

Introduction to the Atmosphere

Approximately 80% of our air pollution stems from hydrocarbons released from vegetation, so let's not go overboard in setting and enforcing tough emission standards from man-made sources.

— Ronald Reagan



Introduction to the Atmosphere

- ❖ Size of Earth's Atmosphere
- ❖ Composition of the Atmosphere
- ❖ Vertical Structure of the Atmosphere
- ❖ Human-Induced Atmospheric Change
- ❖ Weather and Climate



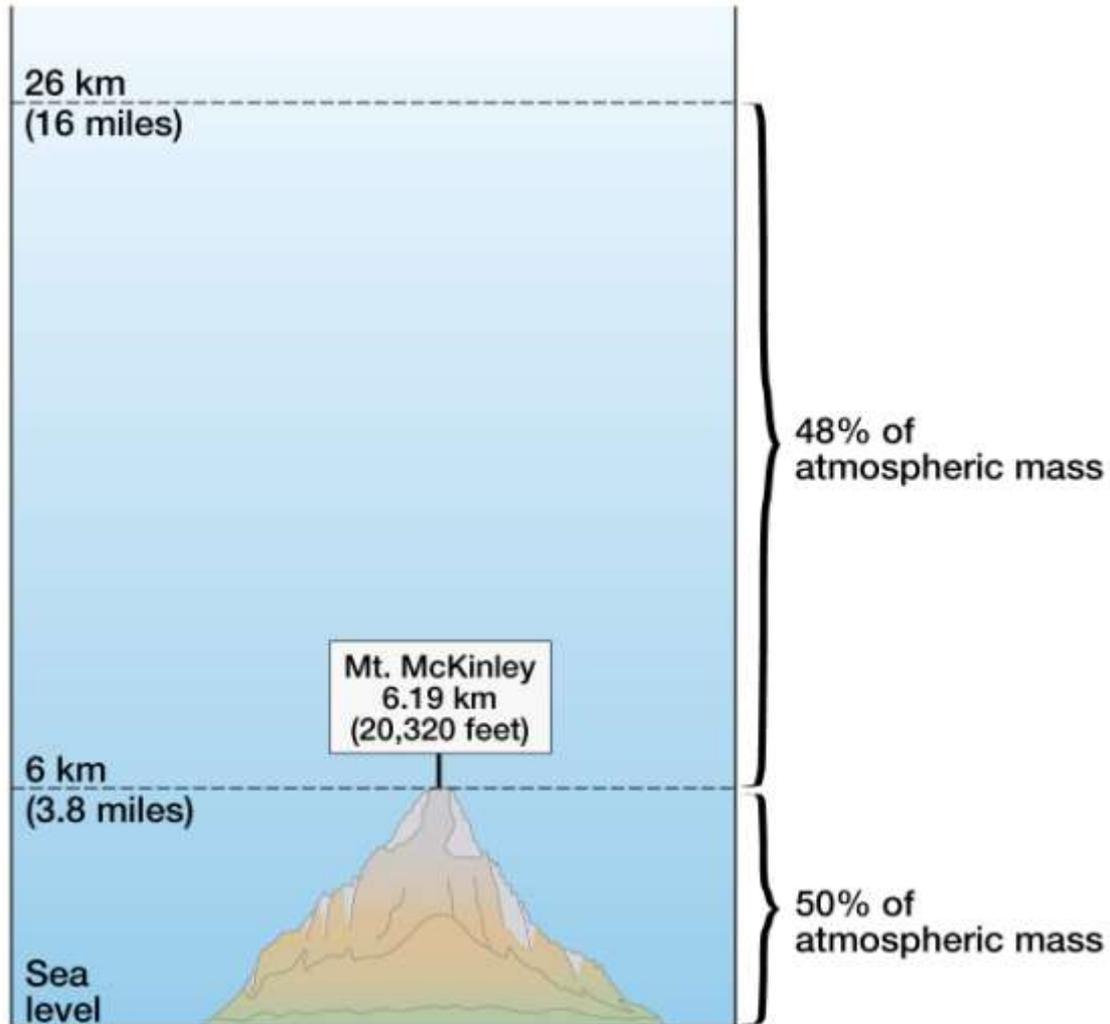
Size of Earth's Atmosphere

- Shallow, encircling envelope of gases that makes life possible
- Unique amongst the planets





