Ch. 3: Weather Patterns

Sect. 1: Air Mass & Fronts

Sect. 2: Storms

Sect. 3: Predicting the Weather
Sect. 1: Air Masses & Fronts

- An air mass is a huge body of air that has similar temperature, humidity, and air pressure at any given height.
  - Air masses are classified by 2 characteristics
    1. Temperature
    2. Humidity
  - The characteristics of an air mass depend on the temperatures and moisture content of the region over which the air mass formed.
    1. Tropical: warm, air masses formed in the tropics
    2. Polar: cold, air masses formed north or south of 50° latitude
    3. Maritime: air masses formed on oceans or seas
    4. Continental: air masses formed over land
– The colder the air the higher the air pressure subsequently the hotter the air the lower the air pressure.

• *Cold air* → *more dense*
• *Hot air* → *less dense*

• **Types of Air masses**
– There are 4 major types of air masses that affect the weather of the U.S.
  1. Maritime tropical
  2. Maritime polar
  3. Continental tropical
  4. Continental polar
1. **Maritime tropical**
   - Warm, wet air masses
   - On the east coast they **form over the Gulf of Mexico & south Atlantic Ocean**.
   - On the west coast they **form over the southern Pacific Ocean**.
   - Influence weather along the entire east coast.
     - Summer: thunderstorms & summer showers
     - Winter: heavy snow or rain
2. **Maritime polar**

- Cold, wet air masses
- On the east coast they are formed over the north Atlantic Ocean.
- On the west coast they are formed over the north Pacific Ocean.
- Influence the weather of the west coast more so than that of the east coast.
  - Summer/Winter: fog, rain, & cooler temperatures
3. **Continental tropical**
   - Warm, dry air masses
   - Typically form over the southwest (New Mexico, Arizona, Nevada, as well as northern Mexico) during the summer months.
     - Influence the weather of the southwestern part of the US & southern Great Plains (Kansas, Oklahoma, Texas, Iowa).
     - Summer: Hot, dry
4. **Continental polar**
   - Cold, dry air masses
   - Typically form over central & northern Canada as well as Alaska.
   - Influence the weather of the entire United States.
     - Winter: Clear, cold, dry
     - Summer: Potential for storms due to interaction with Maritime tropical air moving up from the Gulf of Mexico.
• 2 primary methods for air mass movement

1. **Prevailing Westerlies**
   – Pushes air masses from west to east.

2. **Jet streams**
   – Pushes fast moving air masses from west to east.
• Fronts are the boundary between two air masses.
• Storms & different types of weather phenomena occur along fronts.
  – Air masses do not easily mix with each other due to the differences in...
  1. *Density (Air pressure)*
  2. *Temperature*
  3. *Moisture content*
Cyclones

- Formed around centers of low pressure.
- Represented on weather maps by an \( L \).
- Greek for “wheel”
- Warm air rises and spins counterclockwise around the center.
- Caused as the boundary between fronts become distorted by surface features; mountains or strong winds.
- Storms and precipitation are associated with areas of low pressure as the warm air rises & condenses to form clouds & precipitation.
• **Anticyclones**
  – Formed around centers of high pressure.
  – Represented on weather maps by an $H$.
  – Cold air sinks and spins clockwise around the center.
  – **Dry weather and clear skies are associated with areas of high pressure** as the cooler air falls & becomes warmer causing a drop in relative humidity.
Sect. 2: Storms

• Storms:
  – Violent disturbances within the atmosphere.
  – Caused by sudden changes in air pressure which cause rapid air movement in an area.
  – Similar conditions often produce different types of storms.
• Types of storms
  – **Thunderstorms**
    • Fast moving storms that are often accompanied by heavy precipitation, frequent thunder and visible lightning.
      – **Lightning**: sudden spark or electrical discharge typically caused by the build up of positive charges on Earth with negative charges within the air.
        » Cloud to cloud
        » Cloud to ground
        » Ground to cloud (rare)
      – Thunder is caused as air is superheated (30,000ºC), expands, and explodes.
        » **Thunder** is the sound wave created from the explosion.
        » Because sound travels slower than light, thunder always comes after lightning not the other way around.
• Formed within cumulonimbus clouds or thunderheads.
• Typically form on hot, humid afternoons or when a fast moving warm front overtakes a slower cold front.
• Within the cloud fast moving updrafts & downdrafts.
• Because thunderstorms have the potential to dump a lot of water in a small amount of time, flooding is a potential problem.
  – *Flash floods*: flooding of low lying areas within a short time period; less than 6 hours.
• Thunderstorm safety
  – Safest place is indoors away from objects that can conduct electricity.
  – The metal cage of a car will provide protection if trapped inside a car however try to avoid touching any part of the metal frame.
  – If outside find a low lying area & lay down.
– Tornadoes

• Tornadoes can form in any situation that produces severe weather.
• Typically form during the Spring & Summer under the same conditions as those of a thunderstorm.
• Tornado formation
  – Warm, moist air flows in at the bottom of a cumulonimbus cloud & rapidly moves upward generating a low pressure area inside the cloud.
  – The warm air begins to rotate due to winds within the cloud blowing in different directions: The result is the cloud begins to spin like a top.
  – As part of the cloud descends to touch the ground, a tornado or funnel cloud is generated with winds up to 340 mph.
• **The Fujita Scale**
  – Used to determine the severity of a tornado.
  – Based on the amount of damage created as well as the wind speed.
    - F-0: Gale tornado, 40-72 mph winds
    - F-1: Moderate tornado, 73-112 mph winds
    - F-2: Significant tornado, 113-157 mph winds
    - F-3: Severe tornado, 158-206 mph winds
    - F-4: Devastating tornado, 207-260 mph winds
    - F-5: Incredible tornado, 261-300+ mph winds

