REMINDERS

❖ **Two required essays are due by April 9, 2019.**

- A third may be used for extra credit in place of a "Think Geographically" essay.
- **ESSAY TOPICS (choose any two):**
  - **Contributions of a noted geographer, earth scientist or explorer (chapter 1)**
  - **Relationship of climate change to a listed current event topic (ch. 2)**
  - **Discuss a natural process that is deemed a natural hazard (ch. 3)**

❖ **Extra Credit: "Think Geographically" Essays** from any five of the text-book's chapters 4-12.

- **Last day to submit is May 14** but it is best to do them as you finish reading a chapter.

- **Any essay may be handed in before the deadline.**
- **Don't wait for the night before to write them!!**

GEOG 101 Part II
People and their Physical Environment

12: The Atmosphere

Aspects of Weather and Climate

Chapter 2

Prof. Anthony Grande
Hunter College Geography

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 <u>interconnected</u> 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.

5

WEATHER and CLIMATE

What is the difference between

weather

and

climate?

6

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 it will be like in the future <u>based on models</u> constructed from recorded sequential events in the past.

7

CLIMATE

- **CLIMATE: The average of all weather events at a particular location over a long period (50+ yrs) of time.**
  - ✓ Climates change naturally as weather events change in relation to earth-sun relationships.
- **Climate maps** show the distribution of <u>averaged data</u>.
- **Climographs** give us <u>snapshots</u> of the climate characteristics of individual locations.

8

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.

https://www.youtube.com/watch?v=jCNhM_ANvy4
Hurricane Michael TV coverage 2018

9

Elements of Weather

1. TEMPERATURE: the amount of heat contained in a substance.

Earth's surface air temperature varies with various interrelated relationships and conditions:

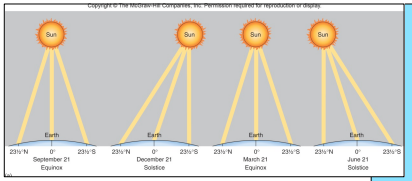
✓earth-sun relationships

✓atmospheric conditions

✓surface conditions

10

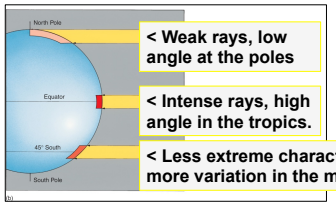
Earth-Sun Relationships



– **Angle at which the rays hit the surface**

– **Varies daily and seasonally** as the sun changes position in the sky.

❖ **Review rotation, revolution, inclination and parallelism.**



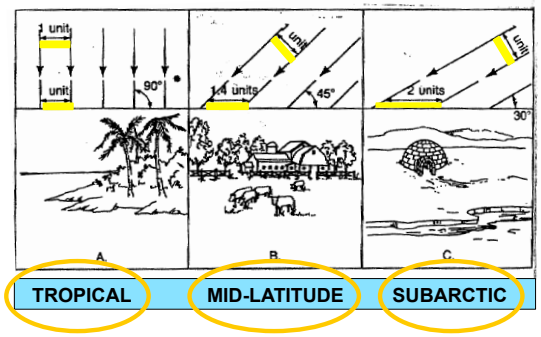
< Weak rays, low angle at the poles

< Intense rays, high angle in the tropics.

< Less extreme characteristics and more variation in the middle latitudes.

11

Angle of Sun's Rays



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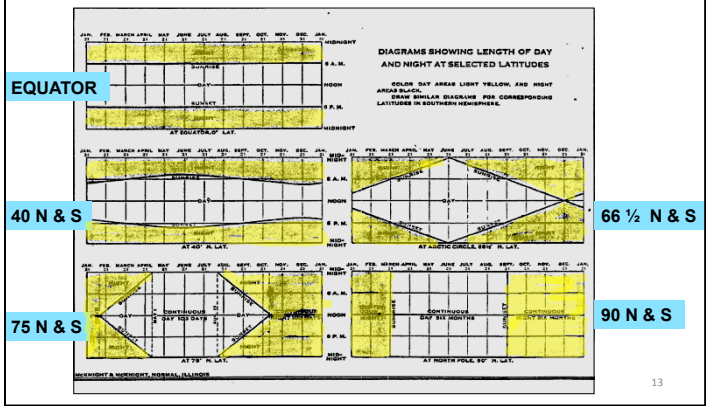
Length of Day and Night

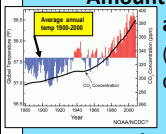


13

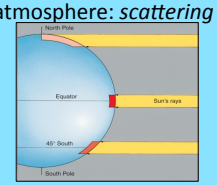
Temperature Variations

1. ATMOSPHERIC REASONS

- **Amount of material in the air**: water vapor (clouds), dust and carbon dioxide.