Gravity and density

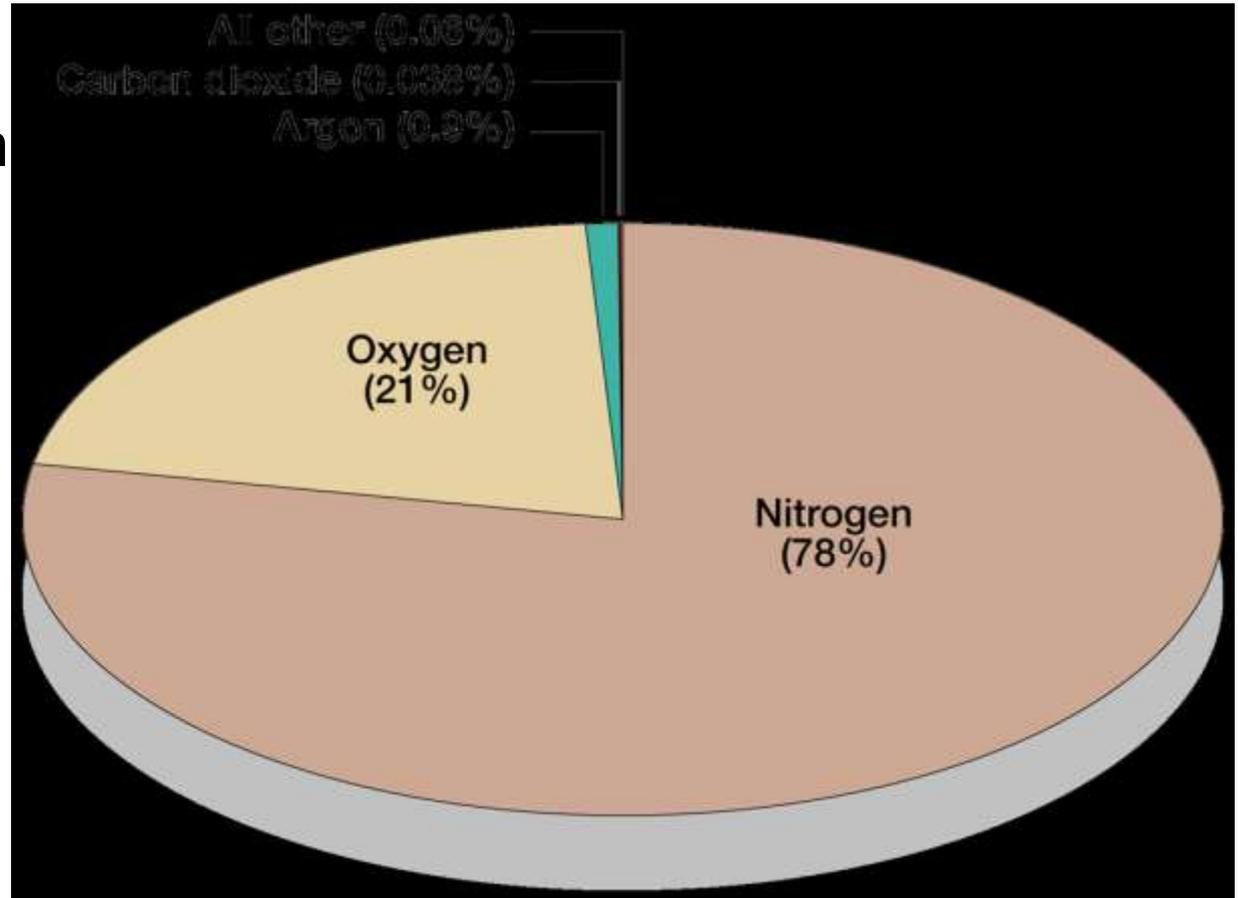




Composition of the Atmosphere

- Permanent Gases

- Nitrogen and oxygen dominant





Variable Gases

- Water Vapor
- Carbon Dioxide
- Ozone

Gas	Percent of Volume of Dry Air	Concentration in Parts per Million Parts of Air
<i>Permanent gases</i>		
Nitrogen (N ₂)	78.084	
Oxygen (O ₂)	20.946	
Argon (Ar)	0.934	
Neon (Ne)	0.00182	18.2
Helium (He)	0.00052	5.2
Krypton (Kr)	0.00011	1.1
Hydrogen (H ₂)	0.00005	0.5
<i>Variable gases</i>		
Water vapor (H ₂ O)	0–4	
Carbon dioxide (CO ₂)	0.038	380
Carbon Monoxide (CO)		Less than 100
Methane (CH ₄)	0.00017	1.7
Ozone (O ₃)		Less than 2
Sulfur dioxide (SO ₂)		Less than 1
Nitrogen dioxide (NO ₂)		Less than 0.2



Particulates (Aerosols)

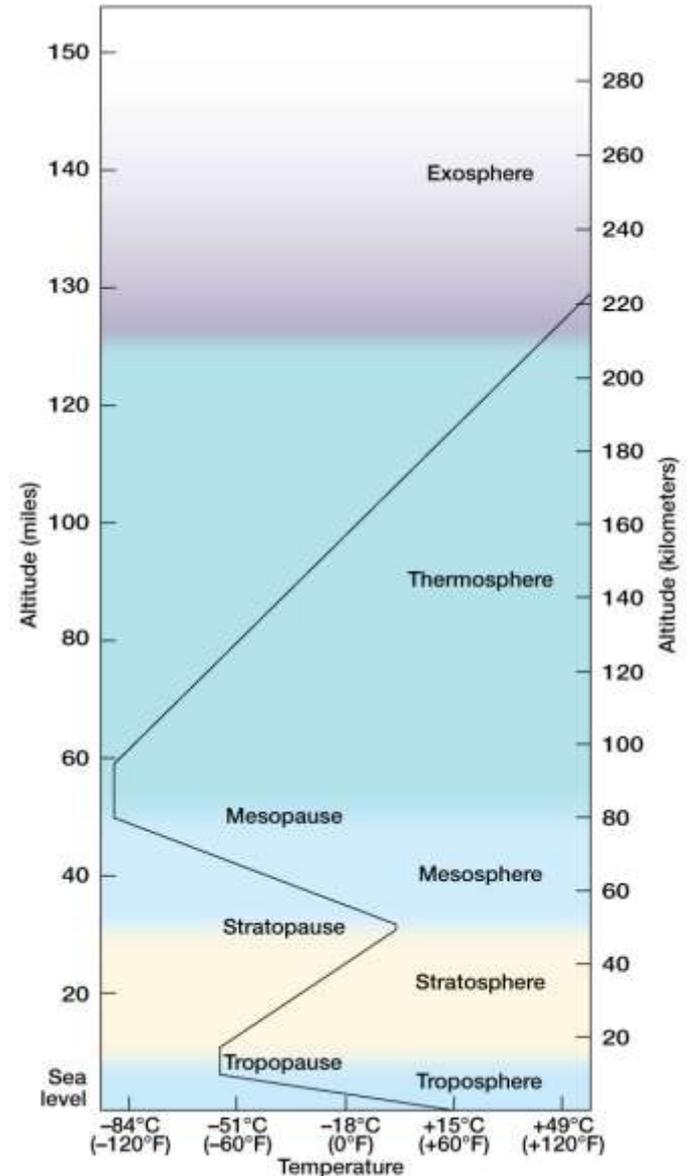
- Tiny solid and liquid particles
- Effects on weather and climate





