

Introduction to Climate

The earth's climate is generally defined as the average weather over a long period of time.

Why study climate/weather

- Climate is a significant factor in the development of all major aspects of the life.
- Certain biospheres attract people.
- What was available for civilizations to last/develop?
- Levels of economic growth

- **Primary economic activities** are those that use natural resources directly and activities are located at the site. The economy is dominated by subsistence activity where output is consumed by producers rather than traded. Any trade is carried out by barter where goods are exchanged directly for other goods. Agriculture is the most important industry and production is labor intensive using only limited quantities of capital.

- **Secondary economic activities** use raw materials to produce or manufacture something new and more valuable. Examples of secondary economic activities include manufacturing steel, processing wheat into flour, milling lumber into plywood, iron smelting, chemical industries, power production, and construction. Activities are located either at the site of the resource or close to the market for the manufactured/processed good depending upon whether which affect the location of economic activities (labor costs, energy costs, availability of capital, land, resources, and expertise). In the case of lumbering, the finished product is cheaper to ship than the raw materials so lumber mills are located close to forests to minimize costs (and maximize profit). In the case of flour and bread, it is cheaper (and easier) to ship wheat than the finished product, bread. Consequently, bakeries are located close to consumers in cities, again, to minimize costs.

Tertiary economic activities are those activities which provide services, personal and professional services such as doctors, teachers, dry cleaners, and secretaries as well as retail and wholesale services such as store clerks, truck drivers, and fast-food providers. These activities are located where services are required, that is where people are.

- **Quaternary.** In modern economies some individuals process, administer, and disseminate information. Such activities are termed **quaternary** which is used to describe "white collar" professionals working in education, government, management, information processing, and research. These activities are not tied to resources, the environment, or access to a market. With improvements in telecommunications, these economic activities can be located anywhere. Factors which do tend to affect the location of "high-tech" economic activities include access to universities and research centers and to a pool of highly trained and skilled workers, availability of venture capital, proximity to places with high quality of life attributes (scenery, recreation, climate, quality education system) and access to excellent transportation and communication networks.

**It is the climate that attracts
people to a location
and
the weather that makes them
leave.**

Climate is what you expect,

weather is what you get!!!!

