Atmospheric Forces and winds
AOSC 200

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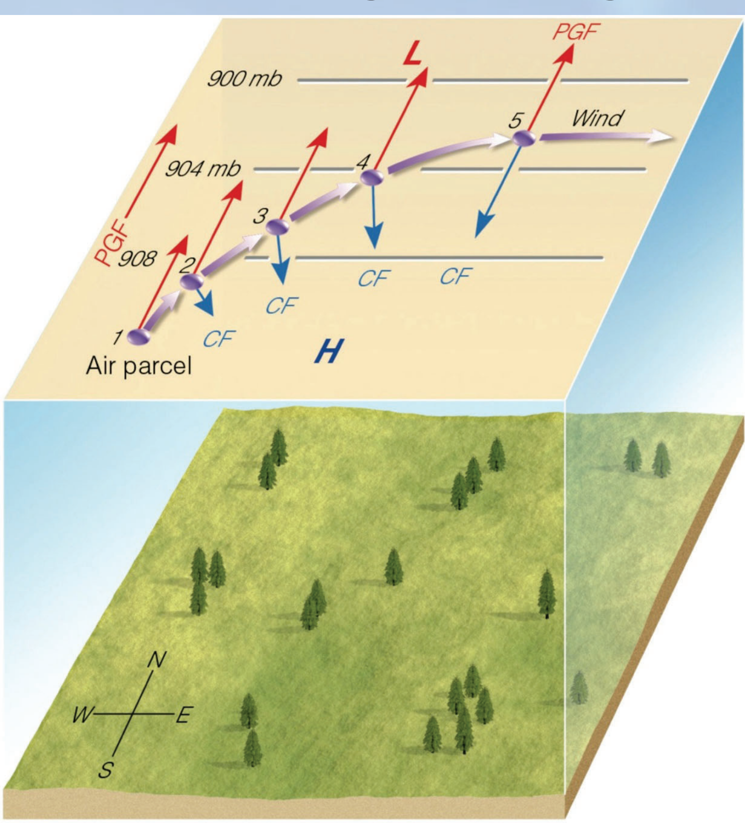
Class Web Site: http://www.atmos.umd.edu/~tcanty/aosc200

Topics for today:

Pressure
Forces
Types of winds

Lecture 17
Oct 24 2019

Combining pressure gradient and coriolis forces



Wind is forced from high pressure to low pressure (PGF)

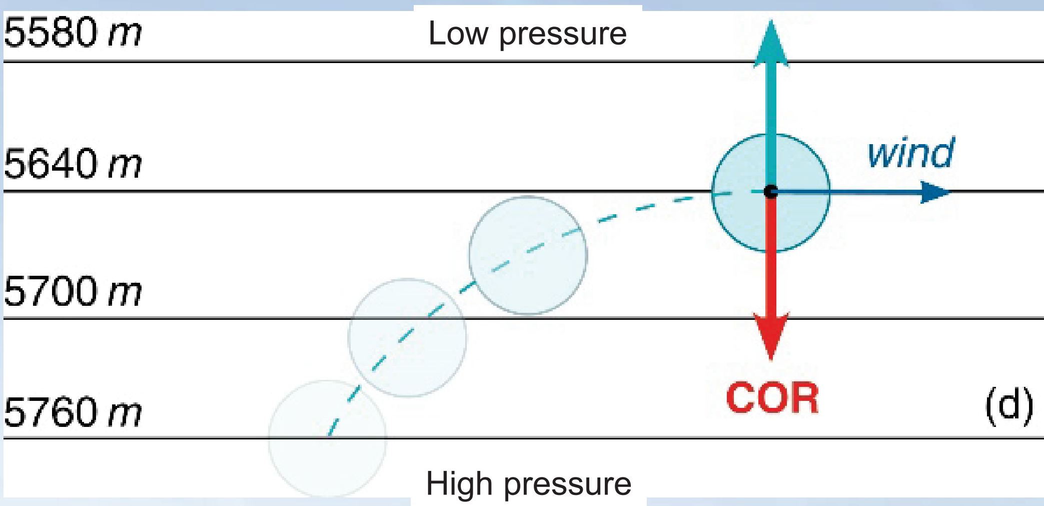
Wind is pulled to the right (CF)

When the isobars are straight and the two forces balance, it is called the

Geostrophic Wind

Fig 6.16: *Essentials of Meteorology*

Geostrophic Wind



- Wind blows parallel to isobars
- Wind speed is proportional to the pressure gradient force

What happens when the isobars are curved?