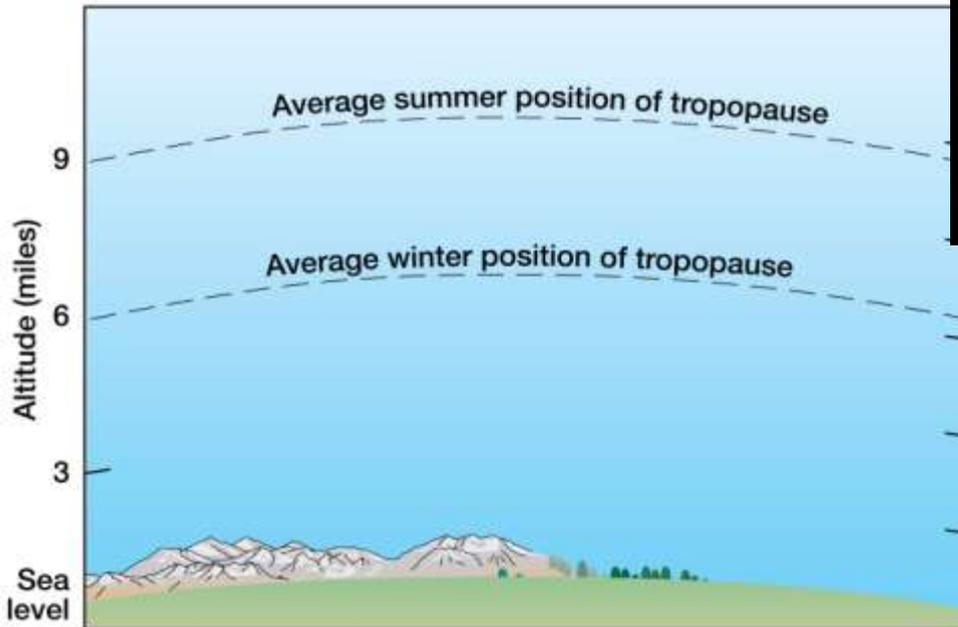
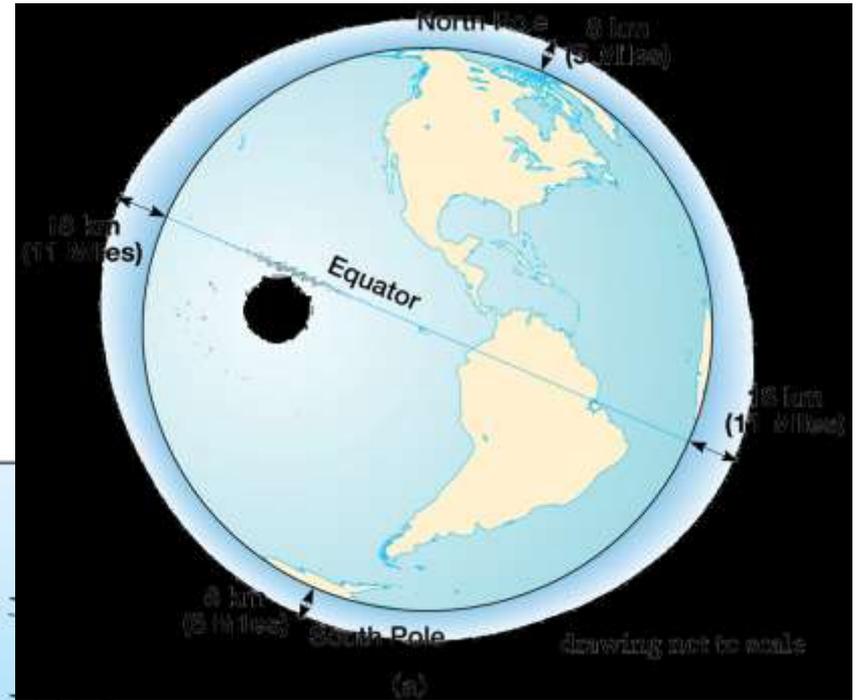
Vertical Structure of the Atmosphere

- Temperature
 - Thermal layers
 - Troposphere
 - Stratosphere
 - Mesosphere
 - Thermosphere
 - Exosphere





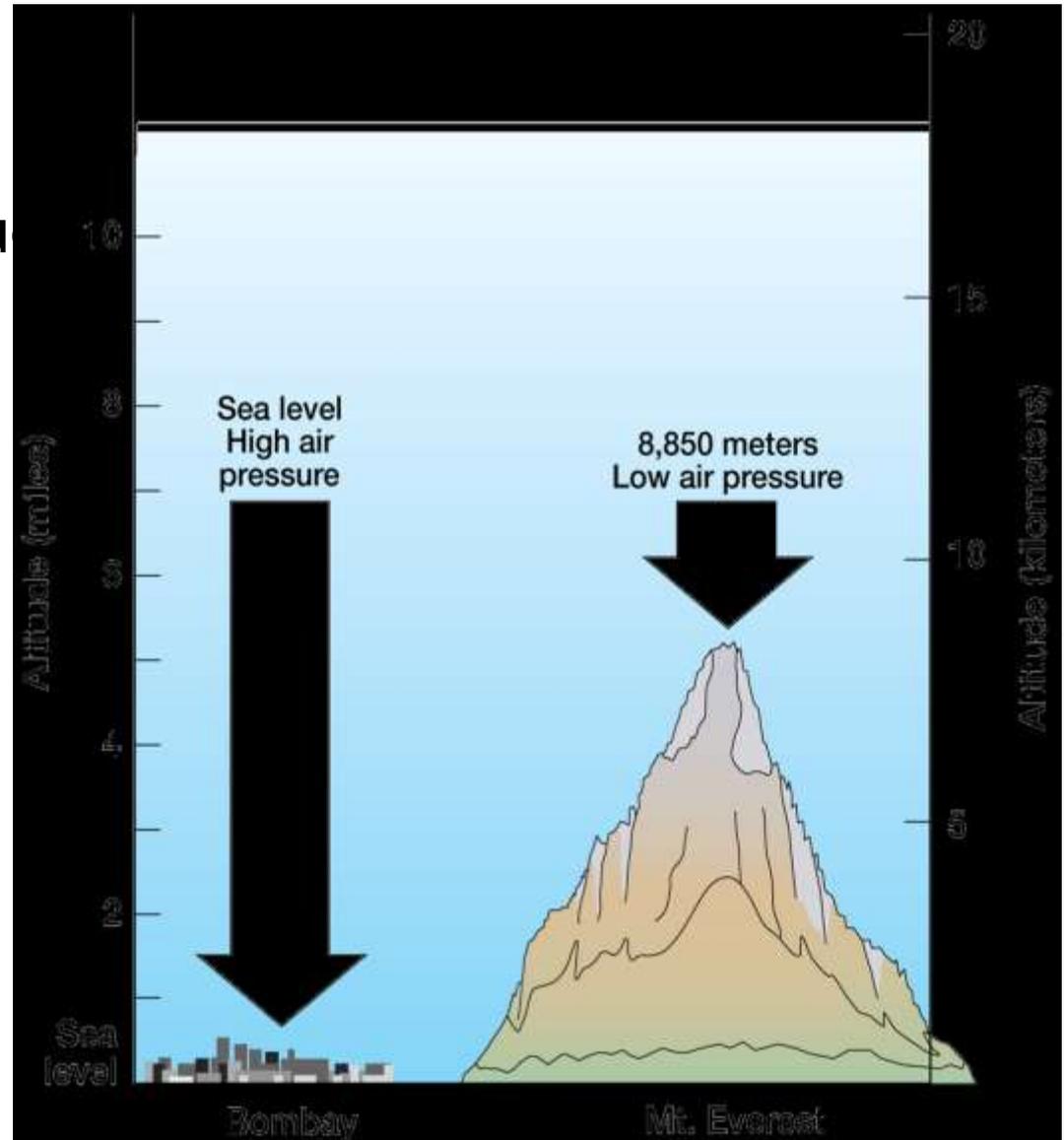
- Troposphere
 - Our weather occurs here



