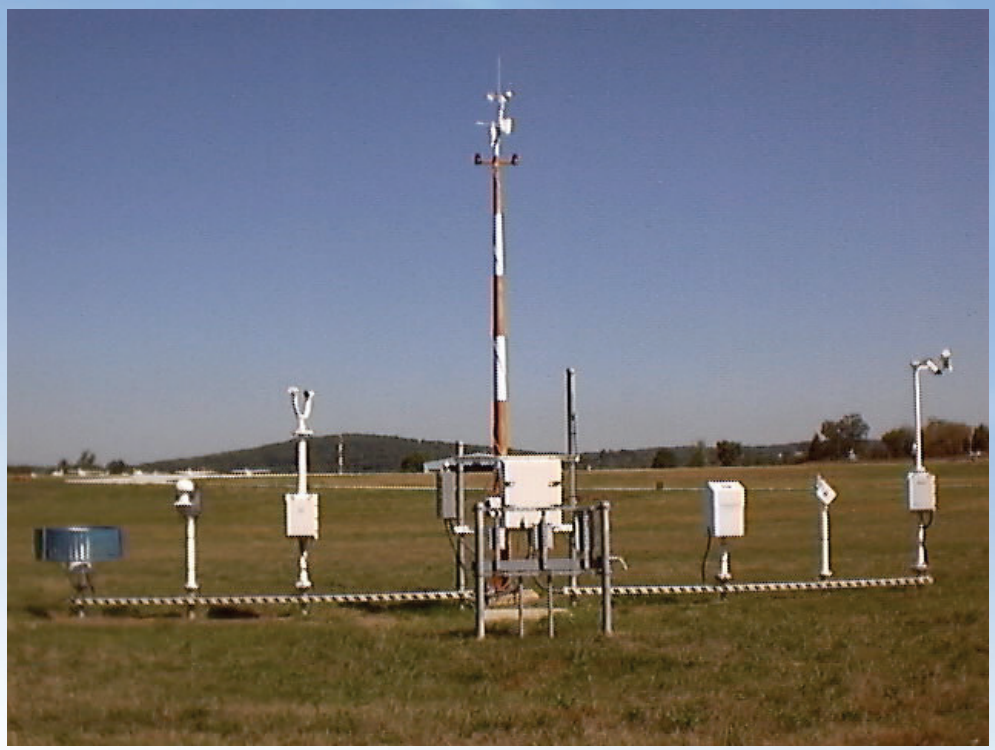
Meteorological Observations

Automated Surface Observing System (ASOS)

Measures:

- cloud height
- visibility
- precipitation
- pressure
- temperature
- dew point
- wind direction
- wind speed
- rainfall amount

Meteorological Observations



http://www.allweatherinc.com/programs/faa-asos/

Meteorological Observations: Maryland

Meteorological Observations: College Park

Weather observations for the past three days

College Park Airport

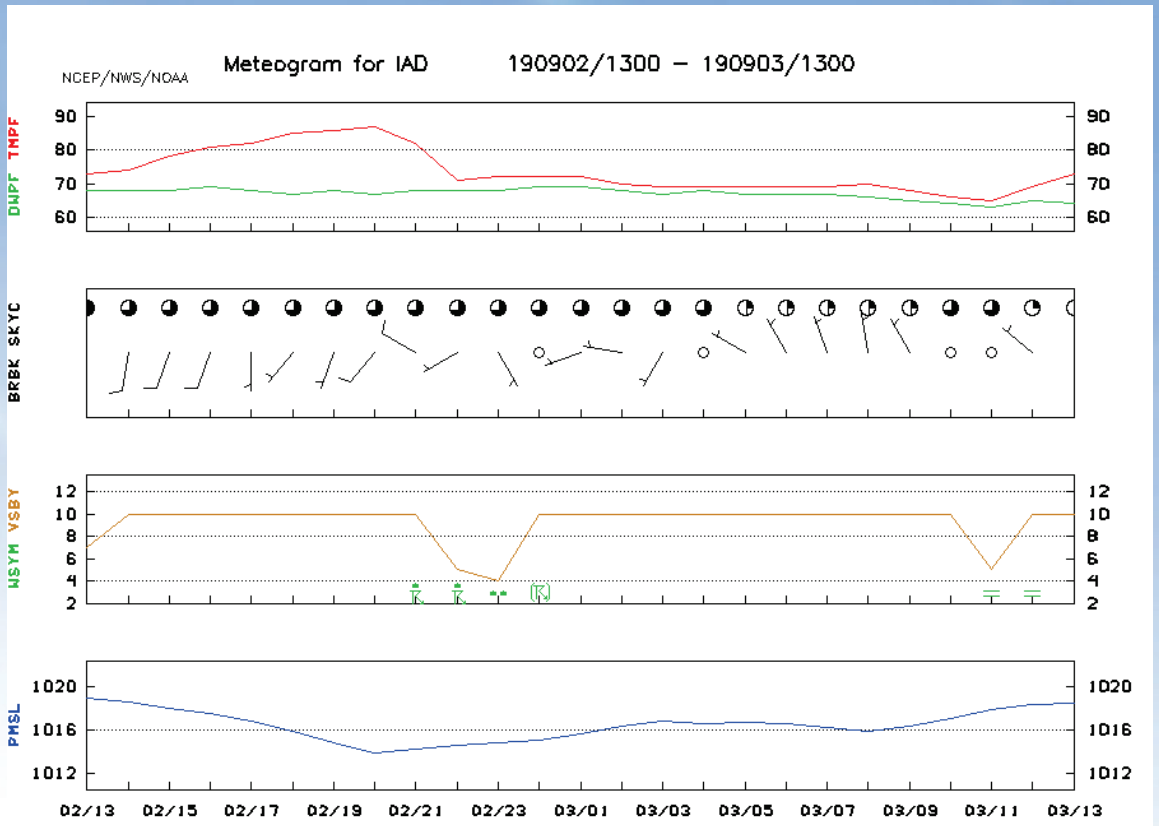
weather.gov

Enter Your "City, ST" or zip code Go metric

Date	Time (edt)	Wind (mph)	Vis. (mi.)	Weather	Sky Cond.	Temperature (°F)				Relative Humidity	Wind Chill (°F)	Heat Index (°F)	Pressure		Precipitation (in.)		
						Air	Dwpt	6 hour Max.	6 hour Min.				altimeter (in)	sea level (mb)	1 hr	3 hr	6 hr
03	09:22	N 5	10.00	Fair	CLR	74	59			60%	NA	NA	30.07	NA			
03	09:02	NE 6	10.00	Fair	CLR	73	59			62%	NA	NA	30.07	NA			
03	08:42	Calm	10.00	Fair	CLR	72	61			69%	NA	NA	30.07	NA			
03	08:22	N 6	10.00	Fair	CLR	71	69			93%	NA	NA	30.07	NA			
03	08:02	N 3	10.00	Fair	CLR	NA	NA			NA	NA	NA	30.07	NA			
03	07:42	Calm	10.00	Fair	CLR	NA	NA			NA	NA	NA	30.06	NA			
03	07:22	Calm	10.00	Fair	CLR	NA	NA			NA	NA	NA	30.06	NA			
03	07:02	Calm	7.00	Fair	CLR	NA	NA			NA	NA	NA	30.05	NA			
03	06:42	Calm	7.00	Fair	CLR	NA	NA			NA	NA	NA	30.04	NA			
03	06:22	Calm	10.00	Fair	CLR	NA	NA			NA	NA	NA	30.03	NA			
03	06:02	Calm	7.00	Partly Cloudy	SCT045	NA	NA			NA	NA	NA	30.03	NA			
03	05:42	Calm	7.00	Partly Cloudy	SCT045	NA	NA			NA	NA	NA	30.02	NA			
03	05:22	Calm	10.00	Partly Cloudy	SCT044	NA	NA			NA	NA	NA	30.02	NA			
03	05:02	Calm	7.00	Fair	CLR	NA	NA			NA	NA	NA	30.01	NA			
03	04:42	Calm	10.00	Partly Cloudy	SCT075	NA	NA			NA	NA	NA	30.01	NA			
03	04:22	Calm	10.00	Partly Cloudy	SCT075	NA	NA			NA	NA	NA	30.01	NA			
03	04:02	Calm	10.00	Fair	CLR	NA	NA			NA	NA	NA	30.01	NA			
03	03:42	Calm	10.00	Fair	CLR	NA	NA			NA	NA	NA	30.01	NA			
03	03:22	Calm	10.00	Fair	CLR	NA	NA			NA	NA	NA	30.00	NA			
03	03:02	Calm	10.00	Fair	CLR	NA	NA			NA	NA	NA	30.00	NA			
03	02:42	Calm	10.00	Partly Cloudy	SCT085	69	67			93%	NA	NA	30.01	NA			
03	02:22	Calm	10.00	Partly Cloudy	SCT085	69	67			93%	NA	NA	30.01	NA			
03	02:02	Calm	10.00	Partly Cloudy	SCT085	70	68			94%	NA	NA	30.01	NA			
03	01:42	N 5	10.00	Fair	CLR	70	68			93%	NA	NA	30.02	NA			