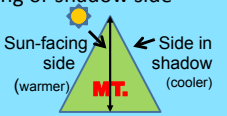


- **Length of passage** through atmosphere: *scattering*



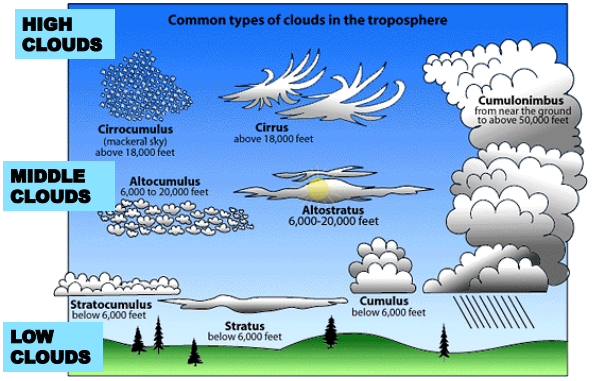
2. SURFACE REASONS

- **Land vs. water**: heat transfer difference
- **Color of surface**: reflectivity
- **Elevation** of surface: less surface to heat; ave. cooling rate is **3½°F/1000 ft**
- **Orientation** of surface: sun-facing or shadow side



14

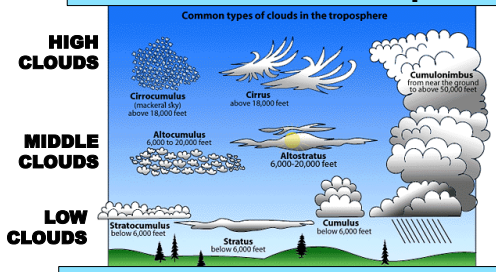
Clouds



15

Clouds as a Temperature Control

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



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

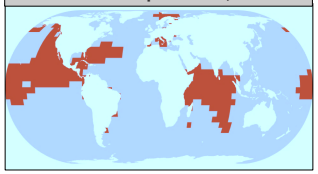
16

Changing Temperature of the Oceans

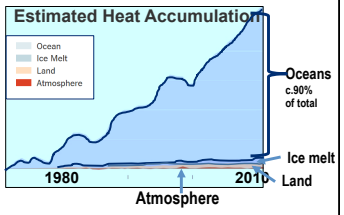
The oceans are both a heat sponge and a heat redistribution system at the same time.

- ➢ 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

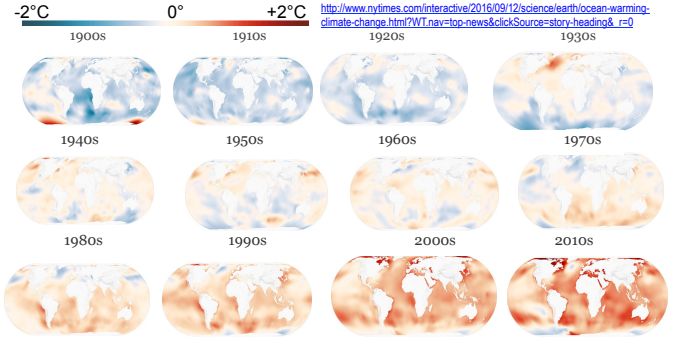


Estimated Heat Accumulation



17

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



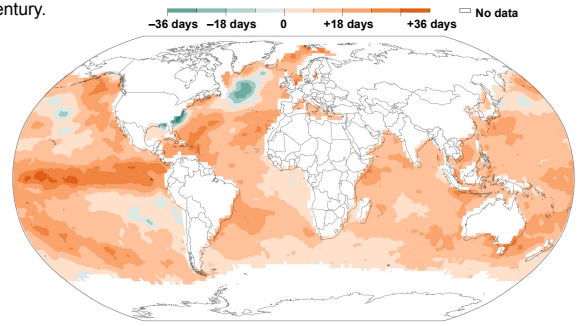
http://www.nytimes.com/interactive/2016/09/12/science/earth/ocean-warming-climate-change.html?WT.nav=top-news&clickSource=story-heading&_r=0

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.

Marine Heat Waves

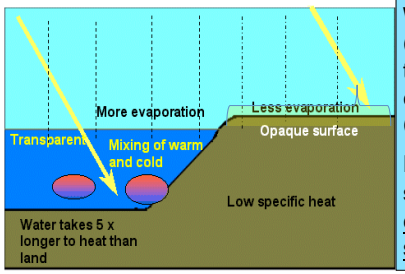
Change in the number of "**marine heat wave days**" compared to the mid-20th century.



https://www.nature.com/articles/s41558-019-0412-1
Source: Journal of Nature Climate Change (2019)

19

Heating of Land vs. Water



Why the difference?

Water is transparent (heat energy passes through it) **and has a circulation system** (heat is distributed).

Land is opaque and solid, so heat is concentrated at the surface.