(b)

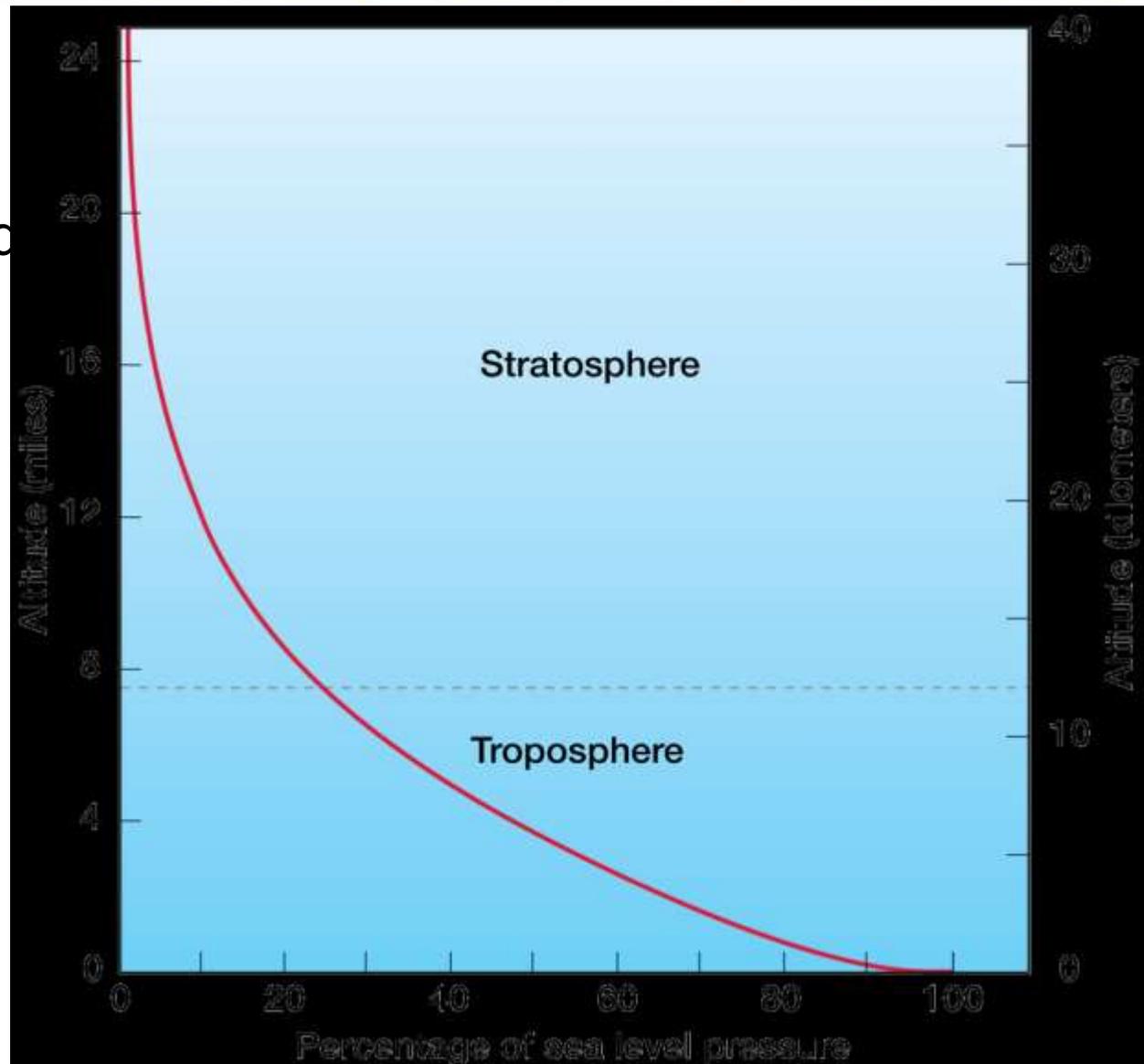


- Pressure
 - Decreases with increasing altitude





Air pressure decreases with increasing altitude but not at a constant rate/





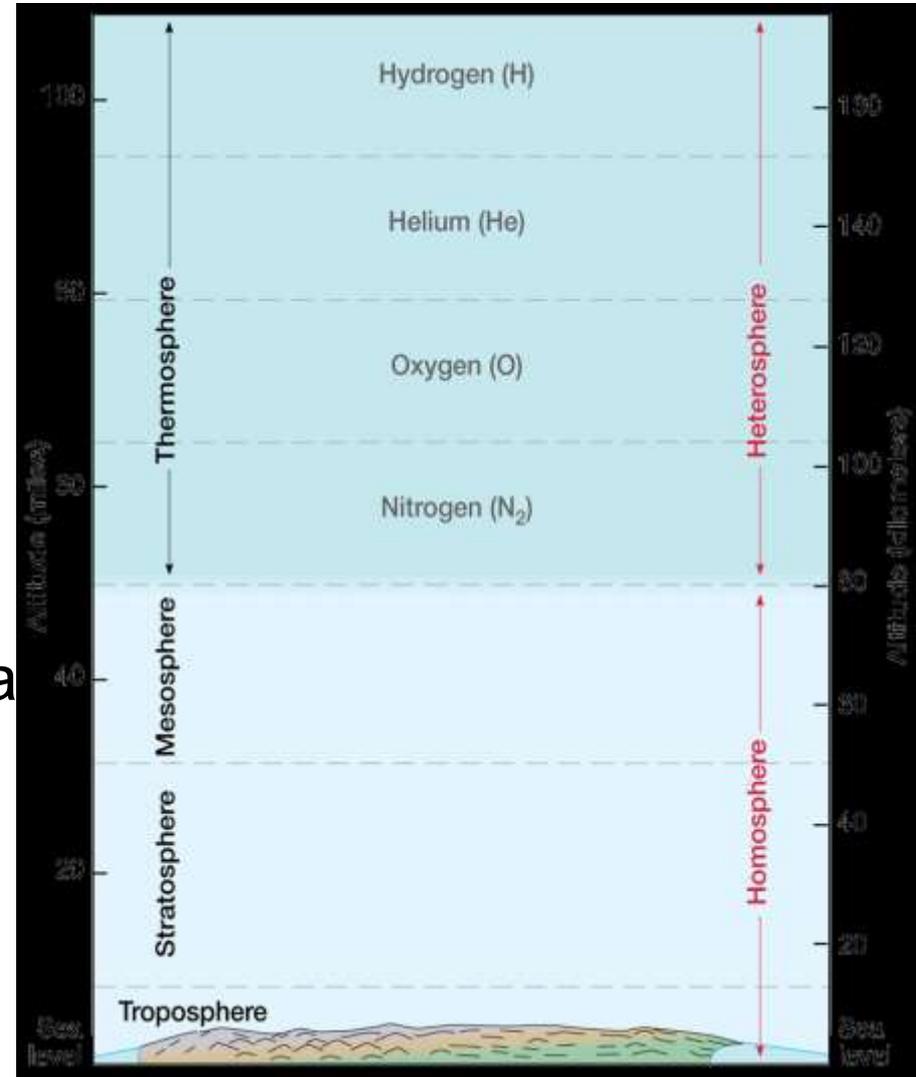
Atmospheric Pressure at Various Altitudes (Expressed as a percentage of sea-level pressure)

Altitude		<i>Percentage of Sea-Level Pressure</i>
<i>Kilometers</i>	<i>Miles</i>	
0	0	100
5.5	3.5	50
16	10	10
32	20	1
48	30	0.1
80	50	0.001
96	60	0.00001



Composition

- Homosphere
 - Zone of uniform distribution of gases
- Heterosphere
 - Zone of layers
 - Gases are in layers according to molecular weights

