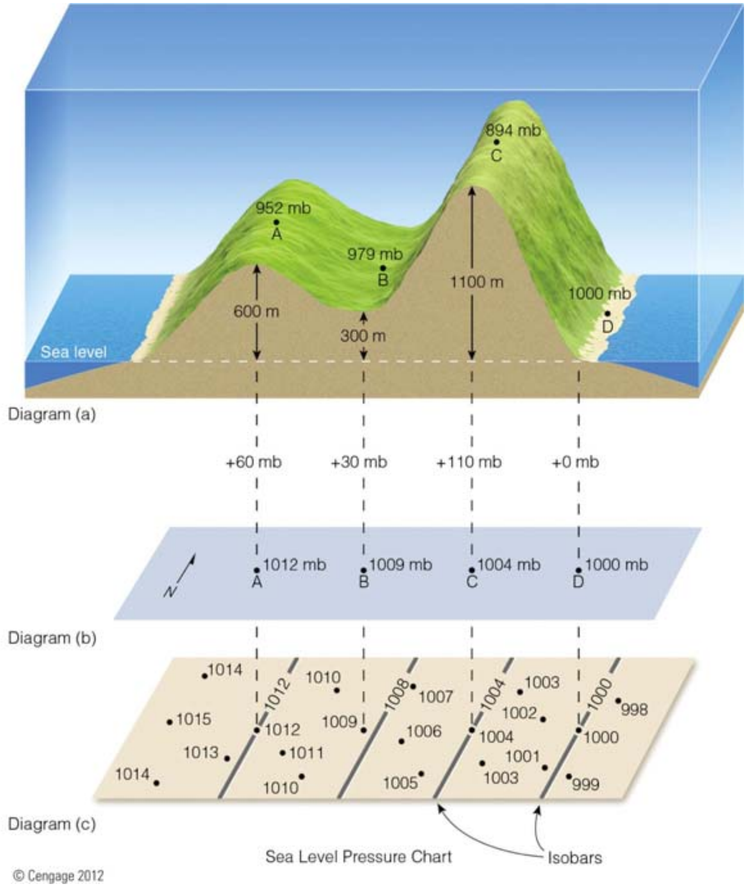
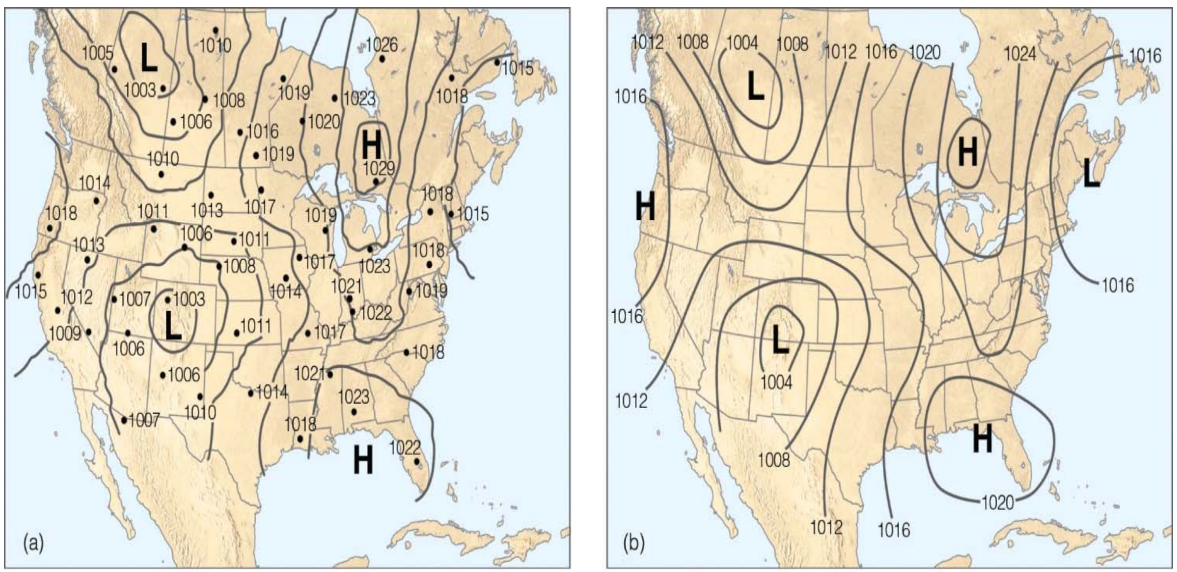
Comparing Pressures at the Surface



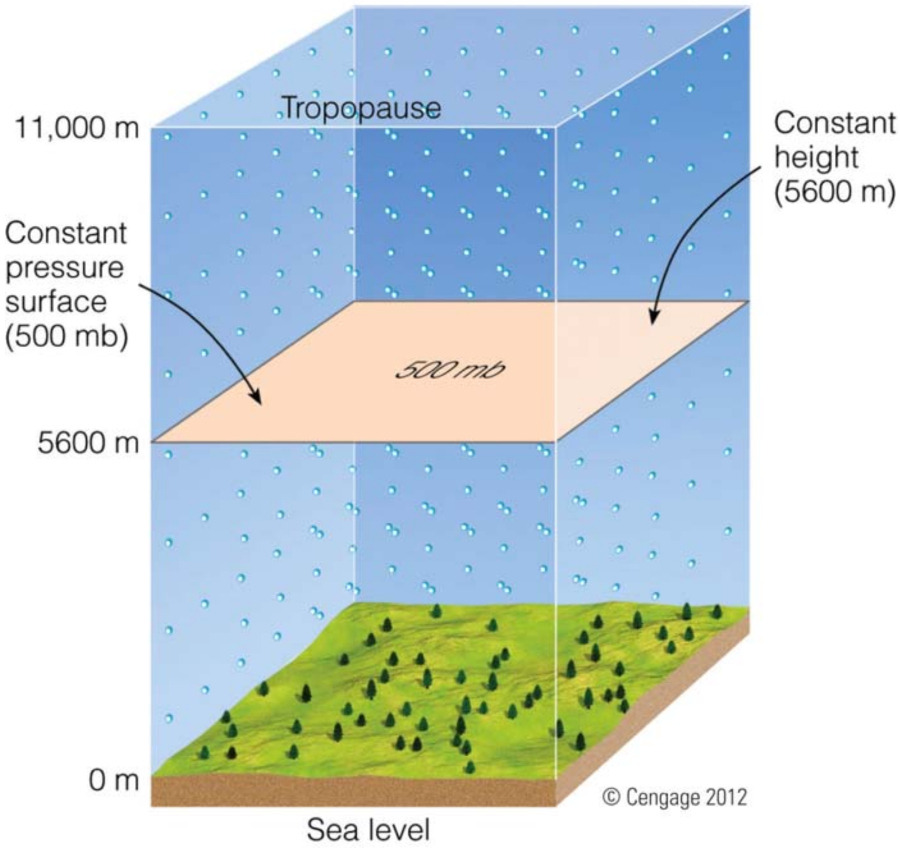
* Station Pressure: After being corrected for temperature, gravity and instrument error the barometer reading at a particular location
* Altitude corrections must be made to compare stations
  * 10 mb for every 1000 m in altitude
* Surface Weather Map (or Sea Level Pressure Chart) : plot of pressure values that have been corrected for altitude
*