Fig 8.6 *Weather: A Concise Introduction*

Geostrophic Wind

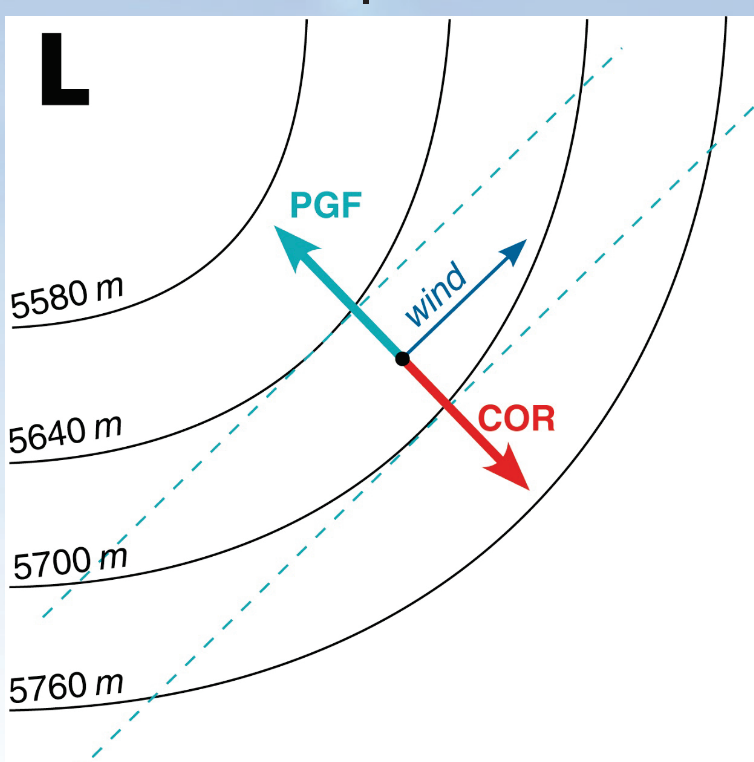
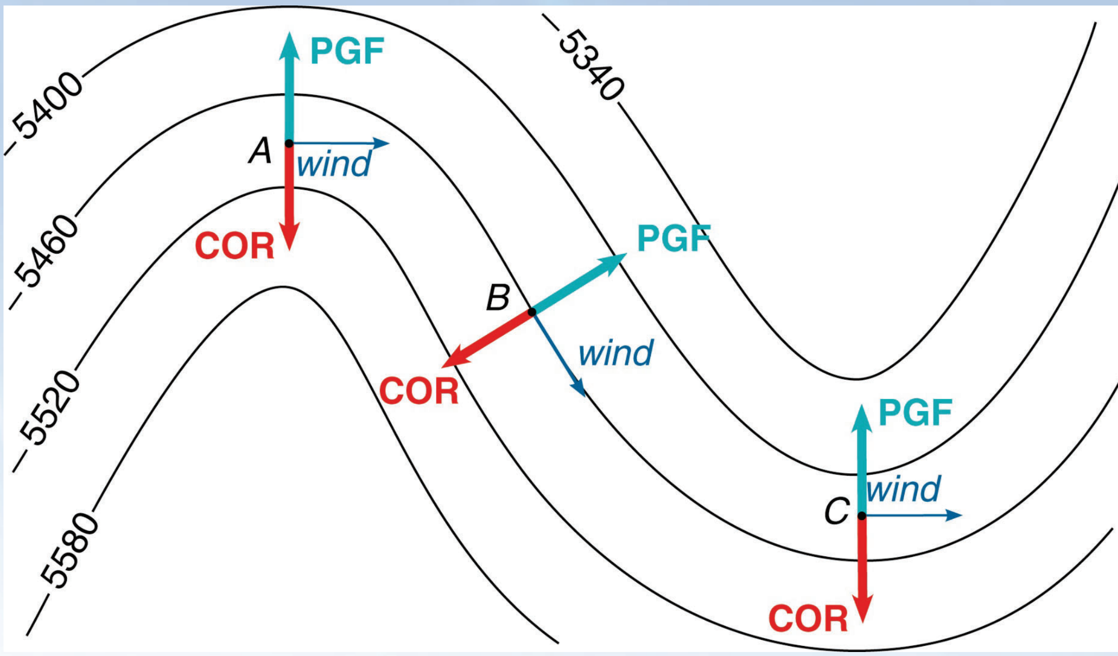


Fig 8.8 *Weather: A Concise Introduction*

Geostrophic Wind

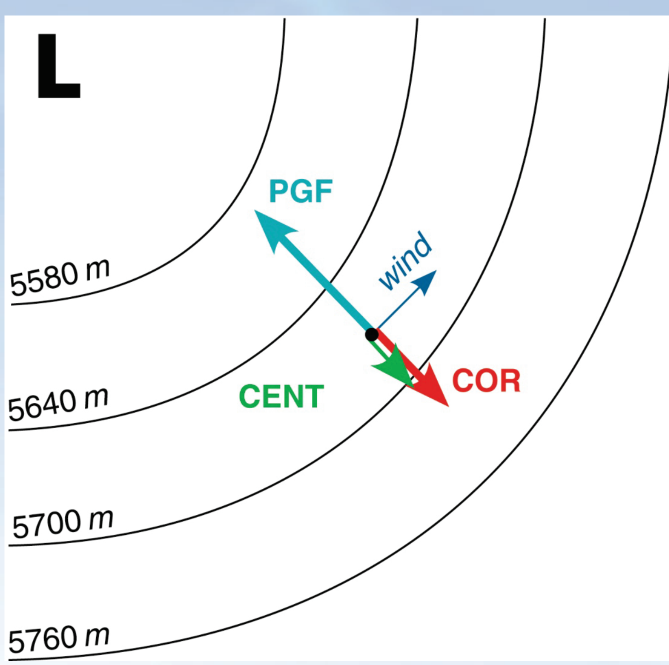


What happens when the isobars are curved?

We have to account for the centrifugal force

Fig 8.9 *Weather: A Concise Introduction*

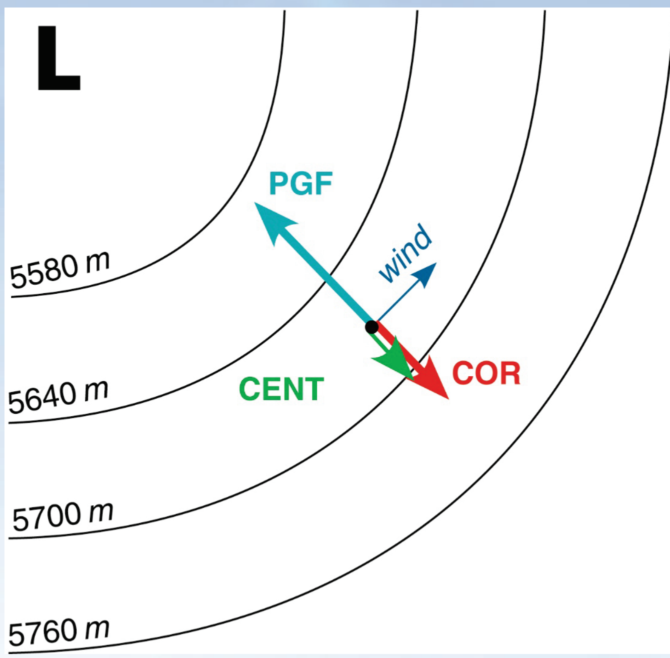
Gradient Wind



Centrifugal force points "outward". Like Coriolis, it's an apparent force and depends on wind speed