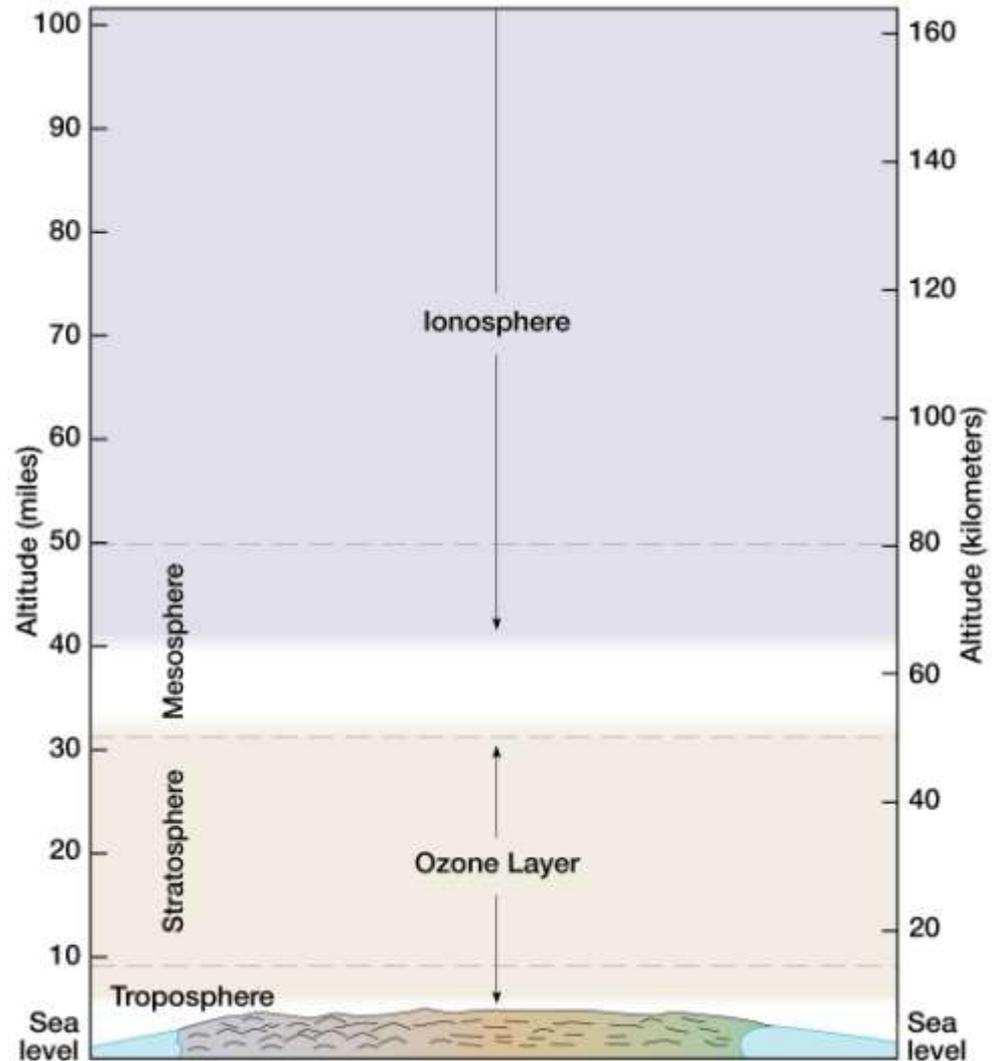




- Special layers
 - Ozonosphere
 - Ionosphere



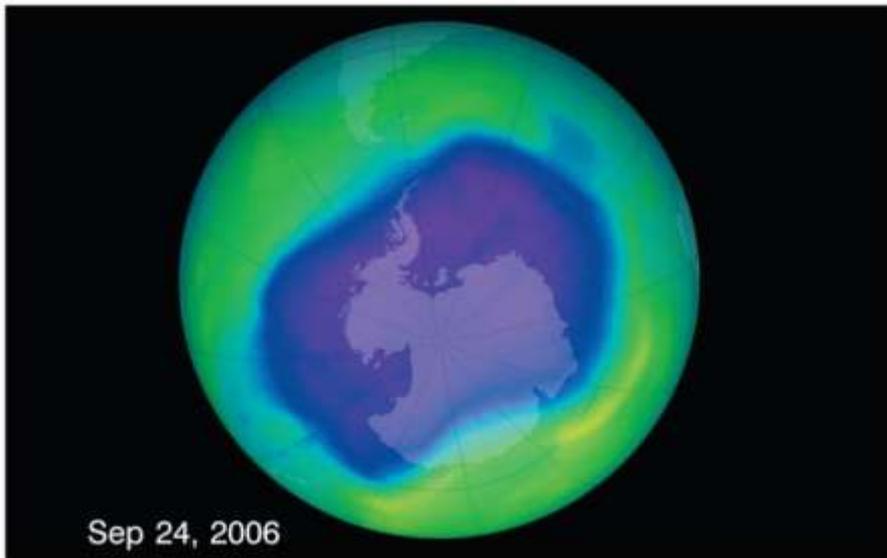
Aurora Borealis in the Ionosphere



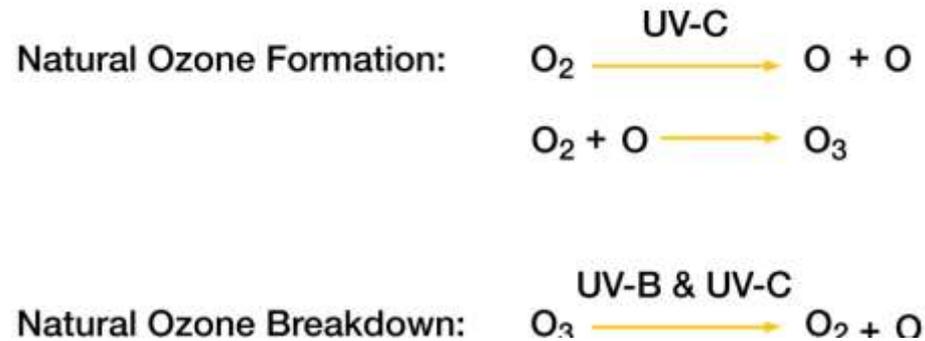


Human-Induced Atmospheric Change

- Ozone Depletion
Animation



Antarctic Ozone Hole





- Pollution

- Smoke
- Sulfur Compounds
- Nitrogen Compounds
- Photochemical Smog
- Consequences of Anthropogenic Pollution
