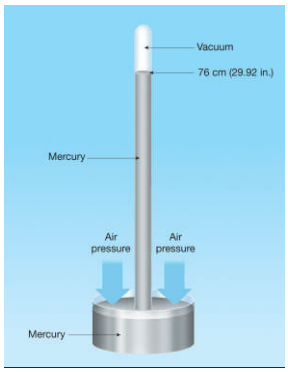
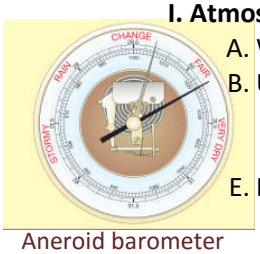
Chapter Outlines

NOTE: This is intended to help students 'organize' their understanding of each topic.
It is <u>not</u> a comprehensive study guide for quizzes or midterms, i.e. <u>study your text!</u>



Mercury barometer

Air Pressure & Wind



Aneroid barometer

I. Atmospheric pressure - Force exerted by the weight of the air above

A. Weight of the air at sea level is 14.7 psi (1 kg/cm^2), and decreases with altitude

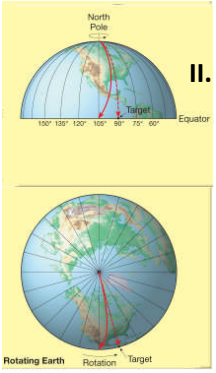
B. Units of measurement include:

1. Millibar (mb)—standard sea level pressure is 1013.2 millibars
2. Inches of mercury—standard sea level pressure is 29.92 inches of mercury

E. **Barometer** is used for measuring changes in air pressure

1. Mercury barometer – invented by Torricelli in 1643, uses a glass tube filled with mercury
2. **Aneroid barometer** *('without liquid')* – uses an expanding chamber
   …barograph is the recorded record

Weather map with isobars & wind symbols



Coriolis effect

II. Wind – the horizontal movement of air - out of areas of higher pressure, into areas of lower pressure

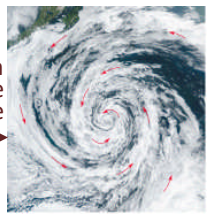
A. Controls of wind

1. **Pressure gradient** force *(the change of air pressure over distance)*
   …isobars - lines of equal air pressure *(shown on weather maps)*
2. **Coriolis Effect** – the apparent deflection in wind direction due to Earth's rotation
   …deflection is to the right in the Northern Hemisphere, and to left in the Southern Hemisphere
3. Friction – important only near surface, it slows the air and turns it more toward the low pressure

C. Upper-air winds

1. Generally blow parallel to isobars—called geostrophic winds
2. **Jet stream -** is a high altitude 'river' of air, with a high velocity of 120–240 km per hour

Northern Hemisphere cyclone



III. Cyclones and anticyclones

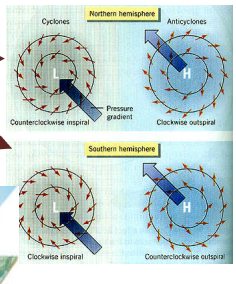
A. **Cyclone** – a 'swirling' center of low pressure with pressure decreasing toward the center

1. Associated winds
   a. Northern Hemisphere - Inward *(convergence)* in a counterclockwise direction
   b. Southern Hemisphere - Inward *(convergence)* in a clockwise direction
2. Associated with rising air near the center, and often brings clouds and precipitation

B. **Anticyclone** – a 'swirling' center of high pressure with pressure increasing toward the center

1. Associated winds
   a. In the Northern Hemisphere - Outward *(divergence)* in a clockwise direction
   b. In the Southern Hemisphere - Outward *(divergence)* in a counterclockwise direction
2. Associated with subsiding air, and usually brings 'fair' weather

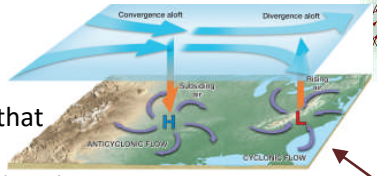
Cyclonic wind flow in N & S hemispheres



IV. General atmospheric circulation

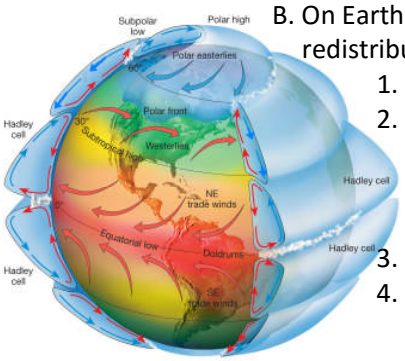
A. Underlying cause is unequal heating of Earth's surface

B. On Earth there are three 'idealized' atmospheric cells that redistribute the heat, resulting in four 'zones':



Surface & upper air cyclonic air flow

1. Equatorial low pressure zone - rising air and abundant precipitation
2. Subtropical high pressure zone
   a. Subsiding, stable, dry air; near 30° latitude; location of great deserts
   b. Air traveling equatorward from the subtropical high produces the trade winds
   c. Air traveling poleward from the subtropical high produces the westerly winds
3. Subpolar low pressure zone - warm & cool winds interact creating the 'polar front'
4. Polar high pressure zone
   a. Cold, subsiding air; air spreads equatorward and produces polar easterly winds
   b. Polar easterlies collide with the westerlies along the polar front

