

Atmospheric Processes

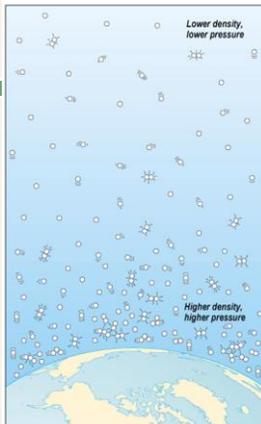
- Atmospheric pressure is the force exerted by gas molecules on some area of the Earth's surface, including physical bodies. At sea level, it is 14.7 pounds/sq. inch.
- We don't feel it because we are at equilibrium with nature – the pressure inside of us, is the same as that outside. We only notice it when we leave sea level.

Atmospheric Processes

Pressure, Density, and Temperature:

- While pressure is directly related to density (proportional), it is inversely related to temperature.
- So, the higher the density, the higher the pressure, and vice-versa. So solids are more dense than gases (gases spread).
- The lower the temperature of air or water (colder), the higher the pressure; and the higher the temperature (hotter), the lower the pressure. This is because things expand as they get warmer and vice-versa. Sea floors have the highest pressures (**why?**).

Pressure and Density

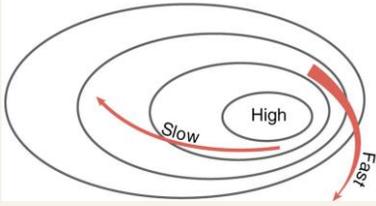


Wind Speed

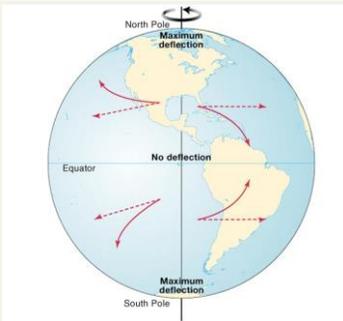
Same concept as an isoline: lines close together means "steep" pressure or **fast**, far apart lines means "gentle" pressure or **slow**.

"Pressure gradient" is the **spacing** of the isobars.

*Note the direction of **flow**.



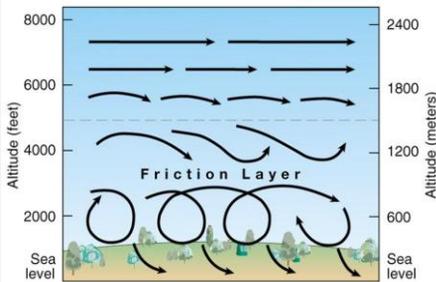
Coriolis Effect



Friction

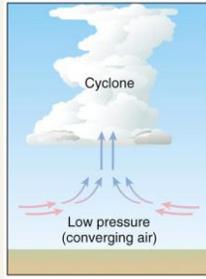
Friction is caused by trees, buildings, mountains, hills, etc – anything in the way.

It slows air down & changes its direction, causing more turbulence



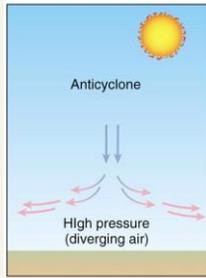
Cyclones

- Cyclones are low pressure centers (air flows into them) e.g. hurricanes, tornadoes. Also assoc. with clouds (air condenses as it rises)



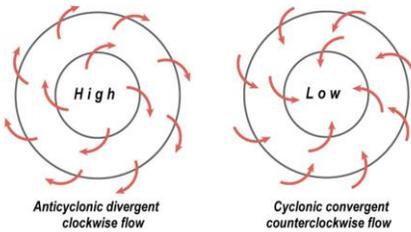
Anticyclones

- Anticyclones are the opposite; air flows out and are associated with clear weather.

