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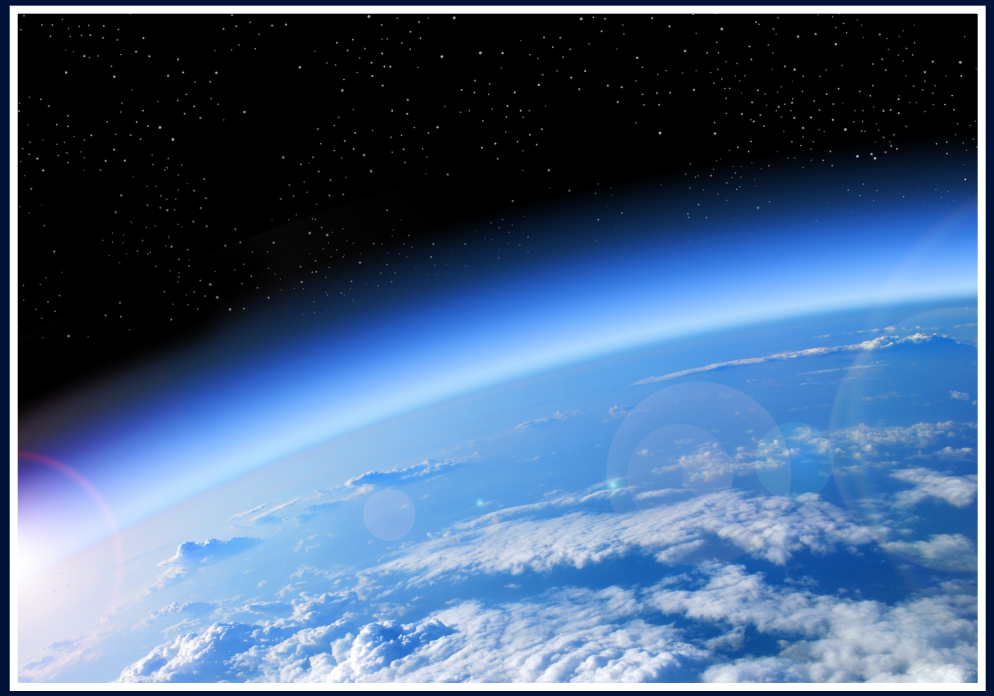

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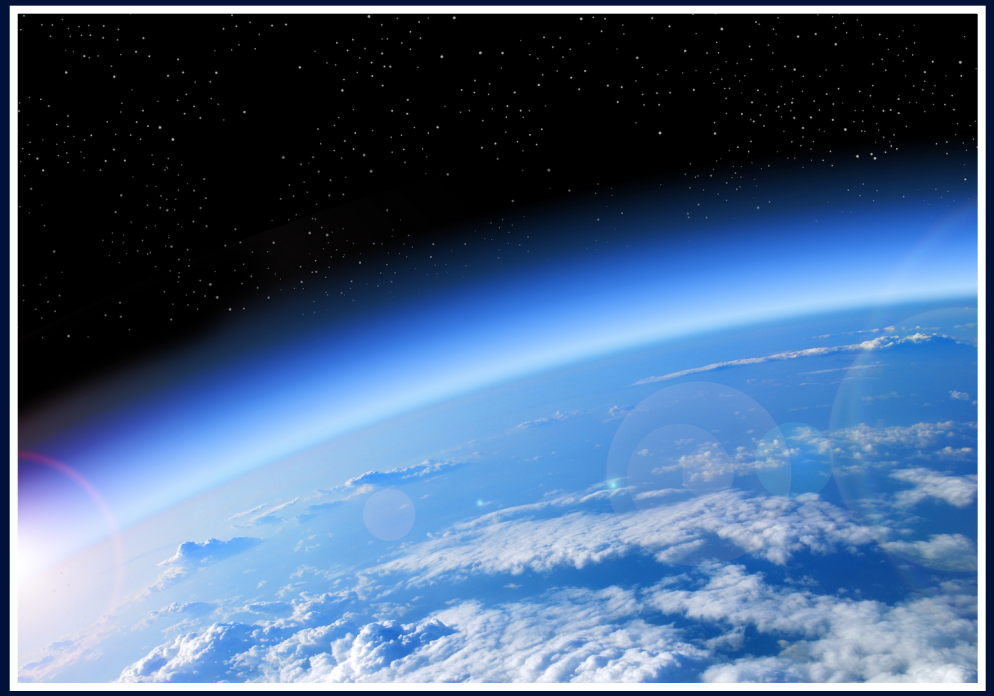

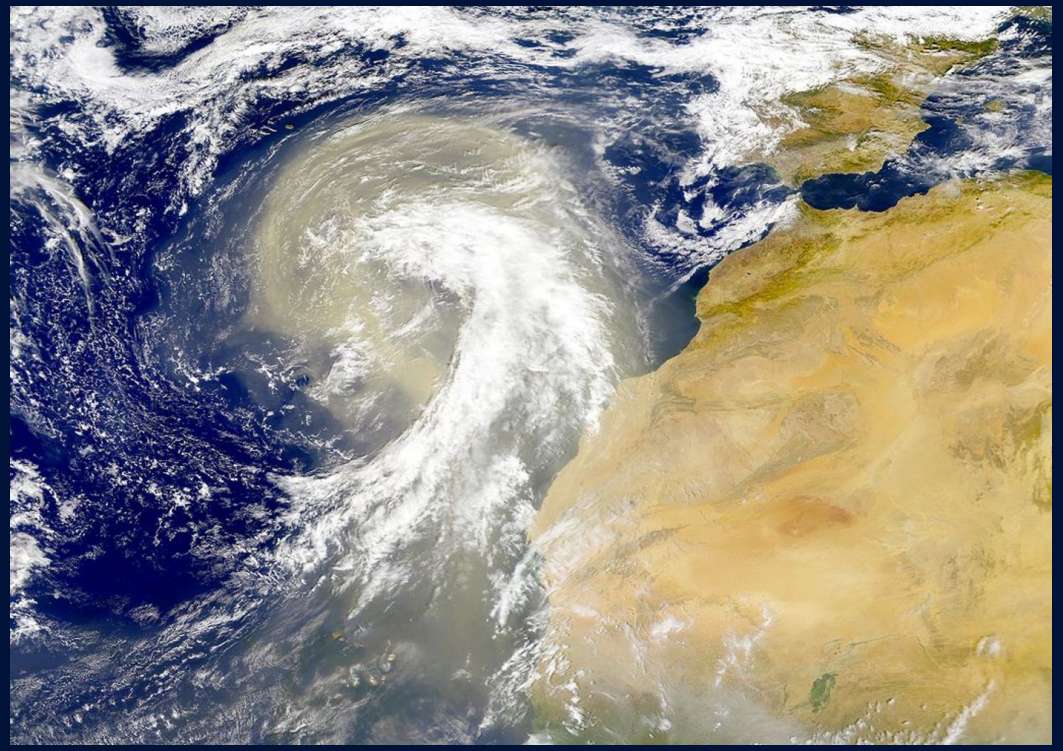

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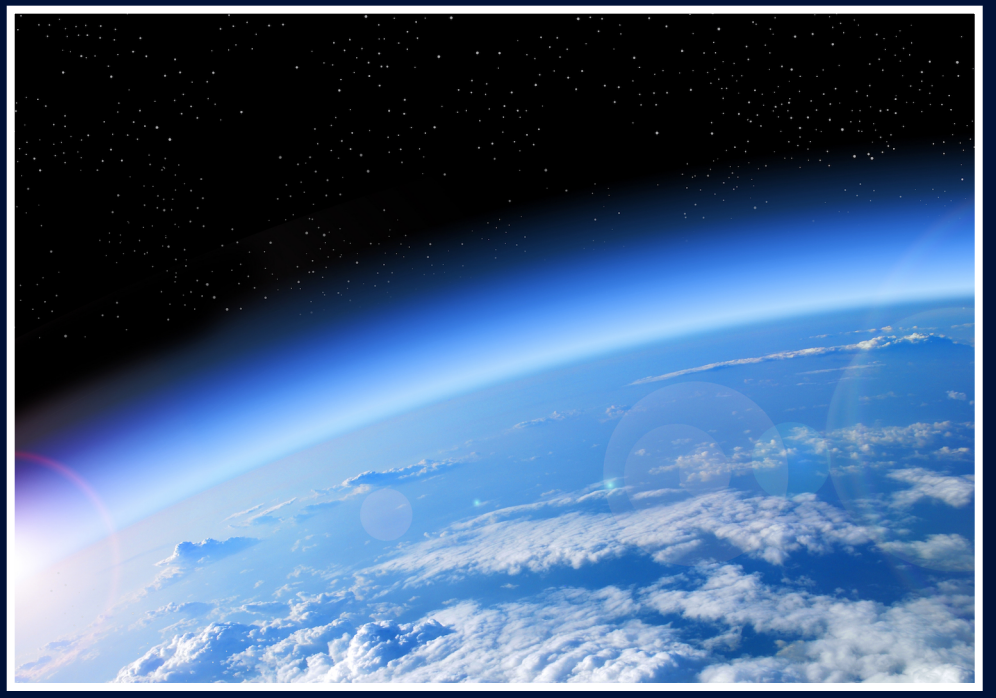