day-to-day weather conditions

Hot

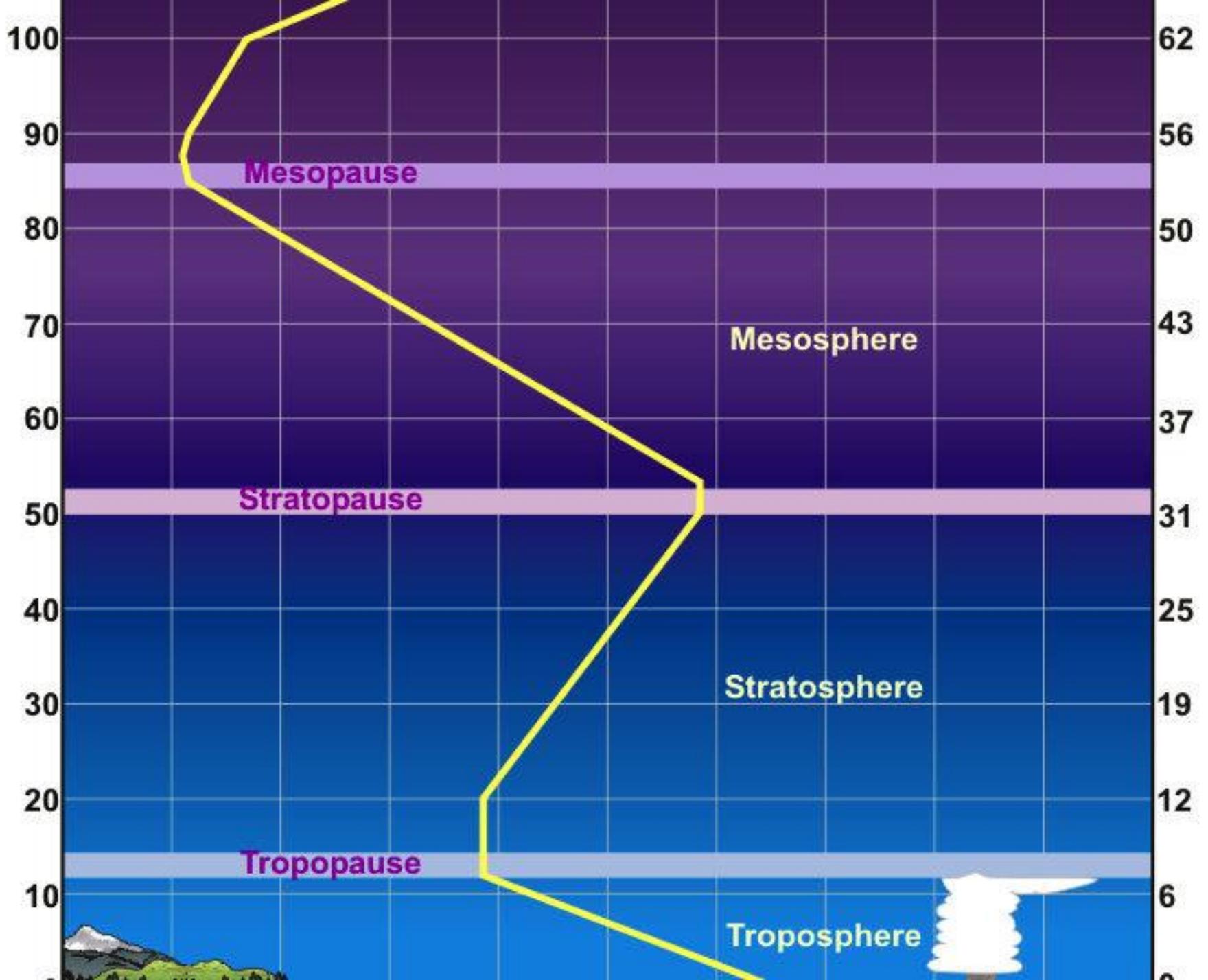
Cold

Wet

Dry

Wind

Come up with an average



- All **weather** occurs in the Troposphere
- Atmosphere is made up of 78% nitrogen and 21% oxygen (0.9 Argon 0.06 all other gasses)
 - Nitrogen is added to the air by decaying or burning organic matter and cleared out of the air by rain and snow. the addition and removal of nitrogen is in balance and remains constant.
 - Oxygen is produced by vegetation and is removed by a variety of organic and inorganic processes
- *These gases have little to no affect on weather/climate
- Variable gasses- (other gasses)available in the atmosphere in parts per million and yet have significant affect on weather/climate.
 - Water vapor (H₂O)
 - Carbon Dioxide
 - Carbon Monoxide
 - Methane
 - **Ozone**
 - Sulfur dioxide
 - Nitrogen dioxide

Water vapor (H₂O)– distribution is variable, amount consistent

- * most abundant over warm moist surfaces least over cold dry areas-

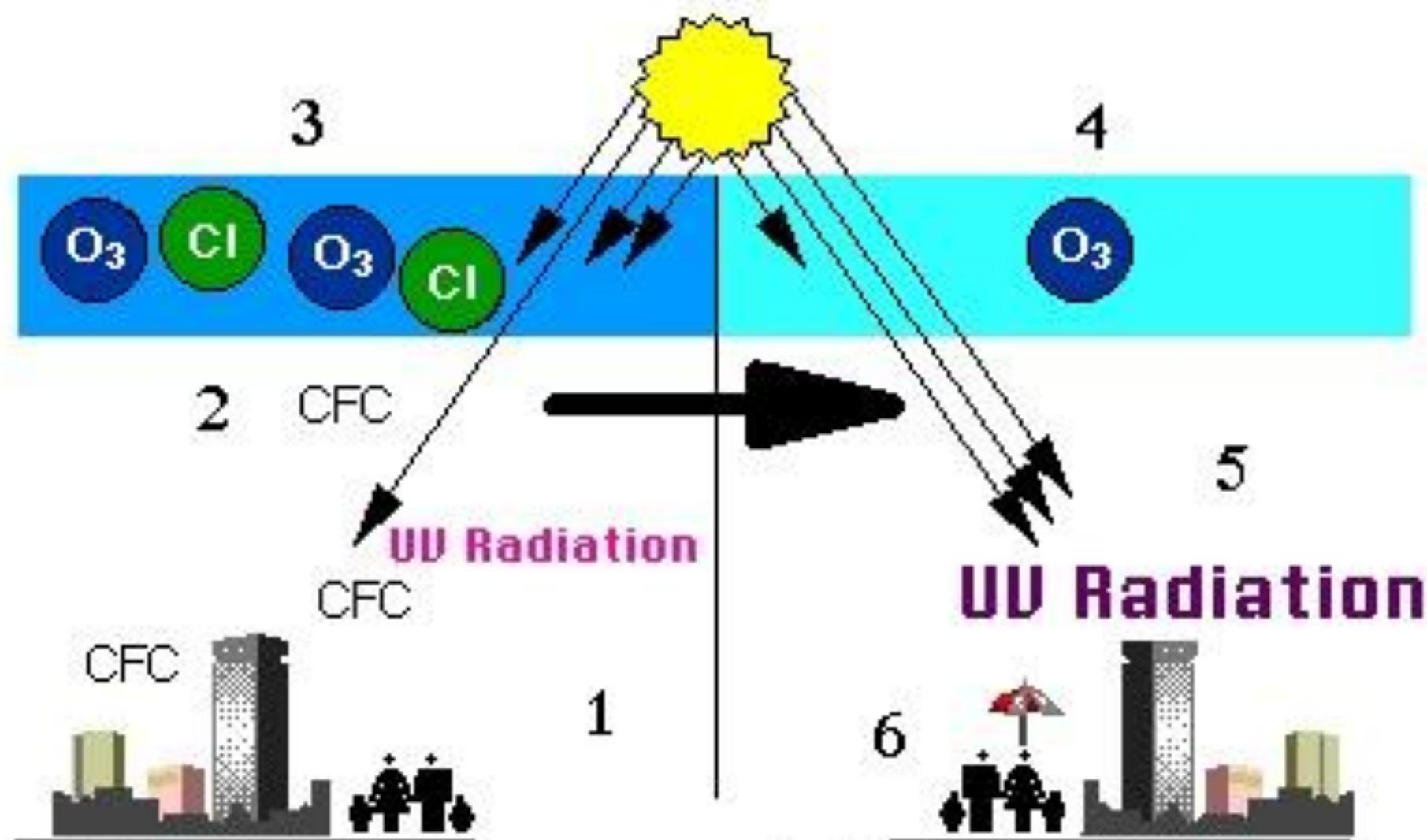
(Amazon vs Atacama Desert)

