

# The Atmosphere

*Characteristics, Water, Wind,  
Weather, and Climate*  
Chapter 20

Earth systems have internal and external sources of energy, both create heat

### External Energy

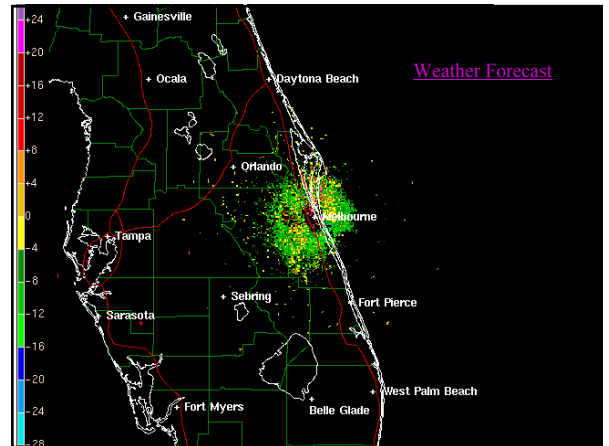
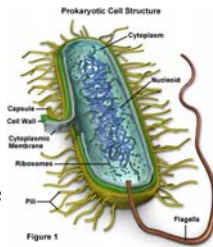
- sun is the major source



### Internal Energy

- Two primary sources
  - decay of radioactive isotopes
  - gravitational energy from the Earth's original formation

- Evidence for one-celled forms of life—the bacteria—extends back more than 3.5 billion years.
- The evolution of life caused dramatic changes in the composition of the Earth's atmosphere, which did not originally contain oxygen.

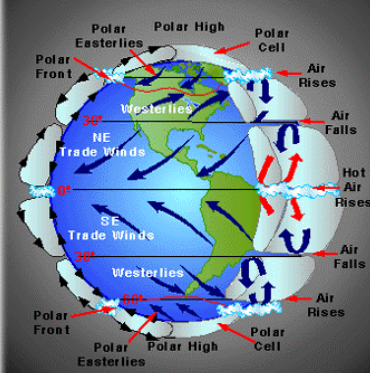


- Heating of Earth's surface and atmosphere by the sun drives convection within the atmosphere and oceans, producing winds and ocean currents



View of the Earth's Clouds

### Model Of Airflow On a Rotating Earth



## Climate Change

### Coastal Erosion:

- Many of America's major cities are located directly on the ocean.
  - could face major land loss if sea level rise predictions are correct
- **Problem in Florida**
  - flat coast means a one foot vertical rise in sea level could mean the loss of tens of feet of beach land.
  - Wetlands also vulnerable to sea level rise.

[http://www.climate.org/topics/climate/impacts\\_na.shtml](http://www.climate.org/topics/climate/impacts_na.shtml)

## Greenhouse Effect

- Keeps Earth warm
- Atmosphere traps energy from the sun in the troposphere
- Without the greenhouse effect Earth would have a much colder average temperature
- Too much greenhouse effect causes problems

## Global Warming

- Increased amounts of carbon dioxide may lead to global warming
- CFC's & burning fossil fuels

- Movement of matter between reservoirs is driven by the Earth's internal and external sources of energy.
- These movements are often accompanied by a change in the physical and chemical properties of the matter.

## Oxygen - CO<sub>2</sub> Cycle

- Plants produce oxygen as a byproduct through the process of photosynthesis
- Humans breathe in oxygen and release CO<sub>2</sub> and the process continues

## Where Carbon Occurs

- in carbonate rocks such as limestone
- in the atmosphere as carbon dioxide gas
- in water as dissolved carbon dioxide gas
- in water as dissolved carbon dioxide
- and in all organisms as complex molecules that control the chemistry of life