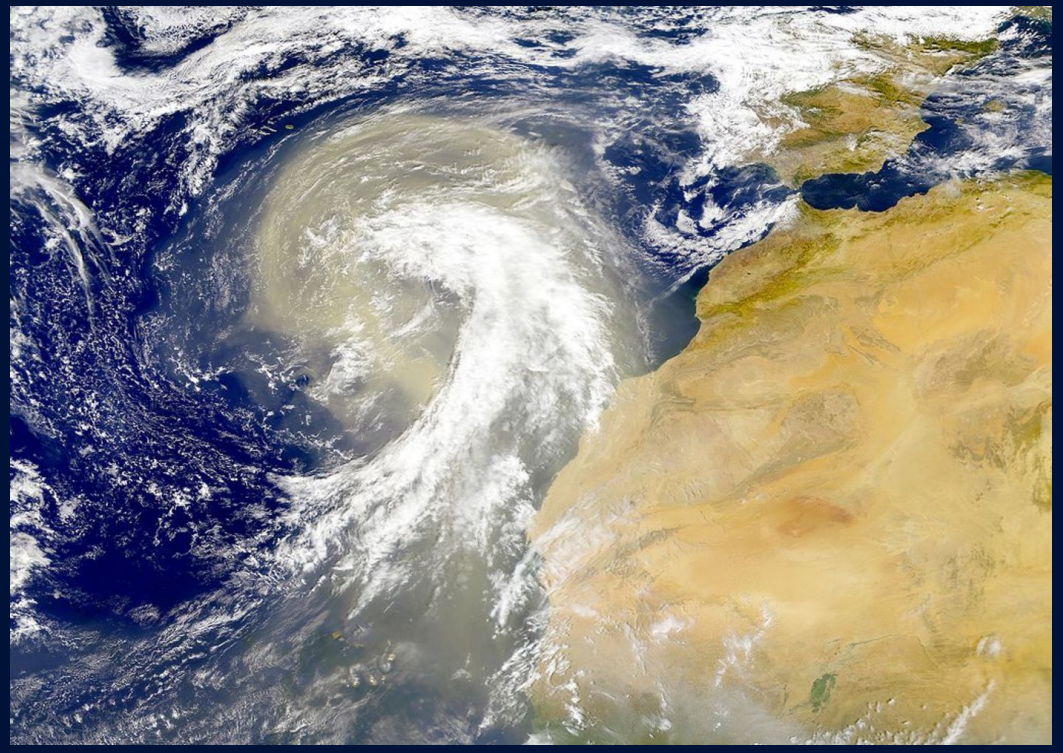

~ The ***composition*** of the atmosphere is not constant, but there are ***two gases*** that make up **99%** of clean, dry air: ***nitrogen*** (N_2; 78%) and ***oxygen*** (O_2; 21%).

Chemical Composition of Air		
Name	**Symbol**	**% by volume**
Nitrogen	N2	78.084 %
Oxygen	O2	20.9476 %
Argon	Ar	0.934 %

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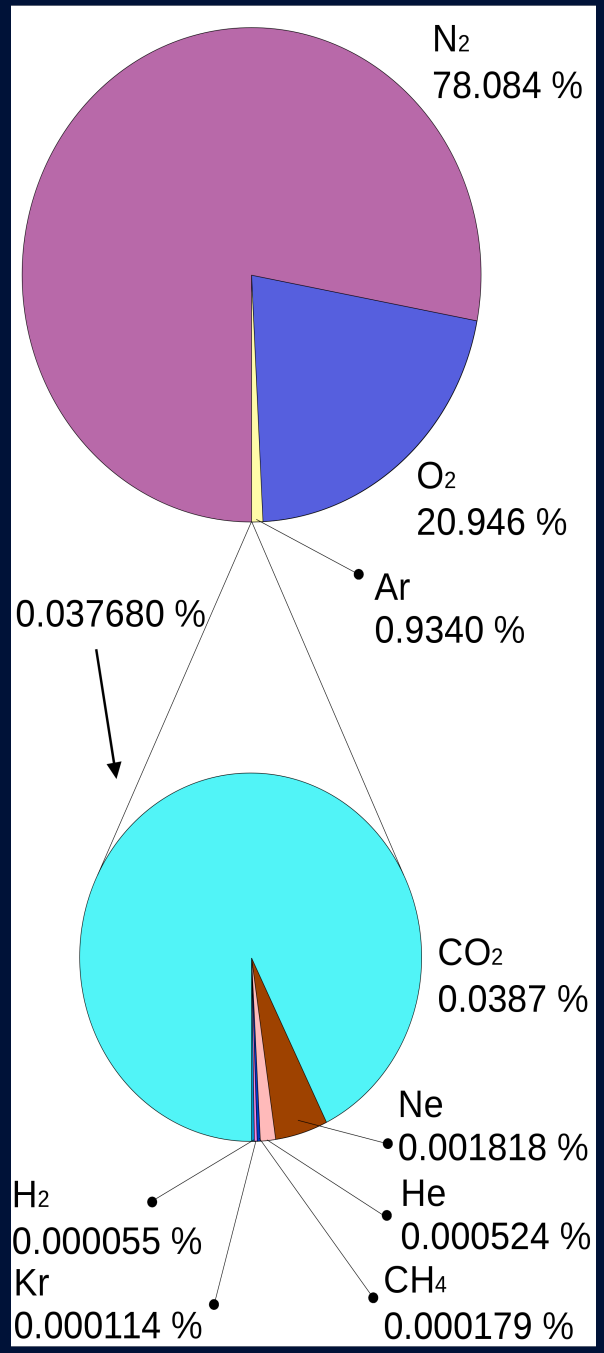

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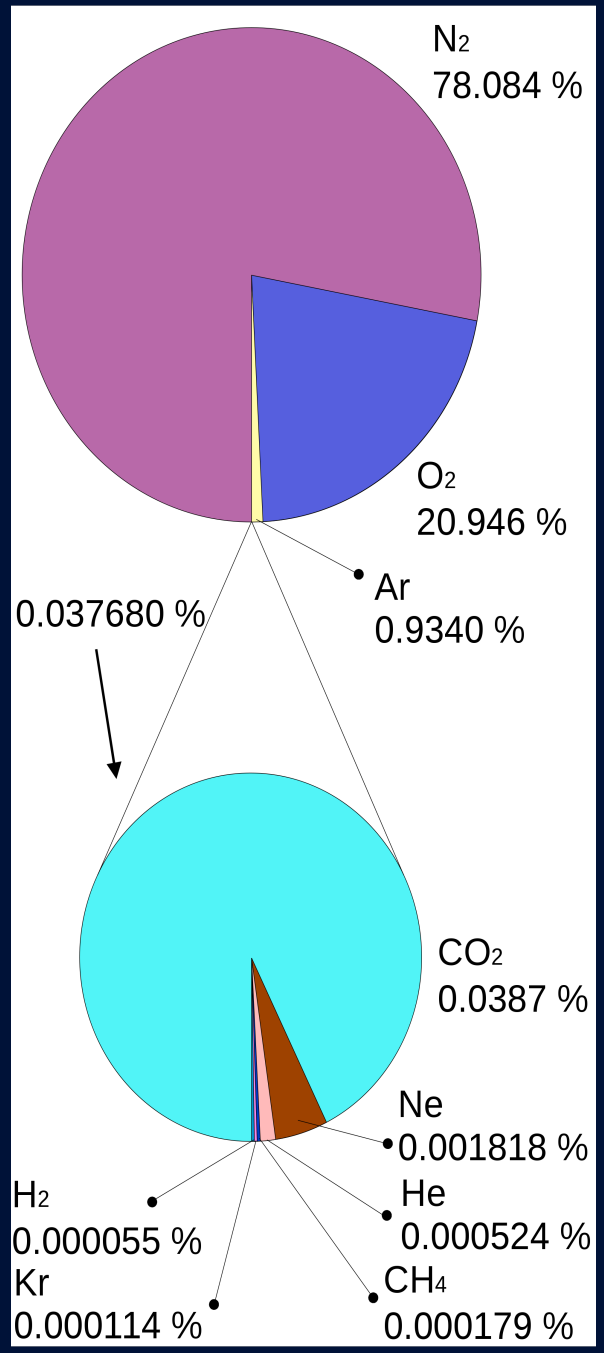
~ It is this ***< .07%*** that is most ***important meteorologically*** as N_2, O_2, and Ar are of great importance to life, but have little effect on weather.



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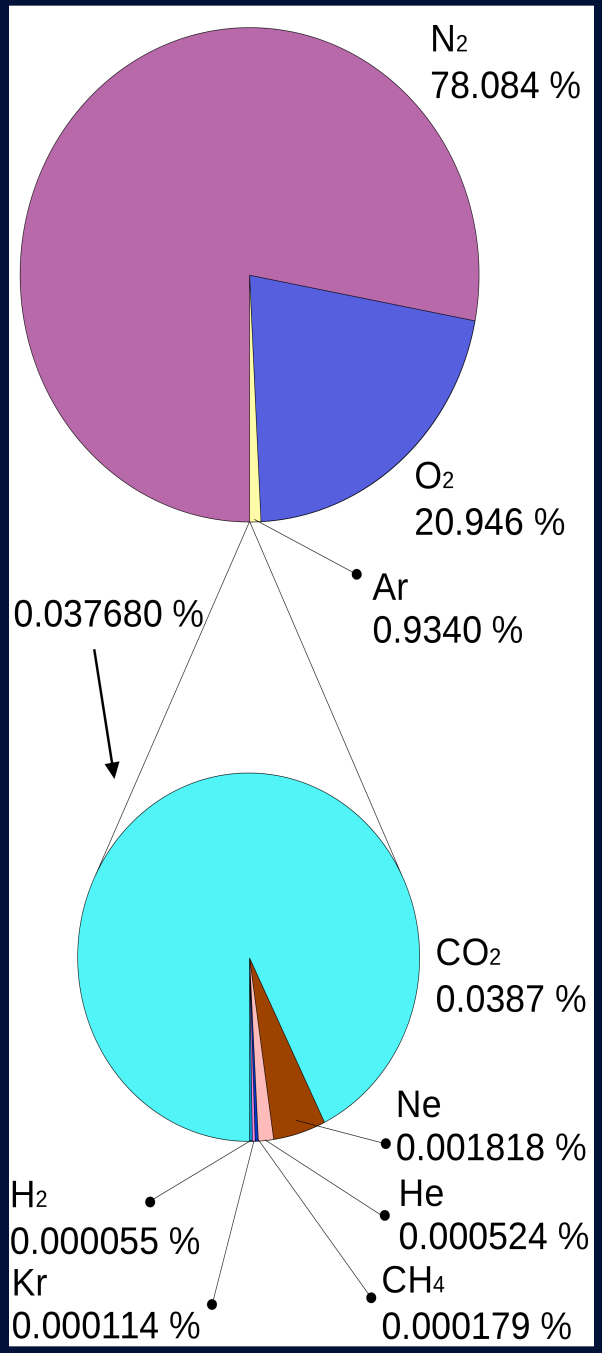