- * source of clouds and precipitation and plays important roles in a number of heating and cooling processes

Carbon Dioxide (CO₂)– historically distributed uniformly until the burning of fossil fuels and now is becoming more concentrated

- * it's affect on weather is its ability to absorb infrared radiation

Ozone (O₃)



- 1 - CFCs released
- 2 - CFCs rise into ozone layer
- 3 - UV releases Cl from CFCs

- 4 - Cl destroys ozone
- 5 - Depleted ozone -> more UV
- 6 - More UV -> more skin cancer

Emissions

Deposition

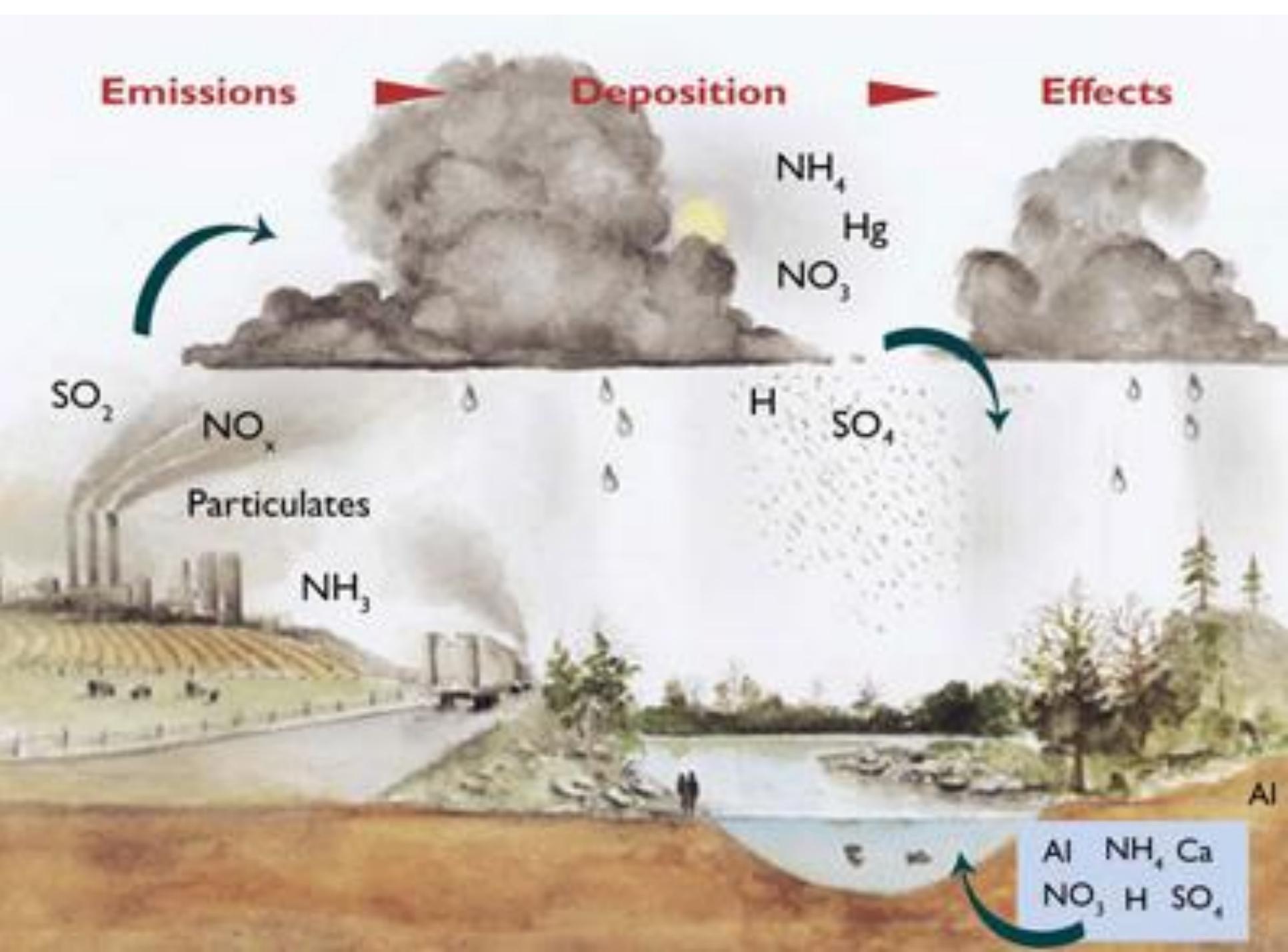
Effects

SO_2
 NO_x
Particulates
 NH_3

NH_4
 Hg
 NO_3

H^+ SO_4^{2-}

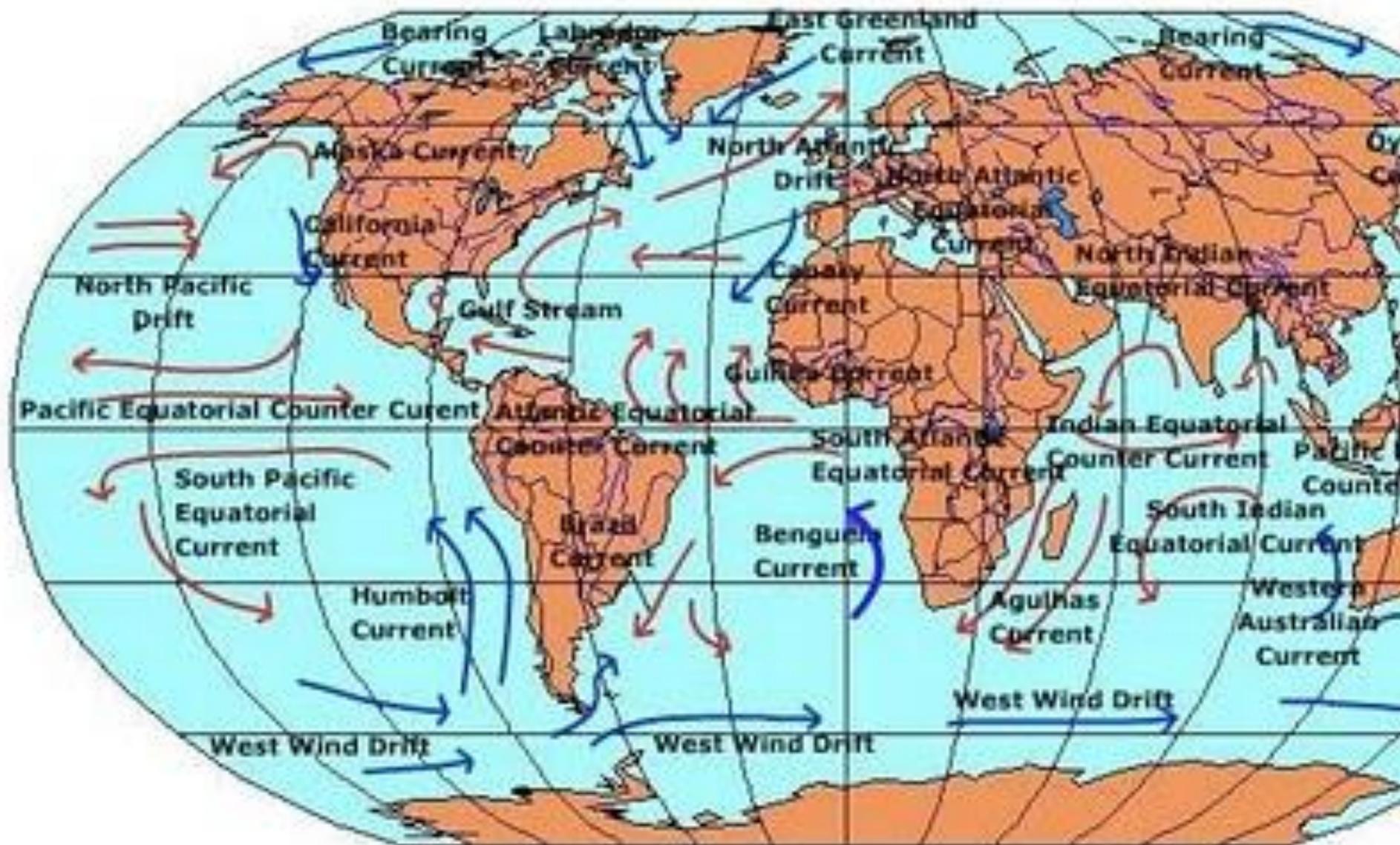
Al
 NH_4 Ca
 NO_3 H^+ SO_4^{2-}

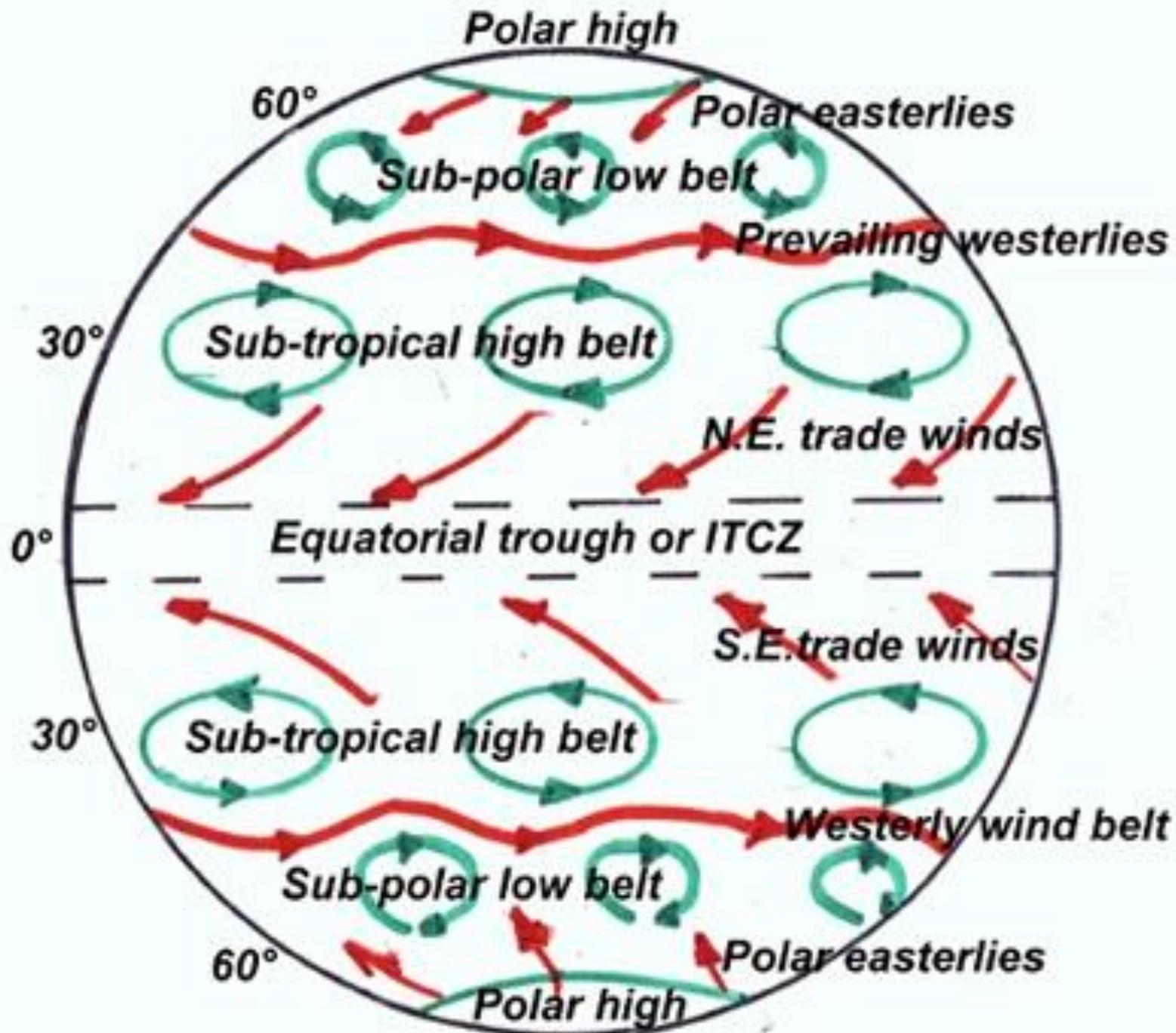




- Particulates- solid and liquid particles found in the atmosphere
 - Sources-
 - Natural – volcanic ash, windblown soil, pollen grains, meteor debris, smoke from wildfires, salt spray
 - Human source – industrial emissions, automotive emissions, smoke and soot from human introduced fires
 - All are hazardous to life and have some effect on climate. (Methane absorbs certain wavelengths of radiation and therefore plays with temperature.) (sulfur dioxide (SO₂)- from factories)
- How do they affect weather/climate