http://w1.weather.gov/obhistory/KCGS.html

Meteorological Observations: Meteogram



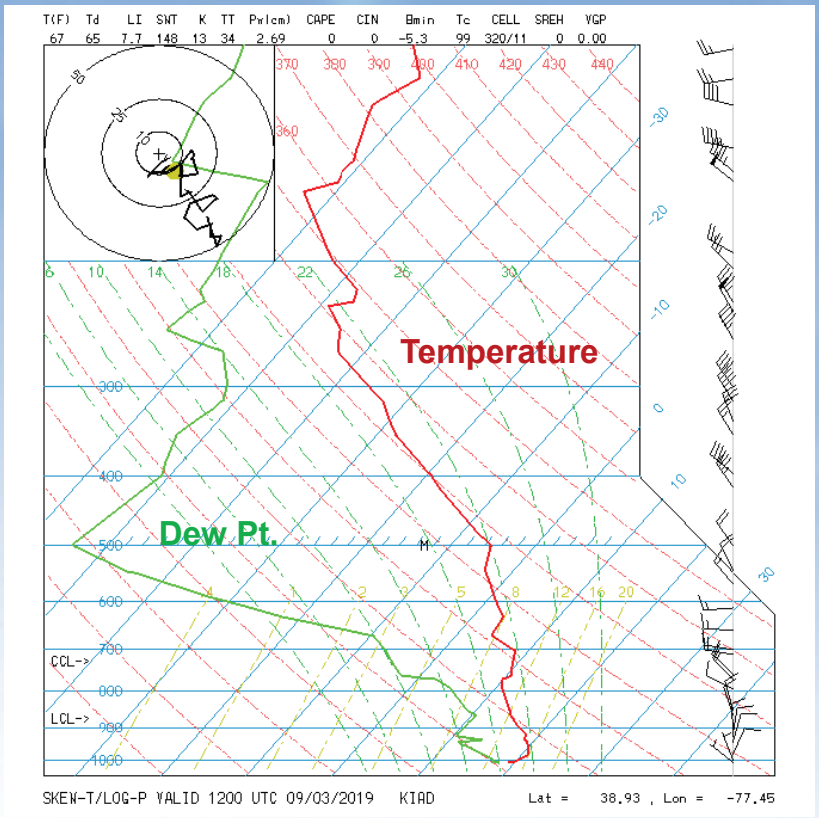
https://www.ametsoc.org/amsedu/dstreme/images/met_IAD.gif

Radiosondes

Weather doesn't just happen at the surface!!!

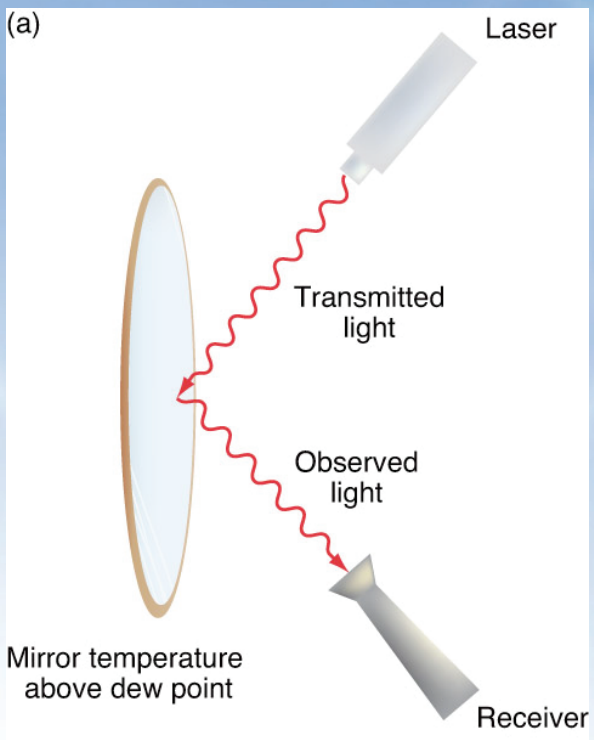
Radiosondes

Position of balloon



http://weather.rap.ucar.edu/upper/iad.gif

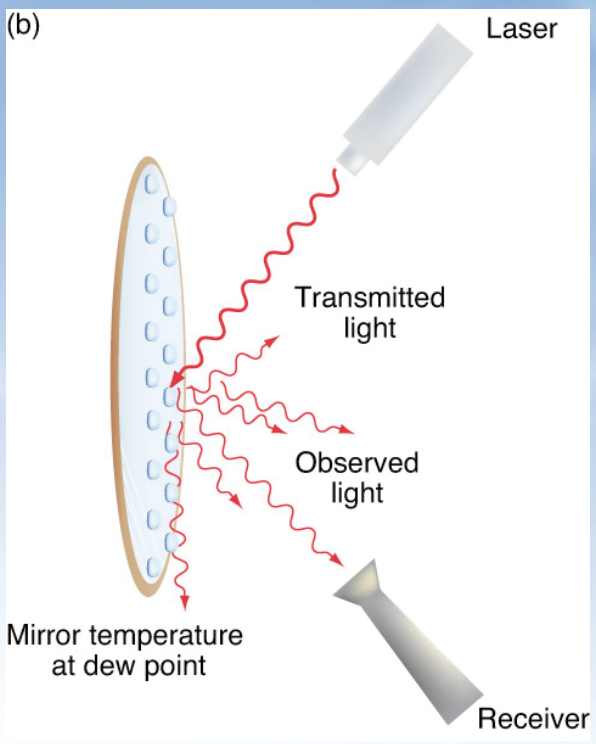
Dew Point Hygrometer



When temperature is above the dew point, observed light is unchanged

Fig 5-3a *Meteorology: Understanding the Atmosphere*

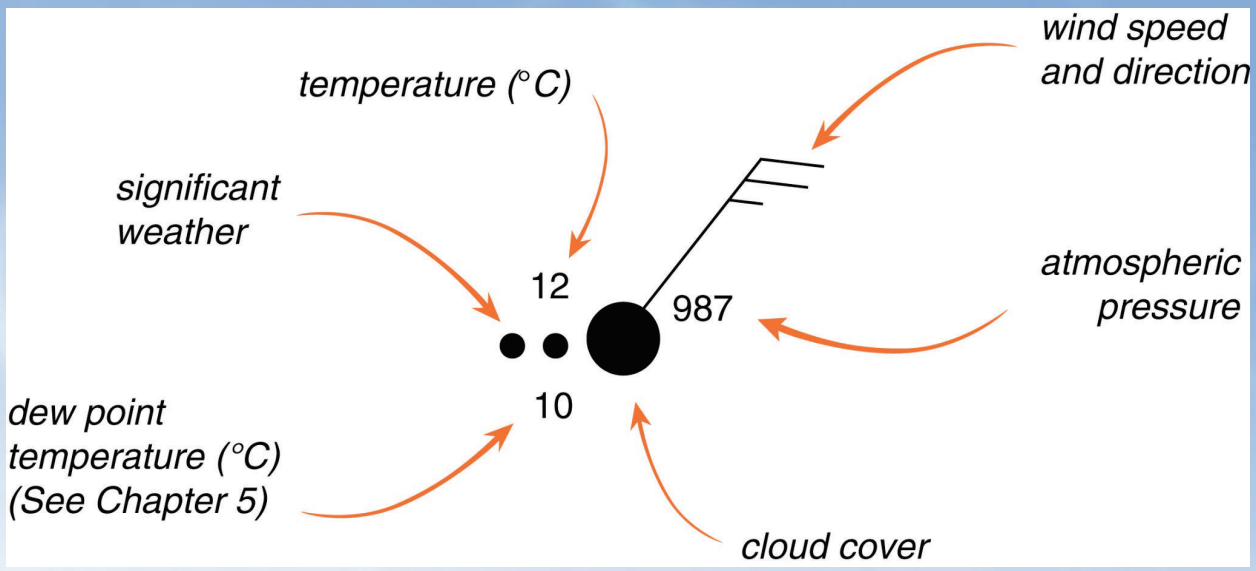
Humidity: Dew Point Hygrometer



When temperature reaches dew point, water condenses on surface and observed light is scattered

