Air Pressure and Winds

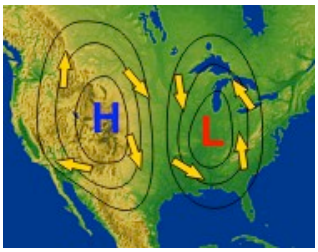
Wind is simply the air in motion. Usually when we are talking about the wind it is the horizontal motion we are concerned about. If you hear a forecast of west winds of 10 to 20 mph that means the horizontal winds will be 10 to 20 mph *FROM* the west.

Although we cannot actually see the air moving we can measure its motion by the force that it applies on objects. For example, on a windy day leaves rustling or trees swaying indicate that the wind is blowing. Officially, a wind vane measures the wind direction and an anemometer measures the wind speed.

The vertical component of the wind is typically very small (except in thunderstorm updrafts) compared to the horizontal component, but is very important for determining the day to day weather. Rising air will cool, often to saturation, and can lead to clouds and precipitation. Sinking air warms causing evaporation of clouds and thus fair weather.

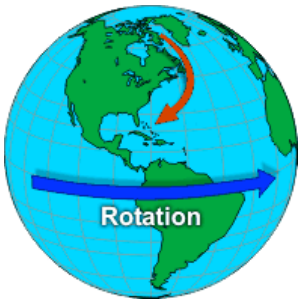
You have probably seen a surface map marked with H's and L's which indicate high and low pressure centers. Surrounding these "highs" and "lows" are lines called isobars. "Iso" means "equal" and a "bar" is a unit of pressure so an isobar means equal pressure. We connect these areas or equal pressure with a line. Everywhere along each line is constant pressure. The closer the isobars are packed together the stronger the pressure gradient is.

Pressure gradient is the *difference* in pressure between high and low pressure areas. Wind speed is *directly proportional* to the pressure gradient. This means the strongest winds are in the areas where the pressure gradient is the greatest.



Also, notice that the wind direction (yellow arrows) is clockwise around the high pressure system and counter-clockwise around the low pressure system. In addition, the direction of the wind is across the isobars slightly, away from the center of the high pressure system and toward the center of the low pressure system. Why does this happen? To understand we need to examine the forces that govern the wind.

The **pressure gradient force** (Pgf) is a force that tries to equalize pressure differences. This is the force that causes high pressure to push air toward low pressure. Thus air would flow from high to low pressure if the pressure gradient force was the only force acting on it.



However, because of the earth's rotation, there is second force, the **Coriolis force** that affects the direction of wind flow. This force is what causes objects in the northern hemisphere to turn to the right and objects in the southern hemisphere to turn to the left.

When viewed from space, wind travels in a straight line. However, when view from the Earth, air (as well as other things in flight such as planes and birds) is deflected to the right in the northern hemisphere (red arrow on image at right).

What happens to the converging winds near a low? Air cannot "pile up" at a given spot. It has to go somewhere so it is forced to rise. As it rises it cools. When air cools it can hold less water vapor so some of the invisible vapor condenses, forming clouds and precipitation. That is why there is often inclement weather near low pressure areas. What about the diverging air near a high? As the air spreads away from the high, air from above must sink to replace it. Sinking air warms. As air warms it can hold more water vapor, which means that clouds will tend to evaporate. That is why fair weather is often associated with high pressure.