 - some absorb water (hygroscopic) or particulates adhere to water droplets creating rain. Some
 - reflect or absorb light thus affecting temperature

- Elements of and Controls over Weather/Climate-
- Elements
 - Temperature, Humidity/ Precipitation
- Controls
 - Latitude, Land/Water distribution, Geographic Position,
 - Mountains, Ocean Currents, Pressure





Air Pressure

- atmospheric or air pressure is the force per exerted on the Earth's surface by the weight of the air above the surface.
- created by the molecules, their size, motion, and number present in the air.
- they determine the temperature and density of the air and thus its pressure.

Low Pressure

- Lows are usually associated with high winds, warm air, and atmospheric lifting. Because of this, lows normally produce clouds, precipitation, and other bad weather such as tropical storms and cyclones.
- do not have extreme diurnal (day vs. night) nor extreme seasonal temperatures because the clouds present over such areas reflect incoming solar radiation back into the atmosphere so they cannot warm as much during the day (or in the summer) and at night they act as a blanket, trapping heat below.

High Pressure

- Air moves clockwise in the northern hemisphere and counterclockwise in the southern due to the Coriolis Effect.
- as the air in the high cools it becomes denser and moves toward the ground and evaporates most of the atmosphere's water vapor so high pressure systems are usually associated with clear skies and calm weather.
- the absence of clouds means extremes in diurnal and seasonal temperatures since there are no clouds to block incoming solar radiation or trap outgoing radiation at night.

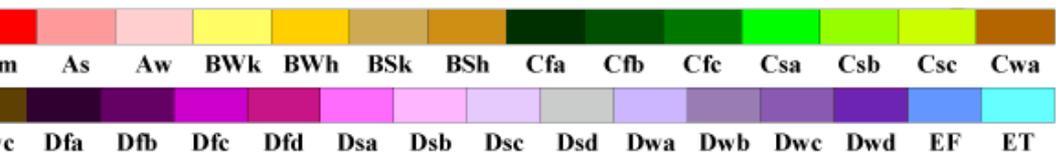
- Seasonally
 - In winter, areas of high pressure tends to build up over cold continental land masses, while low-pressure development takes place over the adjacent, relatively warm oceans.
 - Exactly the opposite conditions occur during summer, although to a lesser degree. These contrasting pressures over land and water areas are the cause of monsoon winds.

Wind

- The prevailing wind systems of the earth blow from high pressure toward adjacent low-pressure belts.
- earth's rotation deflect air to the right in the Northern Hemisphere and to the left in the Southern Hemisphere
- The heating and cooling of the air due to rotation and revolution of the earth creates wind daily and seasonally
- modified by the distribution of land and water, especially in the temperate regions, where temperature differences between land and water are greatest.