Fig 5-3b *Meteorology: Understanding the Atmosphere*

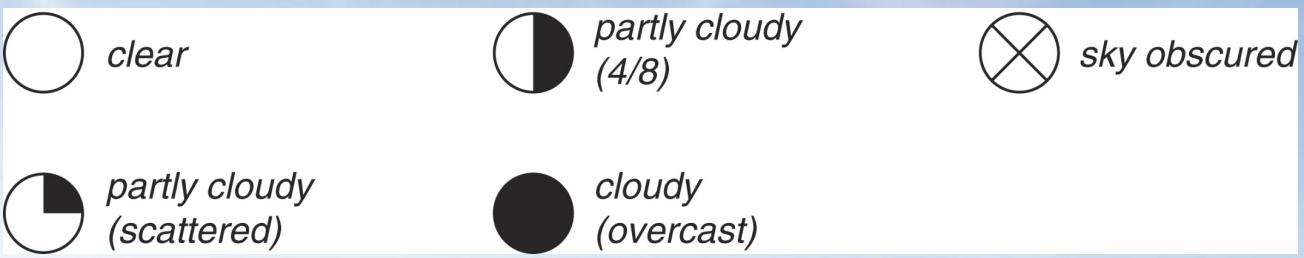
Weather Station Model



The weather station model tells you what the conditions are like at the surface

Fig 2-1-1 *Weather: A Concise Introduction*

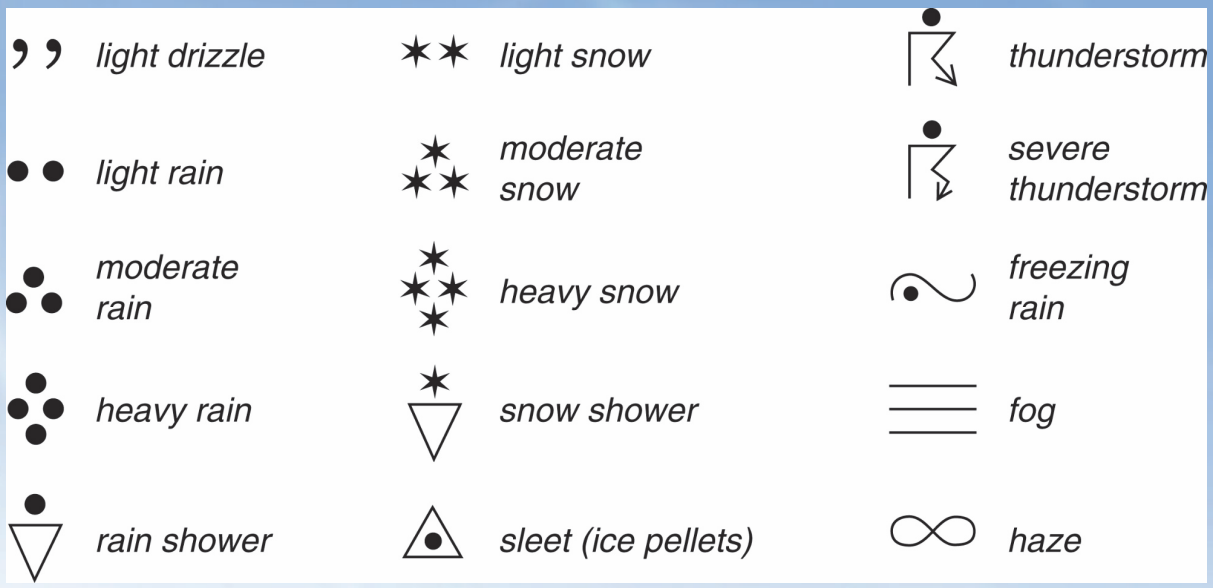
Weather Station Model



The central circle indicates cloud cover

Fig 2-1-2 *Weather: A Concise Introduction*

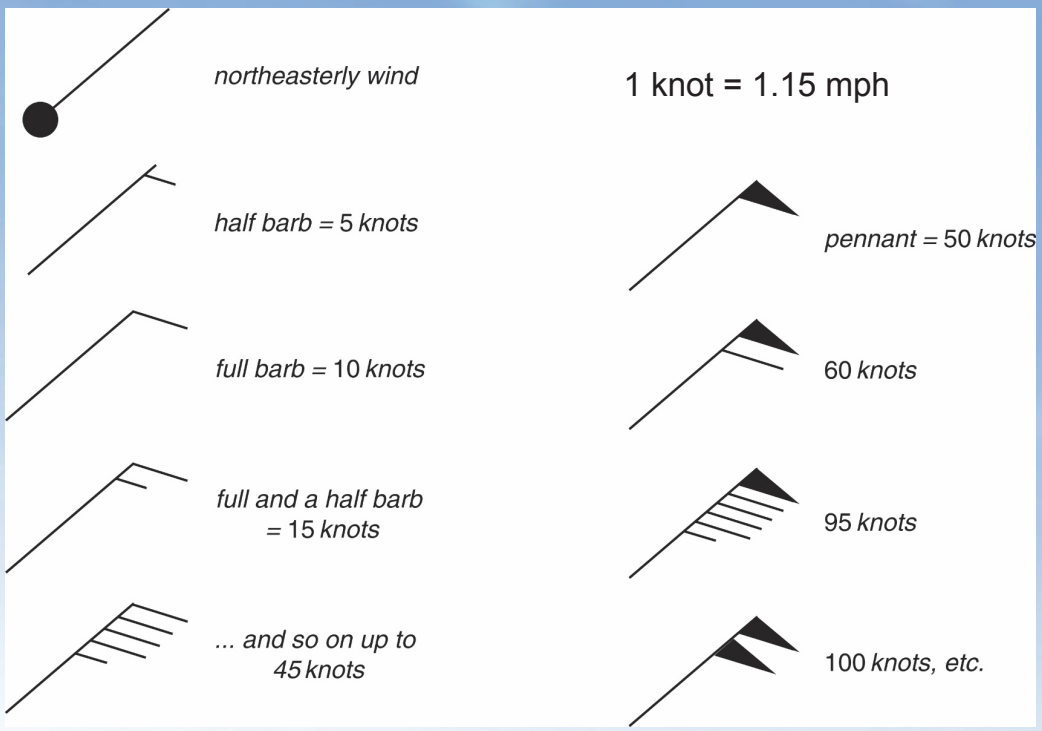
Weather Station Model



The symbol located between the air temperature and dew point temperature indicates significant weather

Fig 2-1-3 *Weather: A Concise Introduction*

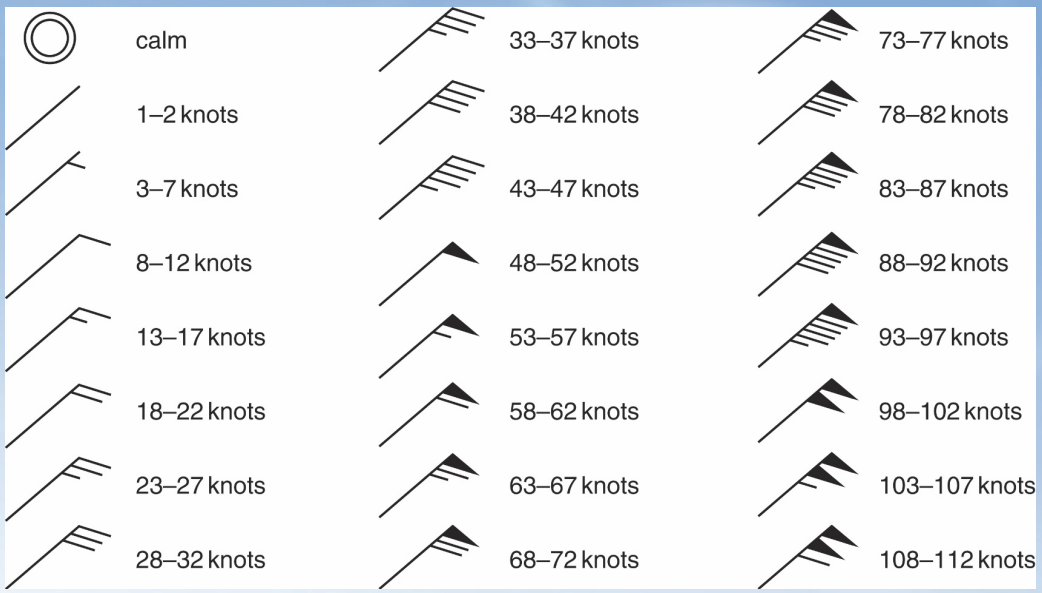
Weather Station Model



The line indicates the direction the wind is coming from (in this case from the Northeast) and the “barbs” and “pennants” indicate wind speed

Fig 2-1-4 *Weather: A Concise Introduction*

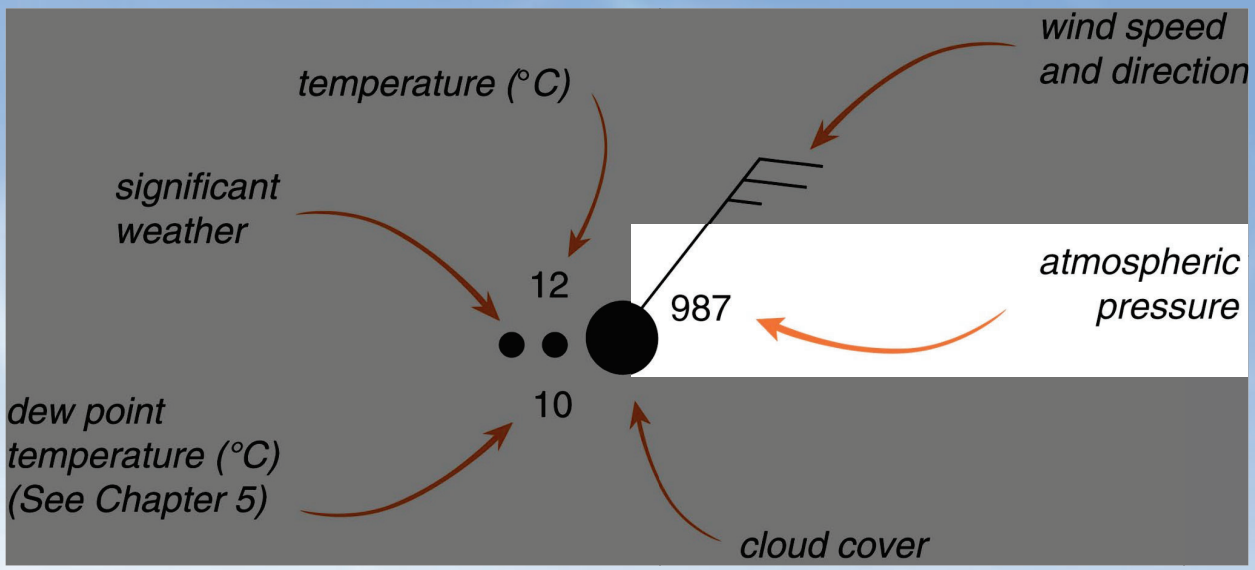
Weather Station Model



The line indicates the direction the wind is coming from (in this case from the Northeast) and the “barbs” and “pennants” indicate wind speed

