

The Atmosphere: Structure and Temperature

17.1 Atmospheric Characteristics

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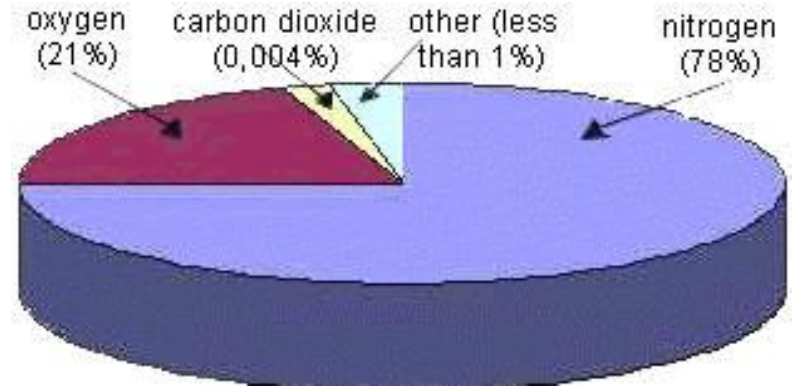
“Weather” vs. “Climate”

- “Weather” is the state of (conditions in) the atmosphere at a given place and time
- Weather is described by current temperature, pressure, humidity, clouds, precipitation, wind direction and speed, etc.
- “Climate” refers to long-term weather patterns, including averages and extreme events
- Climate uses many statistical tools, such as ‘mean,’ ‘maximum,’ ‘minimum,’ and ‘frequency’

Composition of the Atmosphere

“Dry, clean air” includes:

- 78% N₂
- 21% O₂
- 0.93% Ar
- 0.04% CO₂
- “trace gases”



<http://www.saburchill.com/chapters/chap0052.html>

“Real Air” contains
varying amounts of
H₂O, dust, and other
solids

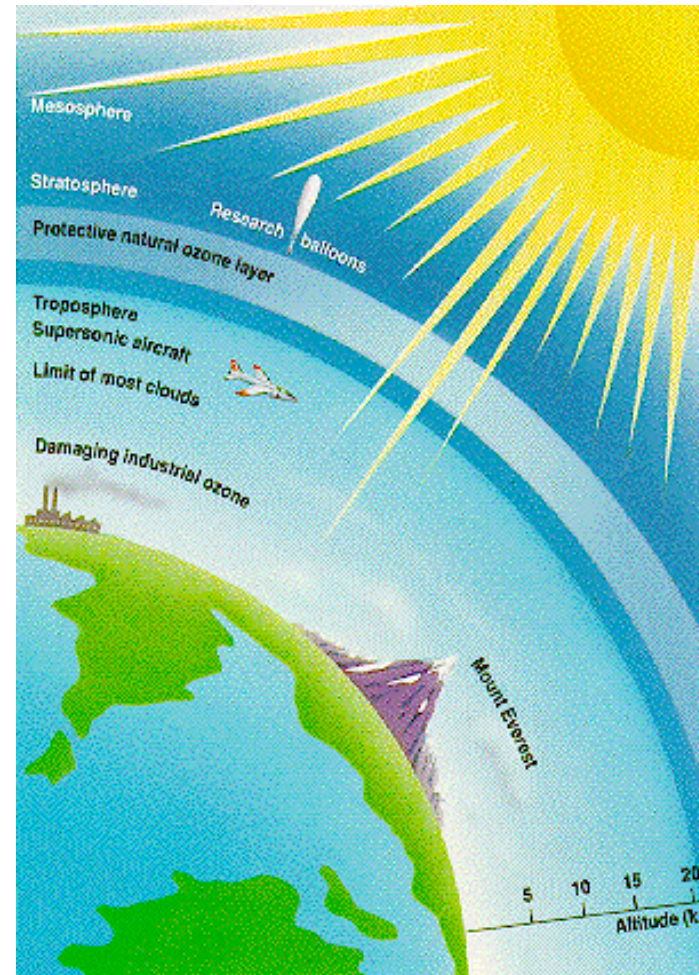
Water Vapor



- Water vapor $\text{H}_2\text{O}_{(g)}$ can range from almost 0% to about 4%
- “Condensation” changes $\text{H}_2\text{O}_{(g)}$ into $\text{H}_2\text{O}_{(l)}$ to form clouds or dew
- “Deposition” changes $\text{H}_2\text{O}_{(g)}$ into $\text{H}_2\text{O}_{(s)}$ to form snow, hail, or frost