World Map of Köppen–Geiger Climate Classification

with CRU TS 2.1 temperature and VASCLimO v1.1 precipitation data 1951 to 2000



Main climates

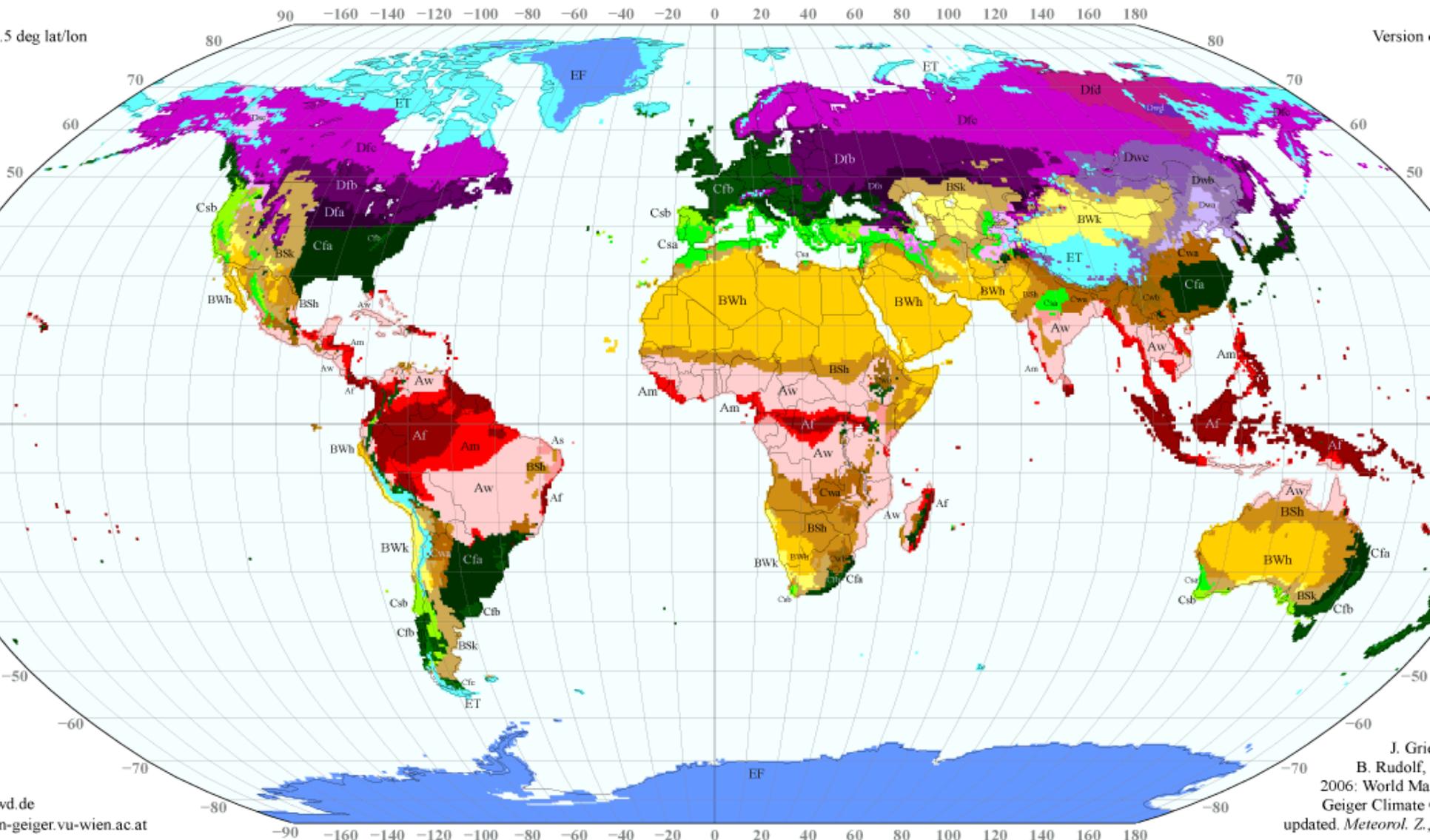
- A: equatorial
- B: arid
- C: warm temperate
- D: snow
- E: polar

Precipitation

- W: desert
- S: steppe
- f: fully humid
- s: summer dry
- w: winter dry
- m: monsoonal

Temperature

- h: hot arid
- k: cold arid
- a: hot summer
- b: warm summer
- c: cool summer
- d: extremely continental





TEXAS

- Texas has more diverse weather on a typical day than any other state within the union—with the possible exception of California.
- Due not only to its inordinate size, but also to its strategic position on the North American continent.
- Gulf of Mexico is the predominant geographical feature affecting the state's climate
 - moderating seasonal temperatures along the Gulf Coast and more importantly
 - providing the major source of precipitation for most of the state

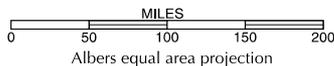
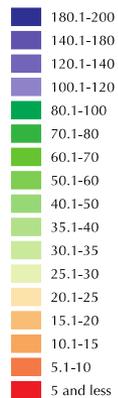
Precipitation-

- Average annual precipitation decreases from over 55 inches in Beaumont to less than 10 inches in El Paso (east to west)
- as it moves westward over the coastal plain and successively reaches the Balcones Escarpment, the Edwards Plateau, and the mountains of the Trans-Pecos.
 - Precipitation in the Trans-Pecos and the Panhandle regions of Texas originates mostly from the eastern Pacific Ocean and from convection.

PRECIPITATION

Precipitation varies widely across the United States, from a low of 2.3 inches per year in California's Death Valley to a high of 460 inches on Hawaii's Mount Waialeale. Nevada ranks as the driest state, with an average annual precipitation of 9.5 inches, and Hawaii is the wettest, at 70.3 inches. The average annual precipitation for Texas is 27.78 inches.

