

**GEOG 101 Part II  
People and their  
Physical Environment**

**12: The Atmosphere**  
Aspects of  
Weather and Climate  
Chapter 2

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**PART II: People and their  
Physical Environment**

- ✓ I. Introduction to the Physical Environment
- ✓ II. Earth-Sun Relationship
- III. Earth Systems
  - ✓ A. The Hydrosphere: Oceans
  - B. The Atmosphere: **Weather and Climate**
  - C. The Lithosphere: Geologic Influences
- IV. Earth Habitat
  - A. Biosphere
  - B. Natural Controls and Cycles
  - C. Human Impact
  - D. Natural Hazards
  - E. Earth Resources

**THE ATMOSPHERE**

- ✓ We need to be aware of and understand atmospheric processes: **decision making**.
- ✓ All life is dependent on favorable conditions in the atmosphere: **chemical composition, air pressure, temperature, humidity and air movement**.
- The atmosphere is a shield: it **protects us from meteorites, UV rays and heat loss**.

**The Atmosphere**

- ❖ **All parts of the atmosphere are interconnected and linked to conditions in the oceans.**
  - ✓ They are influenced by change any place on the planet.
- **People have had and continue to have an impact on both weather and climate.**
  - ✓ Initiating and magnifying **global climate change** and local **microclimate and microweather** developments.

**WEATHER and CLIMATE**

What is the difference between  
**weather**  
and  
**climate?**

**WEATHER**

- ❖ **WEATHER: The state of the atmosphere at any one point in time.**

There are 4 parts to weather: *What are they?*

Temperature  
Air pressure  
Wind  
Moisture

- **Weather forecast** or prediction is an attempt to **guess** what each of the 4 elements will be like in the future **based on models** constructed from recorded data of sequential events that occurred over a long period of time in the past. *By recognizing and studying these events, we may be able to predict their recurrence.*



### Atmospheric Reasons for Temperature Variations

- Amount of material in the atmosphere:
  - water vapor (clouds)
  - dust
  - carbon dioxide
  - other greenhouse gases
- Length of passage through atmosphere: scattering of incoming solar energy (varies with the items listed above)

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### Surface Reasons for Temperature Variations

- Land vs. water: heat transfer difference
- Color of surface: reflectivity
- Elevation of surface: less surface to heat; average change rate (cooling or heating) is **3½°F/1,000 ft**
- Orientation of surface: sun-facing or shadow side

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### Clouds

Common types of clouds in the troposphere

**HIGH CLOUDS**

**MIDDLE CLOUDS**

**LOW CLOUDS**

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### Clouds as a Temperature Control

**Cloud tops absorb 3% of solar energy but reflect 21% back into space**

**HIGH CLOUDS**

**MIDDLE CLOUDS**

**LOW CLOUDS**

**Cloud bottoms act as a blanket, providing insulation and keeping the surface warm.**

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### Changing Temperature of the Oceans

The oceans are both a heat sponge and a heat redistribution system at the same time.

- The chart shows that **nearly all** (+90%) heat absorption has occurred in the oceans since 1971.
- ✓ The map locates the areas of the ocean with **record high average surface temperatures**.

Record High Annual Mean Ocean Surface Temperatures, 2015

Estimated Heat Accumulation

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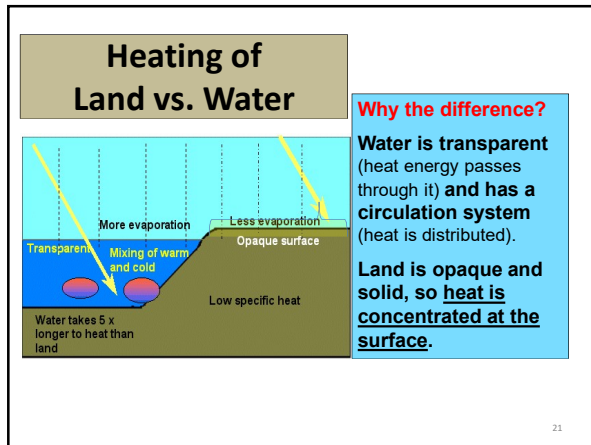
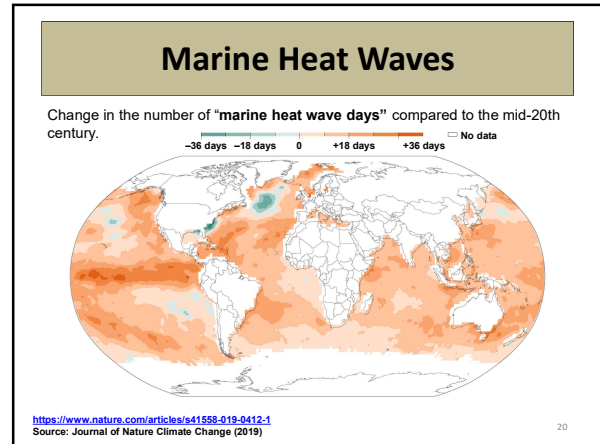
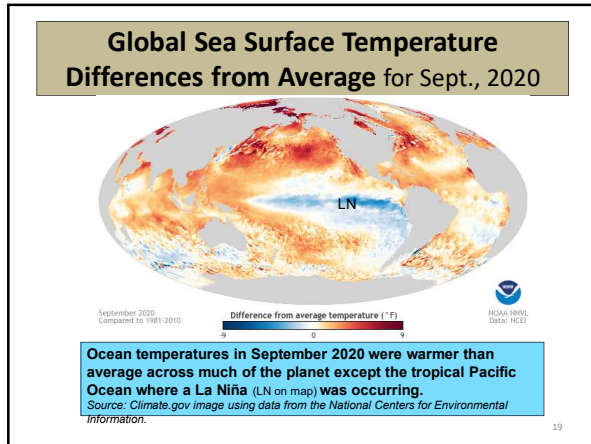
### Where the Oceans Have Been Colder and Hotter Than Average (by decade)