Fig 8.10 *Weather: A Concise Introduction*

Gradient Wind

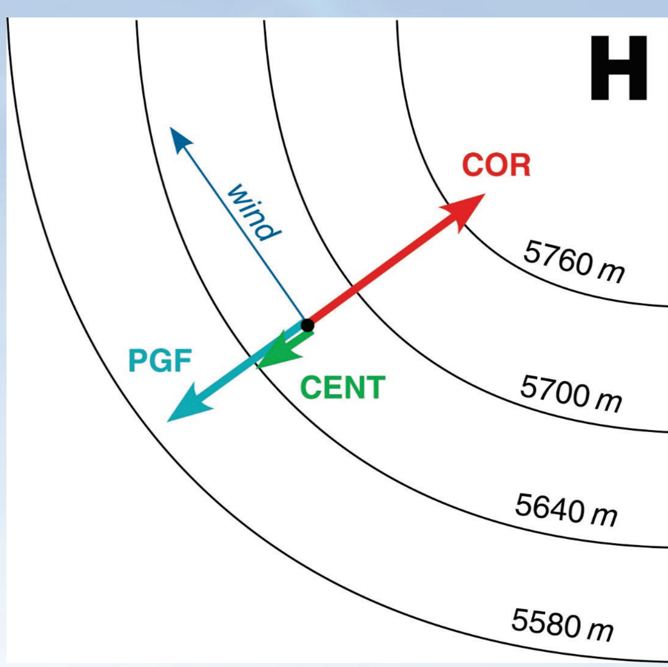


Off the surface, around a low pressure system,

PGF = Coriolis + Centrifugal

Fig 8.10 *Weather: A Concise Introduction*

Gradient Wind

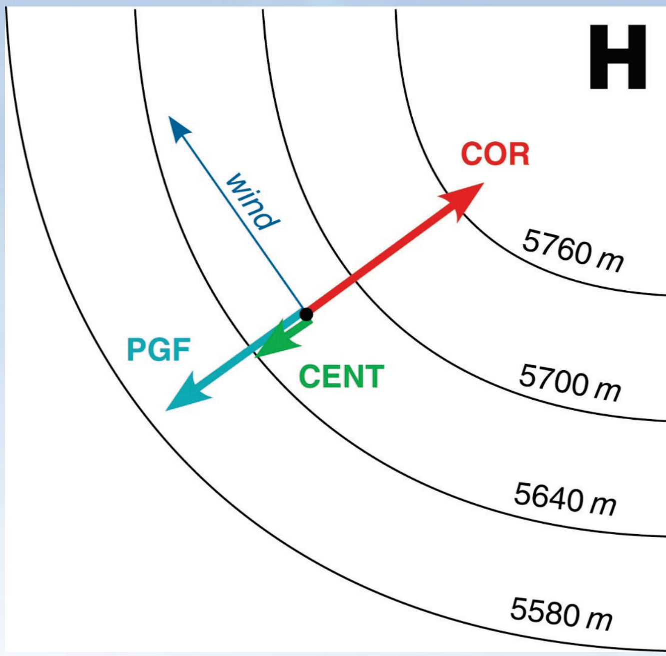


Off the surface, around a high pressure system,

PGF + Centrifugal = Coriolis

Fig 8.11 *Weather: A Concise Introduction*

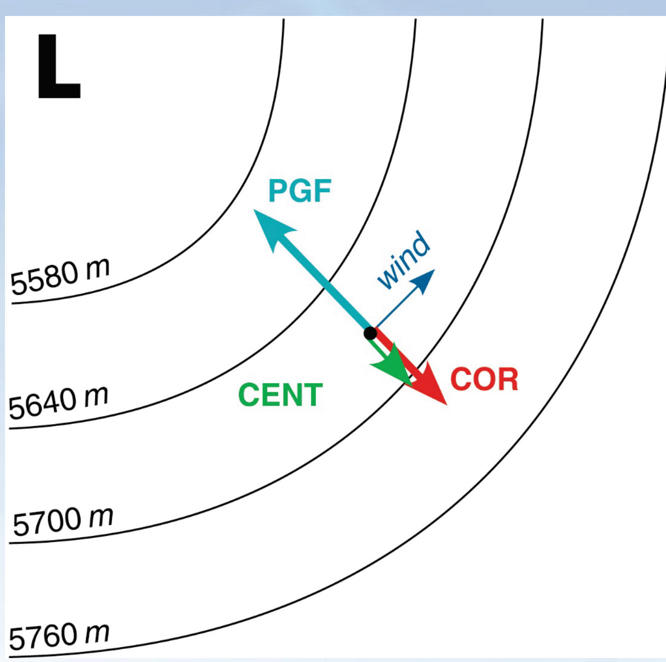
Gradient Wind



Notice how the wind speed changes…
Coriolis and Centrifugal forces and wind speed are related.

Fig 8.11 *Weather: A Concise Introduction*

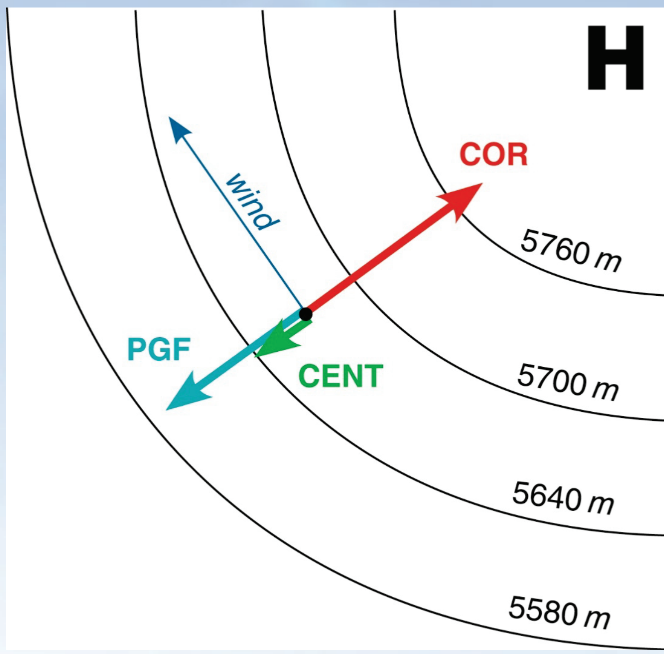
Gradient Wind



Notice how the wind speed changes…
Coriolis and Centrifugal forces and wind speed are related.
Around a low, neither of these forces needs to be huge to offset PGF.
So…. the wind speed is slower… subgeostrophic

