Weather Notes

Chapter 16, 17, & 18
Weather

• Weather is the condition of the Earth’s atmosphere at a particular place and time
Weather

• It is the movement of energy through the atmosphere

– Energy comes from the Sun
Weather

• The sun is the force that drives weather
  • The sun’s energy interacts with earth’s atmosphere
About 25 percent of incoming sunlight is reflected by clouds, dust, and gases in the air.

About 50 percent is absorbed by Earth’s surface. This energy heats the land and water.

20 percent is absorbed by gases and particles in the atmosphere.

5 percent is reflected by the surface back into the atmosphere.

Some absorbed energy is radiated back into the atmosphere.
Energy in the atmosphere

- 50% absorbed by earth’s surface. This heats the land and water.
- Some absorbed energy is radiated back to the atmosphere. As infrared radiation...
Energy in the Atmosphere

- 5% is **reflected** by the surface back into the atmosphere
- 20% is absorbed by **gases** and particles in the atmosphere
- 25% of incoming sun is **reflected** by dust, clouds, & particles
Heat Transfer

- Conduction: direct transfer from one substance to another (touching)
Heat Transfer

- **Radiation**: direct transfer of heat by electromagnetic waves (through space)
Heat Transfer

• **Convection:** transfer of heat by the movement of **fluid** (liquid or gas)
Wind

• Wind is the horizontal movement of air from an area of high pressure to an area of low pressure

  • High pressure

  • Low Pressure
Wind

• Difference in pressure
  – Caused by the unequal heating of the atmosphere
  • The hot air (by equator) rises
  • The cool air sinks or rushes to replace the rising air
Measuring Wind

• Measure wind
  – Use anemometer
• unit of **measure** m.p.h.
  (miles per hour)
Measuring Wind

- **Wind chill**: the blowing of wind on your skin makes you feel colder
Local Winds

- **Local winds**: winds that blow over a small area
- Caused by unequal heating in a small area
Local Winds

- Examples

  - **Sea Breeze**: cool air blows from water toward land where hotter air has risen.
Local Winds

Examples

• **Land Breeze**: land cools faster than body of water at night
  - Hot air over water **expands** and rises
  - **Cool** air from land rushes in over the water
Global Winds

- Global winds: winds that are caused by unequal heating of the globe
  - Occurs over large areas
Global Winds

- Form from giant convection currents in the atmosphere
  • (Hot $\rightarrow$ up, Cold $\rightarrow$ down)
  • Air pressure at the poles is higher than air pressure at the equator
(b) Initial pattern of air circulation

(c) Deflections in the paths of air flow near the earth’s surface
Cause of Wind

• *PRESsure Difference Causes Wind*
Coriolis Effect

- **Coriolis Effect**: global winds **curve** due to the rotation of the earth.

- The Coriolis effect is the way the earth's **rotation** makes the wind **curve**
Coriolis Effect

- Winds in North curve right toward equator
- Winds in South curve left toward equator
The Coriolis Effect

Caused by the earth's rotation

Objects deflect to the right in the Northern hemisphere

Objects deflect to the left in the Southern Hemisphere
Global Wind: Calm Areas

-Doldrums: area near the **equator**

- The hot air rises and is replaced by cold air, but the cold air is heated so **quickly** there is not much horizontal movement
Calm Areas

Horse latitudes: occur at 30° North and South of equator

Cool air sinks: very calm area
Global Wind Belts

- **Trade winds**: blow from the horse latitudes toward the **equator**
  - Used for **trade** routes
Global Wind Belts

- Polar easterlies: Cold air near the poles sinks and flows back toward the lower latitudes.

Coriolis effect shifts these winds so they meet prevailing westerlies. Creates the polar front.
Global Wind Belts

– Prevailing westerlies: occur in the mid-latitudes (30°-60° N & S)

These blow towards the poles. Very important to weather in the USA.
Global Winds

- Jet Stream: bands of high speed air 10 km **above** the earth (200-400 km/hr)
  - Blow from West to East
Prevailing Westerlies blow away from the horse latitudes.