Ozone O₃

- Oxygen (O₂) molecules 10 – 50 km above the surface are split by ultraviolet (UV) rays from the sun to form Ozone (O₃)
- This gas protects Earth's surface from the harmful UV energy and makes possible Life on land



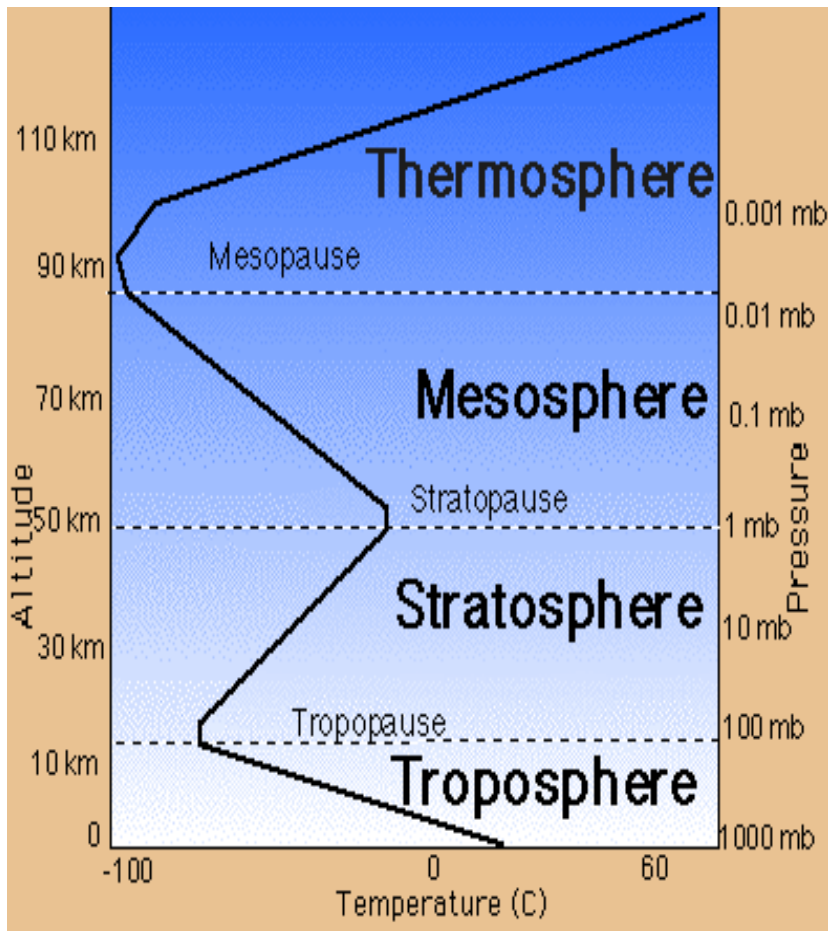
Human Influences



<http://www.msnbc.msn.com/id/23587788/>

- Air pollution comes from transportation, industry, and other activities
- Smog in cities endangers health
- Chemical reactions in air can produce more pollutants, including photochemical smog

Structure of the Atmosphere



- Temperature patterns define four basic layers in Earth's atmosphere
- We live at the bottom in the TROPOSPHERE
- As you go up (in a plane or on a mountain), temperatures become colder

Layers of the Upper Atmosphere

Stratosphere

- temperature increases with height because the ozone layer absorbs UV energy\

Mesosphere

- Temperatures decrease, reaching a minimum of -90° C at about 80 km

Thermosphere (Ionosphere)