Surface Weather Map



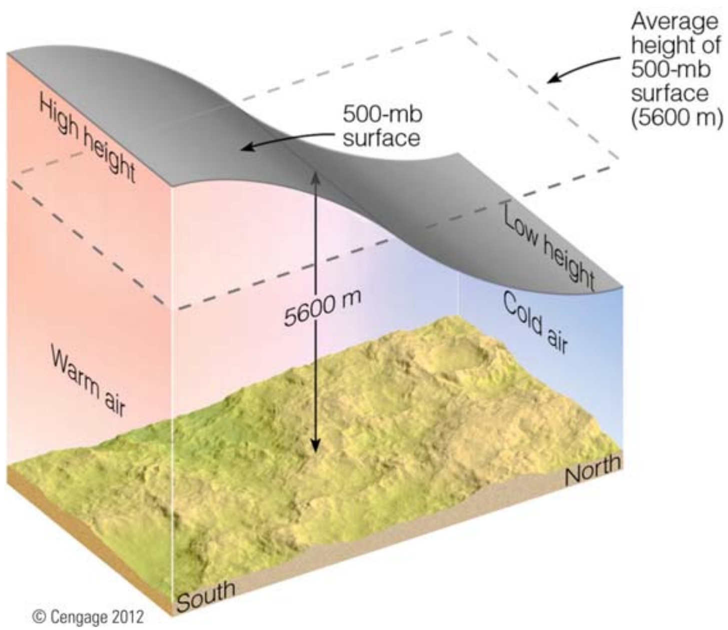
- Could be error when converting to sea level pressure
- Data is typically smoothed

Isobaric Charts



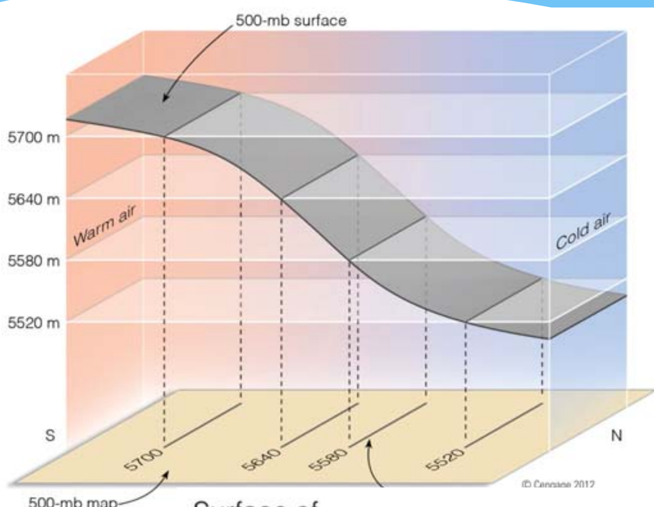
* Isobaric Charts : at constant pressure 9not altitude)
* When there is no horizontal change in pressure the 500 mb surface is at 5600 meters

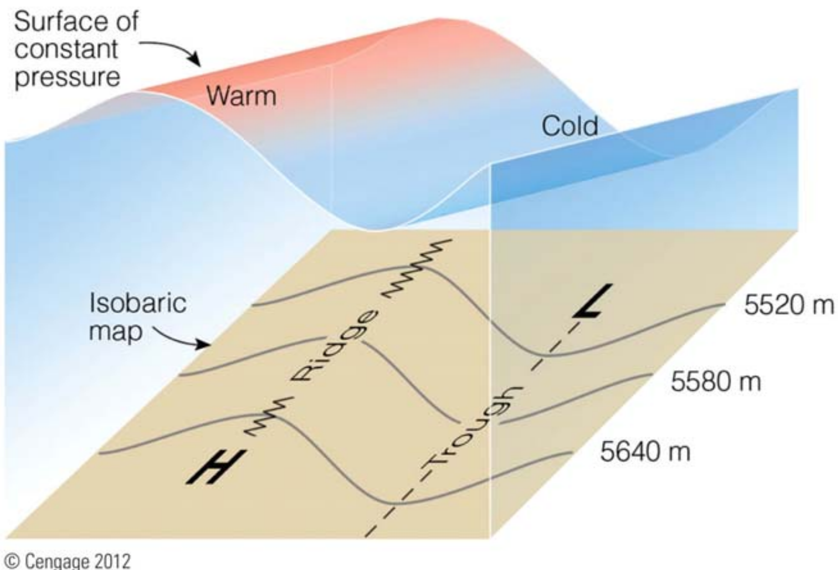
Isobaric Charts (cont'd)



* If the temperature changes with altitude then the isobaric surface is curved rather than flat
* Here the cold air to the North is more dense and the 500 millibar surface is therefore lower in altitude

Isobaric Charts (cont'd)