Horse Latitudes are calm areas of falling air.

Doldrums are a calm area where warm air rises.

Trade Winds blow from the horse latitudes toward the equator.

Polar Easterlies blow cold air away from the poles.
Water in the Atmosphere

- Humidity: is a measure of the water vapor in the air
  - Warm air can hold more H₂O vapor than cool air
Humidity

- Relative Humidity: The actual amount of water vapor the air can hold at a particular time.
## Relative Humidity

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<th>Difference Between Wet- and Dry-Bulb Readings (°C)</th>
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Water in Atmosphere

- **Dew Point**: The temperature where condensation **begins**
  - When water vapor **turns** to liquid water
<table>
<thead>
<tr>
<th>Air Temp °F</th>
<th>% Relative Humidity</th>
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Clouds

- Clouds form when water vapor in the air **condenses** to form liquid water or ice crystals.
• Condensation occurs when the temperature changes and has small particles to rest on.
Clouds Form

- **Dew**: condensation on a **surface**
- **Frost**: condensation on a surface at a Temperature below **freezing**
Clouds

- Three main types of clouds
- Classified by their altitude
Cloud Types

–Cirrus: wispy feathery "hooked ends"
  • only at high altitude
  • made of ice crystals
  • storm is coming
Cloud Types

–Cumulus: **fluffy** white
  • Some indicate **fair** weather
  • Others indicate **thunderstorms** (cumulonimbus)

  –nimbus means **rain**
Cloud Types

– **Stratus**: flat layers
  - can produce *drizzle*, rain or snow
  - Thicker called nimbostratus
Cloud Types

• Altocumulus and Altostratus: mid level clouds
Cloud Types

• **Fog**: cloud that forms on or near ground
Air Masses & Fronts

- Air **Mass** is a huge body of air that has **similar** temperature, humidity and air pressure.
Maritime polar air masses from the Pacific Ocean bring cool, humid air to the West Coast.

Continental polar air masses from central and northern Canada bring cold air to the central and eastern United States.

Maritime polar air masses from the Atlantic Ocean are often pushed out to sea by westerly winds.

Maritime tropical air masses from the Pacific Ocean bring warm, humid air to California and the West Coast.

Continental tropical air masses from the Gulf of Mexico bring hot, dry air to the southern plains.

Maritime tropical air masses from the Gulf of Mexico bring warm, humid air to the eastern United States.
Air Masses

- There are 4 major air masses
- Classified by the temperature and moisture content
Air Masses

- Polar: **cold**
  - Form north of the 50° N. Latitude or South of 50° S. Latitude
  - **High** air pressure
Air Masses

- Tropical: warm
  - Low air pressure
  - Form in the tropics
Air Masses

- **Maritime: humid**
  - Forms over **oceans**
Air Masses

- Continental: **dry** air
  - forms over **land**
<table>
<thead>
<tr>
<th></th>
<th>Maritime (wet)</th>
<th>Continental (dry)</th>
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<tbody>
<tr>
<td><strong>Tropical (Warm)</strong></td>
<td>Maritime Tropical</td>
<td>Continental Tropical</td>
</tr>
<tr>
<td><strong>Polar (Cold)</strong></td>
<td>Maritime Polar</td>
<td>Continental Polar</td>
</tr>
</tbody>
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Air Mass Movement

• Air masses move 2 ways
  – **Jet Streams**
  – Prevailing **westerlies**
Air Masses & Fronts

- Front: the boundary where air masses meet
Four types of fronts

- **Cold Front**: fast moving
  - Can have thunderstorms
  - Heavy cold air pushes lighter **warm** air upwards
Four types of fronts

• Warm Front: slow moving
  – Precipitation
  – Warm air replaces cold air by sliding over it
Warm Front
A warm air mass overtakes a slow-moving cold air mass.