• **Tornado alley**
  – Located in the Midwest region of the U.S. & is known for the development of tornadoes.
  – Includes the states of S. Dakota, Iowa, Nebraska, Kansas, Oklahoma, and Texas.
– Hurricanes

• Tropical cyclone (low pressure) that typically measures 300-500 miles across with winds from 70-200 mph.
• Comes from the West Indian word Huracan or “big wind.”
• Called Typhoons when formed in the Pacific Ocean;
  – Chinese word, Táifēng or “great wind.”
• Hurricanes are named by the World Meteorological Organization.
• Guided or directed by the Trade winds.
• Can only form over water that is at least 80°F.
• Typically forms during the months of late July to early October.
• Stages of Hurricane Development
  1. Stage 1: Tropical disturbance; 10-23 mph
  2. Stage 2: Tropical depression; 23-39 mph
  3. Stage 3: Tropical storm; 40-73 mph
  4. Stage 4: Hurricane; 74 mph

• The Saffir-Simpson scale
  – Scale used to determine the severity of a hurricane.
    • Category 1: wind speed 74-95 mph; storm surge 4-5 feet.
    • Category 2: wind speed 96-110 mph; storm surge 6-8 feet.
    • Category 3: wind speed 111-130 mph; storm surge 9-12 feet.
    • Category 4: wind speed 131-155 mph; storm surge 13-18 feet.
    • Category 5: wind speed 155+ mph; storm surge 18+ feet
      – Hurricane Katrina was a category 3 hurricane when it made landfall near New Orleans, La on August 29, 2008.
        » Costliest natural disaster
        » 6th strongest to form, 3rd strongest to make landfall
        » 1 of the 5 deadliest
– Winter storms

• Lake effect snow
  – Caused as cold dry air moves across a warmer body of water.
  – It becomes more humid as water vapor evaporates from the lake surface.
  – The air reaches land & cools causing lake-effect snow to fall.

  » Great Lakes area (Michigan, Wisconsin, & Buffalo, NY)
Sect. 3: Predicting the Weather

• **Weather Forecasting**
  - The process by which scientists use weather data from current and past weather to make predictions about future weather.
    - **Meteorologist**: Scientist who studies the weather.
  - Data collection is the first step in weather forecasting.
    - Data can be collected through simple observation or the use of weather instruments & computers.
      - Simple observation: Location & types of clouds
      - Types of data collected include via instruments…
        » Air pressure & Air Temperature
        » Humidity & Relative Humidity
        » Wind speed & Wind direction
        » Location & types of fronts
        » Location & types of air masses
        » High & low pressure areas
Meteorological tools

1. Maps
   - Helps track & locate different weather phenomena and factors that influence weather.

2. Charts
   - Help scientist to see patterns in the weather data and use this information to make possible predictions about future weather.

3. Computers
   - Can analyze data quickly and more accurately due to the volume of data and the number of factors that influence weather.
   - “Computer models” use the information to make 1, 2, 3, 5 or weekly forecasts based on the data.
   - Most 1-2 day forecast about 80-90% accurate.
   - Accuracy decreases as you increase the days of a forecast as weather factors can change quickly and suddenly.
     - “Butterfly Effect”: small changes today can cause major changes tomorrow.
• Sources of data

1. National Weather Service
   • Government agency responsible for tracking weather and making predictions about the weather & possible impact on certain areas.
   • Employs hundreds of meteorologists in various areas throughout the country.

2. Local weather observers
   • Trained observers who collect local data and notice patterns in local weather and submit this information to the National Weather Service.

3. Satellites
   • **TIROS-1**: 1st weather satellite launched in 1960
   • Located within the exosphere
   • Carries a variety of scientific weather instruments
     – Cameras: to take pictures of various weather factors.
     – Temperature gauges, Radiation detectors, humidity detectors, wind speed gauges, etc.
4. **Weather balloons**
- Located within the troposphere and the lower portion of the stratosphere.
- Carries instruments to measure air pressure, humidity, and temperature.

5. **Radar stations**
- Technology that sends out radar waves that can then interpret the returning signal to determine the location of storms, rain, snow, tornadoes, hurricanes, etc.
  - Doppler 5000: owned and operated by WRAL-TV.
  - Dual Doppler: owned and operated by WTVD.

6. **Automated weather stations**
- Over 2,000 stations located throughout the U.S., Canada, and other parts of the world.
- Automatically collects data and send this data to the National Weather Service.
• **Weather maps**
  
  – “snapshots” of the conditions of an area at a particular time & place.

  – Most weather maps are generated and distributed by the National Weather Service.
    
    • **Isobar**: lines joining places on the map with the same pressure.
    
    • **Isotherm**: lines joining places on the map with the same temperature.

  – Information shown on a weather map
    
    • Precipitation type
    
    • Fronts
    
    • Temperature
    
    • Air pressure
    
    • Cloud cover
    
    • High pressure and low pressure area.
### A Key to Symbols used on the AAWU Graphic Products

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