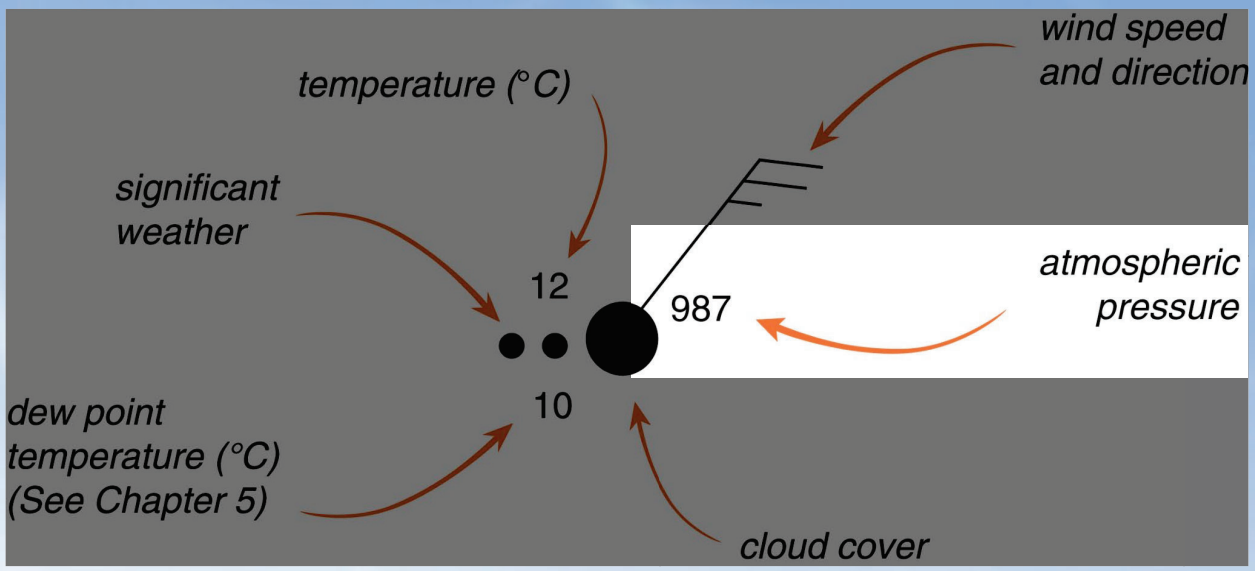
Fig 2-1-5 *Weather: A Concise Introduction*

Weather Station Model



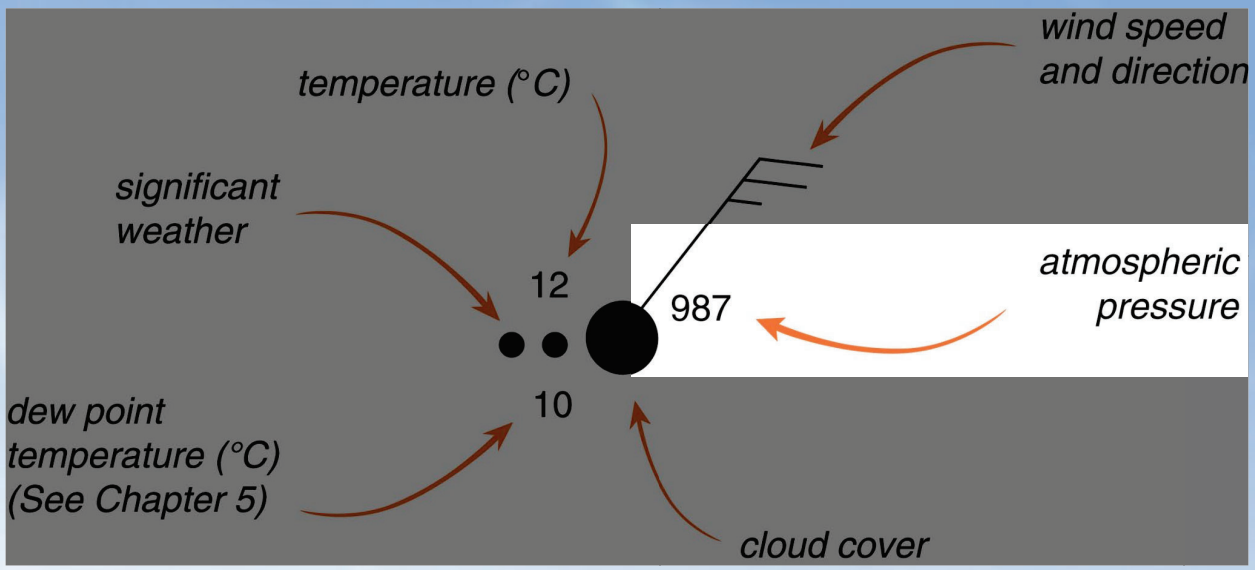
Reading the pressure can be a little confusing. In the figure above, the pressure is 987 hPa (mbar) at the surface

Weather Station Model



Sometimes weather maps use a “shorthand” to represent pressure.

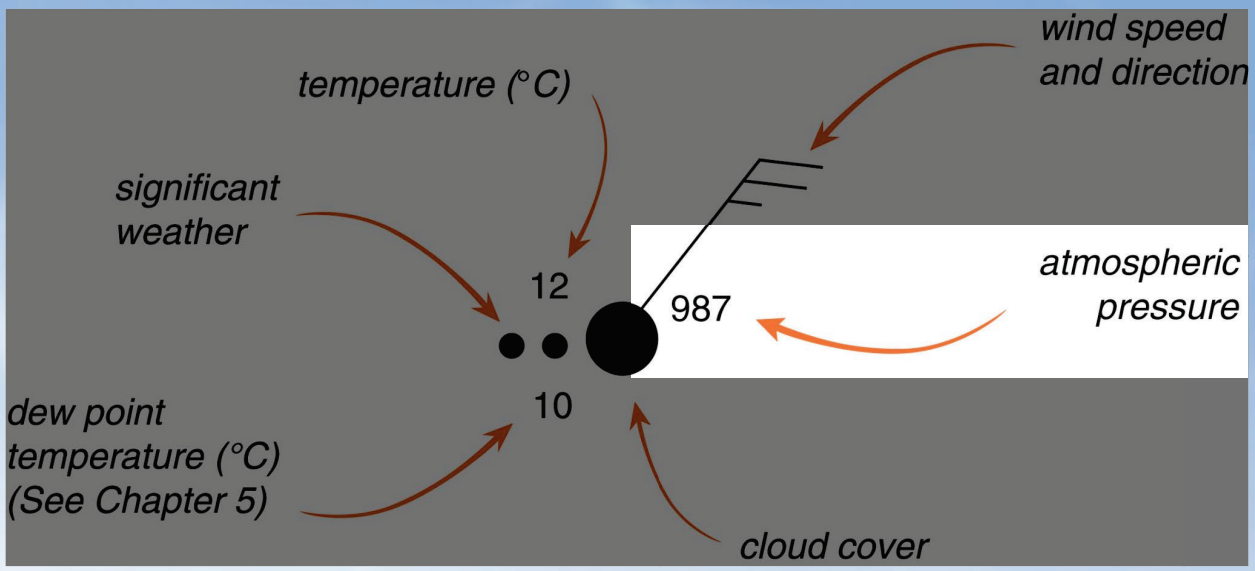
Weather Station Model



If reported value greater than 500:

Initial 9 is missing. Place it on left, then divide by 10.
For example: **827** becomes **982.7 mb**.

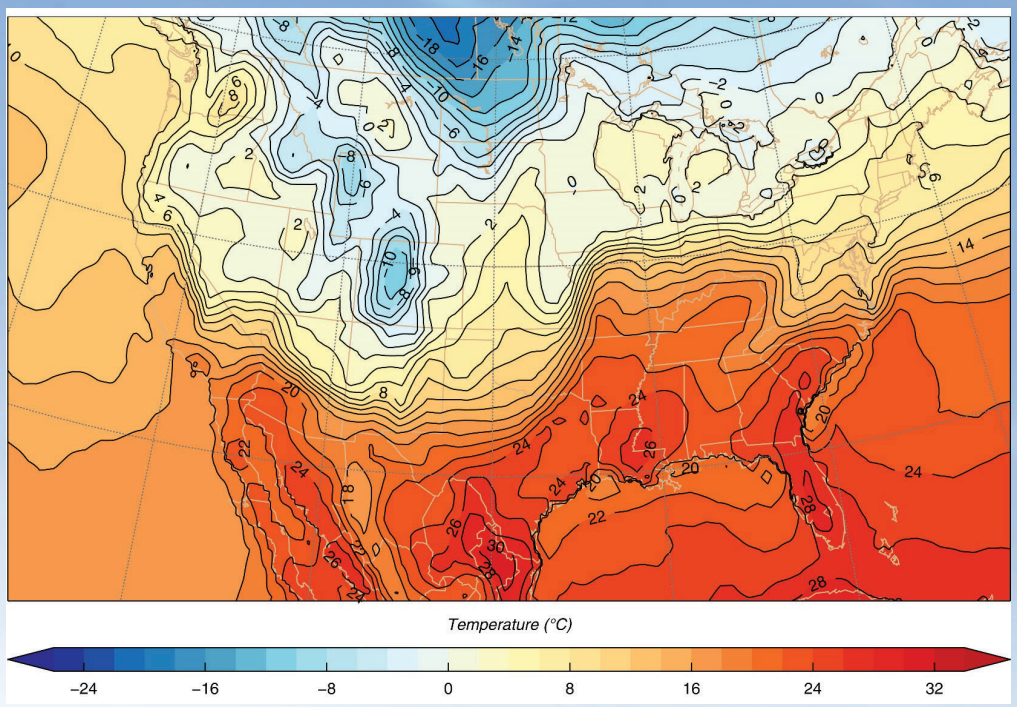
Weather Station Model



If reported value less than 500:

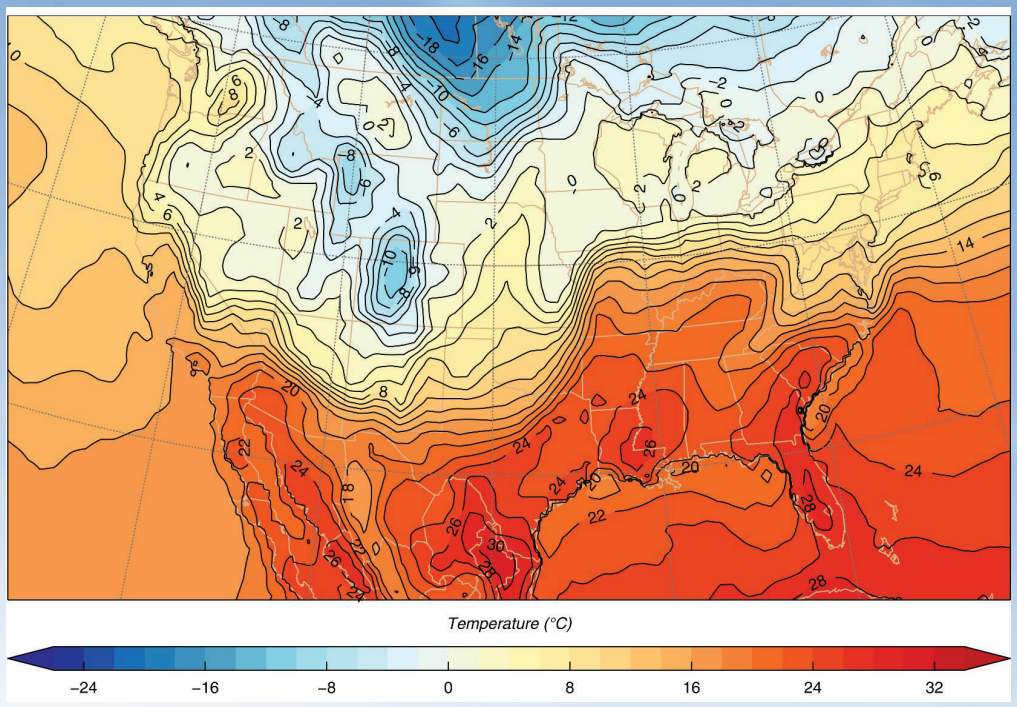
Initial 10 is missing. Place it on left, then divide by 10.
For example: **027** becomes **1002.7 mb**.

Temperature Maps



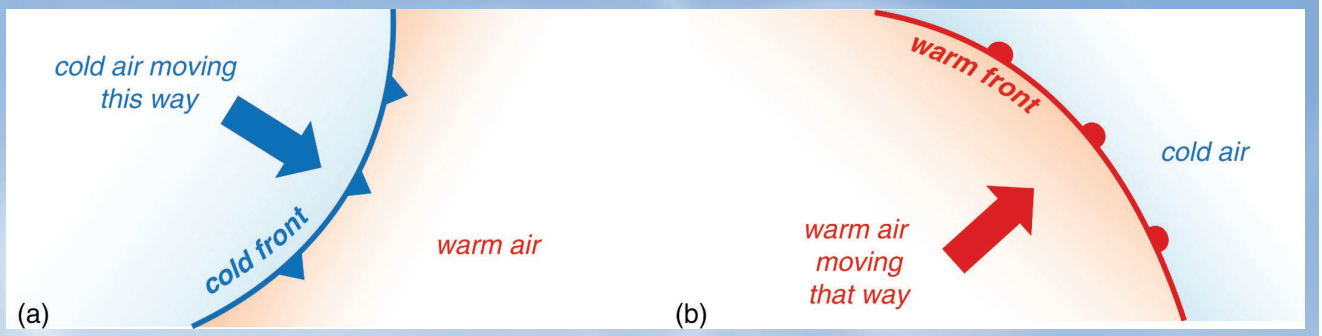
Temperature maps are often colored based on how warm (red) or cold (blue) the surface temperatures are

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

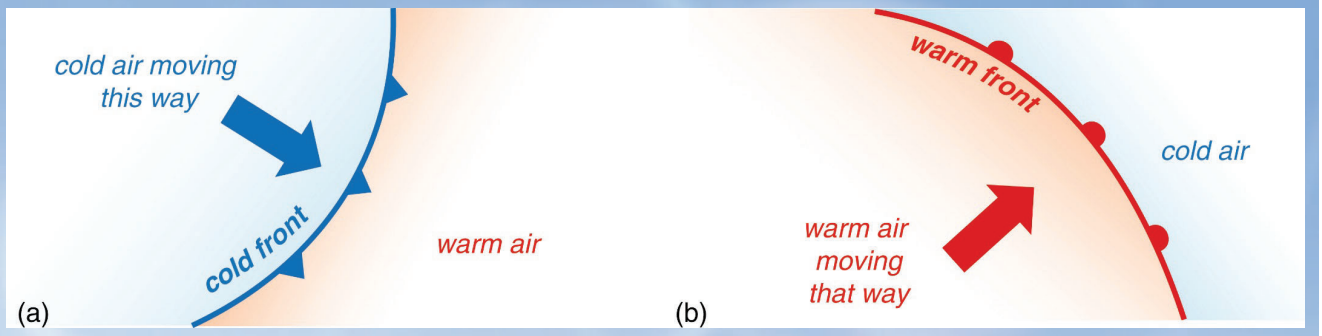
Temperature Fronts



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*

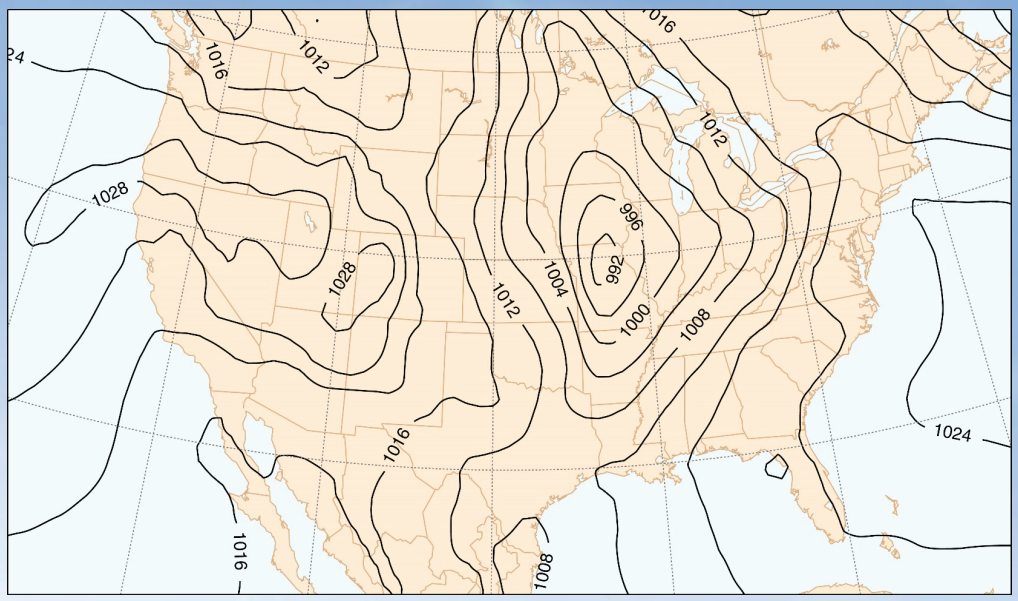
Temperature Fronts



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*

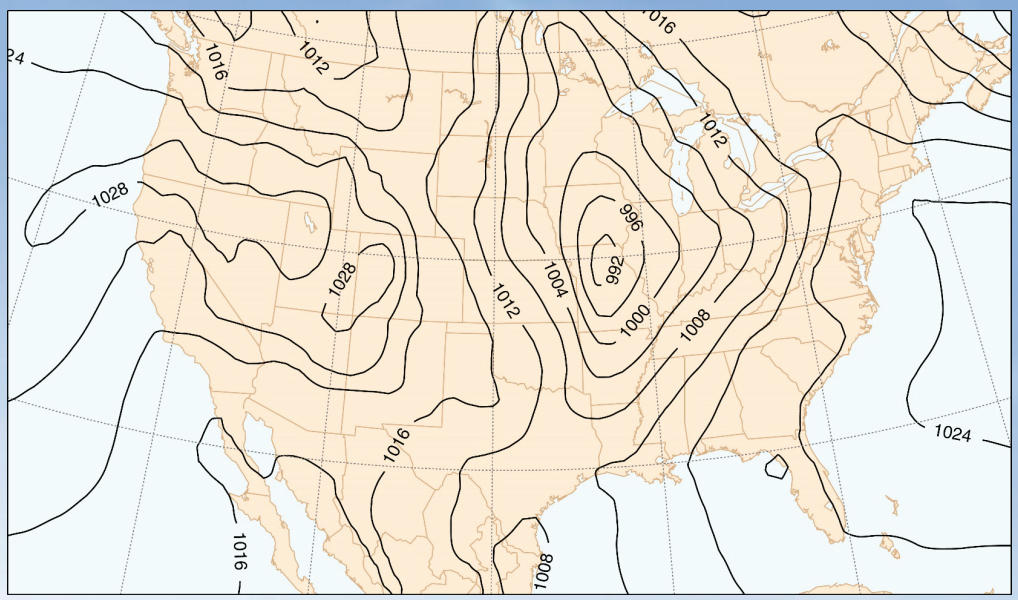
Pressure Maps



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 actual pressure (no conversion needed)