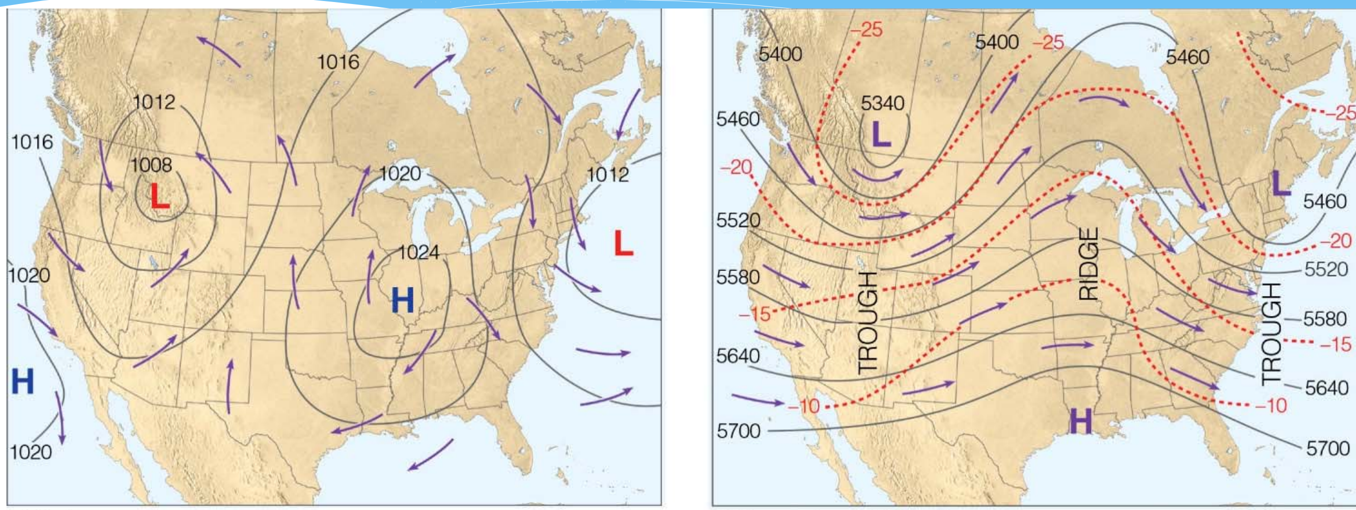




* Change in altitude, due to temperature change, of an isobaric surface shows up as contour lines on an isobaric chart

  (Note that when the isobaric chart dips rapidly there is closer spacing of the isobars)
* When the change in altitude of an isobaric surface is irregular an isobaric chart may have wavy line (**ridges and troughs**)

Isobaric Charts (cont'd)



(a) Surface map

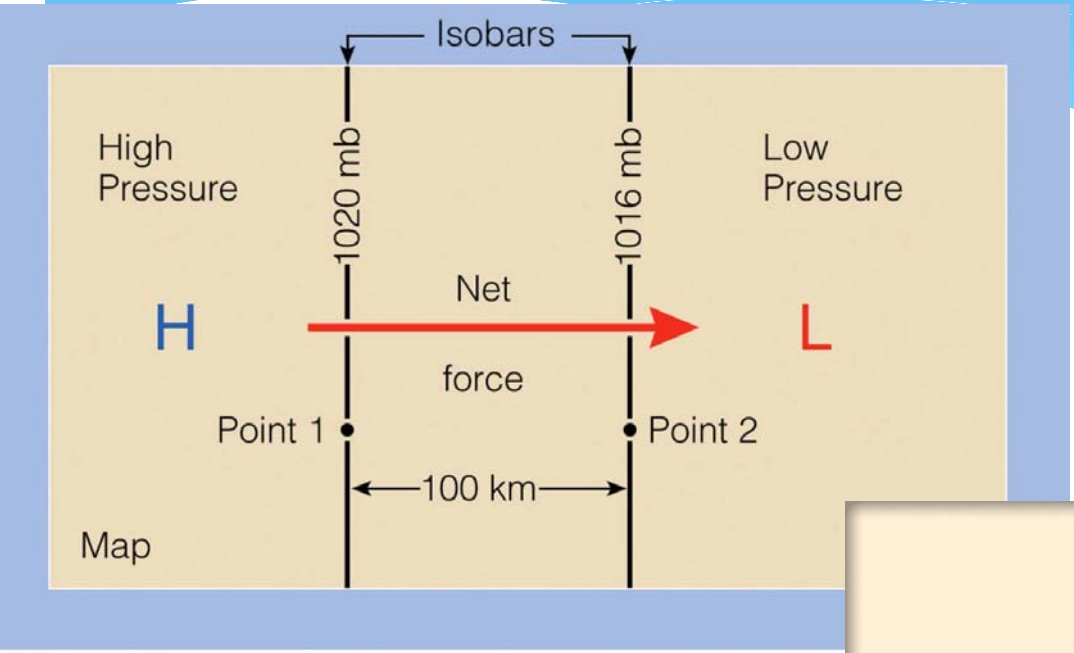
(b) Upper-air map (500 mb)

- Surface map and 500 mb on same day
- Notice that there are surface lows near an upper level trough and surface highs near a upper level ridge
- Notice that wind direction in upper level is parallel to isobars
- Notice direction of wind on surface map around L and H
- Red dotted lines are isotherms

Forces that Influence the Wind

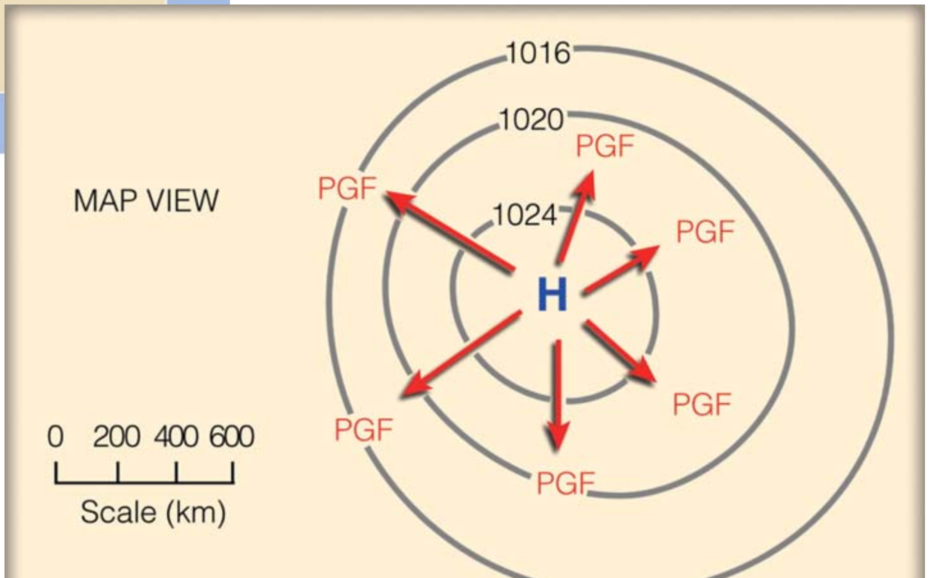
* Pressure Gradient Force
* Coriolis “Force” (Effect)
* Friction Force