## Objectives

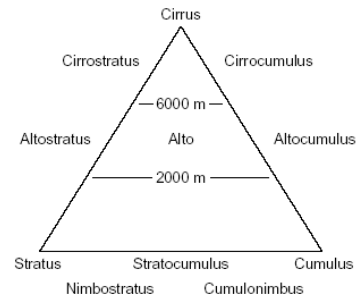
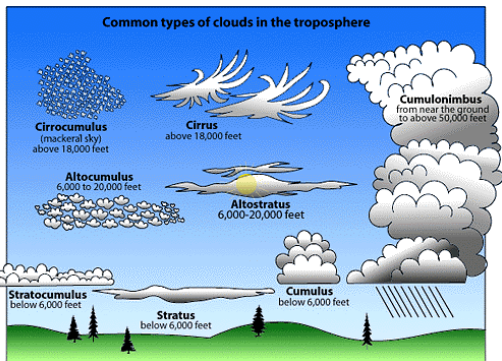
1. **Describe** the three phases of the water cycle.
2. **Explain** how temperature and humidity are related.
3. **Identify** various cloud types by their appearance and the altitudes at which they typically occur.
4. **Use** the concept of pressure gradients to explain how winds are created, and explain how Earth's rotation affects their direction.

## Water Cycle

- Water is constantly being moved through the troposphere in a process called the water cycle.



## Clouds

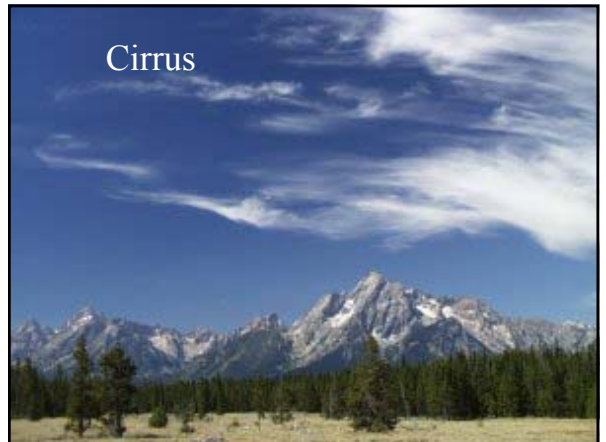


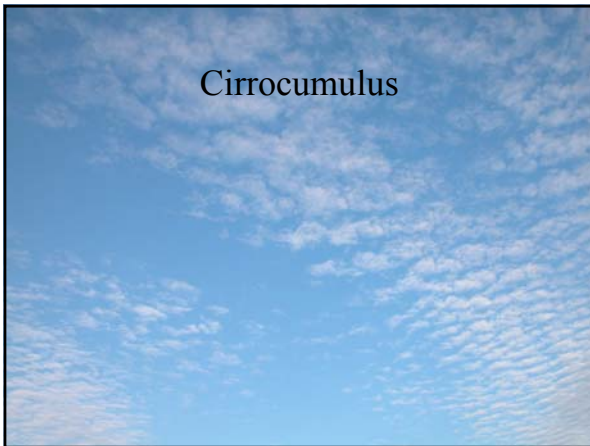
<http://www.met.fsu.edu/explores/Globe/Protocols/clouds.pdf>

## Cloud Types High Altitude

- **Cirrus**
  - wispy, feathery clouds that form high up in the atmosphere.
- **Cirrostratus**
  - high clouds, light gray or white, often thin with the sun or moon seen through them. Usually covers much of the sky.
- **Cirrocumulus**
  - high clouds with puffy, patchy appearance, with small spaces between clouds. Often form wave-like patterns.

## Cirrus





### Middle Altitude

- **Alto cumulus**
  - middle clouds with puffy, patchy appearance, usually with spaces between them.
- **Altostratus**
  - light gray and inform in appearance, generally covering most of the sky.