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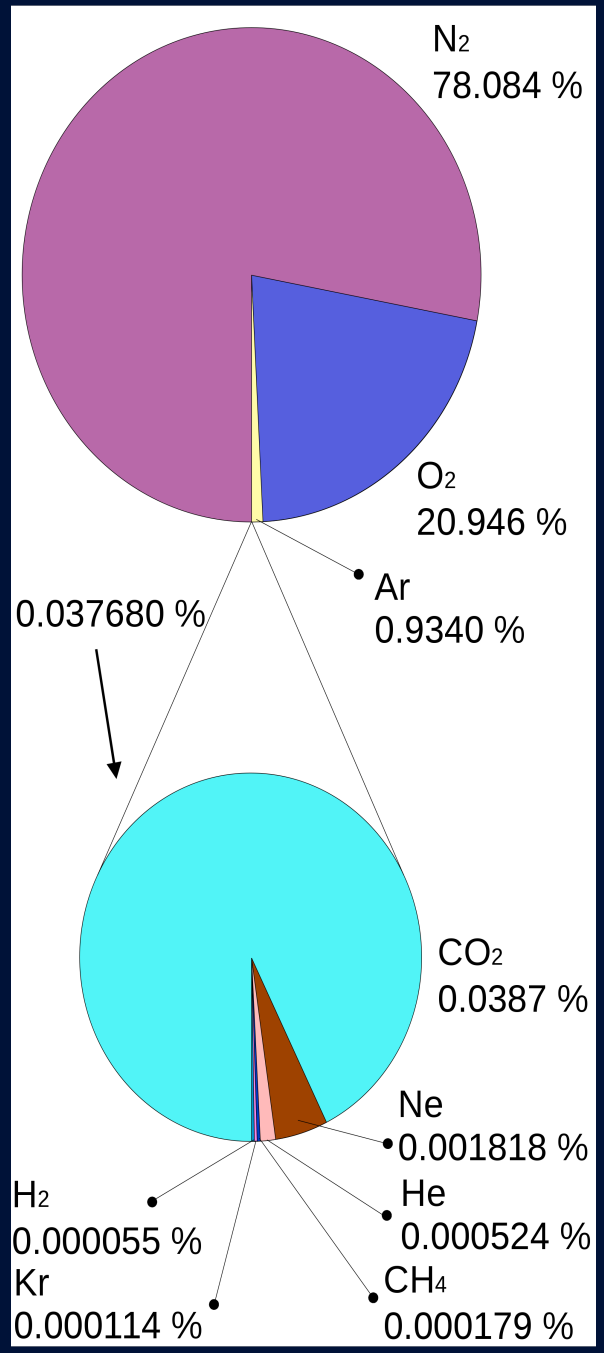

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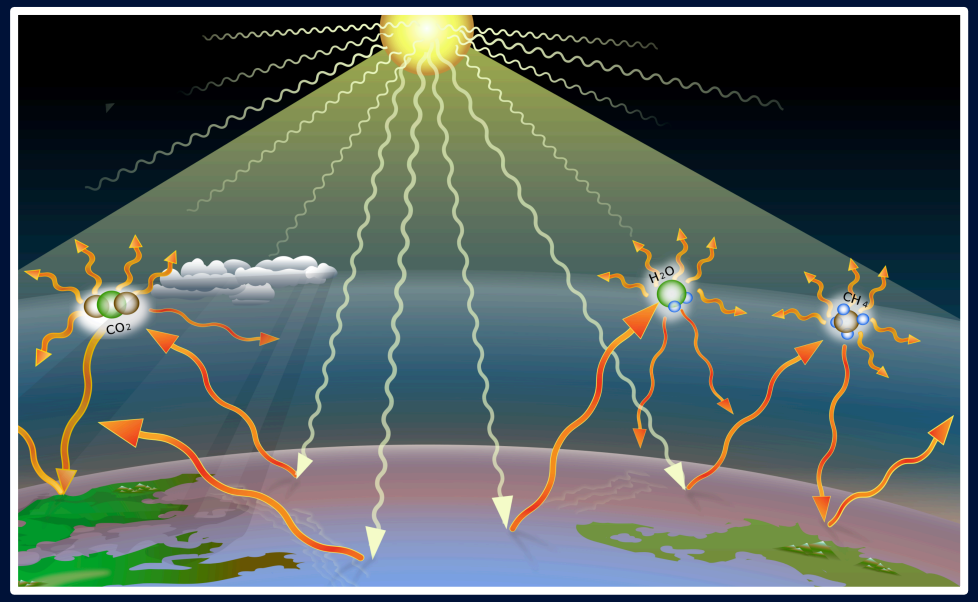

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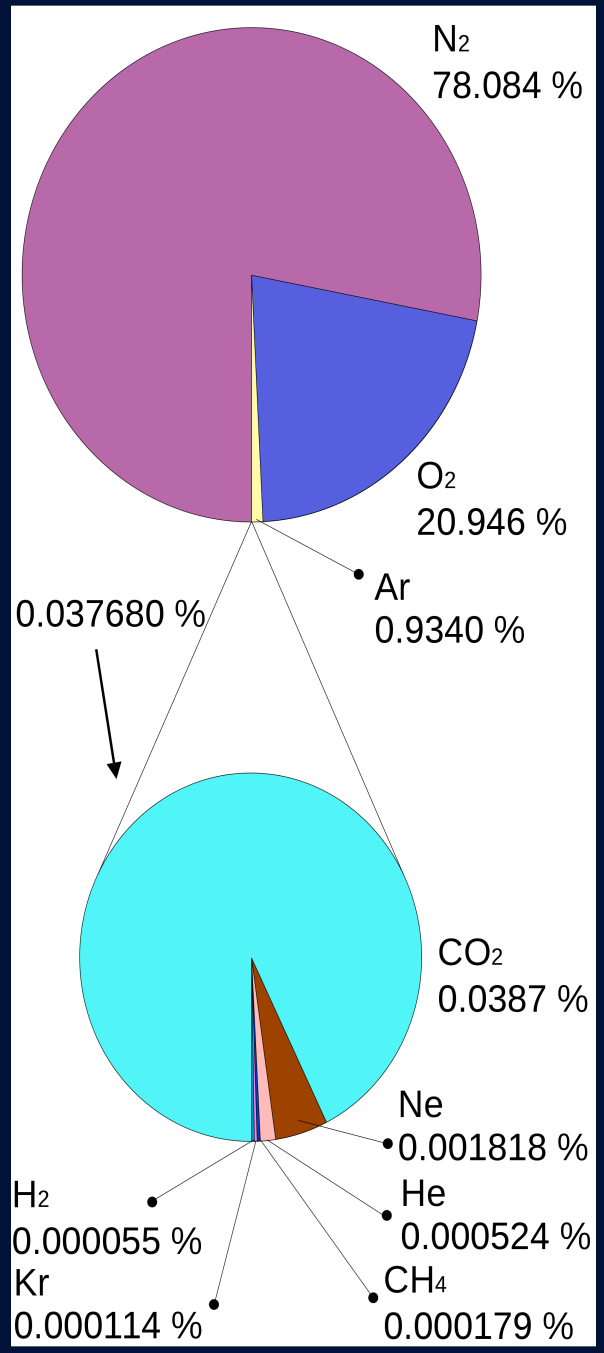