Average Annual Precipitation (in inches)
1961-1990



N Texas



Wind

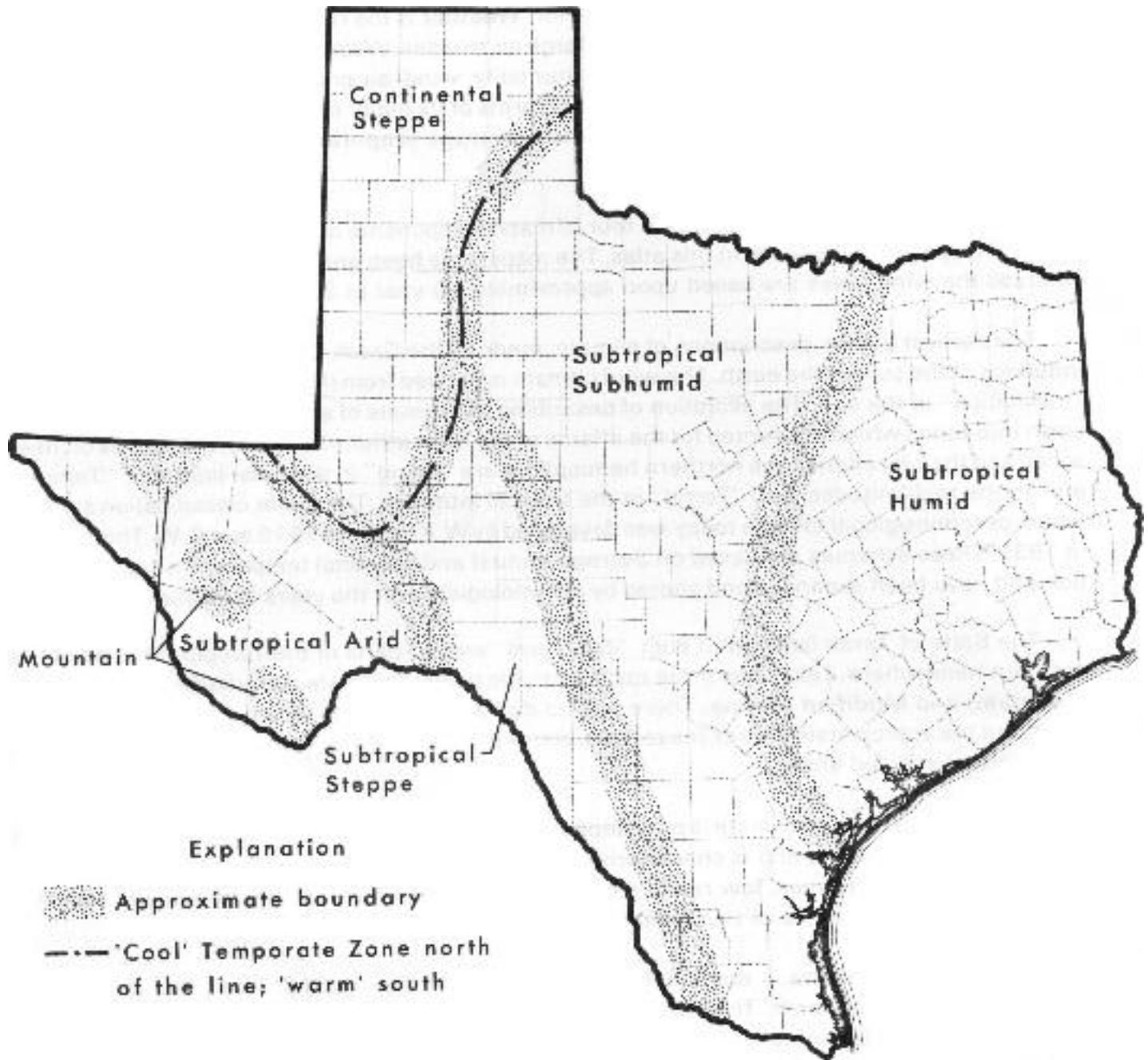
- Average wind speed in TX varies from 7 to 15 MPH
- In the southern half of TX where cool fronts often do not extend, winds are out of the south.
- Texas is within reach of the migration of cool air from Canada and the inevitable interaction of air masses of varying densities.
 - The Rocky Mountains guide polar fronts of cold arctic air southward into the state during the fall, winter, and spring.

Pressure

- TX is located where there is a semipermanent subtropical high
- High pressure is associated with cool temp. but remember it is relative to surrounding temps