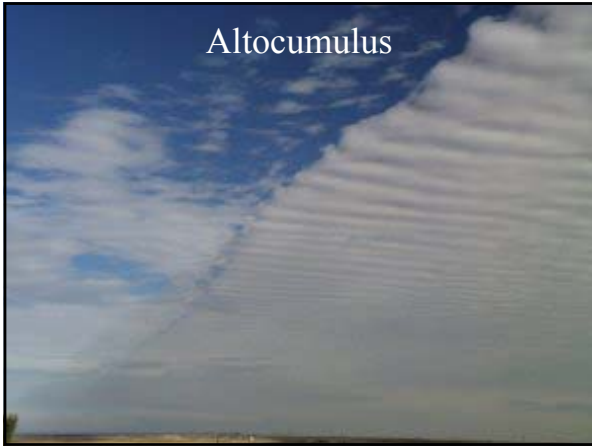
- “The bases of mid-level clouds typically appear between 6,500 to 20,000 feet (2,000 to 6,000 meters). Because of their lower altitudes, they are composed primarily of water droplets, however, they can also be composed of ice crystals when temperatures are cold enough.” [Department of Atmospheric Sciences \(DAS\)](#) at the University of Illinois at Urbana-Champaign.

-- Photograph by Ronald L. Holle --  
-- U. of Illinois Cloud Catalog --

### Low Altitude

- **Cumulus**
  - look like fluffy piles of cotton
- **Stratus**
  - form in flat layers, light or dark gray and generally uniform in appearance and cover most of the sky.
  - Fog is a stratus cloud.
- **Stratocumulus**
  - irregular masses of clouds, rolling or puffy in appearance, sometimes with space between the clouds.

Altostratus



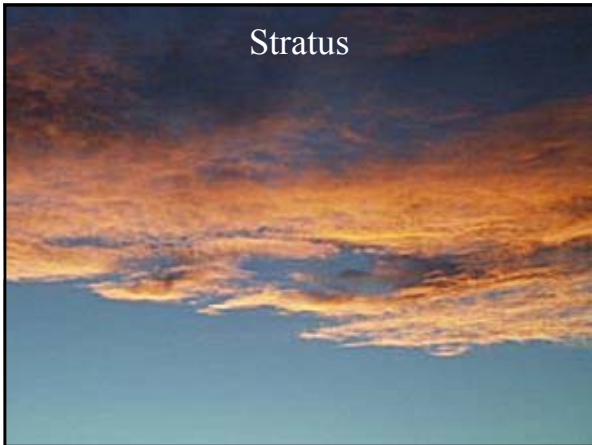
- **Nimbostratus**

- Low and middle dark gray clouds with precipitation falling from them. Bases are diffuse and difficult to determine because of falling precipitation.

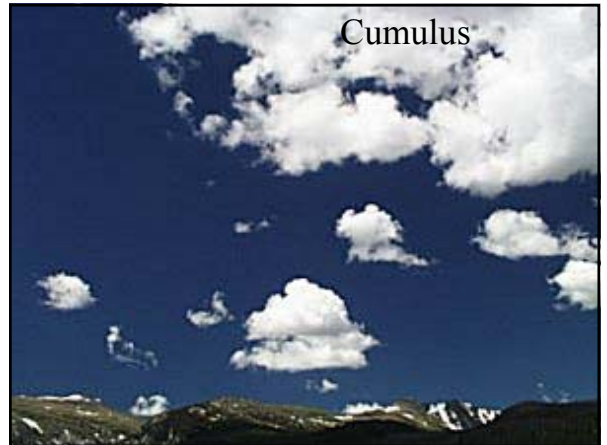
- **Cumulonimbus**

- towering clouds with flat tops that produce thunderstorms.