- Temperatures increase, but the air is very, very thin and you wouldn't feel any warmth

Earth-Sun Relationships

Earth's Motions

Rotation

Earth *rotates* or spins around its imaginary axis once every 24 hr

This creates *day* and *night*—times when a location receives sunlight and times when it does not

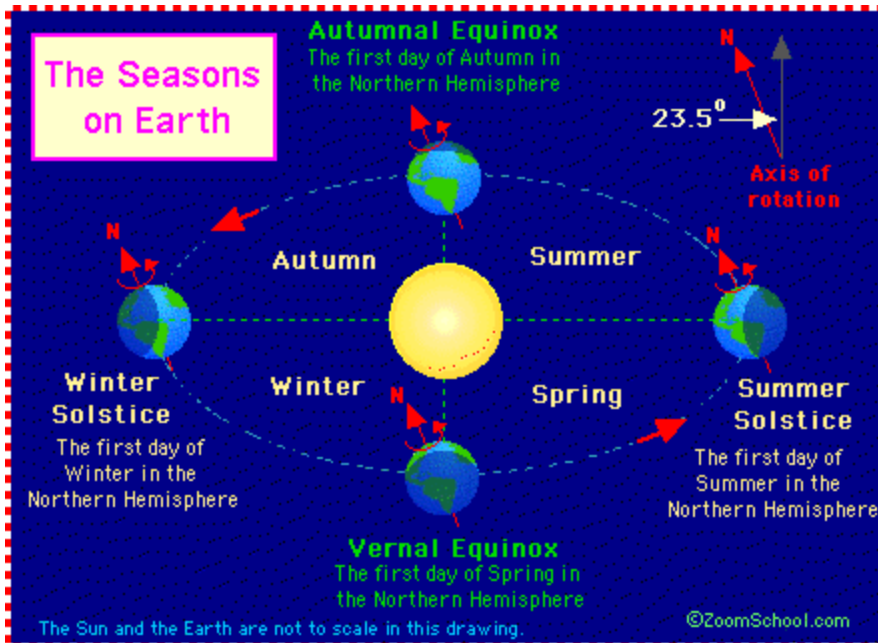
Revolution

Earth *revolves* or orbits around the Sun once every 365-1/4 days or one year

Earth is closest about 3 Jan (*perihelion*) and farthest about 3 Jul (*aphelion*). But the difference is not great enough to cause seasons

Tilt of Earth's Axis and Seasons

Earth's axis is tilted about $23\text{-}1/2^\circ$, so locations in the northern and southern hemispheres receive different amounts of solar energy at different times of the year. This creates the seasons—summer, fall, winter, and spring



- <http://www.enchantedlearning.com/subjects/astronomy/planets/earth/Seasons.shtml>

Solar “Altitude” and Englewood

- Englewood ‘s latitude is approximately 40° N of the equator
- When the Sun is directly over the equator at the equinoxes (Mar 20 and Sep 20), the Sun has an *altitude* of (appears to be) about 50° above the horizon at “solar noon” (exactly south of us) [90 – 40]
- At the Summer Solstice when the Sun is over the Tropic of Cancer ($23\text{-}1/2^{\circ}$ N), the Sun is $73\text{-}1/2^{\circ}$ above the horizon at solar noon
- At the Winter Solstice when the Sun is over the Tropic of Capricorn ($23\text{-}1/2^{\circ}$ S), the Sun is $26\text{-}1/2^{\circ}$ above the horizon at solar noon

Changes in Day and Night Length

- Locations at the equator always have 12 hr day and 12 hr night
- Locations north and south of the equator have varying amounts of day and night
- Longest day – Summer Solstice
- Longest night – Winter Solstice
- Englewood gets about 15 hr 10 min day at the Summer Solstice
- Englewood gets about 8 hr 50 min day at the Winter Solstice