20

Ocean Circulation

Review slides and Youtube videos in Lecture 11

❖ **Ocean currents help regulate the temperature of the earth's surface.**

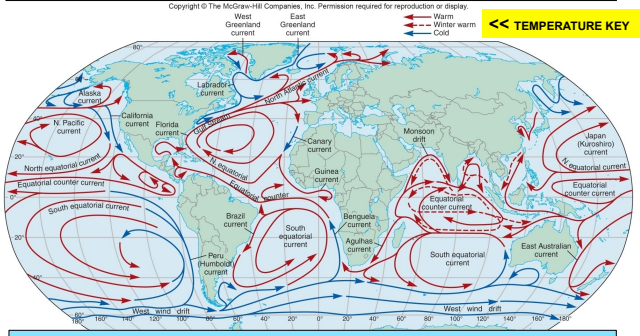
The temperature of the top of the ocean is ***transferred to*** *the bottom of the atmosphere.*

- Ocean currents are generated by earth's rotation, wind friction, water temperature differences and salinity differences.

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

21

Surface Ocean Circulation
(horizontal movement)



Currents are designated warm and cold by their source region, not their temperature. Surface currents influence climate on land.

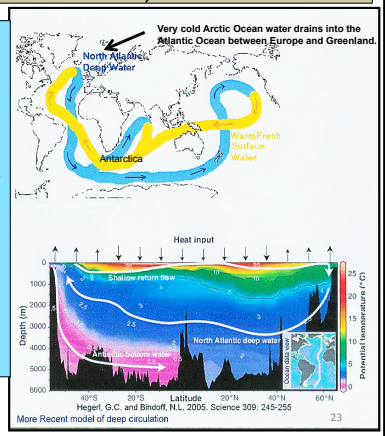
22

Deep Ocean Circulation
(vertical movement)

Deep ocean circulation is a "conveyor belt" of sea water.

Warm surface water is cooled in the Arctic Ocean and sinks to the bottom of the Atlantic.

Cold water is drawn to the surface in the Indian and Pacific oceans because of great evaporation in the equatorial regions.



23

Elements of Weather

2. AIR PRESSURE

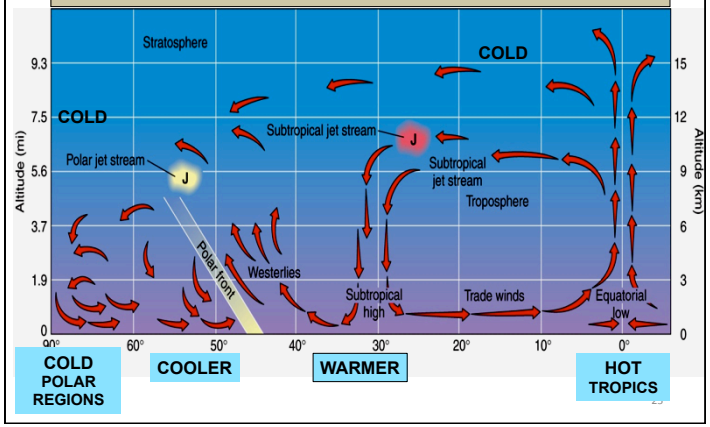
is the **weight** of the atmosphere (14 lbs./sq in at sea level).

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.

24

Global Belts of Air Pressure



Elements of Weather

3. <u>WIND</u>:

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

26

Wind Systems

<u>Wind Systems</u>: Areas where wind blows in a unique and predictable fashion based on pressure gradients.

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

27

Jet Stream Animation

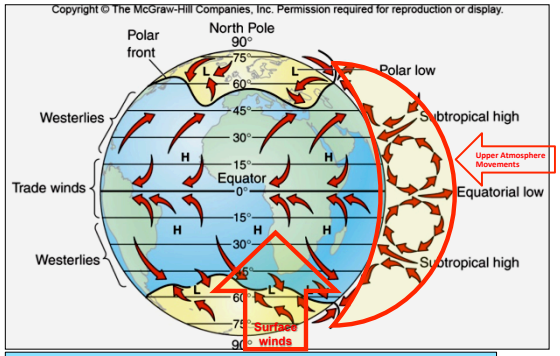
- The Northern Hemisphere's **polar jet stream is a fast-moving belt of westerly winds that traverses the lower layers of the atmosphere**.
- **The jet is created by the convergence of cold air masses descending from the Arctic and rising warm air from the tropics**.
- **This pattern spreads across the 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 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 .