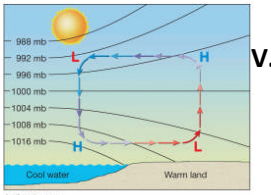


Generalized atmospheric circulation

C. Influence of continents – most obvious in northern hemisphere *(where most land is)*

1. Seasonal temperature differences disrupt global pressure & wind patterns

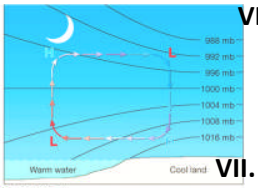
On-shore wind during day…
Off-shore wind during night



A. Sea breeze

2. **Monsoon** *(seasonal change of prevailing wind)*
   a. Warm months bring moist air from the ocean over the land producing rains
   b. Cool months sees dry continental air flow off the land

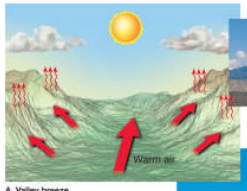
V. Circulation in the middle latitudes – the complex zone of the 'westerlies'
A. Global air flow is interrupted by cyclones
1. Low or high pressure cells move west to east in the Northern Hemisphere creating anticyclonic and cyclonic flows
2. Paths of these cyclones and anticyclones are associated with the upper-level airflow



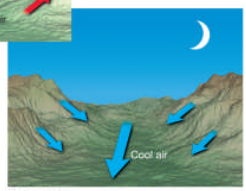
B. Land breeze

Upslope wind during day…
Downslope wind during night

VI. Local winds - relatively small scale winds that result from local temperature differences
Types: Land and sea breezes, Mountain and valley breezes, Chinook and Santa Ana winds

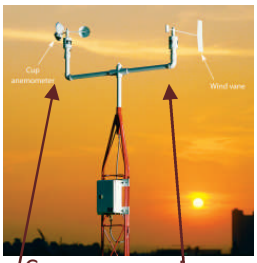


A. Valley breeze



B. Mountain breeze

VII. Wind measurement - two basic measurements are: direction; speed
A. **Direction** – determined by use of a **wind vane**
1. Winds are labeled according to where they originate (e.g., north wind blows from the north toward the south)
2. Direction indicated by either compass points *(N, NE, etc.),* or scale of 0° to 360°
3. '**Prevailing wind**' - a wind that comes more often from one direction

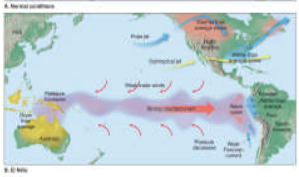


Cup anemometer & wind vane

B. **Speed** is often measured with a **cup anemometer**
C. Changes in wind direction are usually associated with changing locations of cyclones & anticyclones often bringing changes in temperature and moisture conditions

VIII. El Niño and La Niña – these have significant worldwide effect on weather
A. El Niño - a warm countercurrent that flows southward along the coasts of Ecuador and Peru

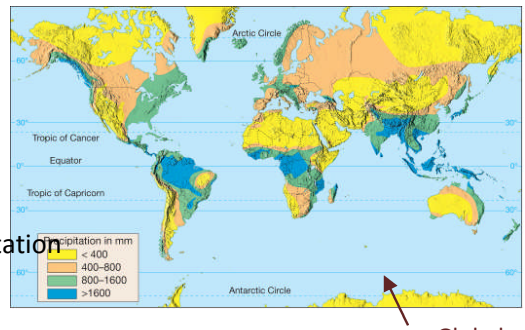

A. Normal conditions


B. El Niño

Normal conditions & El Nino condition

1. Effects of El Niño event include:
   a. Usually appears during the Christmas season
   b. Blocks upwelling of colder nutrient-filled water, and anchovies starve from lack of food
   c. Heavy rains in Ecuador and Peru; strong storms in California
2. Related to large-scale atmospheric circulation
   a. Pressure change between the eastern and western Pacific is called the *Southern Oscillation*
   b. Change in trade winds creates a major change in the equatorial current system, with warm water flowing eastward
3. Effects are highly variable depending in part on the T° and size of the warm-water pools

B. La Niña - opposite of El Niño, colder-than-average surface temperatures in the eastern Pacific
1. Typical La Niña winter:
   a. Blows colder-than-normal air over the Pacific Northwest and northern Great Plains while warming much of the rest of the United States
   b. Greater precipitation is expected in the Northwest



Global precipitation patterns

IX. Global distribution of precipitation – a relatively complex pattern
A. Related to global wind and pressure patterns
1. High-pressure regions: subsiding air, divergent winds, dry conditions;
   Example: Sahara and Kalahari deserts
2. Low-pressure regions: ascending air, converging winds, ample precipitation
   Example: Amazon and Congo basins

B. Related to distribution of land and water
1. Large landmasses in the middle latitudes often have less precipitation toward their centers *(far from the ocean)*
2. Mountain barriers - windward slopes receive abundant rainfall from orographic lifting; leeward slopes are usually deficient