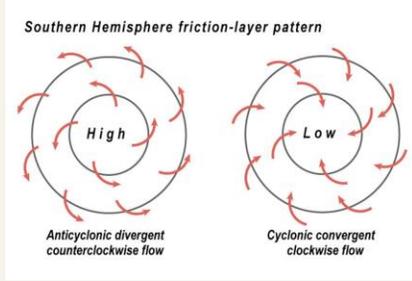


Circulation Patterns

Northern Hemisphere friction-layer pattern



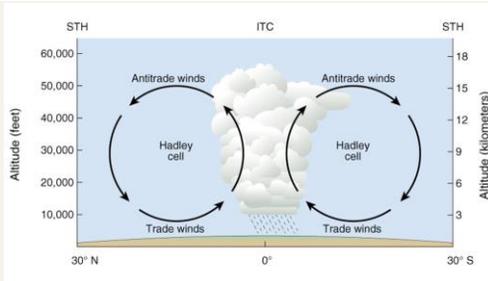
Circulation Patterns



General Circulation of the Atmosphere

- **Hadley Cells** – giant convection systems close to the equator. As the warm air rises to about 50,000 ft, it cools and part of the air moves towards the poles, where it descends at about 30 degrees N and S to become the sub-tropical high pressure winds (STHs). The other part moves back to the equator to repeat the process. See next slide.

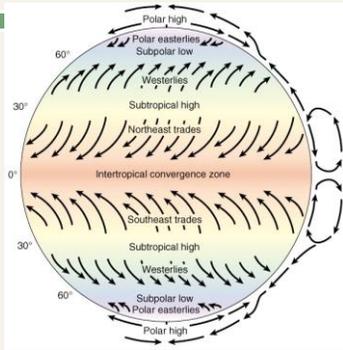
Hadley Cells



Components of General Surface Circulation

- ❑ Subtropical Highs
- ❑ Trade Winds
- ❑ Intertropical Convergence Zone
- ❑ The Westerlies
- ❑ Polar Highs
- ❑ Polar Easterlies
- ❑ Subpolar Lows/Polar Front

General Surface Circulation



Subtropical Highs (STHs)

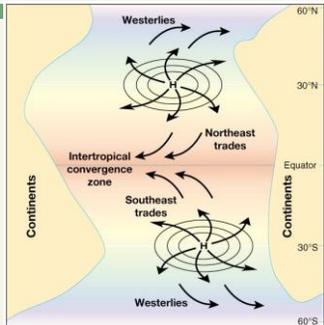
Formed by the high pressure created from descending air of Hadley Cells.

They are giant anticyclones (characteristic?)

They are persistent, and are found about 30 degrees N & S.

Also called the "horse latitudes" (16th & 17th cent.)

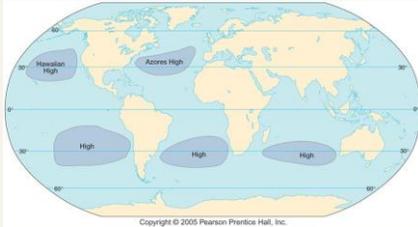
STHs are the source of Trade Winds & Westerlies.



Subtropical Highs

Responsible for the world's greatest deserts.

Dry conditions caused by no uplift of air due to high pressure.



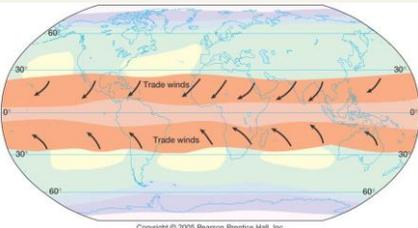
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Trade Winds

Major wind systems of the tropics, btw latitudes 25 degrees N & S.

Dominates the earth more than any other wind system.

They are **Easterly** (blow from East). That's how winds are named

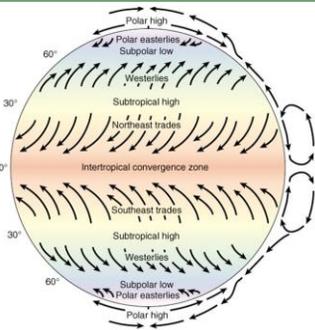


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General Surface Circulation

Trade winds are the most reliable of ALL winds – their direction & speed is extremely consistent (whether it be summer, winter, day or night). There is one exception (discussed later).