Fig 2-4 *Weather: A Concise Introduction*

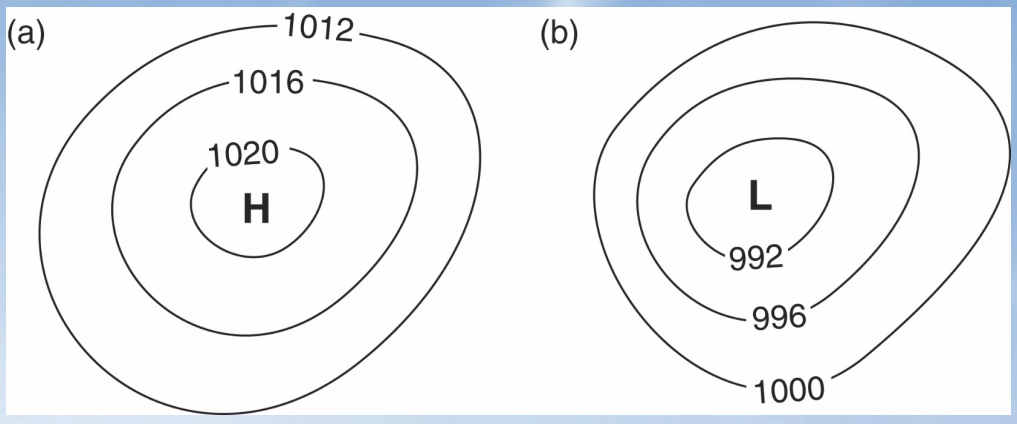
Pressure Maps



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*

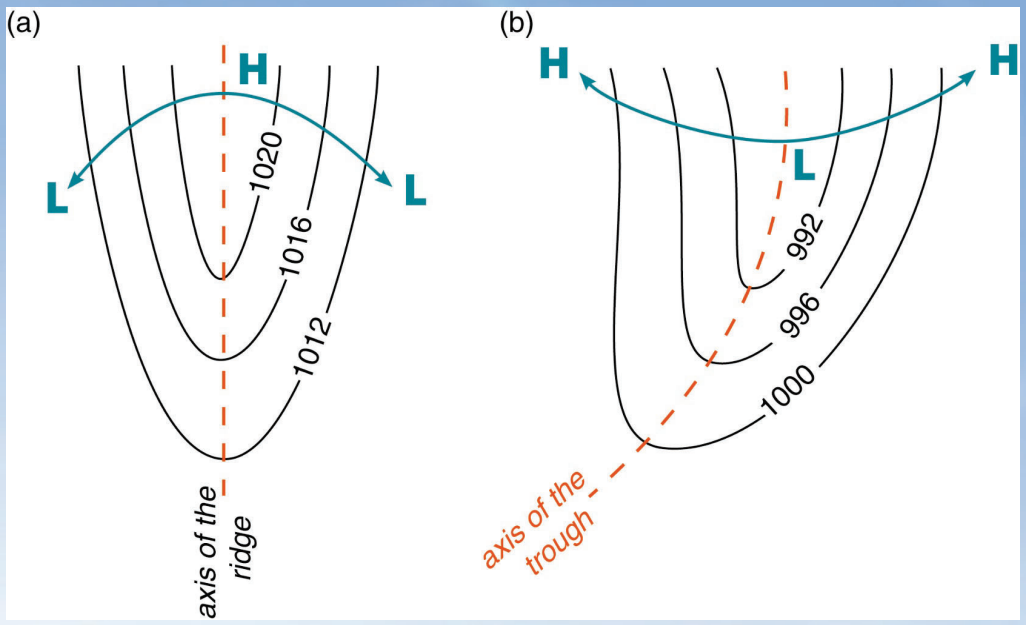
Pressure Maps



Closed contours define regions of high pressure and low pressure.

Fig 2-5 *Weather: A Concise Introduction*

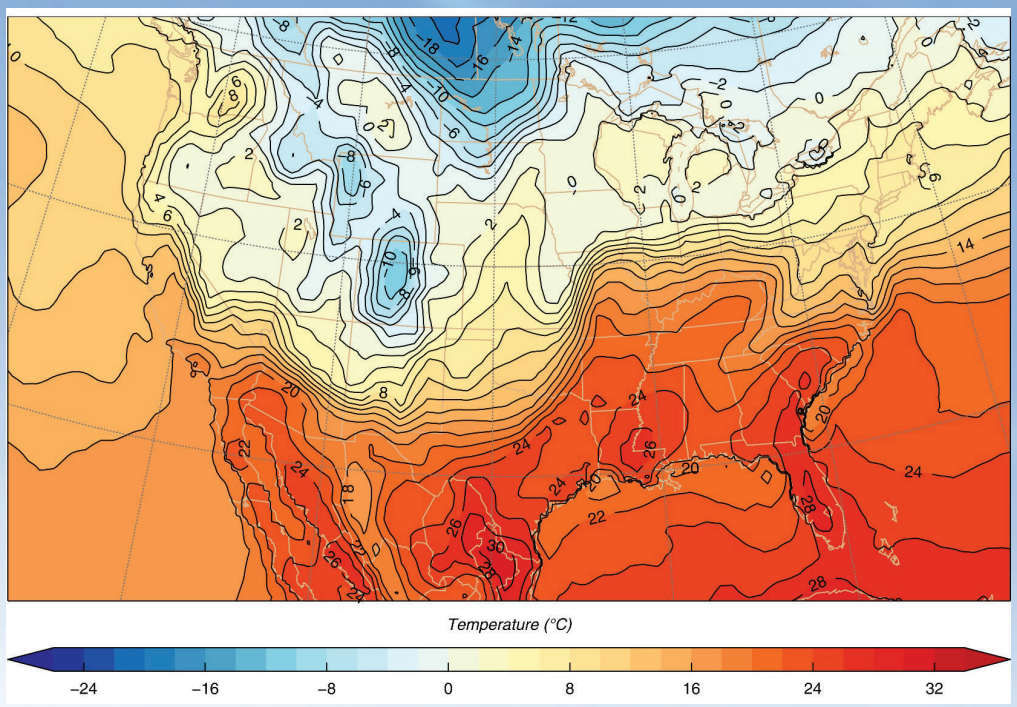
Pressure Maps



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

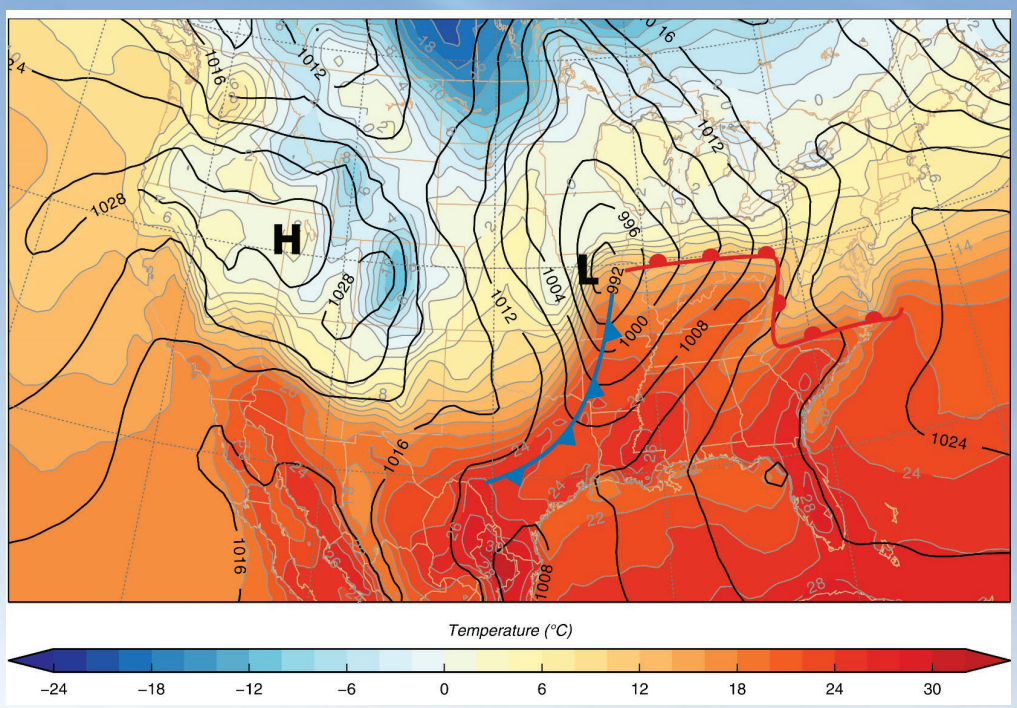
Fig 2-6 *Weather: A Concise Introduction*

Temperature Maps



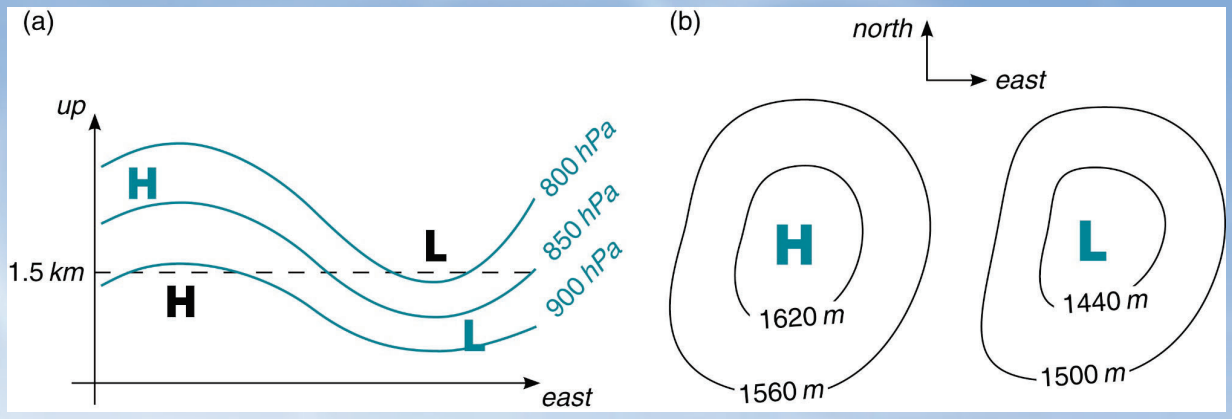
We can combine the different ways of looking at surface data to create what you may recognize as a modern weather map