-2°C      0°C      +2°C

[http://www.nytimes.com/interactive/2016/09/12/science/earth/ocean-warming-climate-change.html?WT.nav=top-news&cid=Source-story-heading&\\_r=1](http://www.nytimes.com/interactive/2016/09/12/science/earth/ocean-warming-climate-change.html?WT.nav=top-news&cid=Source-story-heading&_r=1)

Average temperatures from each decade compared with the 20th-century average. Ocean temperatures have been consistently rising for at least three decades. Scientists believe that global sea surface temperatures will continue to increase over the next decade as greenhouse gases build up in the atmosphere.

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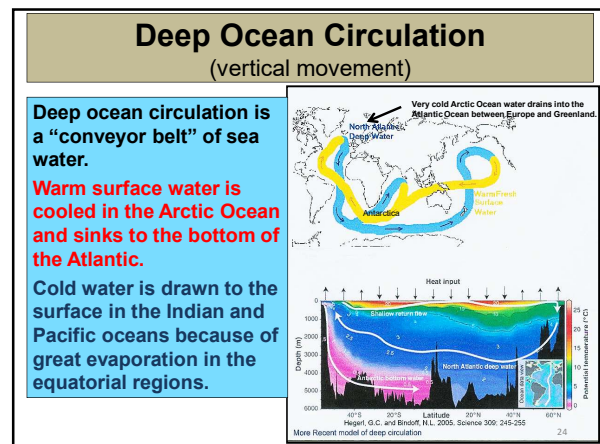
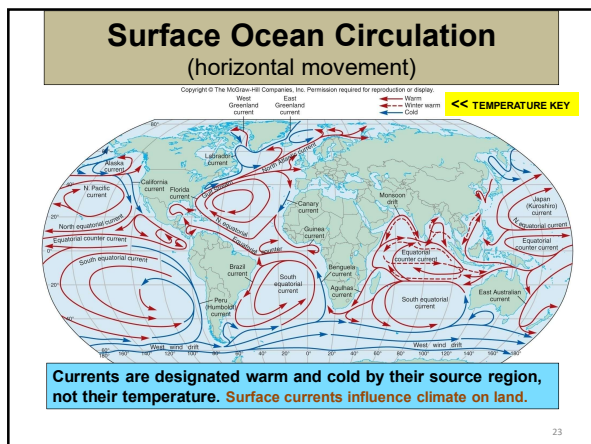


### Ocean Circulation

Review slides and Youtube videos in Lecture 11

- ❖ Ocean currents help regulate the temperature of the earth's surface.
  - The temperature of the top of the ocean is transferred to the bottom of the atmosphere.*
- Ocean currents are generated by earth's rotation, wind friction, water temperature differences and salinity differences.

➤ **Movements are both horizontal and vertical.**

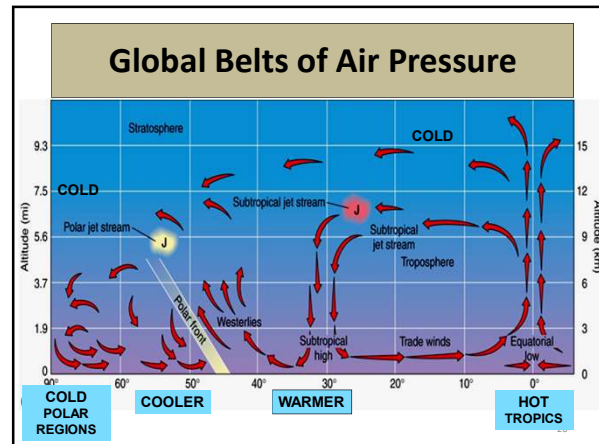


## Elements of Weather

**2. AIR PRESSURE**  
 is the **weight** of the atmosphere (14 lbs./sq in at sea level).  
 It **varies with temperature**.

- **Warm air rises** and lessens surface air pressure = area of low pressure
- **Cool air falls** and increases surface air pressure = area of high pressure.