Hence "trade winds", mean "winds of commerce". 16th century sailors found that it was the fastest & most reliable route from Europe to America.

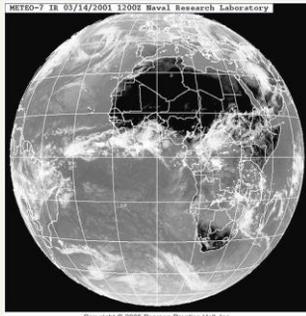


Intertropical Convergence Zone (ITCZ)

This is where the Trade Winds converge.

Known for low pressure & a lot of storms.

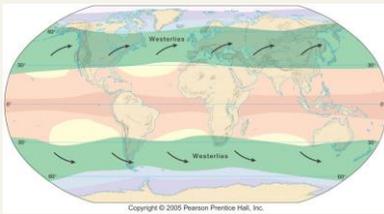
Also called the "doldrums" (calm air) – even though it's a zone of convergence, horizontal air flow is weak.



The Westerlies

Why are they called "Westerlies"?

Found btw 30 to 60 degrees N & S, and originate from the STHs.



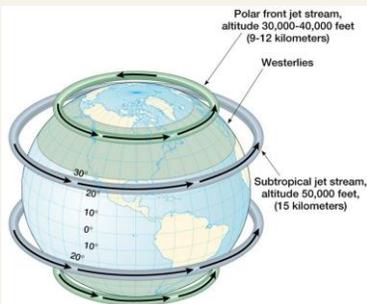
Jet Streams

Jet streams form the BOUNDARIES of the Westerlies.

There are 2 types: polar and subtropical.

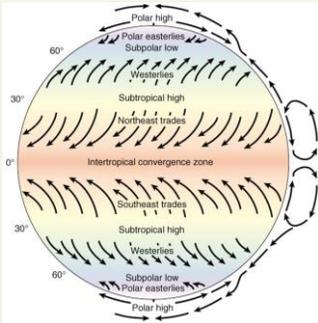
They are **high speed winds**, and **60 knots** is the **minimum** to qualify.

Whenever the paths of jet streams change or meander, they're called "Rossby Waves".



General Surface Circulation

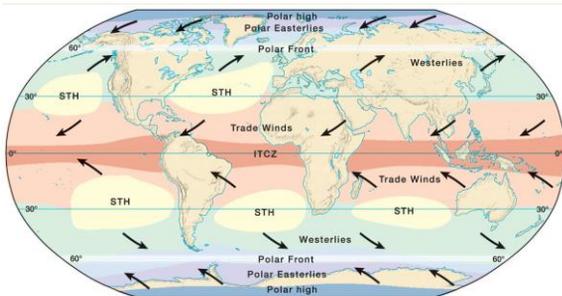
- Polar Highs
- Polar Easterlies
- Subpolar Lows/Polar Front



General Surface Circulation

- Polar Highs – located over both the N & S poles. Air movement is mainly anticyclonic (divergent, high pressure cold air), hence, “polar highs”. The weather is usually “nice” or rather, “clear”, and this leads to them becoming “polar deserts”. The Antarctic high is more persistent than the Arctic high (that’s why it’s colder in the Antarctic).
- Polar Easterlies – located btw the polar highs & latitude 60 degrees N & S. They move from the east, and are very dry.
- Sub-Polar Lows/ Polar Front – btw 50 and 60 degrees N & S, and it’s a low pressure. Usually contains a polar front (where the cold polar easterlies and the warmer westerlies meet). This results in storms & gale-force winds.