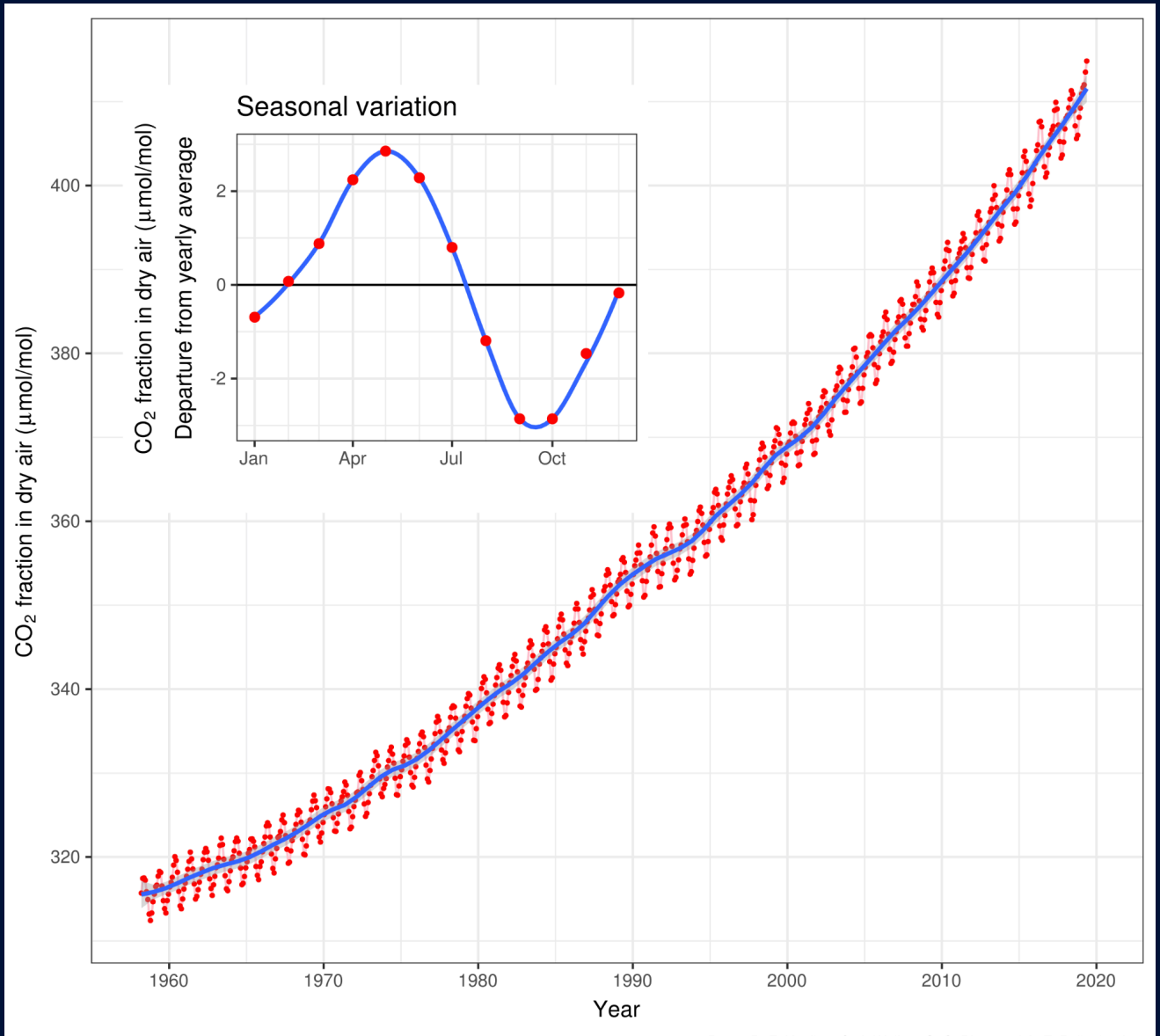

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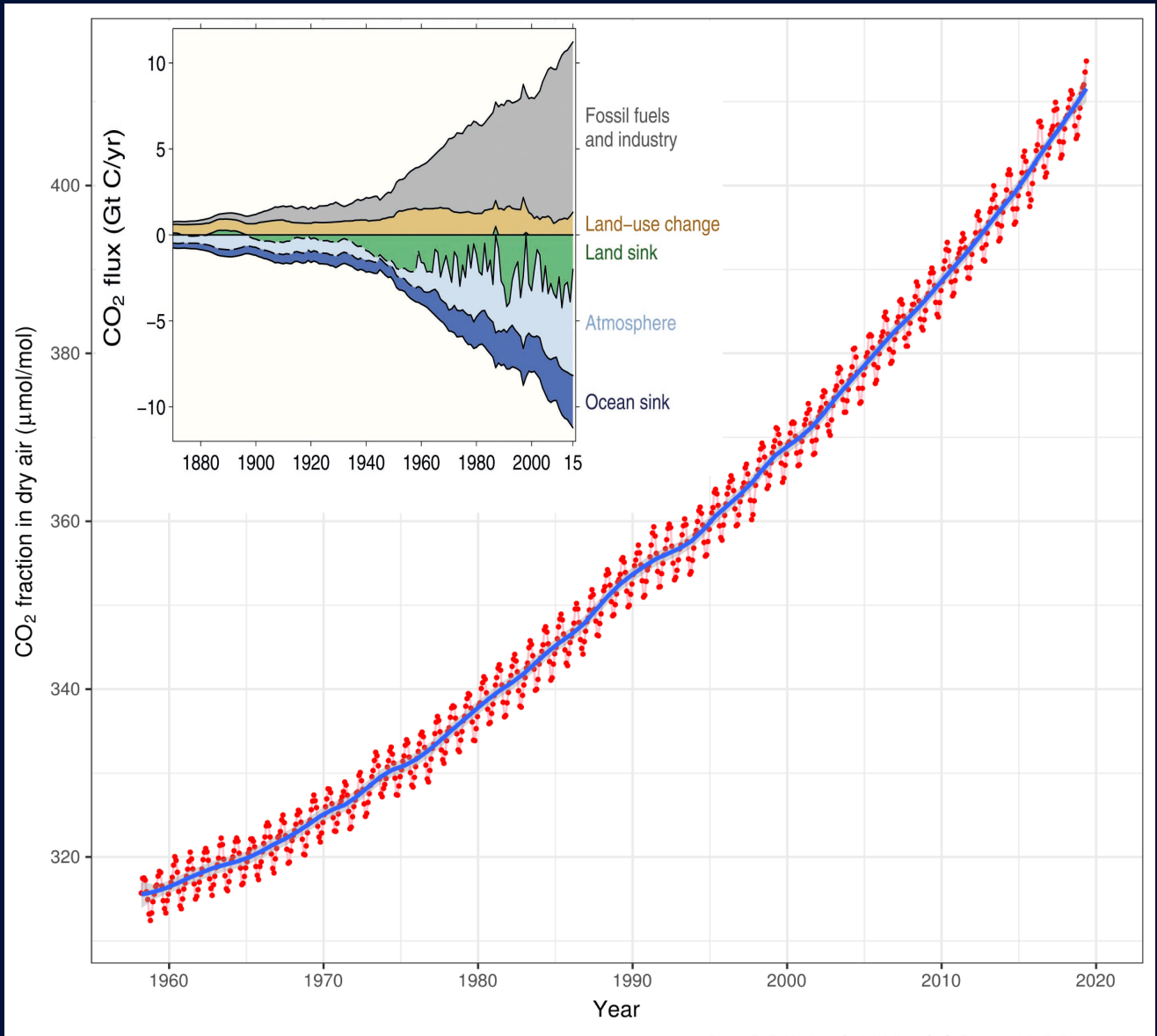

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~ Some CO_2 is taken up by ***plants*** and ***oceans***, but a significant portion ***remains*** in the ***atmosphere***, contributing to the ***warming*** of our ***planet***.

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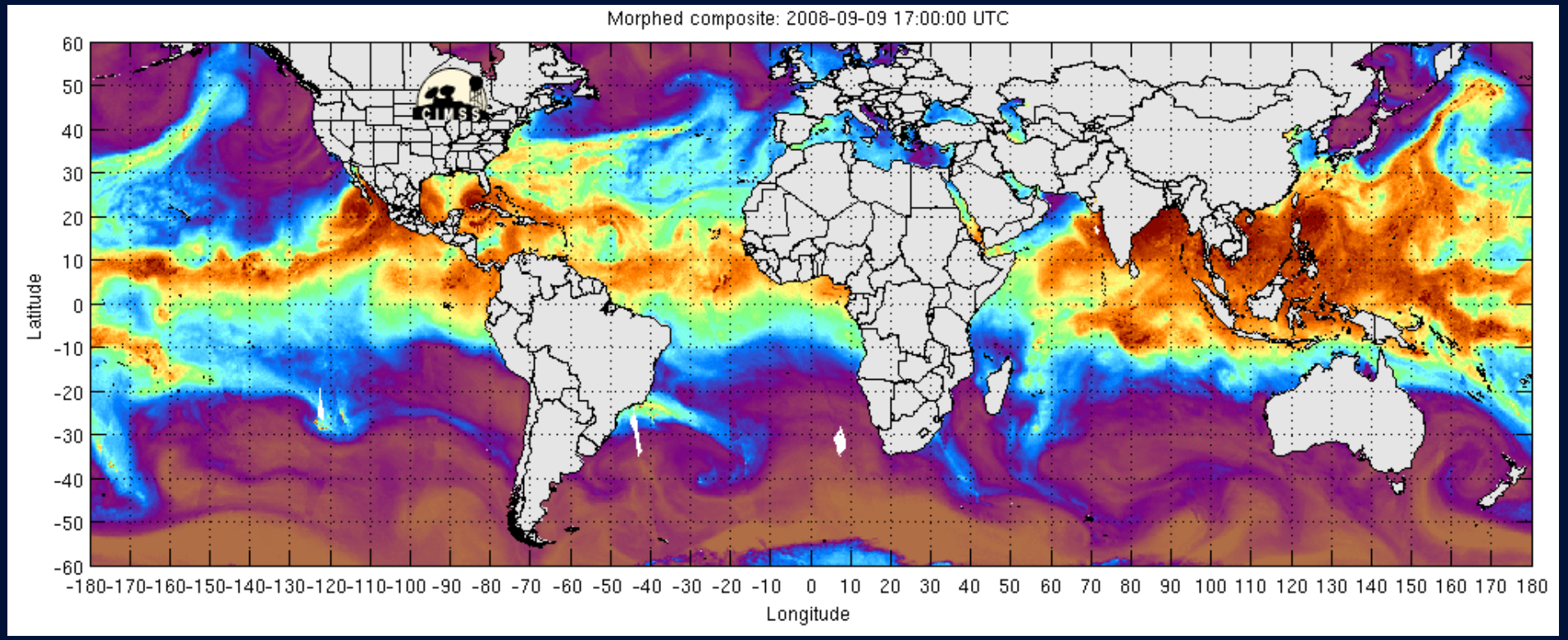
~ The amount of ***water vapor*** in the atmosphere can account for ~0% (desert) to 4% (rainforest) of the air by volume.



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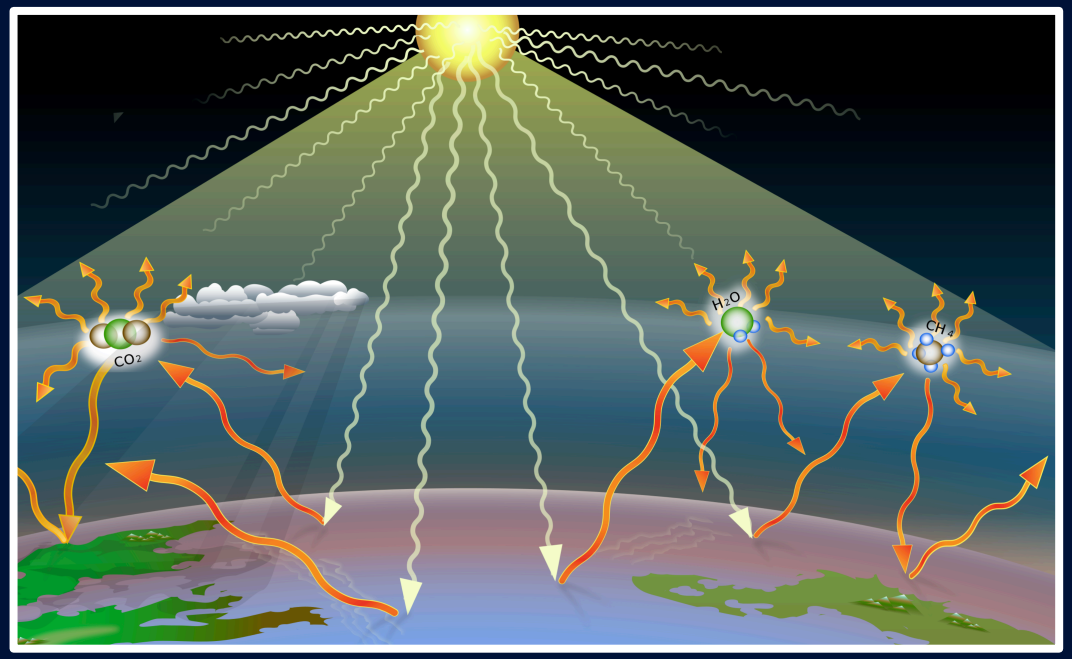