Fig 8.11 *Weather: A Concise Introduction*

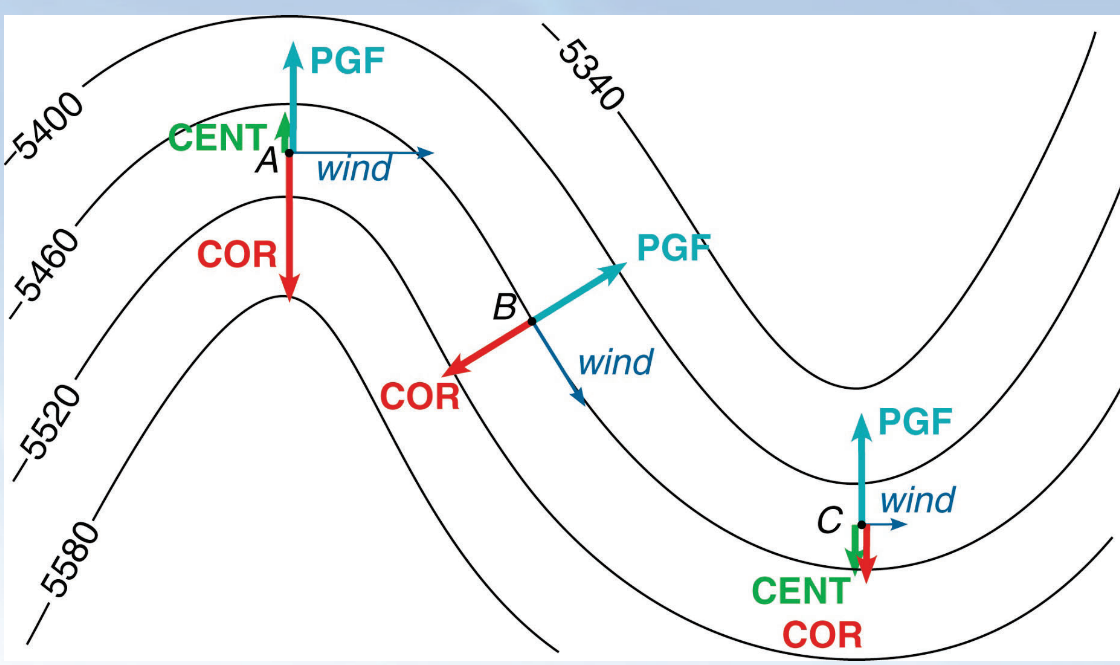
Gradient Wind



Notice how the wind speed changes…
Coriolis and Centrifugal forces and wind speed are related.
Around a high, Coriolis needs to be big to offset PGF and Centrifugal.
So…. the wind speed is faster… supergeostrophic

Fig 8.11 *Weather: A Concise Introduction*

Gradient Wind



In general: wind is supergeostrophic around a ridge and subgeostrophic around a trough

Fig 8.12 *Weather: A Concise Introduction*

Winds aloft

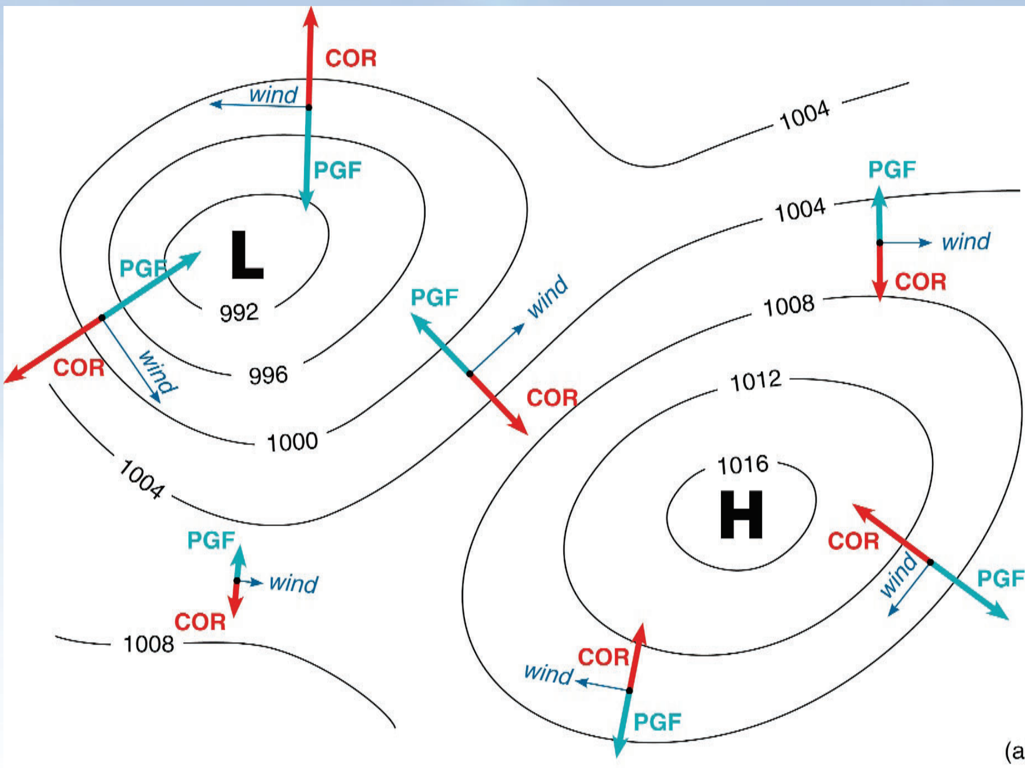
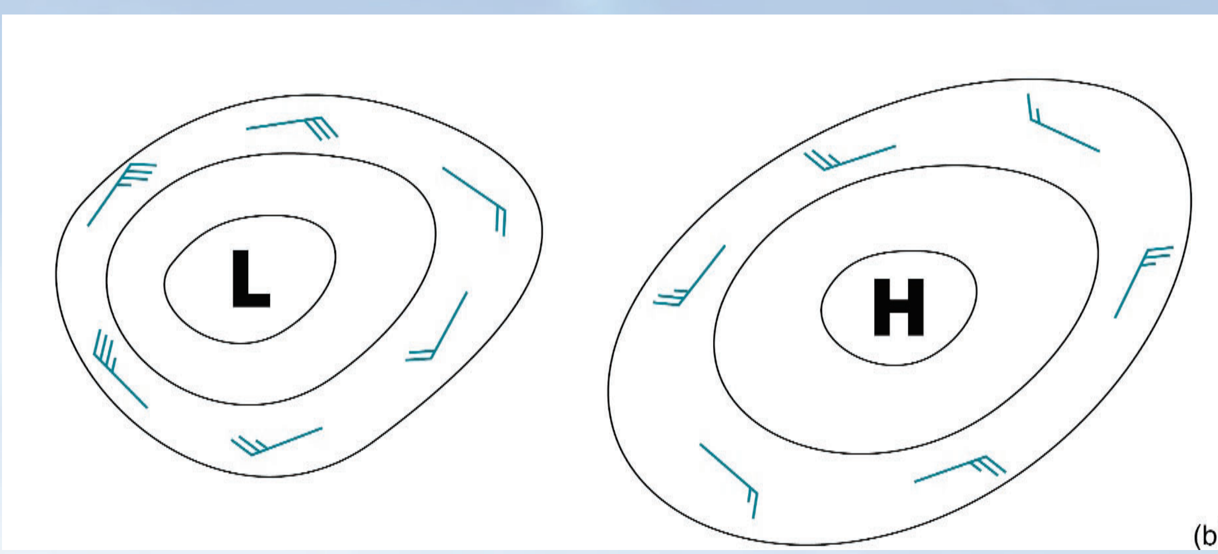