PGF

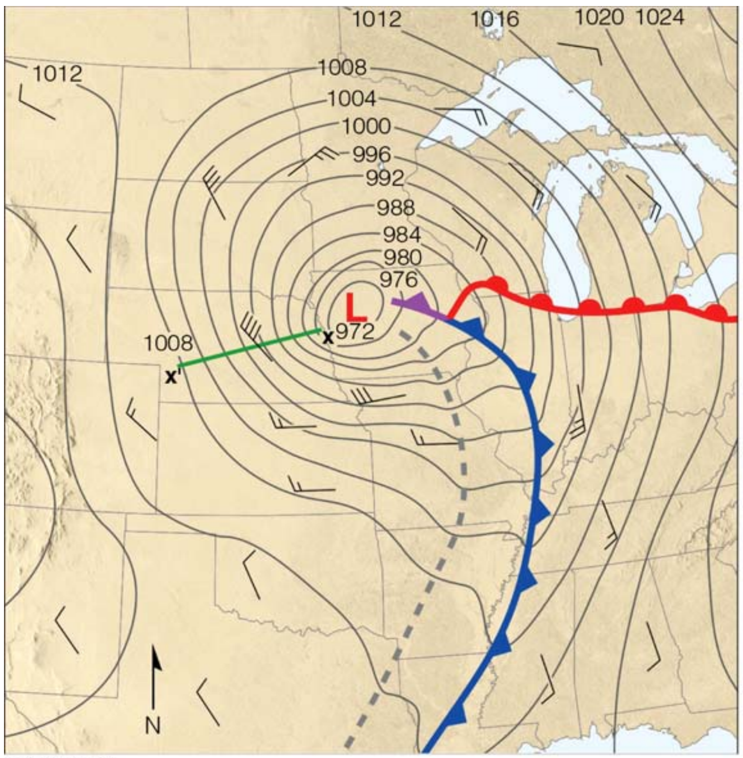


PGF is directed from high to low pressure at right angles to the Isobars

Magnitude of the force is directly related to the pressure gradient



PGF



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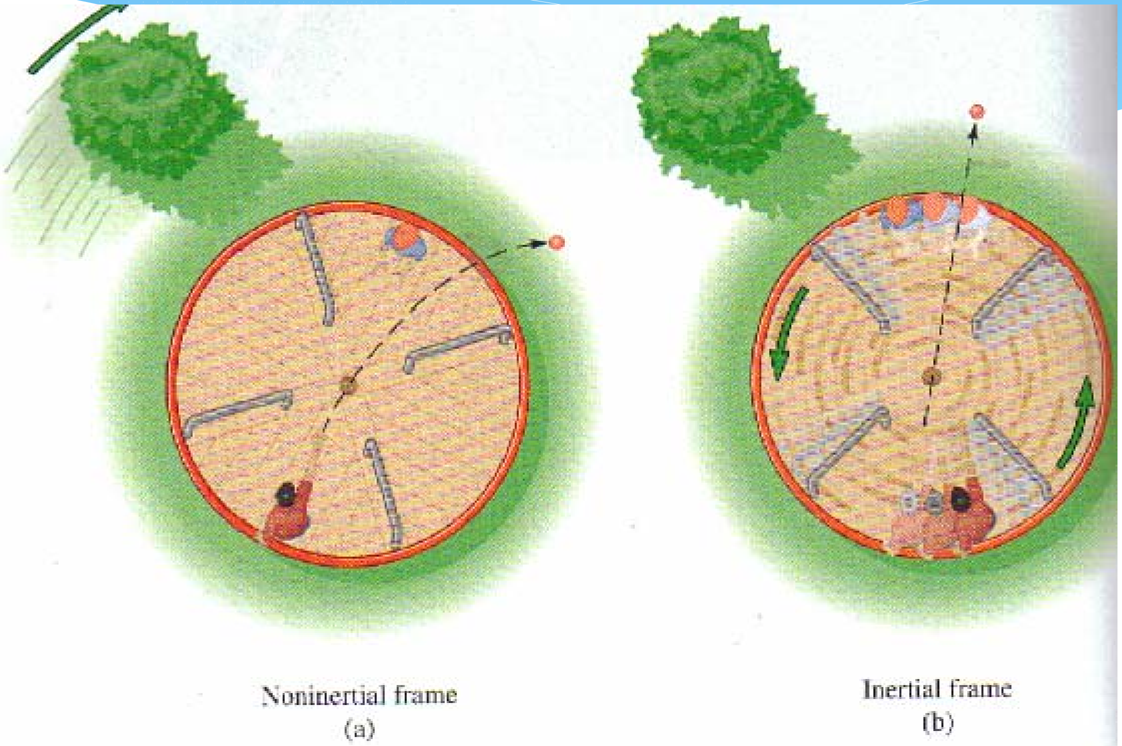
	Miles (statute) per hour	Knots
	Calm	Calm
	1-2	1-2
	3-8	3-7
	9-14	8-12
	15-20	13-17
	21-25	18-22
	26-31	23-27
	32-37	28-32
	38-43	33-37
	44-49	38-42
	50-54	43-47
	55-60	48-52
	61-66	53-57
	67-71	58-62
	72-77	63-67
	78-83	68-72
	84-89	73-77
	119-123	103-107