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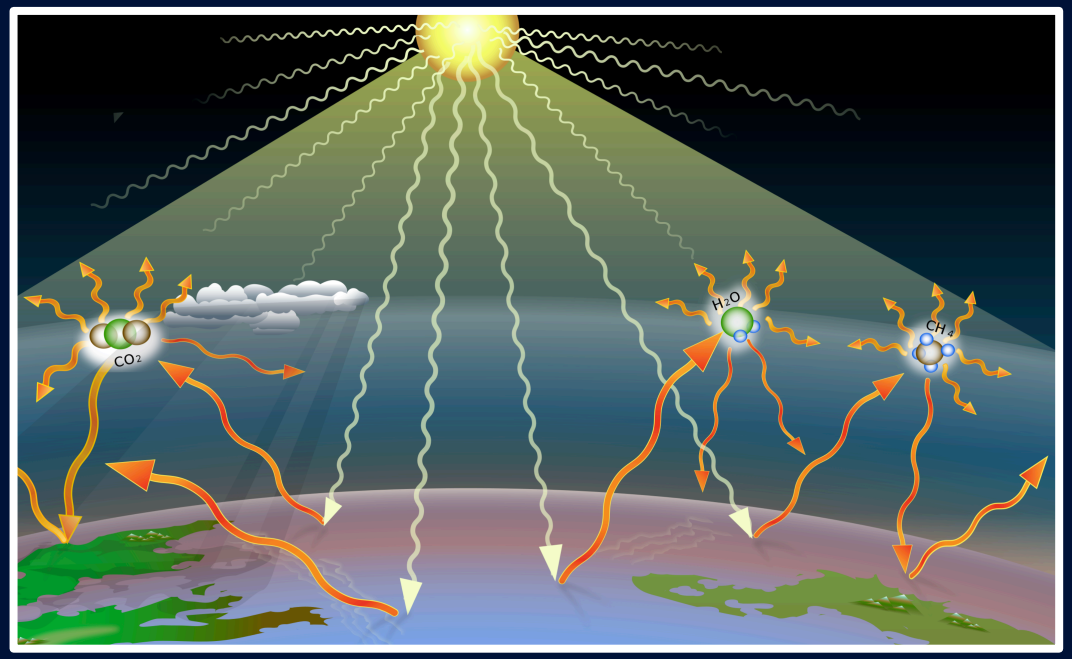

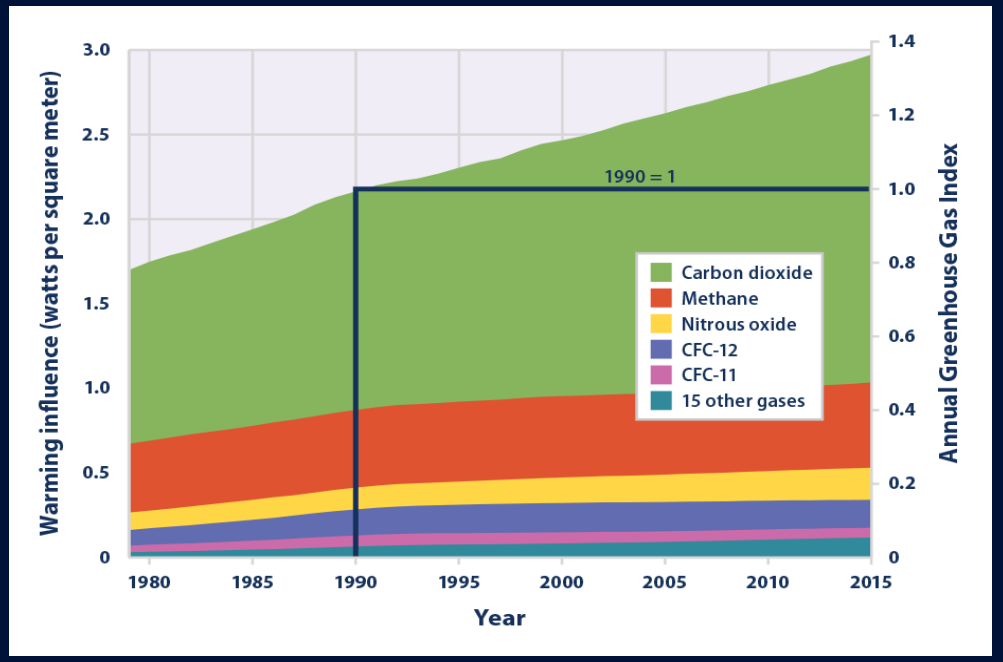

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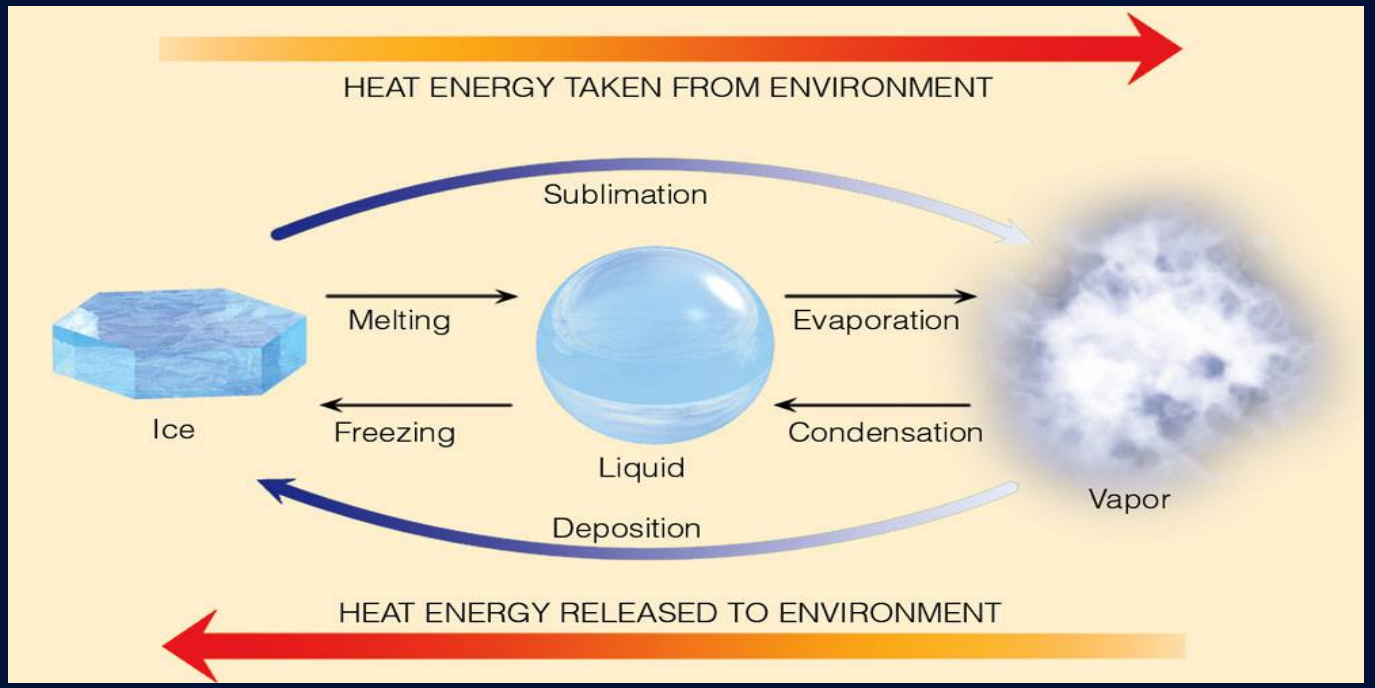

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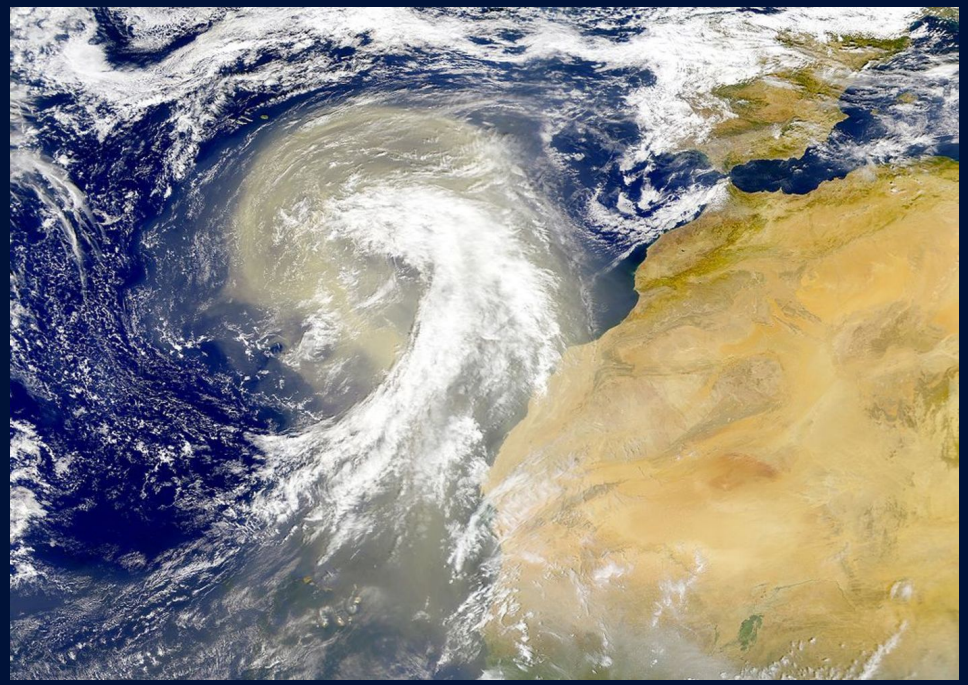