Stratus

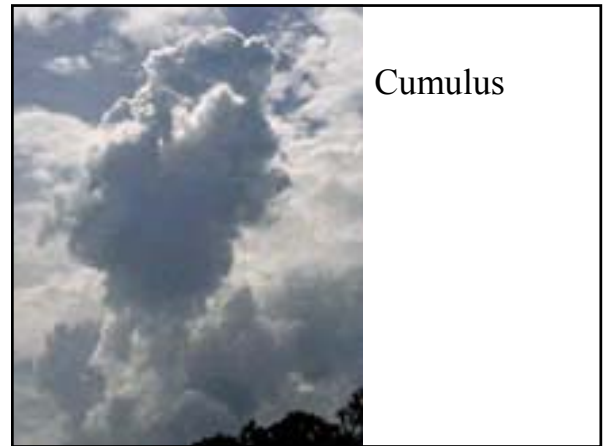
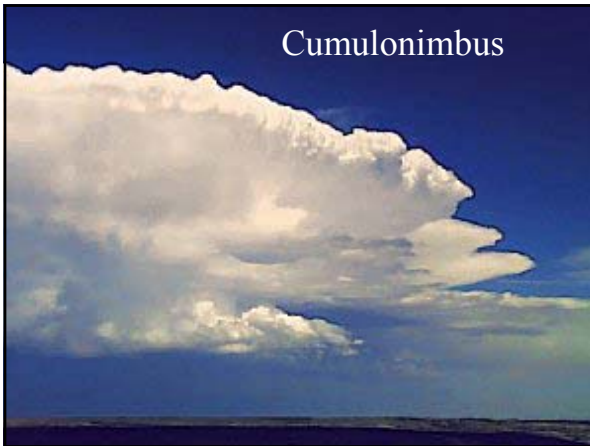


Cumulus



Stratocumulus






Temperature & Humidity

Pressure Gradients

- Air pressure is the result of the weight of air pushing down on a given area.
- A barometer is an instrument that measures the air pressure. It is usually filled with mercury.

**The Weather Glass Barometer**

- The water level decreases, when the atmospheric pressure **rises**
  - sign of good weather.
- The water level increases, when the atmospheric pressure **falls**
  - sign of stormy weather approaching.



[http://www.teachersource.com/catalog/special\\_frame.html](http://www.teachersource.com/catalog/special_frame.html)

- The air pressure at sea level is the highest at 76 mm Hg and the lowest at 0 mm Hg in outer space.
- Air pressure decreases as altitude increases.
  - As air pressure decreases, air density also decreases.
  - High pressure usually means fair weather
  - Low pressure usually means a storm is approaching

## Wind

- All winds are caused by differences in air pressure. Wind is the movement of air from an area of high pressure to an area of lower pressure.
- The movement of air between the poles to the equator produces global winds.
- The Doldrums is a global wind around the equator that has very weak wind or almost no wind.

- The Coriolis Effect is the curving of the wind due to the rotation of the Earth.
- A Sea Breeze occurs during the day when the air above the land is warmer than the air above the sea. The cooler air blows inland from the sea.
- A Land Breeze occurs at night when the air above the sea is warmer than the air above the land. The cooler air blows toward the ocean from the land.

## Moisture

- Evaporation is the process that occurs when the Sun's energy turns liquid water into gas.
- Humidity is a measure of the amount of moisture in the air.
- Relative Humidity is the percentage of moisture the air holds relative to the amount it can hold at a particular temperature.

- Condensation is the process by which moisture in the air turns into water droplets.
- Dew Point is the temperature at which moisture in the air comes together into water droplets.
- Clouds form when moisture in the air becomes liquid water or ice crystals.

## Weather

- Air Mass is a huge body of air that has similar temperature, humidity and air pressure.
- When two air masses meet they form a front.
- Isobars are lines connecting locations that have the same barometric pressure.
- Isotherms are lines connecting locations that have the same temperature.



## Tornadoes

In the southern states,  
peak tornado season  
is March through May



## Works Cited

- NOAA *National Weather Service*. Retrieved 12/27/03 from website <http://www.nws.noaa.gov/>
- NOAA *Severe Storms Photos*. Retrieved 12/27/03 from website <http://www.photolib.noaa.gov/nssl/clouds2.html>
- Department of Atmospheric Sciences (DAS) at the University of Illinois. Retrieved 2/23/04 from website [http://ww2010.atmos.uiuc.edu/\(Gh\)/guides/mtr/cld/cldtyp/home.rxml](http://ww2010.atmos.uiuc.edu/(Gh)/guides/mtr/cld/cldtyp/home.rxml)