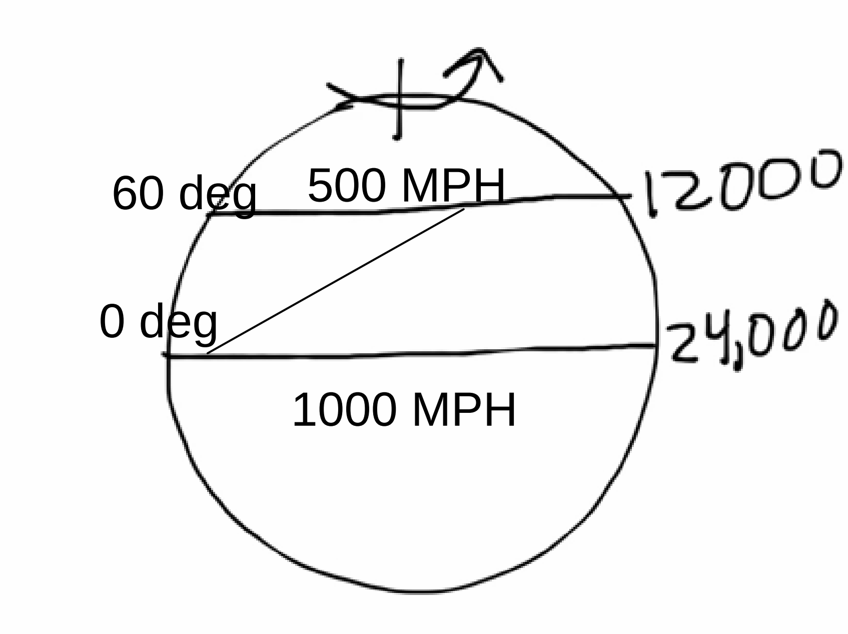
- Tightly packed isobars near green line are producing a steep gradient of 32 mb per 500 km and a strong surface wind of 40 knots (46 mph)
- IF THE PRESSURE GRADIENT FORCE WERE THE ONLY FORCE ACTING ON AIR WE WOULD ALWAYS FIND WIND BLOWING DIRECTLY FROM HIGH TO LOW PRESSURE: BUT IT IS DEFLECTED BY THE CORIOLIS FORCE

Coriolis "Force"

Figure 26.1 A ball tossed across a merry-go-round. (a) Trajectory of the ball as viewed in the *noninertial* frame fixed to the platform. In this frame, the platform is at rest and the tree is moving. The ball is thrown straight toward the catcher but then is deflected sideways, even though no sideways force acts on it. (b) Straight-line trajectory of the ball as viewed in the *inertial* frame fixed to the ground. In this frame, the law of inertia holds and the ball is not deflected. The catcher rotates away from the path of the ball.