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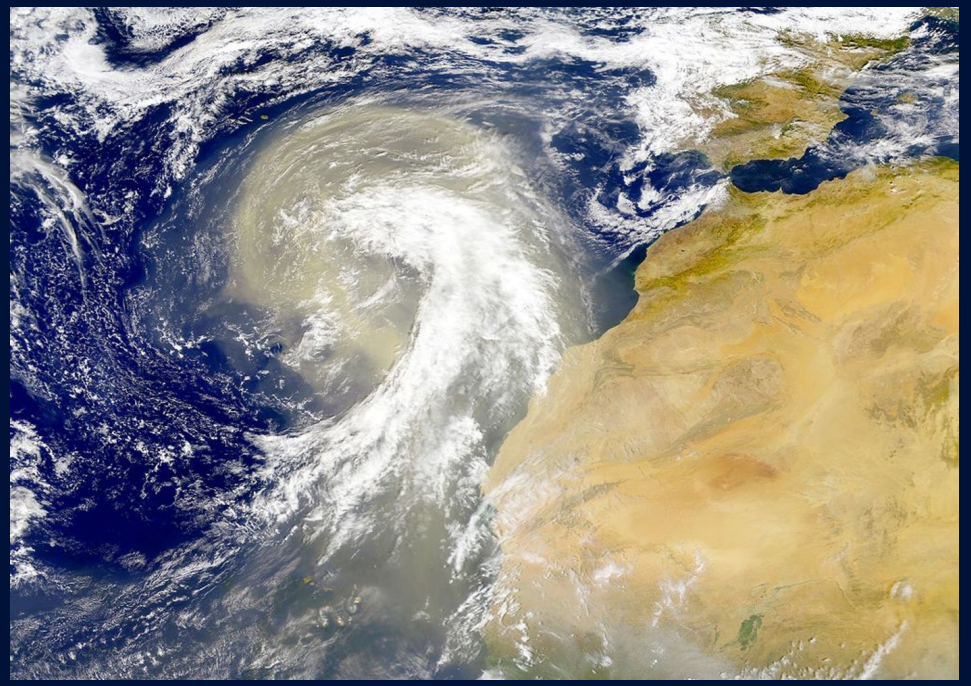

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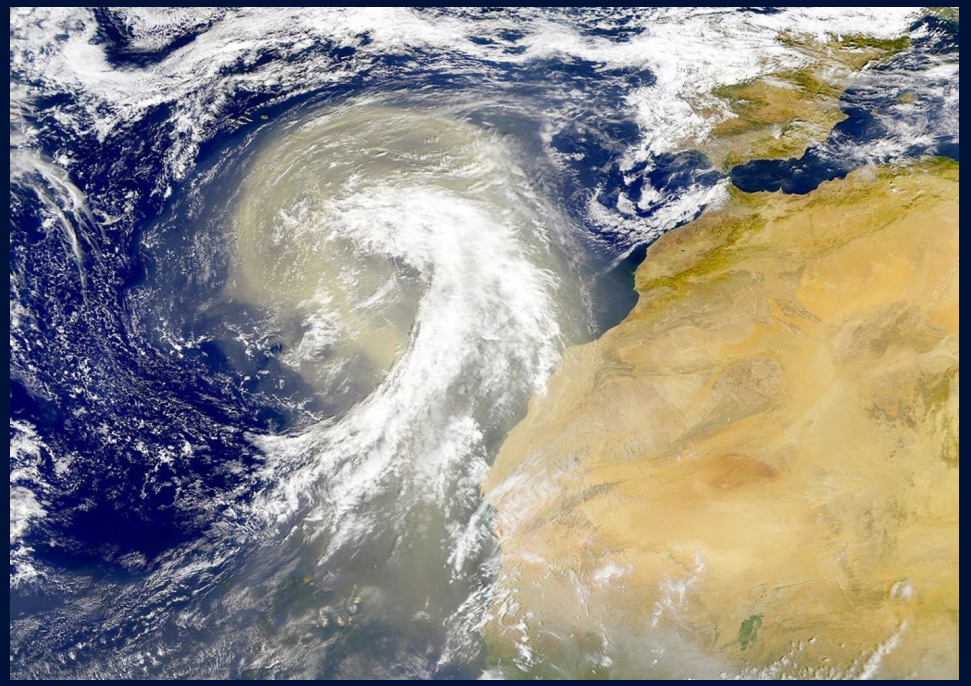

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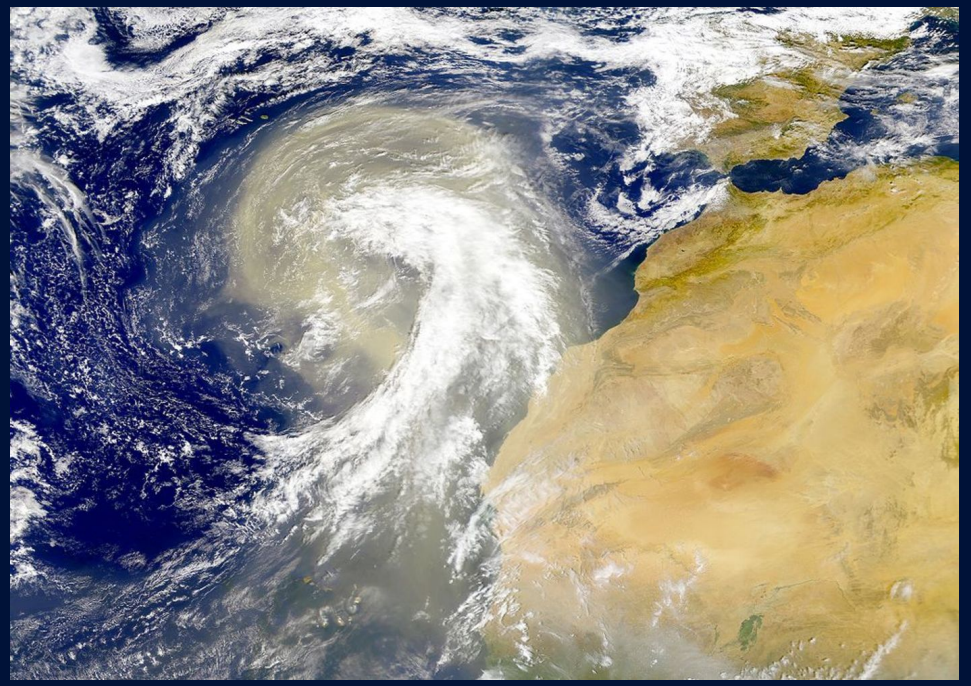

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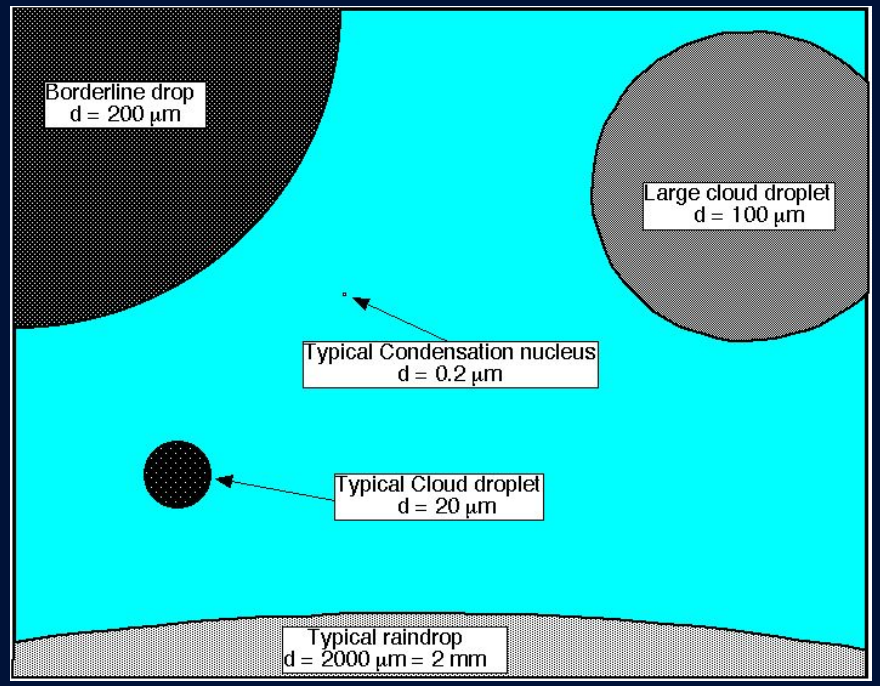

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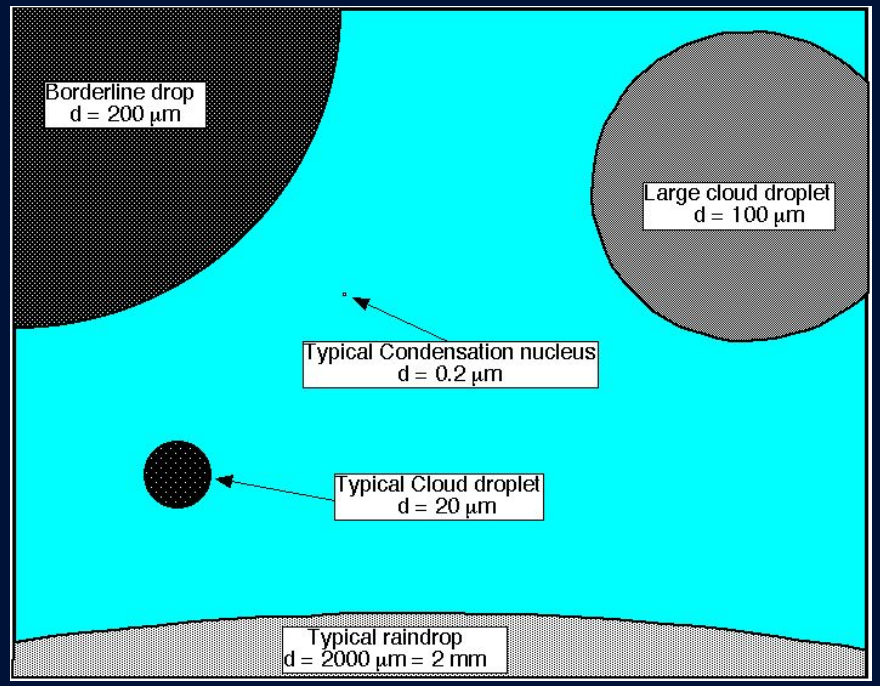