Fig 8.13 *Weather: A Concise Introduction*

Winds aloft

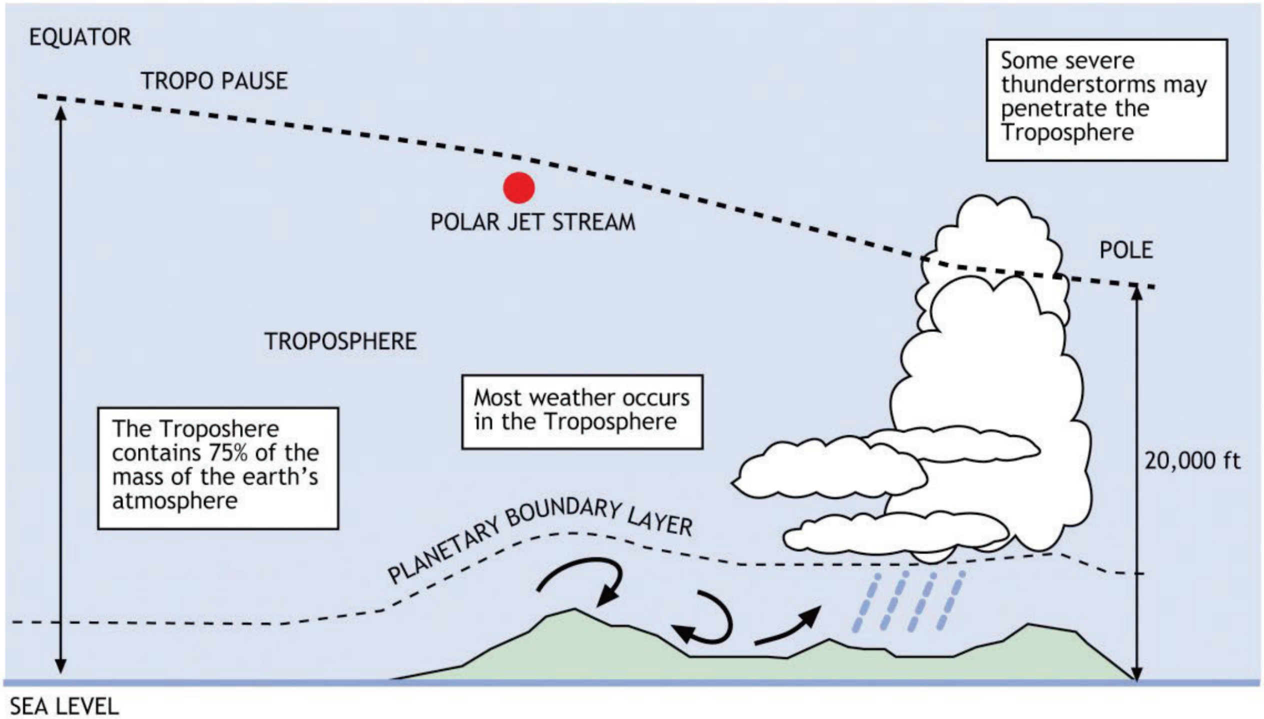


In the *Northern Hemisphere*, winds blow:

- *Clockwise* around a *high*
- *Counterclockwise* around a *low*

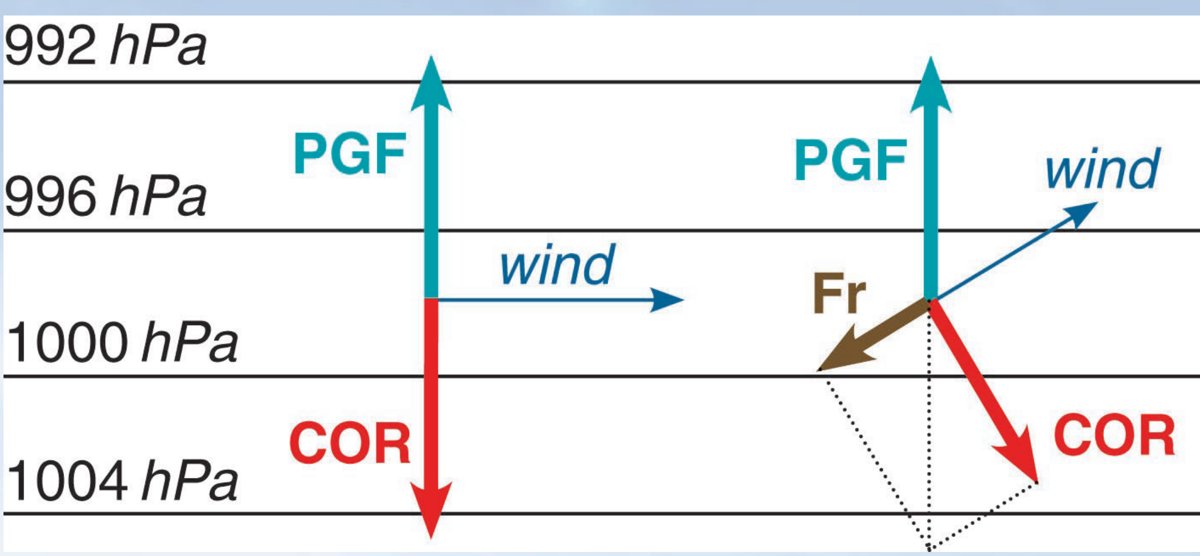
Fig 8.13 *Weather: A Concise Introduction*

Planetary Boundary Layer



The Planetary Boundary layer is the lowest part of the atmosphere that is influenced by the surface (i.e. friction).

Surface Winds



At the surface, you have to account for friction

If the wind is slower, Coriolis and Centrifugal forces will be weaker

Fig 8.14 *Weather: A Concise Introduction*

Surface winds

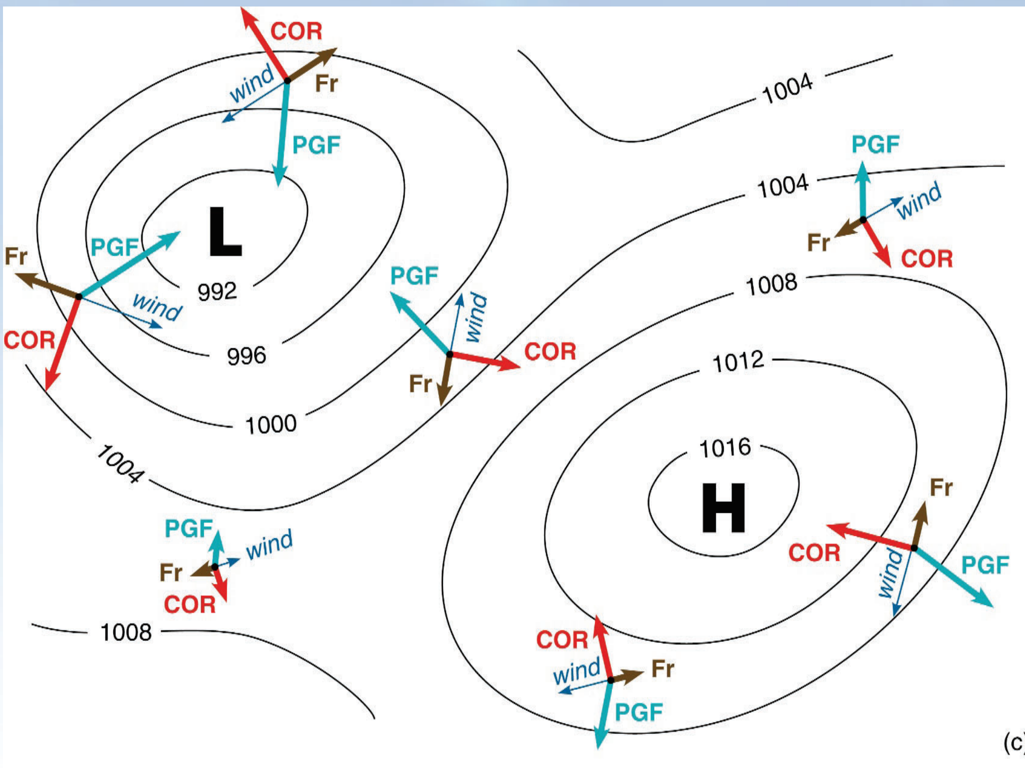
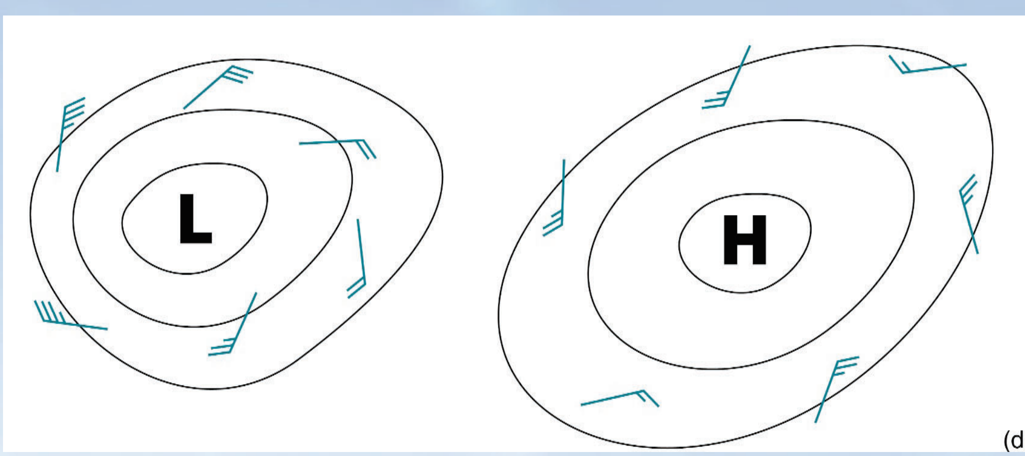