Weather Maps



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

Upper Level Maps

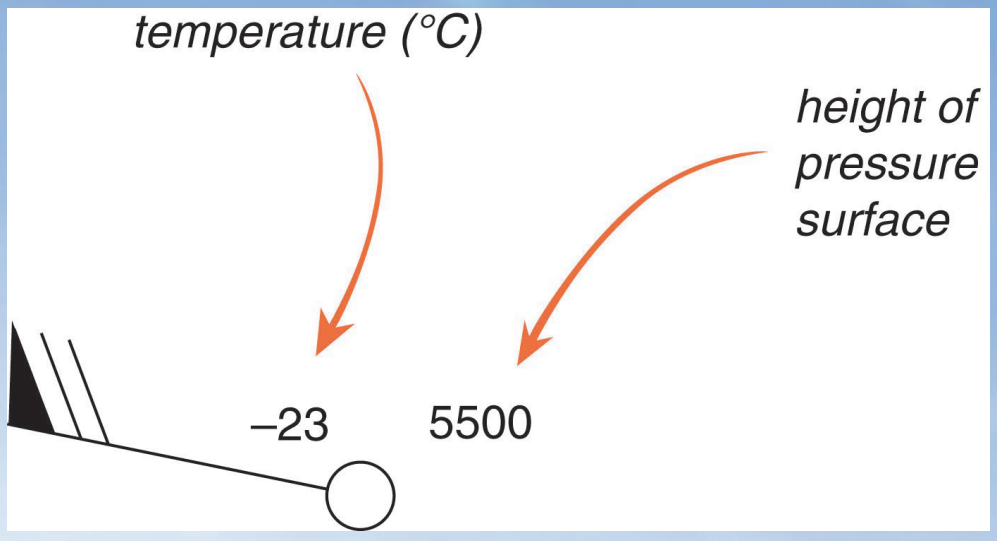


We can look at pressure maps at a some particular altitude but the mathematics becomes very complicated ☹

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*

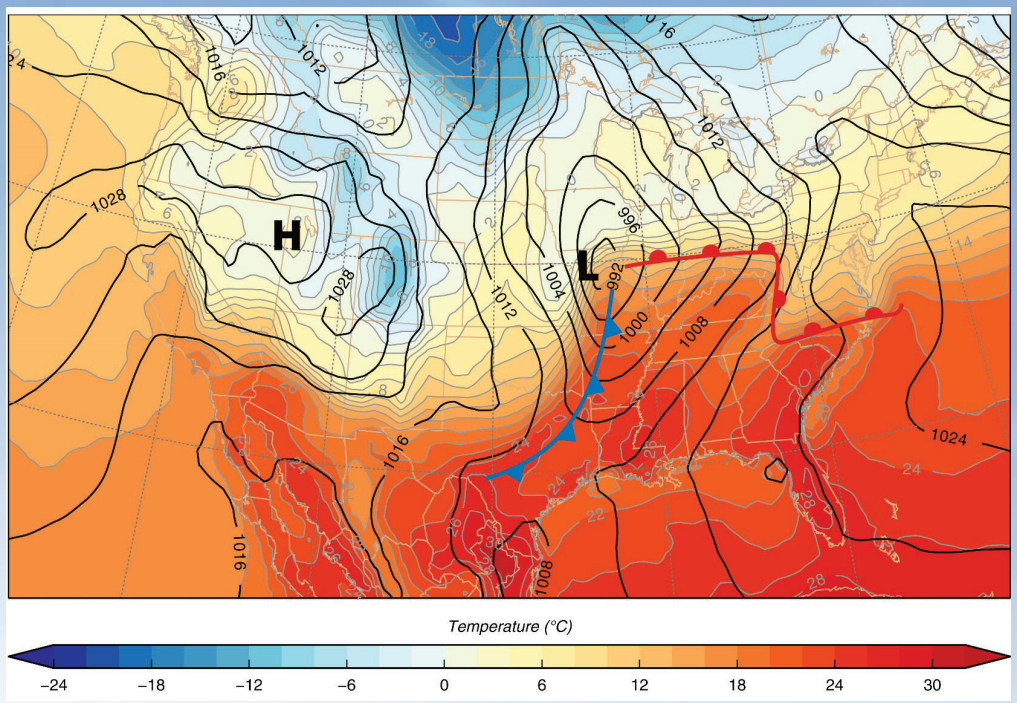
Upper Level Maps



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*

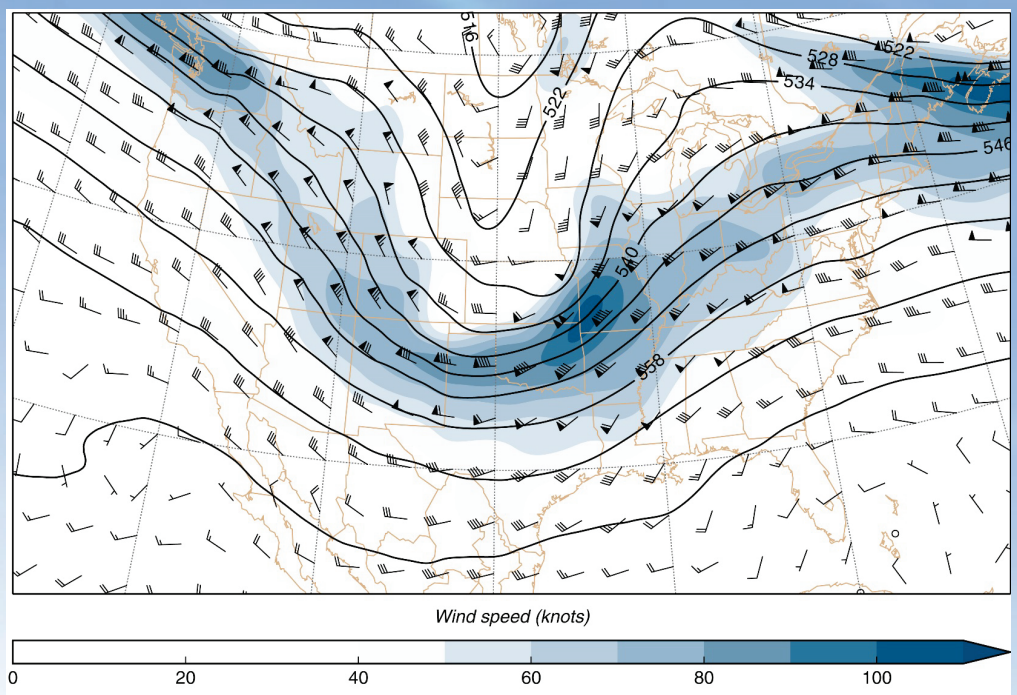
Weather Maps: Surface



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*

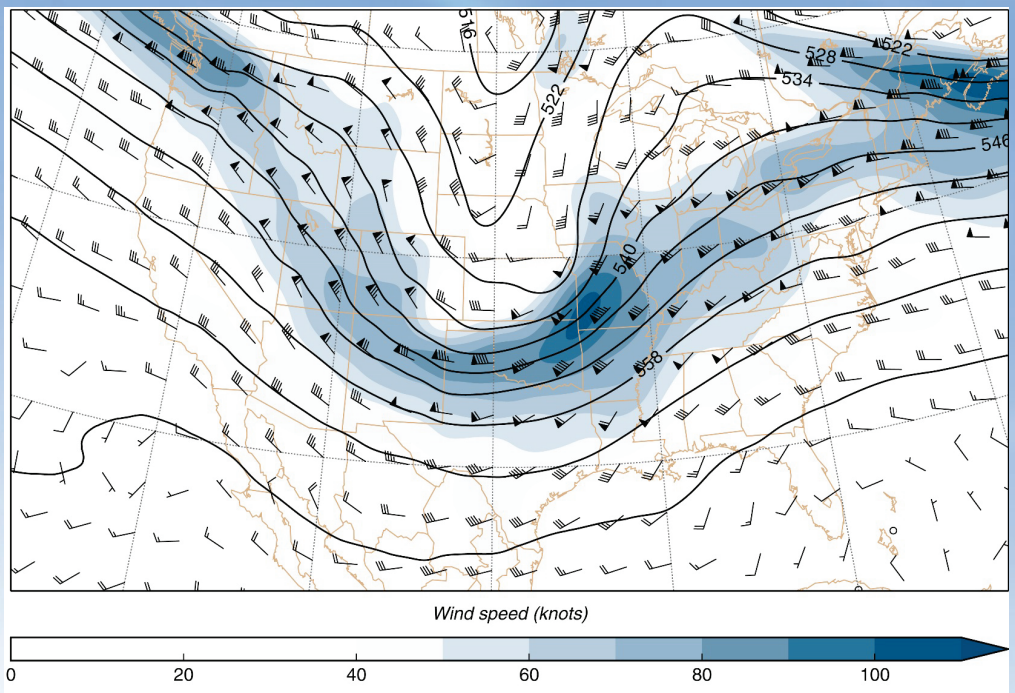
Weather Maps: 500 mb



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”.