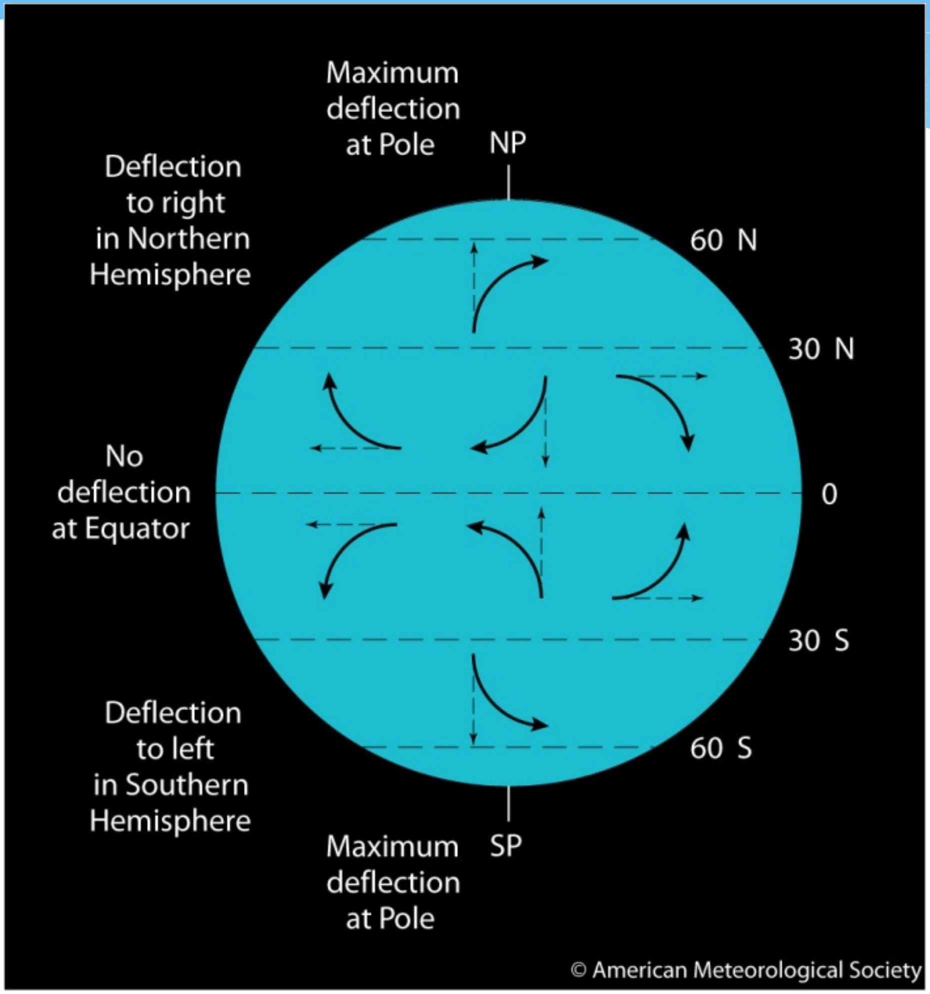


Coriolis Effect



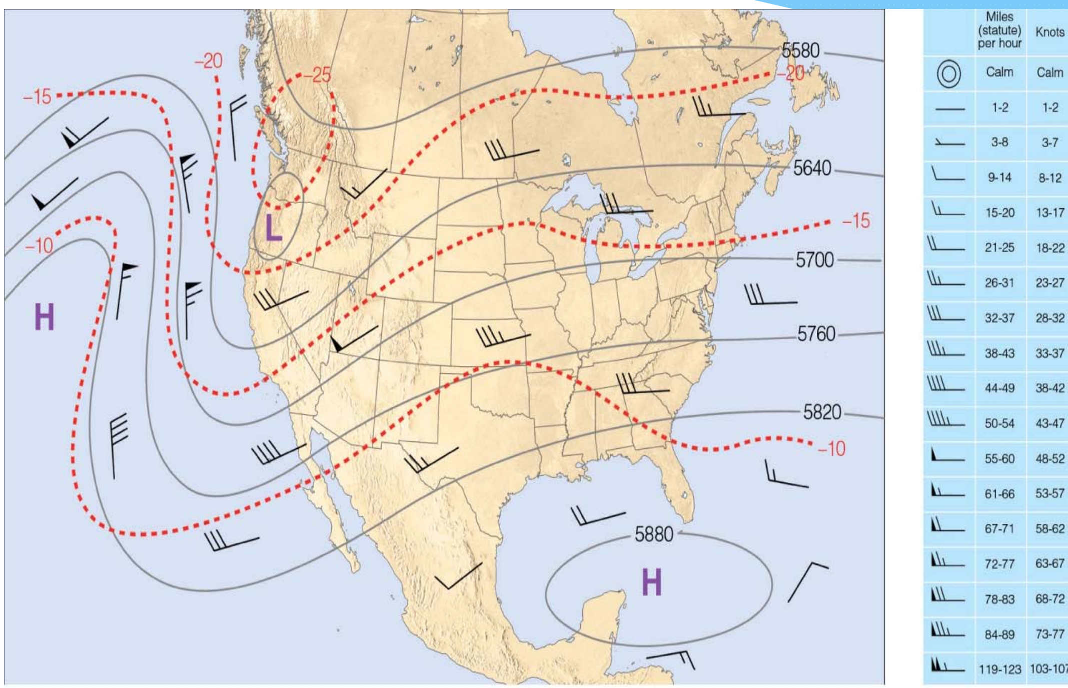
- You are traveling at 500 mph at 60 deg latitude and 1000 mph at the equator
- Suppose you sling shoot a package that could theoretically reach a point 1000 miles directly north in one hour.
- When package leaves the equator it has a north and an east velocity of 1000 miles per hour
- The package will be 500 miles east of its intended location after 1 hour

Coriolis Effect



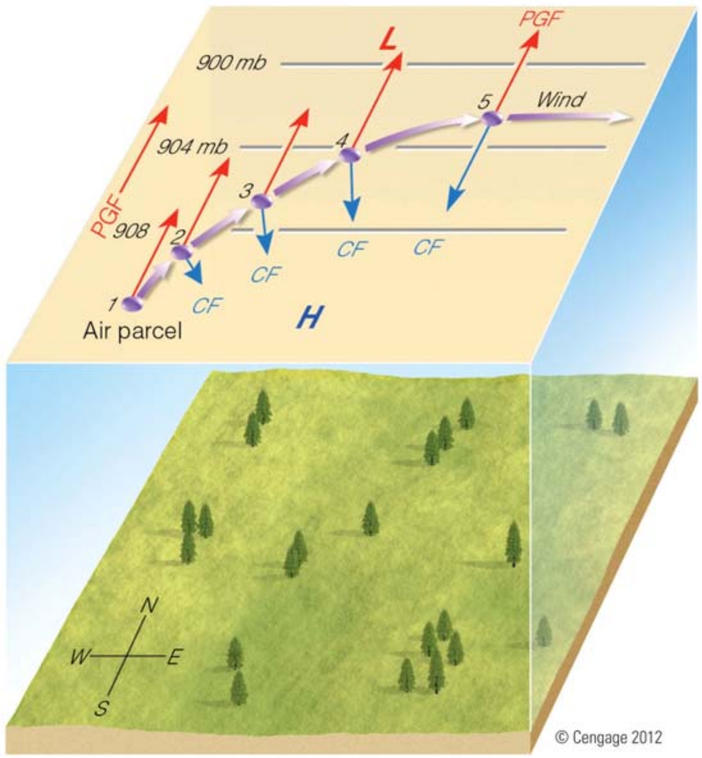
- Coriolis effect arises from the Earth's rotation on its axis
- Wind is deflected to the right of its intended direction in the Northern Hemisphere and to the left in the Southern Hemisphere
- The Coriolis effect increases with increasing wind speed

Upper Level Wind Direction



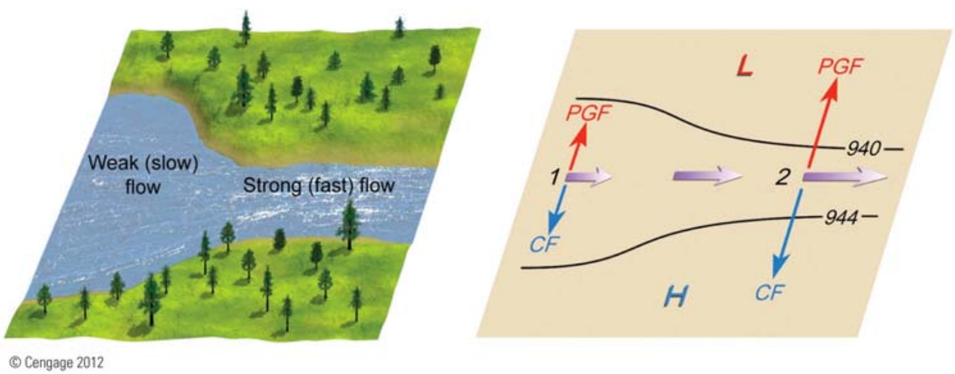
- Contour lines decrease in height from south to north warmer in the south)
- Winds tend to parallel the contour line s in a wavy east to west direction.
- Why isn't the flow perpendicular to the contour lines?(Coriolis Effect)