Fig 8.13 *Weather: A Concise Introduction*

Surface winds

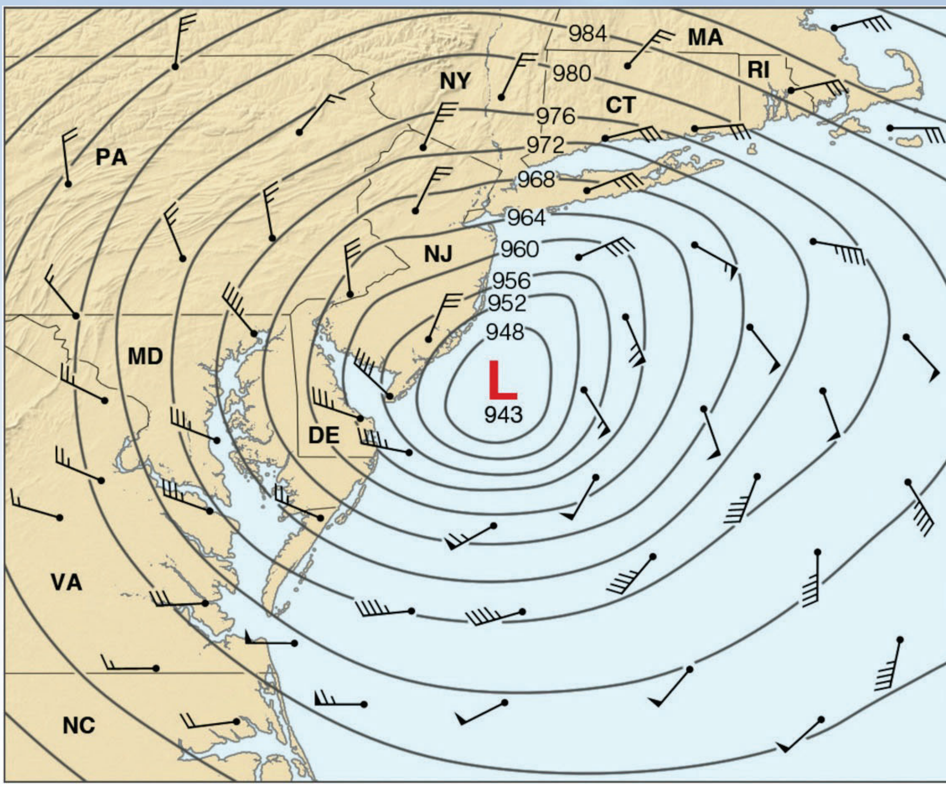


In the *Northern Hemisphere*, winds blow:

- *Clockwise* outward from a *high*
- *Counterclockwise* inward to a *low*

Fig 8.13 *Weather: A Concise Introduction*

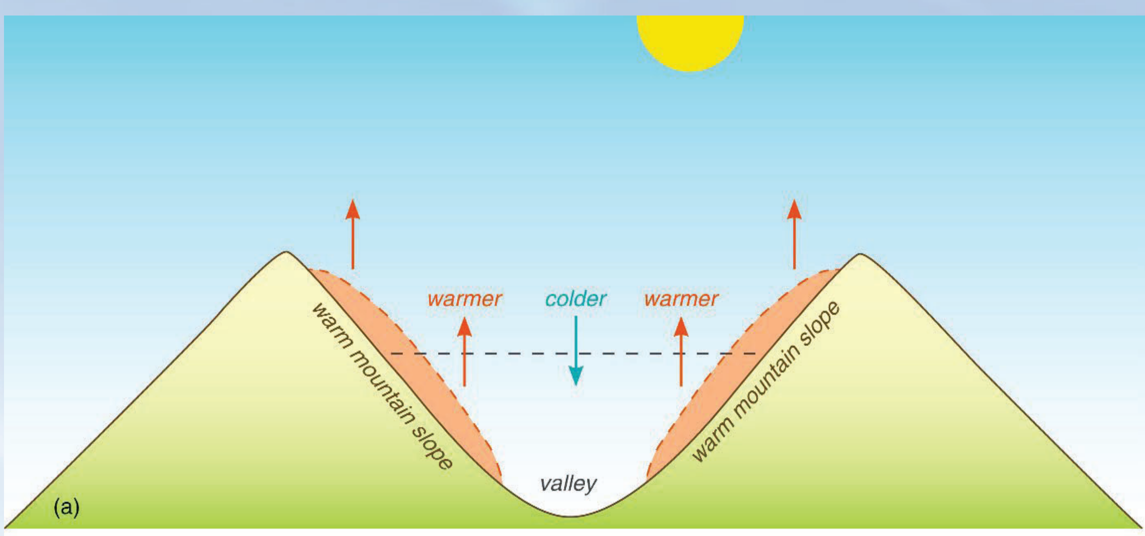
Superstorm Sandy



	Miles 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

Fig 6.13: *Essentials of Meteorology*

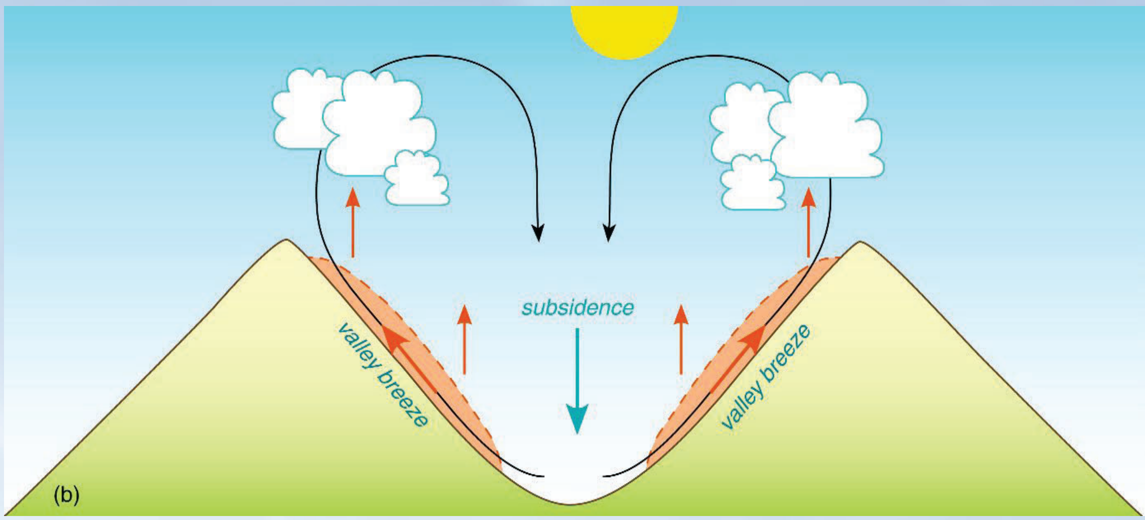
Valley Breeze



Thinner mountain air warms quickly and rises creating low pressure
Air from the valley rushes up and into the low pressure area

Fig 8.18 *Weather: A Concise Introduction*

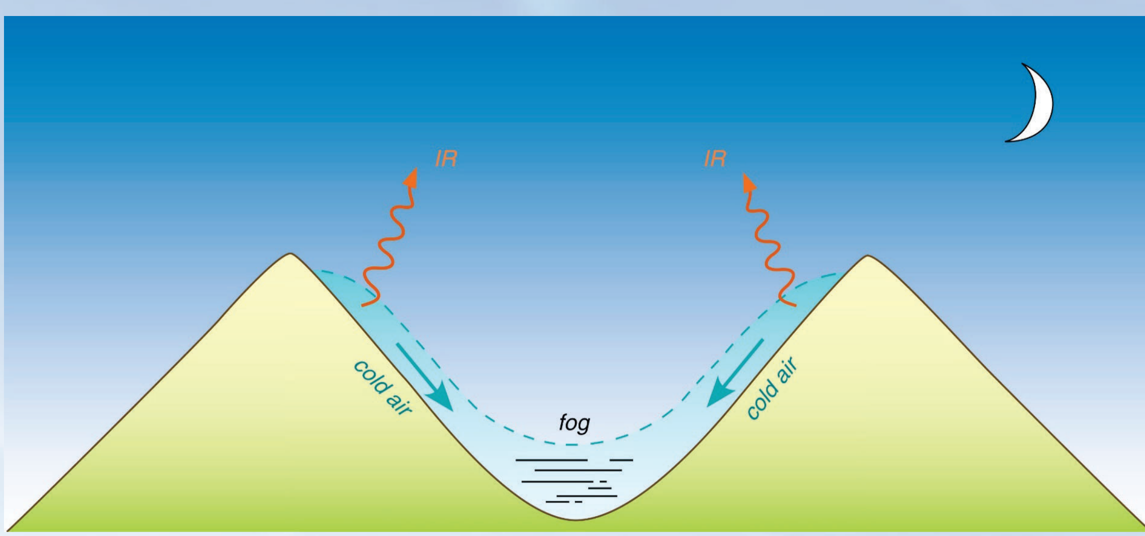
Valley Breeze



Thinner mountain air warms quickly and rises creating low pressure
Air from the valley rushes up and into the low pressure area

Fig 8.18 *Weather: A Concise Introduction*

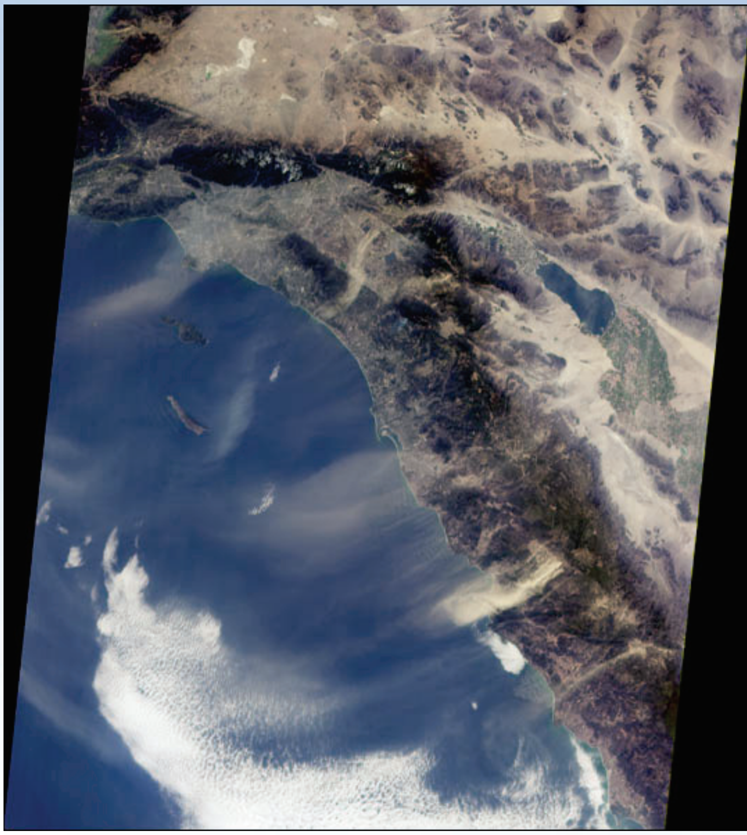
Mountain Breeze



Thinner mountain air cools, gets denser and sinks,
forms local high pressure.
Cold air, slides down the slopes into the valley

Fig 8.19 *Weather: A Concise Introduction*

Santa Ana Winds



Multi-angle Imaging Spectro Radiometer (MISR) shows the pattern of airborne dust stirred up by Santa Ana winds on February 9, 2002.

http://meteora.ucsd.edu/cap/santa_ana.html