Cold Front
A fast-moving cold air mass overtakes a warm air mass.
Four types of fronts

- Stationary Front: Cold air and warm air are at a **standoff**

  Precipitation can **stall** for days

  Neither warm nor cold air advances
Four types of fronts

- Occluded Front: Warm air is **caught** between 2 cool air fronts
  - Very complex
  - Precipitation
  - Cold air is **replacing** cool air at the surface
  - Warm caught air above
Stationary Front
Cold and warm air masses meet, but neither can move the other.

Occluded Front
A warm air mass is caught between two cooler air masses.
Cyclone & Anticyclone

- Cyclone: an area of **low** pressure where wind spins counterclockwise
  - Area of precipitation
Cyclone & Anticyclone

• Anticyclone: an area of high pressure where wind spins clockwise
  – **Clear** dry weather
Storms

• Storms: **violent** disturbance in the atmosphere
Storms

Thunderstorms

- They form in a **large** cumulonimbus cloud
  - Thunderheads
Thunderstorms

• Form when warm air is forced **upward** during a cold front
• Form on **hot** & humid afternoons
Cold Air Moves Downward

Warm, humid air rises.

Heavy rain

Storm movement
Thunderstorms

• Storm Movement
  – Heavy **Rain**
  – Strong **updrafts** within the cloud
Thunderstorms

• Lightning: charged particles travel between the cloud and earth
Tornadoes

- Tornado is a rapidly *whirling*, funnel-shaped cloud that reaches the earth.
Tornadoes

- Form most commonly in cumulonimbus clouds
  - Warm moist air from the bottom of the cloud flows **upward** (LOW PRESSURE AREA IN CLOUD)
Tornadoes

• Warm air begins to **rotate**
• Tornado forms as the funnel **descends**
Cold, dry air moves south from central Canada.

Warm, humid air moves north from the Gulf of Mexico.
- Measuring Tornadoes
  - Fujita scale (F0-F5)
Hurricanes

- Hurricane: tropical cyclone that has **winds** of 119 km/hr or higher
Formation of Hurricane

– Warm moist air rises around the eye in spiraling bands
– Air flow outward near the top of the hurricane
– Cool dry air sinks in the eye
Hurricanes

- Hurricanes form over **warm** ocean water
  - As low pressure area or **tropical** depression

1. Warm, moist air rises around the eye and in spiraling bands of clouds.
2. Air flows outward near the top of the hurricane.
3. Cool, dry air sinks in the eye, the center of the hurricane.
Hurricanes

• Hurricanes move in the **Atlantic** by the Easterly Trade Winds
Hurricane

- **Storm Surge**: a *dome* of water that sweeps across the coast where the hurricane lands.
Lake Effect Snow

• Cool dry air mass moves over a body of water and **picks up** water vapor
• Snow **falls** after the water vapor condenses again.
Climate

• Scientists use two main factors—precipitation and temperature—to describe the climate of a region.
Factors affecting Temperature

- **Altitude** (distance from sea level)
- Distance from bodies of water
- **Ocean** currents
Factors affecting Temperature

• Latitude (distance from equator)
Latitude affects Temperature

- **World Temperature Zones**
  - Polar Zone: **cold** climates
  - Temperate zone: warm or hot in **summer**, cool or cold in **winter**.
  - Tropical zone: **warm** climate
Factors affecting Precipitation

• Prevailing winds
• Mountains
• Seasonal winds
Weather Forecasting Data

- **Model A**
- **Model B**

**Air Pressure (millibars)**
- 1,040
- 1,030
- 1,020
- 1,010
- 1,000
- 990
- 980

**Time of Day**
- 4 A.M.
- 4 P.M.

**Days**
- Monday
- Tuesday

Graph shows the air pressure over time for Model A and Model B on Monday and Tuesday.
Weather Forecasting Data

Air Pressure (millibars)

Actual Data

Time of Day

Monday

Monday

Tuesday

Tuesday