Geostrophic Winds



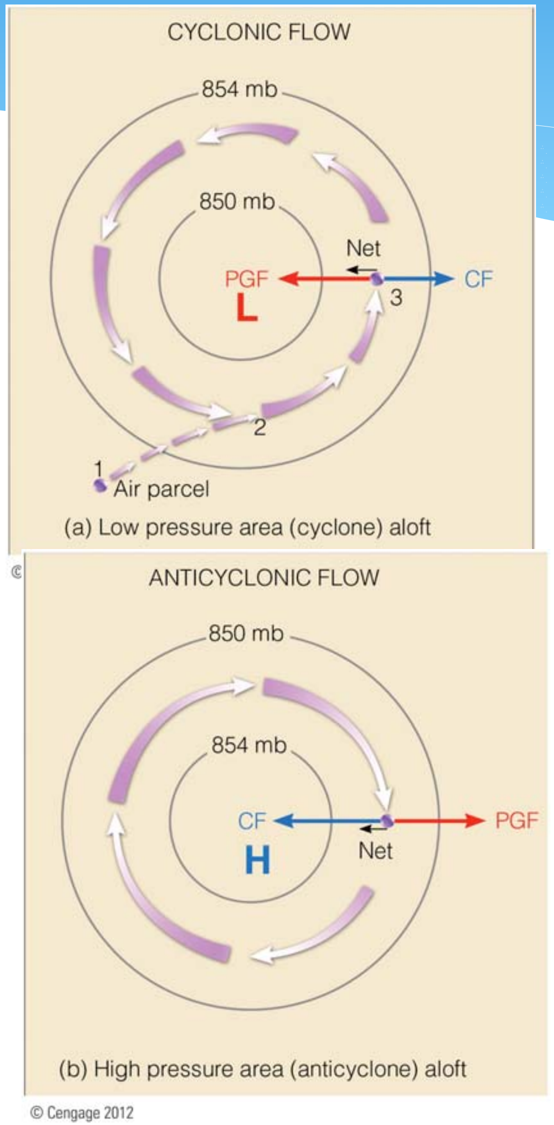
- Geo: earth; strophic: turning
- Air parcel leaving from position 1 is acted upon by two forces :PGF and Coriolis
- Eventually there is a balance between the two forces – this occurs parallel to the isobars if they are straight
- Straight line flow aloft

Geostrophic Wind

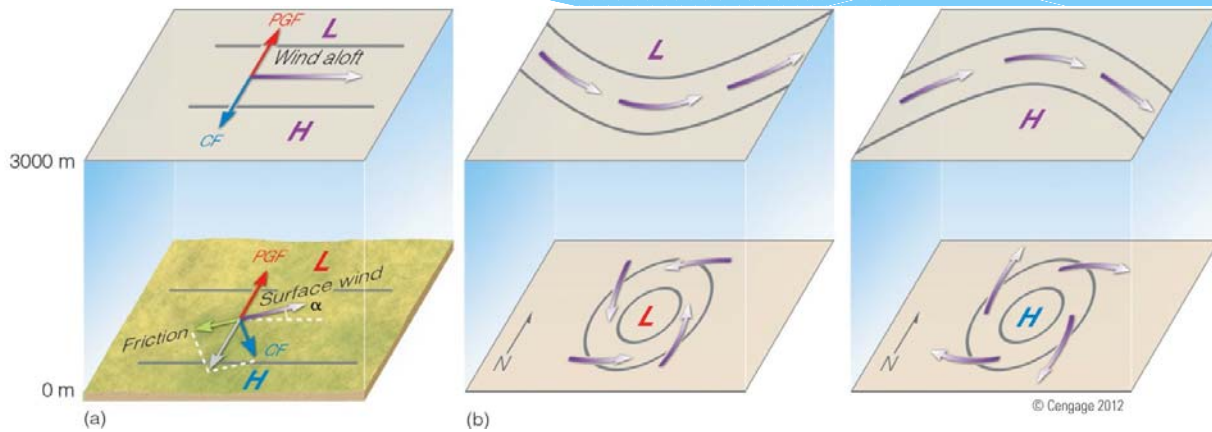


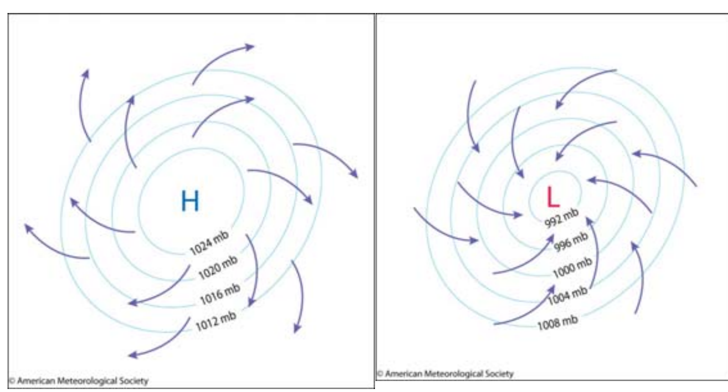
* Speed of Geostrophic winds is directly related to the pressure gradient
* Similar to water flowing in a stream
* In position 1 the wind is blowing at low speed
* In position 2 the pressure gradient increases on the wind speed increases: Higher Coriolis force balances higher pressure gradient