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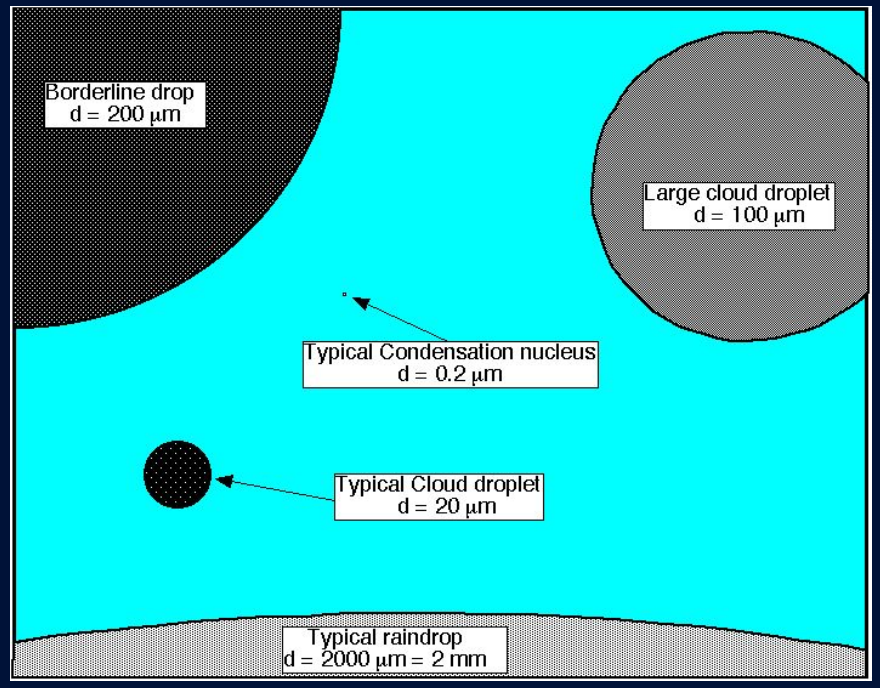

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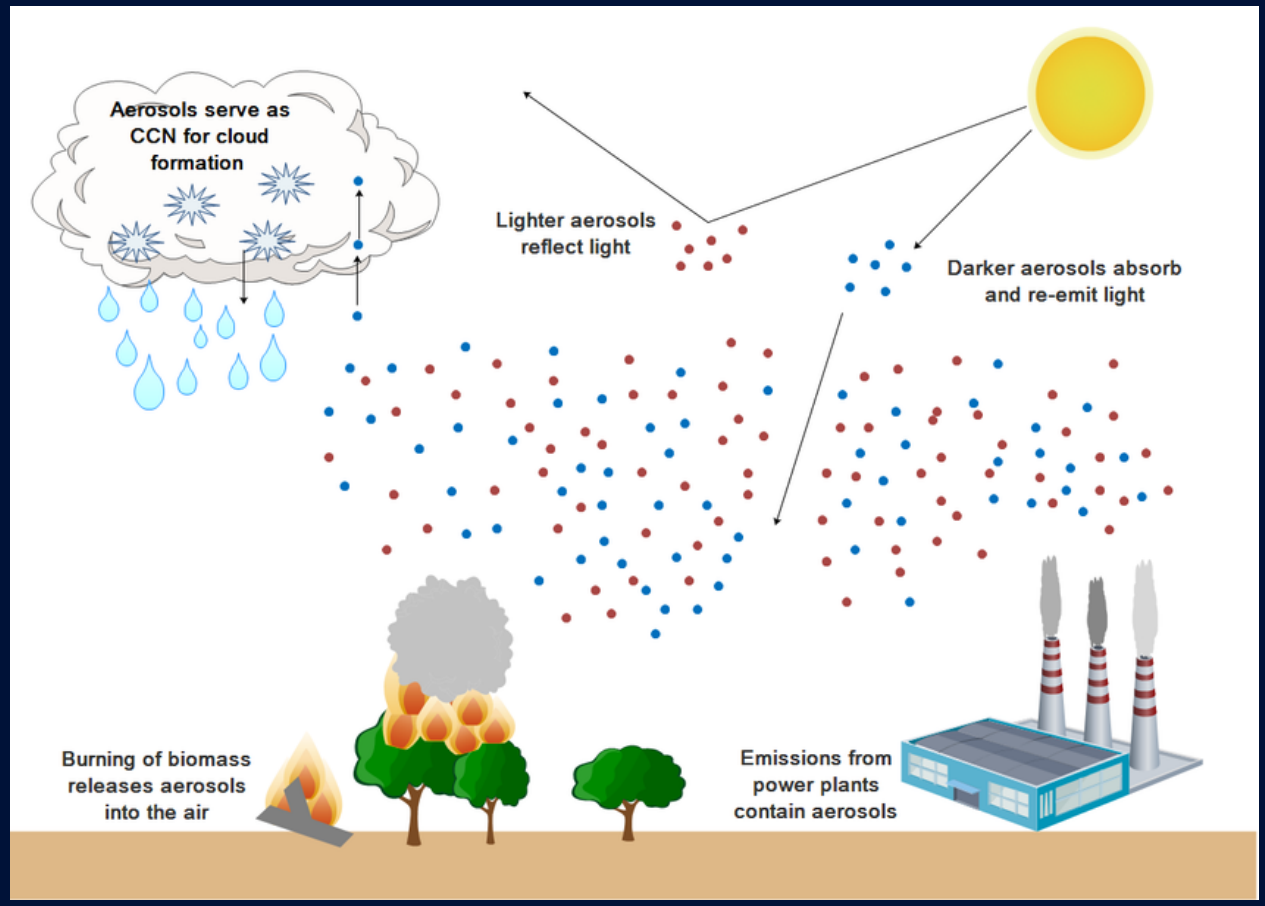

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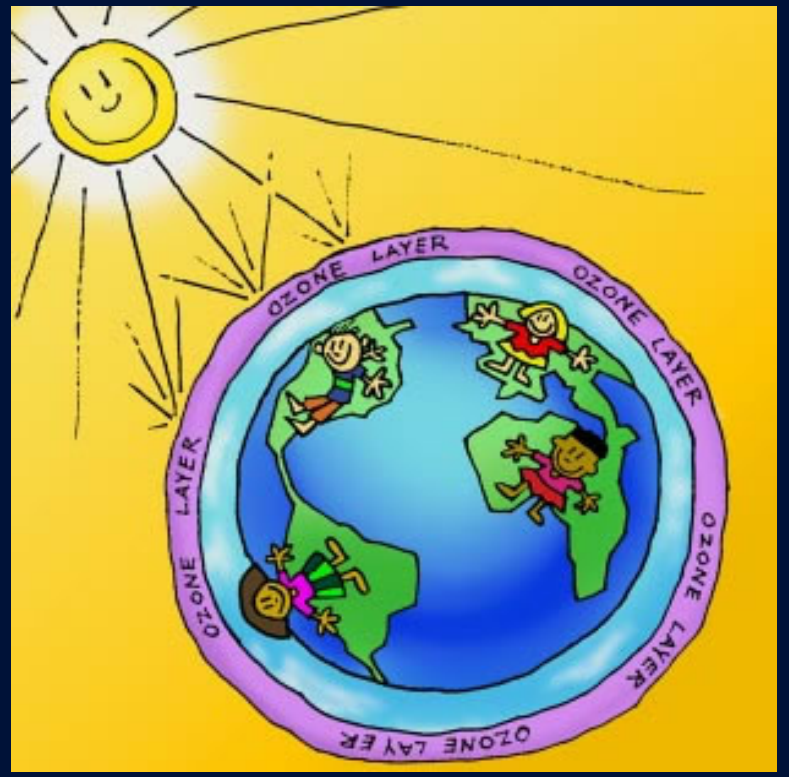

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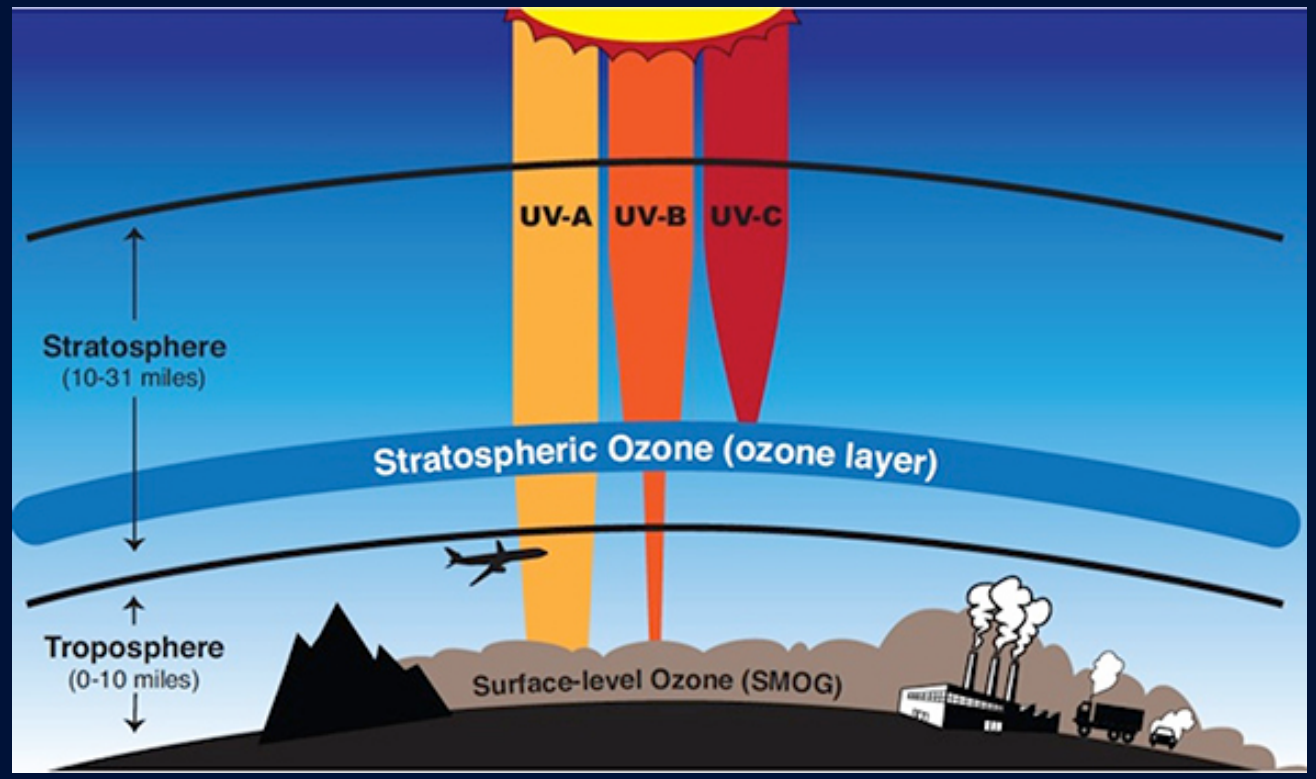
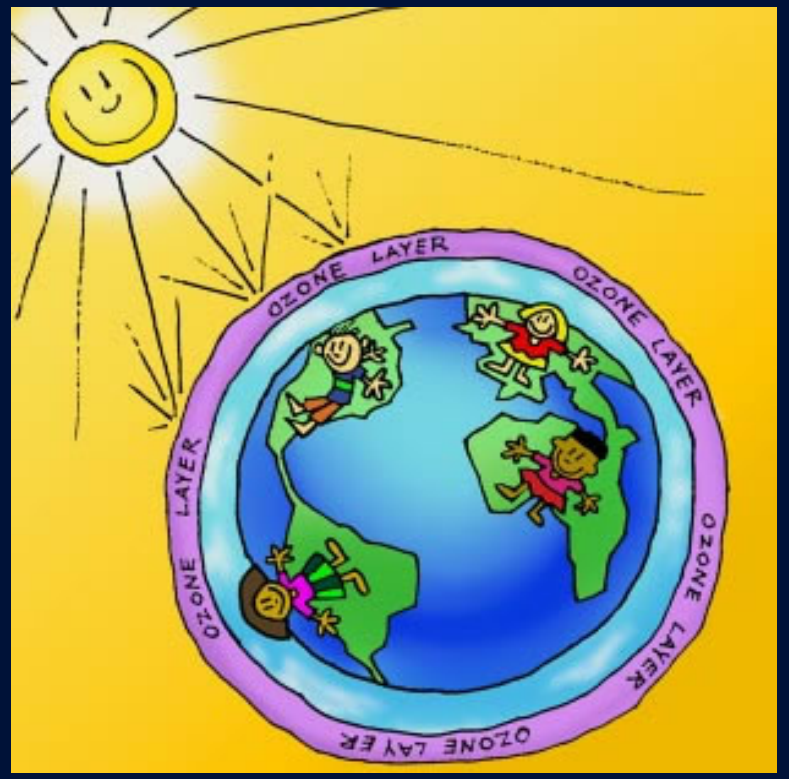
~ The ***ozone (O_3) layer*** (20–30 km above the Earth) is ***crucial*** to life on the planet, as it ***absorbs*** harmful ***ultraviolet*** (UV) ***radiation*** from the Sun.