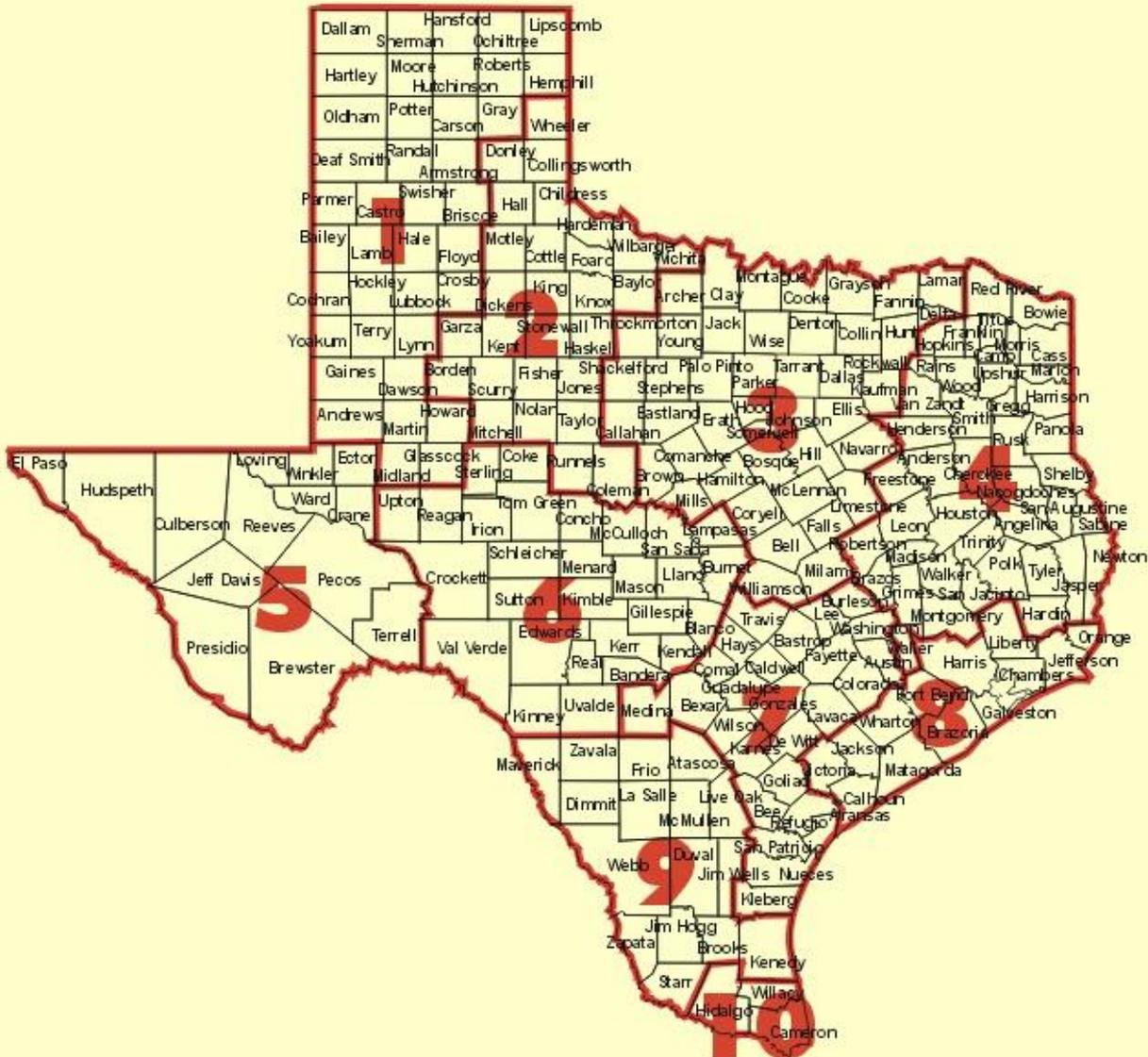
Temperatures

- Average annual temperature gradually increases from about 52°F in the northern Panhandle of Texas to about 68°F in the Lower Rio Grande Valley (north to south)
- Changes as travels north, away from Equator. (latitude)



- The state of Texas lies within both "cool" and "warm" parts of the Temperate Zone of the Northern Hemisphere. Texas has three major climatic types that are classified as **Continental**, **Mountain**, and **Modified Marine**. There are no distinct boundaries which divide these climate types, but the approximate area of Texas that each encompasses is indicated on the following map by the broad stippled lines.
- • The eastern third of Texas has a Subtropical Humid climate that is most noted for warm summers.
- • The central third of Texas has a Subtropical Subhumid climate characterized by hot summers and dry winters.
- • The broad swath of Texas from the mid-Rio Grande Valley to the Pecos Valley has a Subtropical Steppe climate and is typified by semi-arid to arid conditions.
- • The basin and plateau region of the Trans-Pecos features a Subtropical Arid climate that is marked by summertime precipitation anomalies of the mountain relief.
- • A Mountain type climate is common in the higher elevations of the Guadalupe, Davis and Chisos Mountains.
-

Texas



The National Climatic Data Center divides Texas into 10 climate divisions. Climate divisions represent regions with similar characteristics such as vegetation, temperature, humidity, rainfall, and seasonal weather changes.

- Division 1 (High Plains): Continental steppe or semi-arid savanna
- Division 2 (Low Rolling Plains): semi-arid savanna
- Division 3 (Cross Timbers): Sub-tropical sub-humid mixed savanna and woodlands
- Division 4 (Piney Woods): Sub-tropical humid mixed evergreen-deciduous forestland
- Division 5 (Trans-Pecos): Except for the slightly wetter high desert mountainous areas, sub-tropical arid desert
- Division 6 (Edwards Plateau): Sub-tropical steppe or semi-arid brushland and savanna
- Division 7 (Post Oak Savanna): Sub-tropical sub-humid mixed prairie, savanna, and woodlands
- Division 8 (Gulf Coastal Plains): Sub-tropical humid marine prairies and marshes
- Division 9 (South Texas Plains): Sub-tropical steppe or semi-arid brushland
- Division 10 (Lower Rio Grande Valley): Sub-tropical sub-humid marine