Gradient Winds



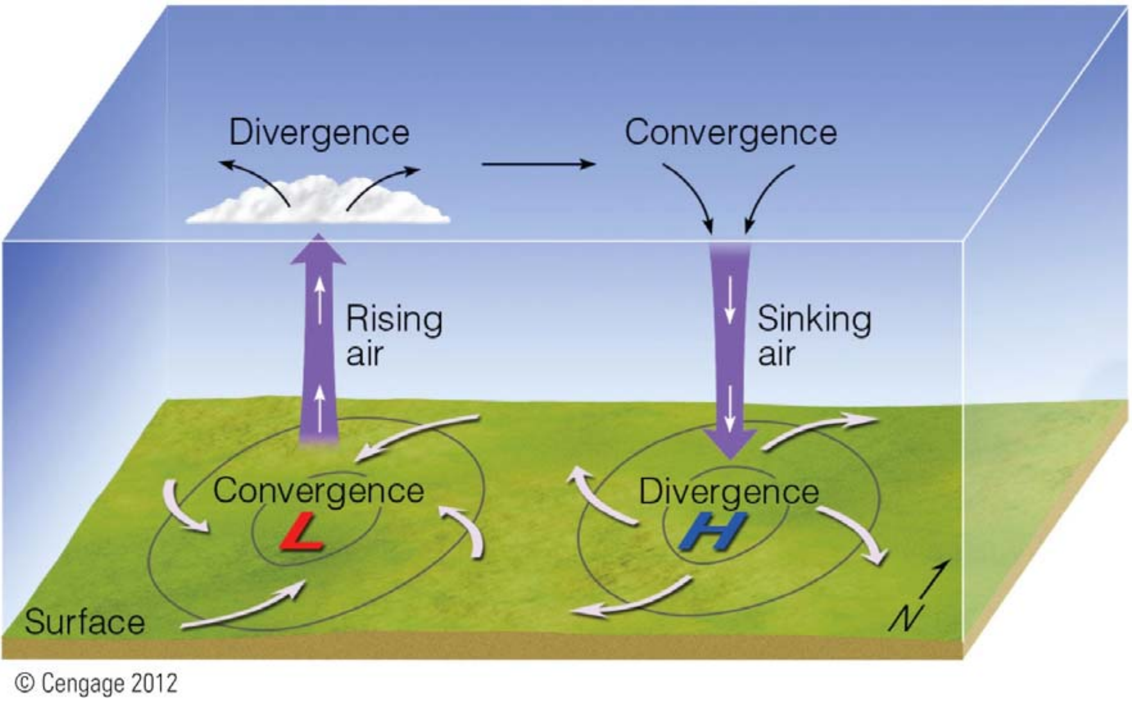
- Isobars bars are usually not straight lines – they curve and bend into meandering patterns
- Path of gradient wind is curved
- Occurs at higher altitudes where there is no friction present
- A gradient wind develops at altitudes above the atmospheric boundary layer around a dome of high air pressure (anticyclone) or around a center of low pressure (cyclone)





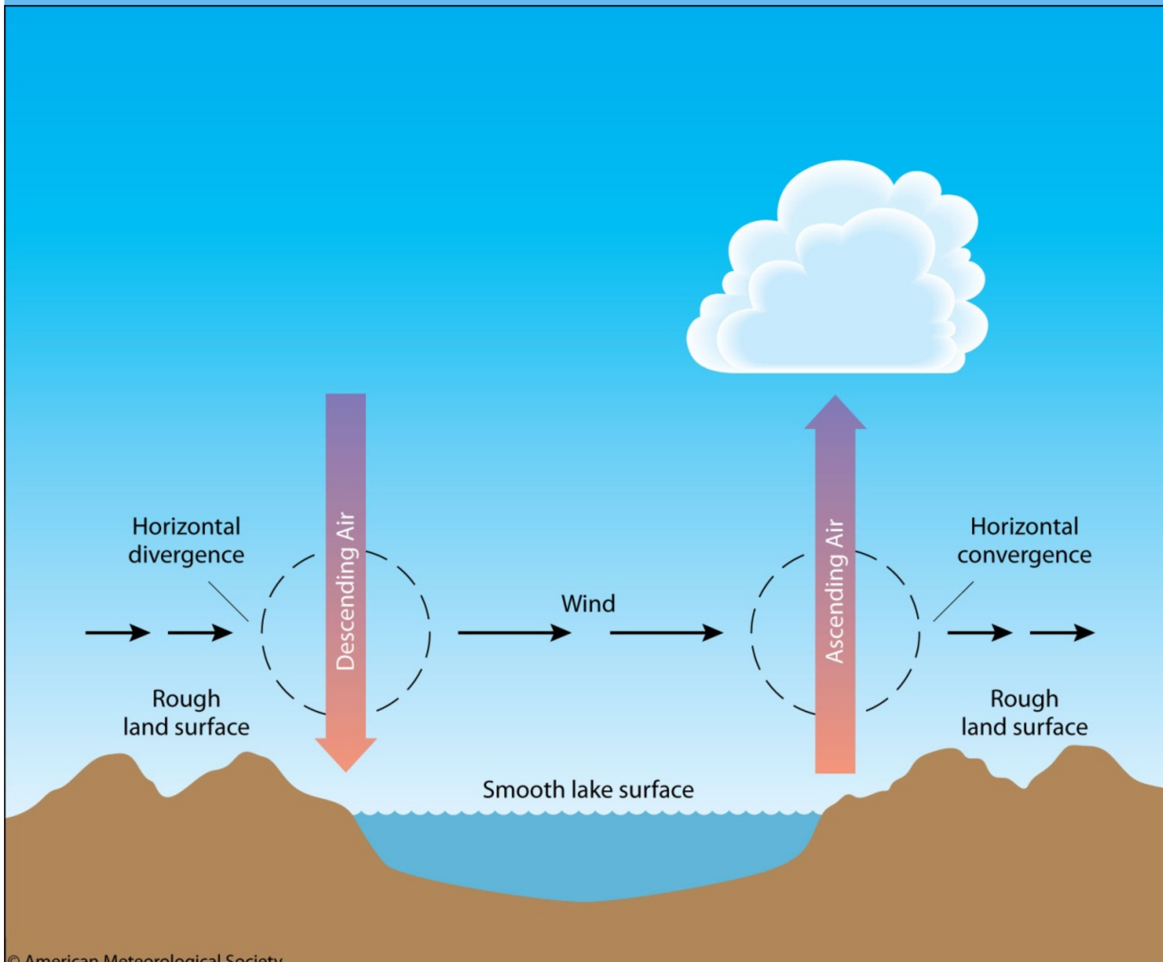
- Geostrophic and gradient winds are frictionless: i.e. they occur where frictional resistance is insignificant.
- How does friction (surface roughness) affect horizontal winds
- Intuitively we expect friction to slow down the speed but it also changes direction

Vertical Air Motion from Surface Highs and Lows



* Surface winds tend to diverge from a surface high.
* To replace this spreading air, air aloft rushes
* Surface winds tend to converge from a surface low
* Air rises from the low

Continuity of Wind



Frictionally Induced Convergence and Divergence

Surface winds accelerate and undergo horizontal divergence when blowing from a rough surface to a smooth surface.

Surface winds undergo horizontal convergence when blowing from a smooth to a rough surface.

Divergence of surface winds causes air to descend, whereas convergence of surface winds causes air to ascend.

Cumulus clouds develop along a coastline with on shore winds

Factor in Lake Effect Snows