 - Adverse effects on human health
 - Acid rain effects on plants and fish



Smog in Santiago, Chile



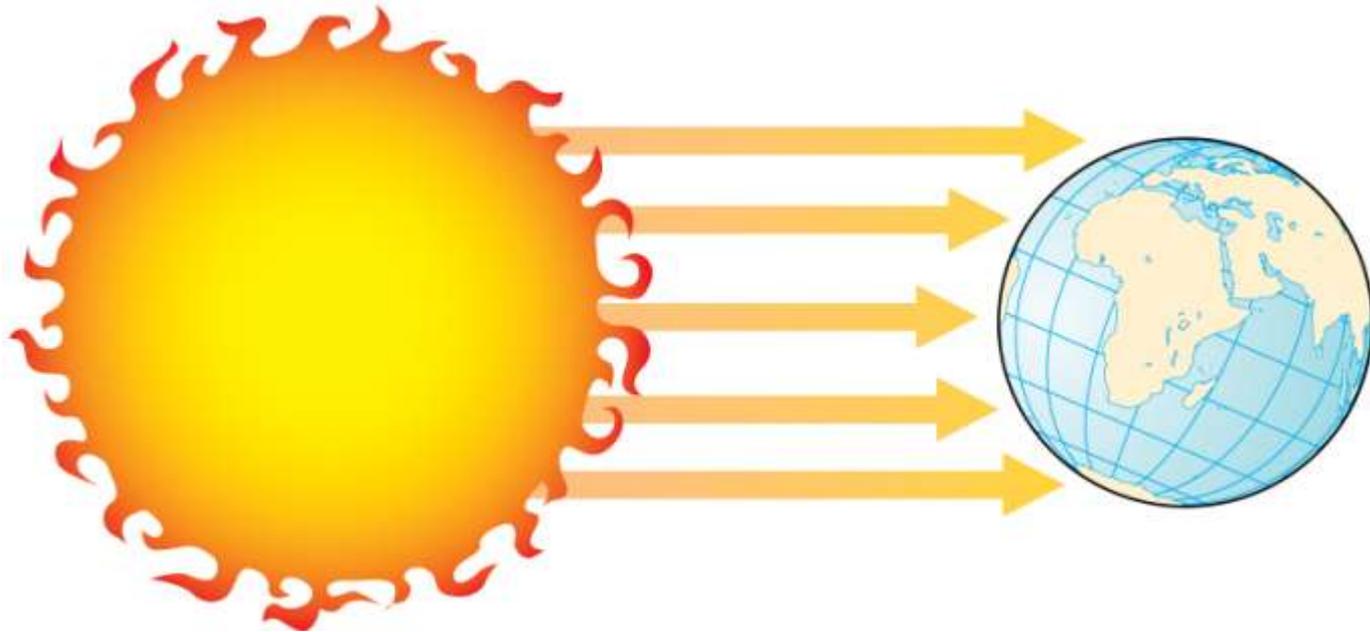
Weather and Climate

- Weather versus Climate

Elements of weather and climate	Controls of weather and climate
Temperature	Latitude
Pressure	Distribution of land and water
Wind	General circulation of the atmosphere
Moisture content	General circulation of the oceans
	Altitude
	Topographic barriers
	Storms