General Surface Circulation

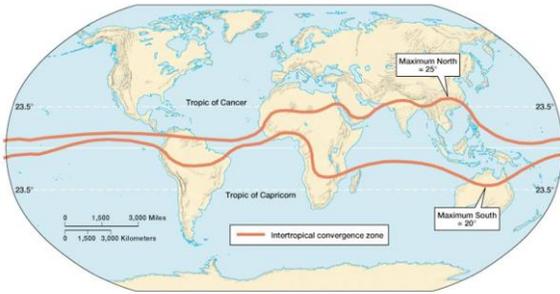


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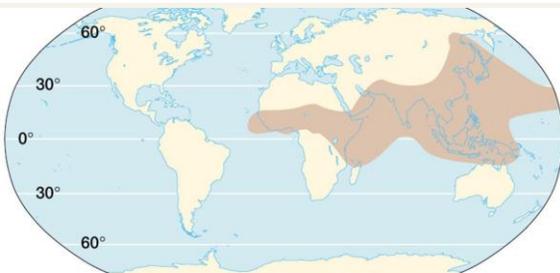
Modifications of General Circulation

- Seasonal Variations in Latitude
- Monsoons

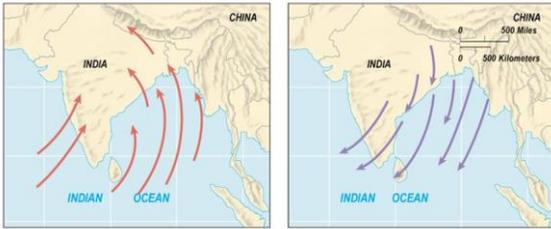
Seasonal Variations in Latitude



Monsoons



South Asian Monsoon



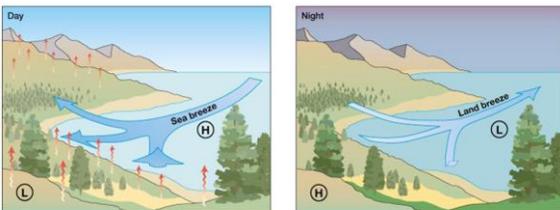
(a) Summer

Winter

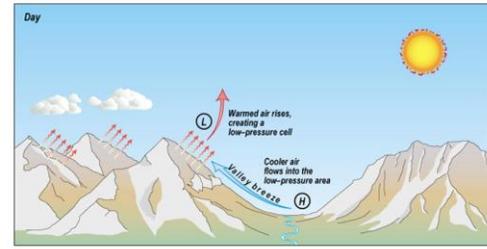
Localized Wind Systems

- Sea and Land Breezes
- Valley and Mountain Breezes
- Katabatic Winds
- Foehn/Chinook Winds

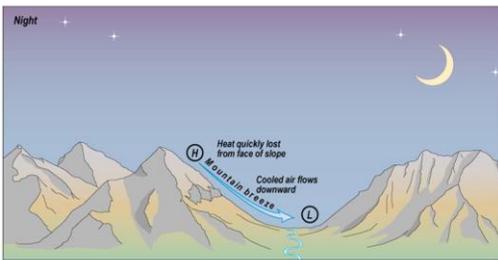
Sea and Land Breezes



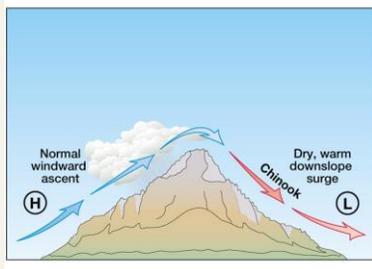
Valley Breezes



Mountain Breezes

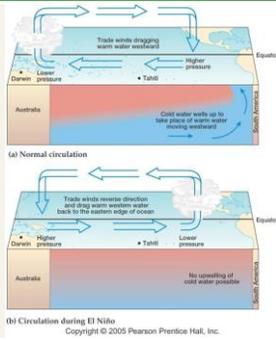


Chinook Winds



El Niño and La Niña

- El Niño Conditions in Pacific Ocean
- Related Weather Events (next slide)
- La Niña



El Niño and Weather Events