Fig 2-10 *Weather: A Concise Introduction*

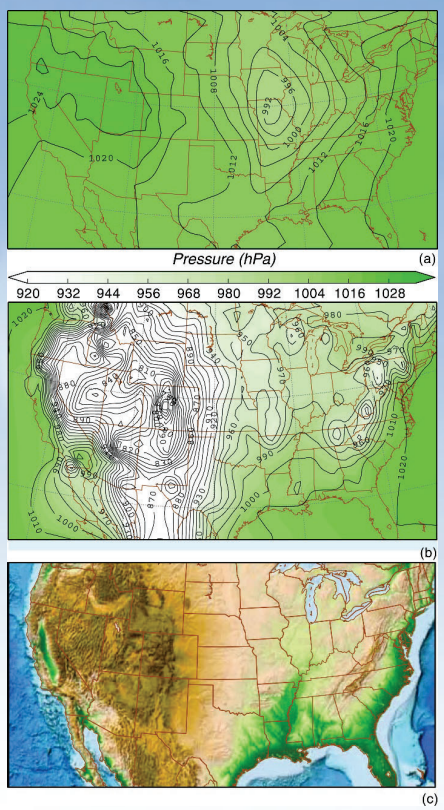
Weather Maps: 500 mb



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

Fig 2-10 *Weather: A Concise Introduction*

Mean Sea Level Pressure



Pressure and altitude are connected: pressure decreases with height

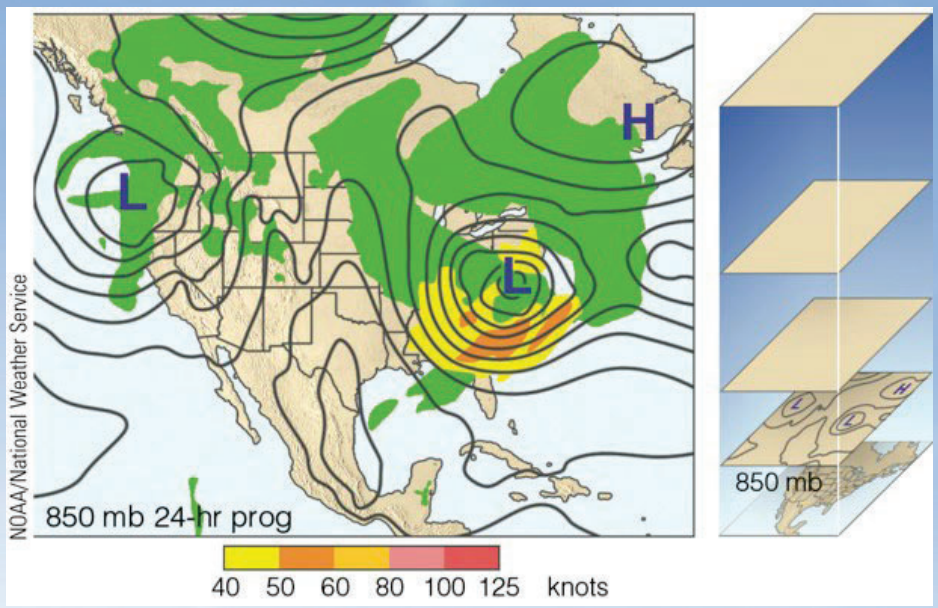
The air pressure at the top of a mountain is lower than at the beach.

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*

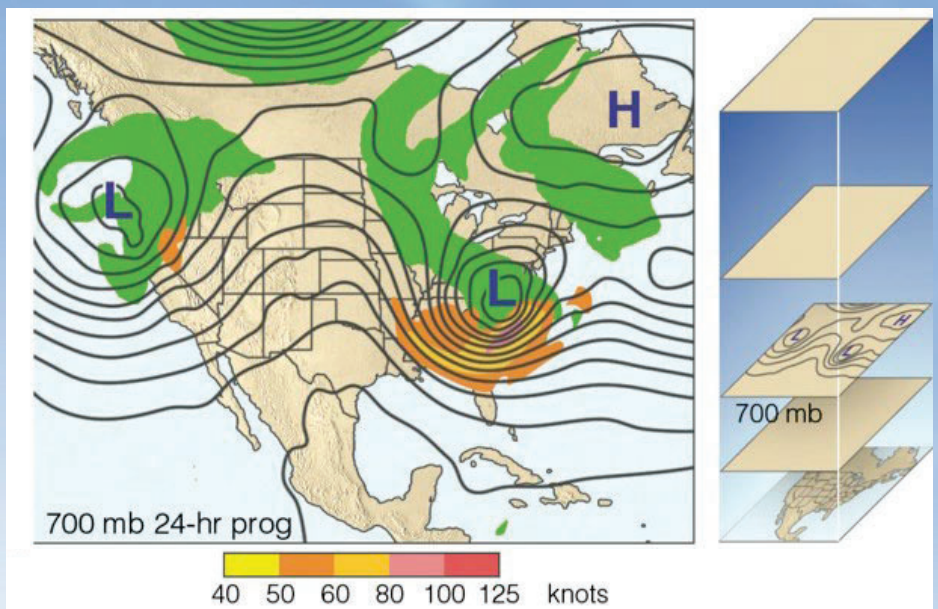
Prognostic Charts



850 mb	1500 m (4900 ft)	• High moisture values that can contribute to heavy precipitation • Convergent winds associated with strengthening low pressure areas • A low-level jet stream that can help intensify thunderstorm development • Temperatures that determine whether precipitation will fall as snow, rain, sleet, or a mixture

Fig 9.5: *Essentials of Meteorology*

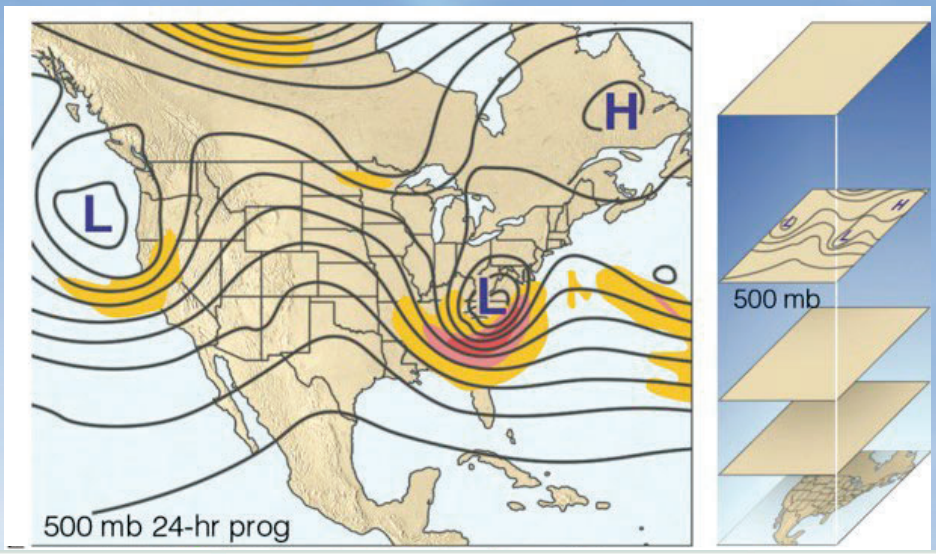
Prognostic Charts



700 mb	300 m (9800 ft)	• Moisture to feed precipitation and mid-latitude storm systems • Temperature advection that could strengthen or weaken fronts • A dry-warm layer that can inhibit thunderstorm development • Temperatures that help determine ice crystal and snowfall type

Fig 9.5: *Essentials of Meteorology*

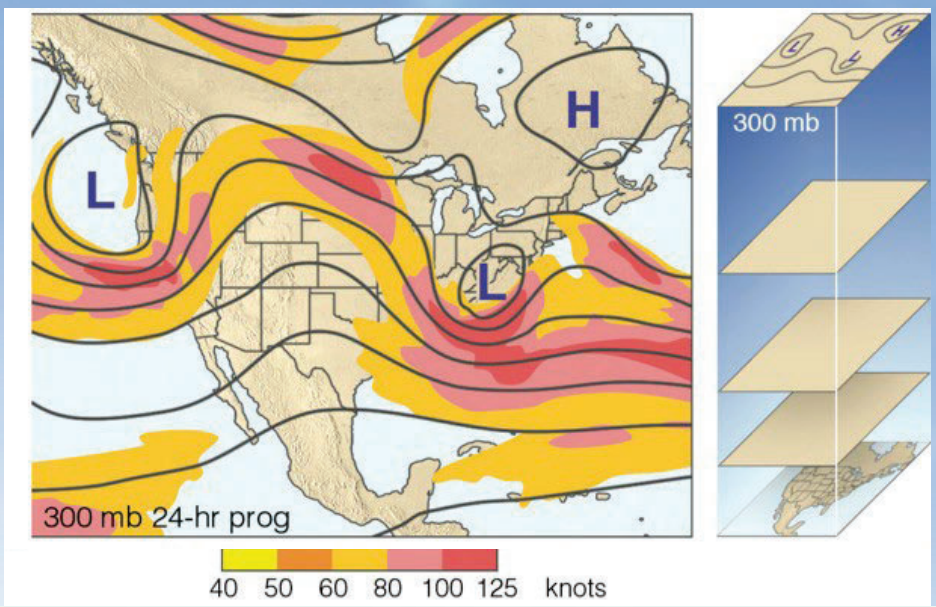
Prognostic Charts



500 mb	5600 m (18,400 ft)	• General steering flow for mid-latitude storm systems, hurricanes, and tropical cyclones • Location and motion of ridges, troughs, and short waves that generate and strengthen surface features • Areas of cold advection that can help increase conditional instability and support thunderstorm development • Large areas of high or low heights that correspond to unusually warm or cold conditions at the surface, depending on region and time of year

Fig 9.5: ***Essentials of Meteorology***

Prognostic Charts



300 mb	9180 m (30,100 ft)	• Location of core of jet stream • Jet streaks and areas of divergence within jet stream that may correspond to intensifying low pressure at the surface • Areas of high pressure and light, divergent wind in the tropics and subtropics that can support hurricane development

Fig 9.5: ***Essentials of Meteorology***