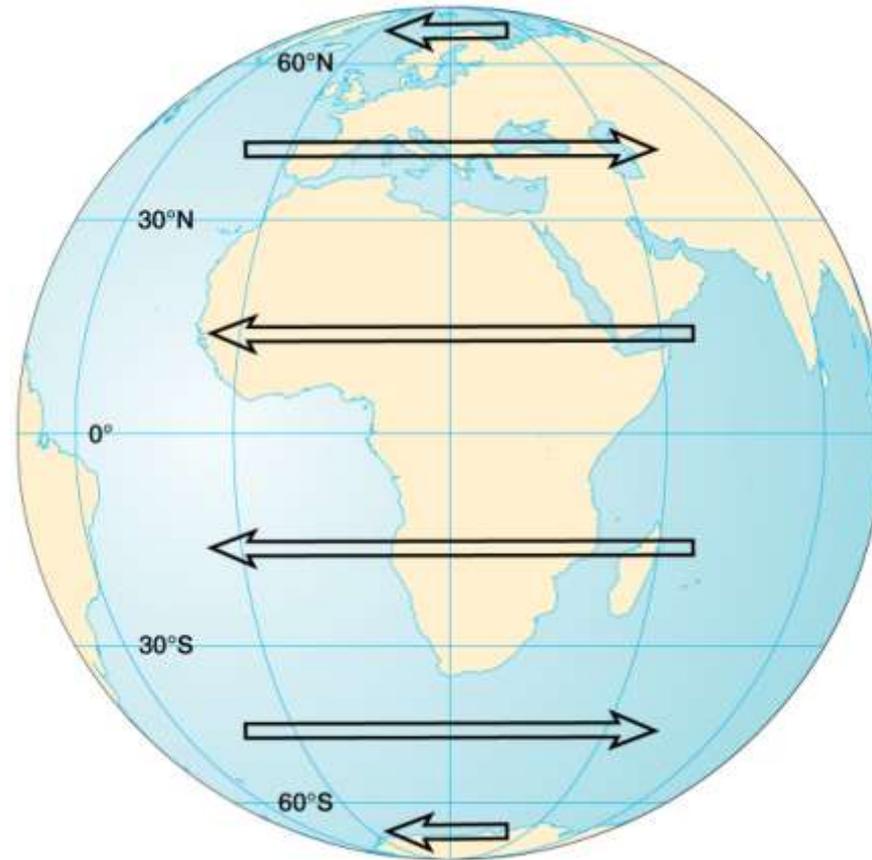


Latitude and Available Solar Energy



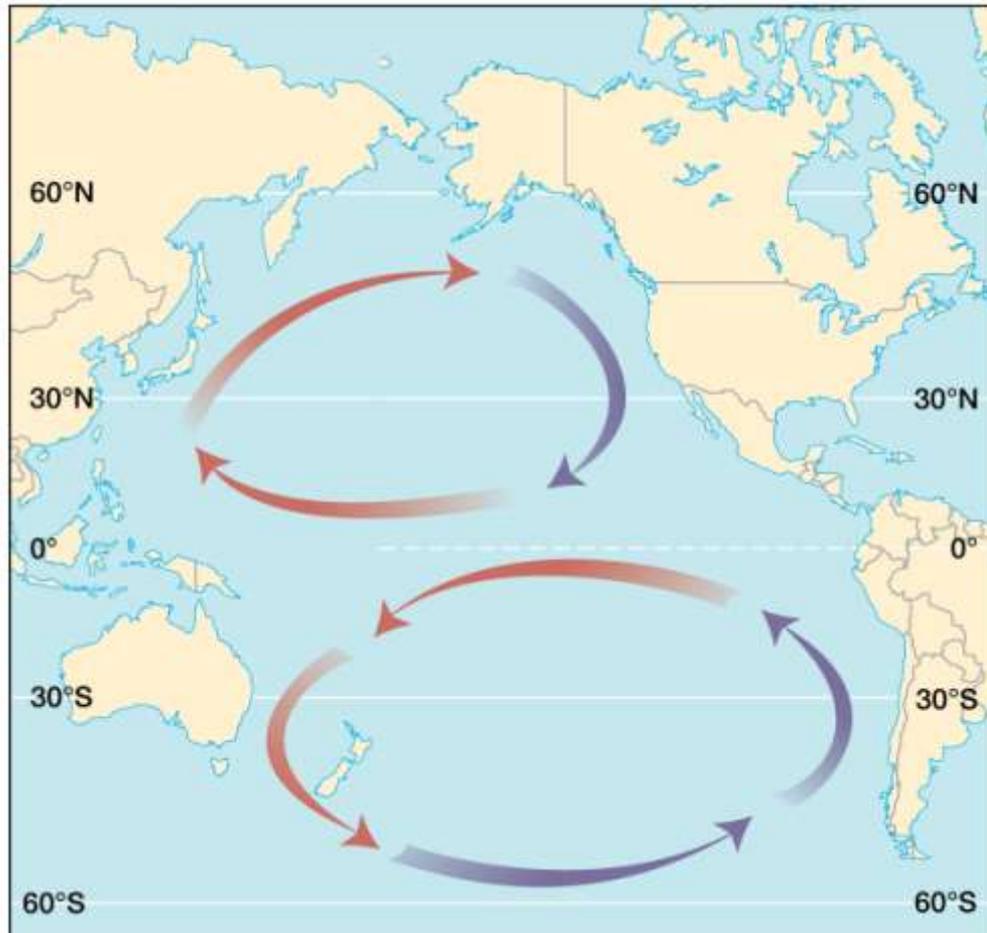


General Circulation of the Atmosphere





General Circulation of the Oceans



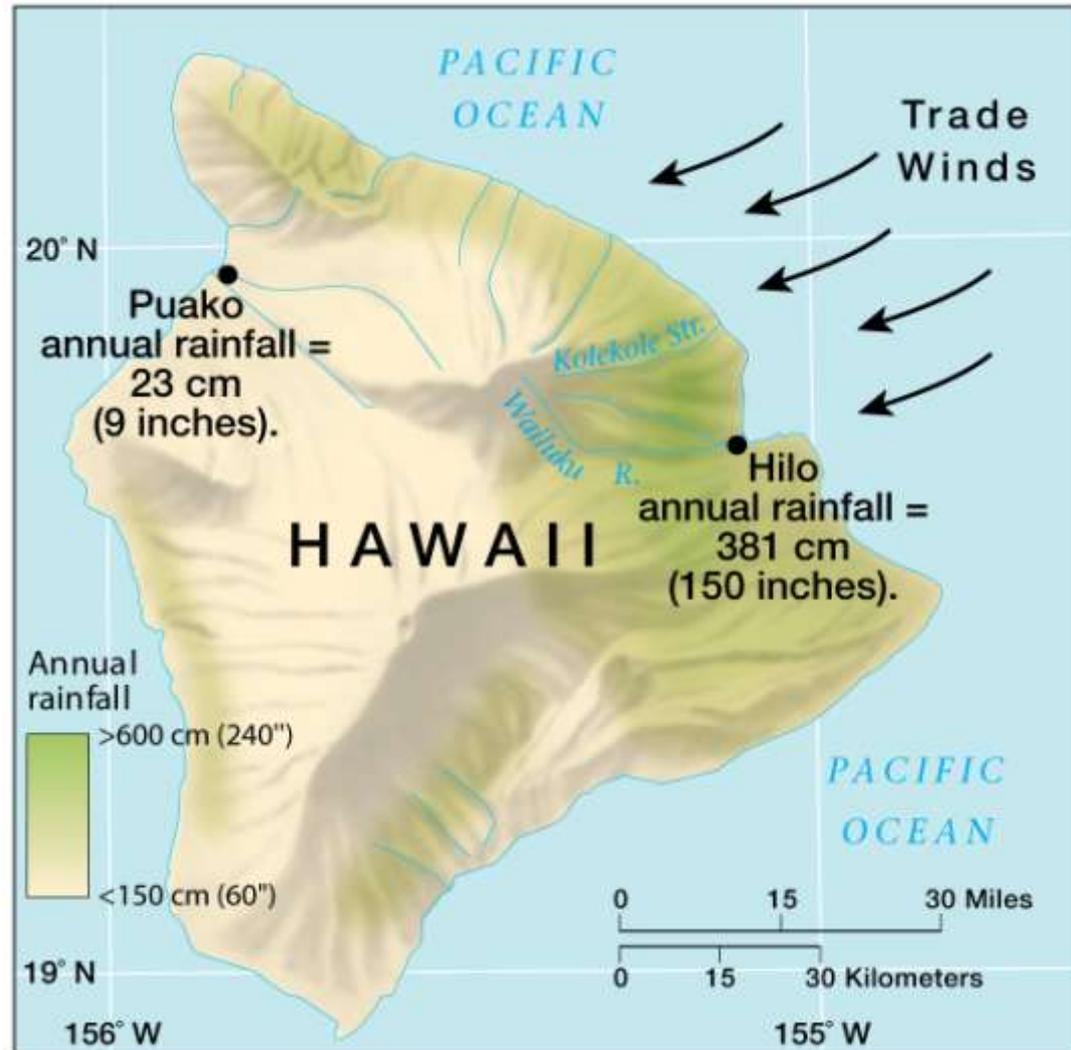


Elevation





Topographic Barriers





Storms





- **Coriolis Effect**

- Definition

- An apparent deflection of any freely moving object from its expected (straight) path

- Four basic points to remember

1. Apparent deflection is to the right in the N.H., to the left in the S.H.
2. Apparent deflection is greatest at the poles, progressively less toward the equator, where there is zero deflection.
3. The effect is proportional to the speed of the object, so a fast-moving object is deflected more than a slower one.
4. The effect influences the direction of movement, not the speed.

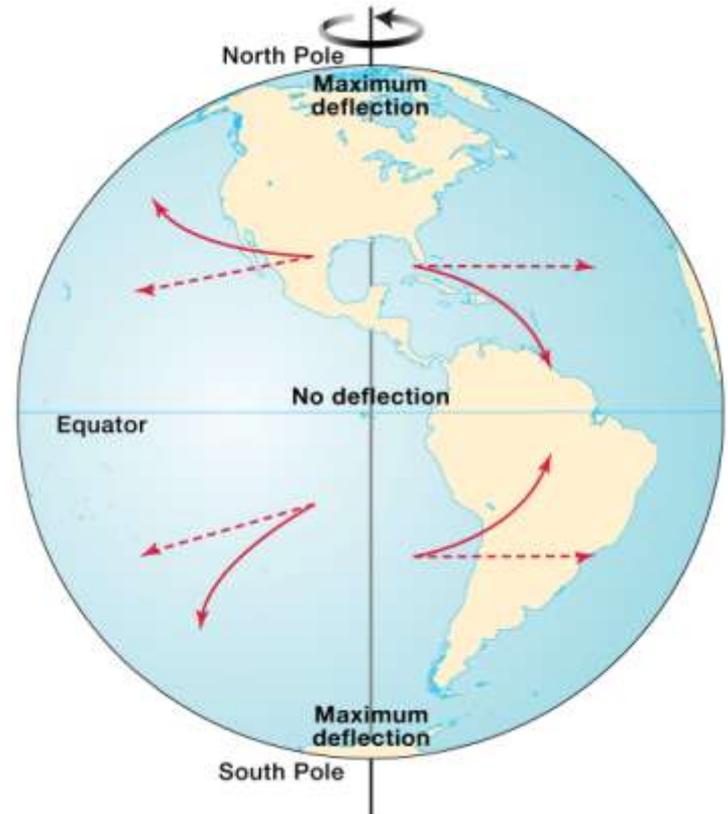


- Coriolis Effect

- Significance

- Winds
 - Ocean currents

Animation 





Summary

- The atmosphere makes life possible.
- The two dominant gases of the atmosphere are nitrogen and oxygen.
- The vertical structure of the atmosphere is complex and varies in terms of density, pressure, temperature and composition.
- Human activities cause changes in the atmosphere.



- Weather takes place in the lowest layer of the atmosphere.
- Weather and climate have different meanings, but they share the same elements.
- The four principal elements of weather and climate are temperature, moisture content, pressure and wind.



- The main controls of these elements are latitude, global distribution of oceans and land masses, circulation of the air in the atmosphere and water in the oceans, altitude, topography and storms systems.
- The Coriolis effect plays an important role in the atmosphere as it affects the formation of storms and the direction of winds, which are important elements of Earth's climate system.