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## Elements of Weather

**3. WIND:**  
**Air moving from an area of high pressure to an area of low pressure** (pressure gradient).

- The **greater the difference** in pressure the faster (stronger) the wind will be.
- The **closer to each other** the centers of high and low pressure are, the faster the wind will be.
- Wind is named by the direction **from which it comes**, NOT the direction it is moving.

↙ North wind  
 ↖ Northwest wind  
 ↑ South wind  
 ↗ Southeast wind

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## Wind Systems

**Wind Systems:** Areas where wind blows in a unique and predictable fashion based on pressure gradients.

- Global wind systems.
- Regional wind systems.
- Local wind systems.

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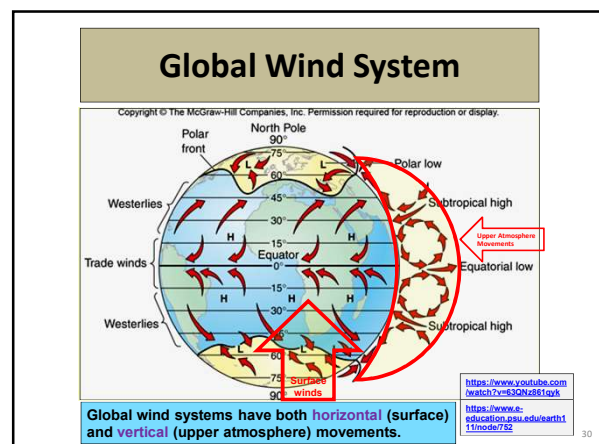
## Jet Stream Animation

❖ The Northern Hemisphere's polar jet stream is a fast-moving belt of westerly winds that traverses the lower layers of the atmosphere.

- The jet is created by the convergence of cold air masses descending from the Arctic and rising warm air from the tropics.
- This pattern spreads across the mid-latitudes of North America, Europe and Asia, as pockets of cold air creep down from the Arctic—creating contrasting waves and flows that accelerate east-ward due to Earth's rotation.

[https://www.youtube.com/watch?v=C\\_HiBj0teRY](https://www.youtube.com/watch?v=C_HiBj0teRY) 25 sec jet stream animation  
 The visualization uses weather and climate observations from NASA's MERRA dataset to model 30 days of the jet stream's whirling journey over North America.  
 Published on Jul 12, 2012 Courtesy: NASA/Goddard Space Flight Center .

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## Regional Wind System

**Asian Monsoon**

**Winter Monsoon**      **Summer Monsoon**

**DRY MONSOON**      **WET MONSOON**

Some islands experience monsoons on different opposite coasts during the year because of the changing wind direction.

**NOTE:** Monsoons occur on all continents except Antarctica, but are not as intense as the Asian monsoon.

## Local Wind Systems

**LAND BREEZE**

**SEA BREEZE**

**MOUNTAIN BREEZE**

**VALLEY BREEZE**

## Elements of Weather

**4. MOISTURE:** Water vapor in the atmosphere includes humidity, precipitation and cloud cover.

- Very important part of earth environment.
- ❖ **Temperature is the controlling factor for the amount of moisture in the atmosphere** (hot and humid / cold and dry).
- Moisture is moved by wind.
- Condensation and precipitation return moisture to the earth's surface (hydrologic cycle).

## Air Masses

**Moisture is moved by air masses.**

They are designated by their source area and have **unique characteristics** of temperature and moisture.

**AIR MASS SOURCE REGIONS**

From T. Madgett, Physical Geography: A Landscape Approach, 4th ed. Copyright © 2003. Adapted by permission of Prentice Hall, Englewood Cliffs, New Jersey.

## CONDENSATION

The conversion of water from a vapor to a liquid state.

1. Warm air containing water vapor (humidity) rises.
2. As air cools, moisture condenses to form clouds.
3. When the air reaches its saturation point (for its temperature), precipitation occurs.

## 3 Types of Precipitation

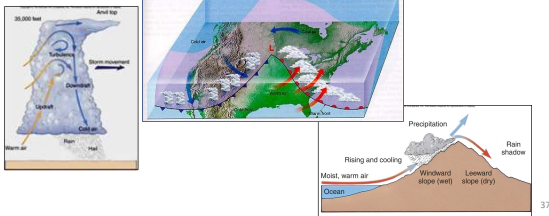
**OROGRAPHIC landform generated**

**CYCLONIC or FRONTAL air mass generated**

**CONVECTION heat generated**

## Precipitation Trigger

Precipitation occurs in air masses when and where there is a change of temperature. This change is the trigger mechanism for all types of precipitation.



## Recap: Elements of Weather

❖ **WEATHER:** The state of the atmosphere at any one point in time.

Weather consists of:

1. temperature
2. air pressure
3. wind
4. moisture

✓ Each is dependent on the others.

✓ Each changes as the others change.

**NEXT**

## CLIMATE and Climate Controls