28

Global Wind System

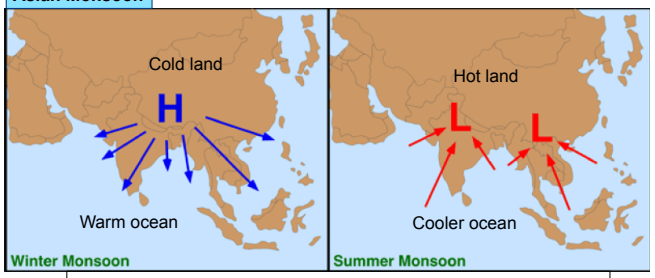


Global wind systems have both horizontal (surface) and vertical (upper atmosphere) movements.

29

Regional Wind System

Asian Monsoon



DRY MONSOON **WET MONSOON**

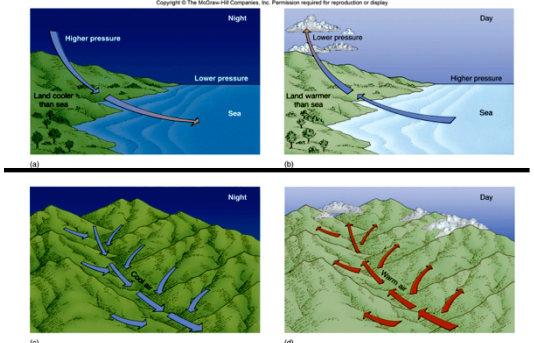
Some islands experience monsoons on different opposite coasts during the year because of the changing wind direction.

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

30

Local Wind Systems

LAND BREEZE **SEA BREEZE**



MOUNTAIN BREEZE **VALLEY BREEZE**

31

Elements of Weather

4. <u>MOISTURE</u>: Water vapor in the atmosphere includes humidity, precipitation and cloud cover.

- Very important part of earth environment.

❖**Temperature is the controlling factor for the <u>amount</u> of moisture in the atmosphere** (hot and humid / cold and dry).

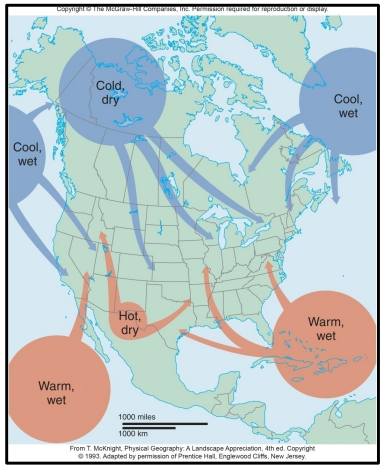
- Moisture is moved by wind.
- Condensation and precipitation return moisture to the earth's surface **(hydrologic cycle).**

32

Air Masses

Moisture is moved by air masses.

They are designated by their source area and have unique character-istics of temperature and moisture.

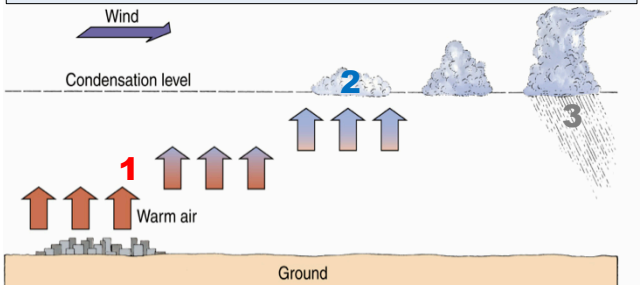


33

CONDENSATION

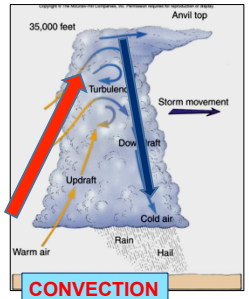
The conversion of water from a vapor to a liquid state.

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.**



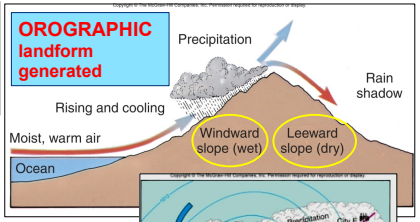
34

3 Types of Precipitation

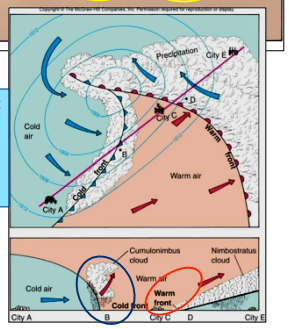


CONVECTION heat generated

OROGRAPHIC landform generated

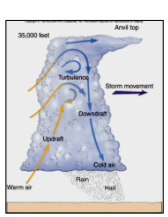


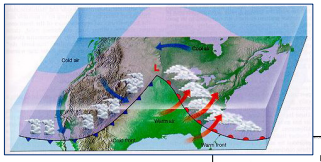
CYCLONIC or FRONTAL air mass generated

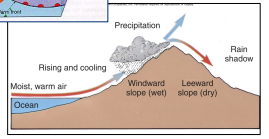


Precipitation Trigger

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.







36

N E X T

C L I M A T E

and

Climate Controls

37