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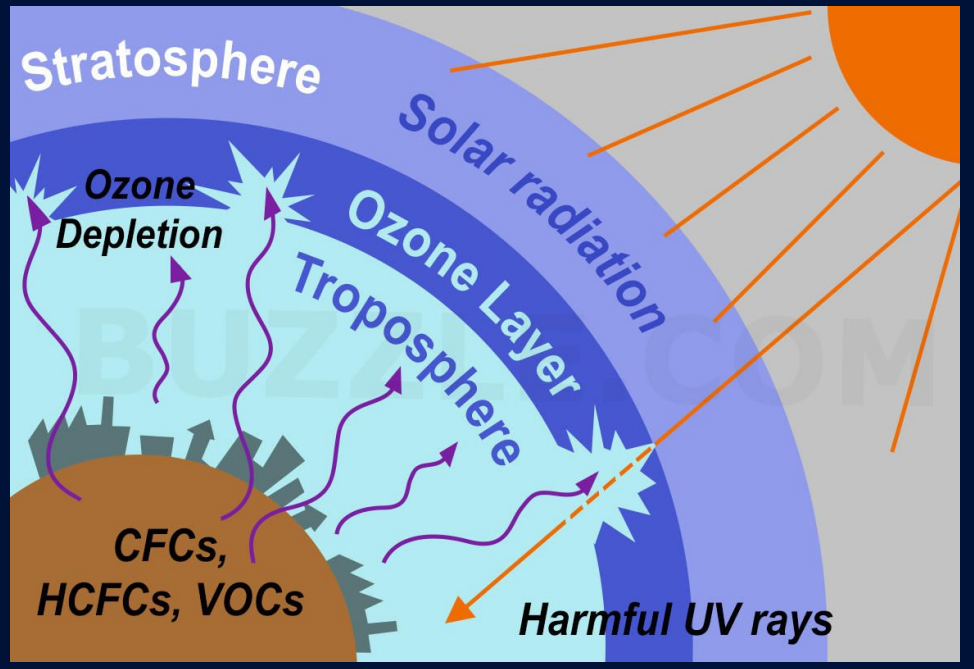

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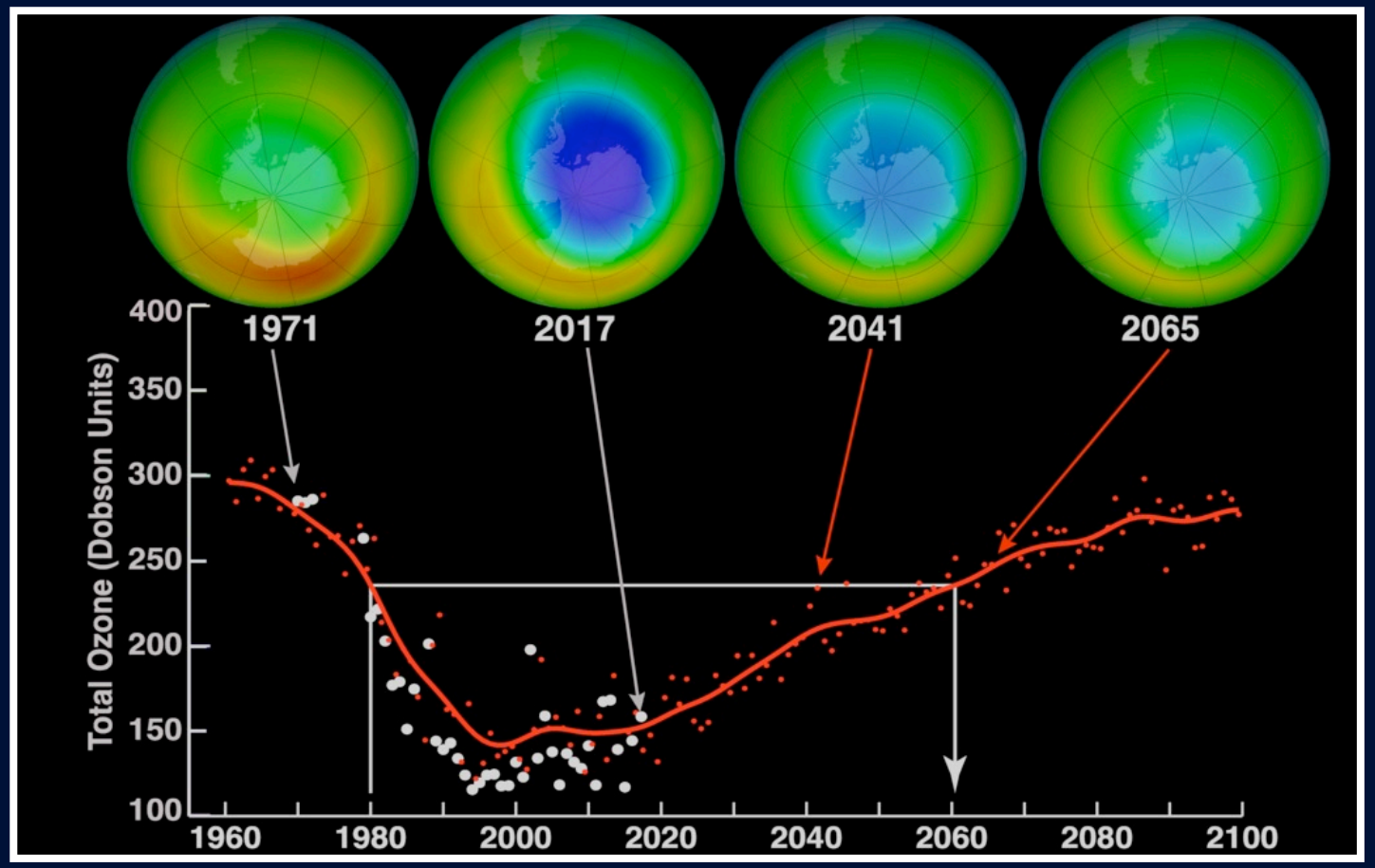

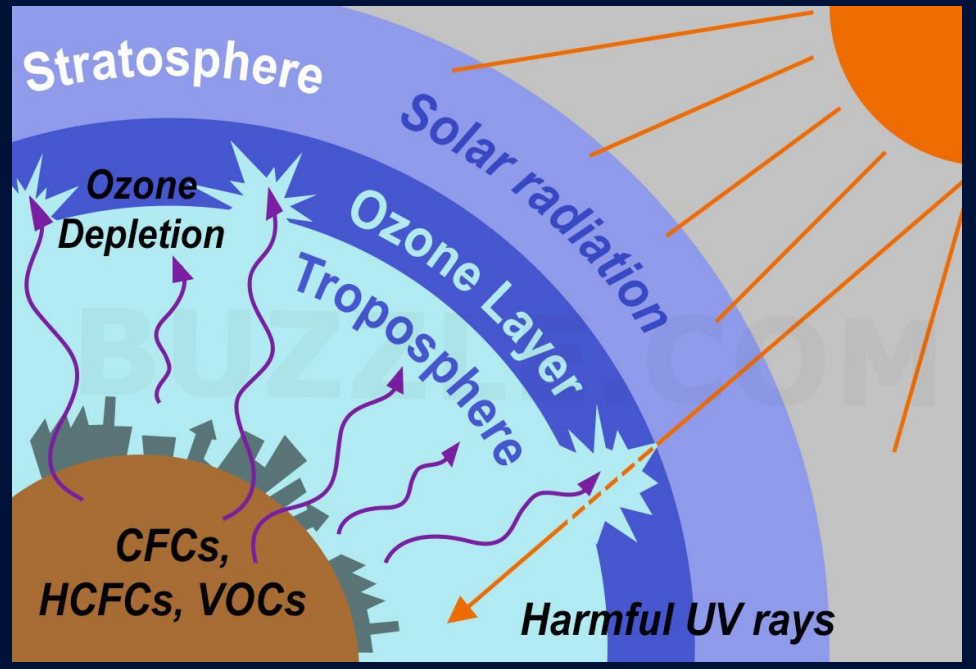

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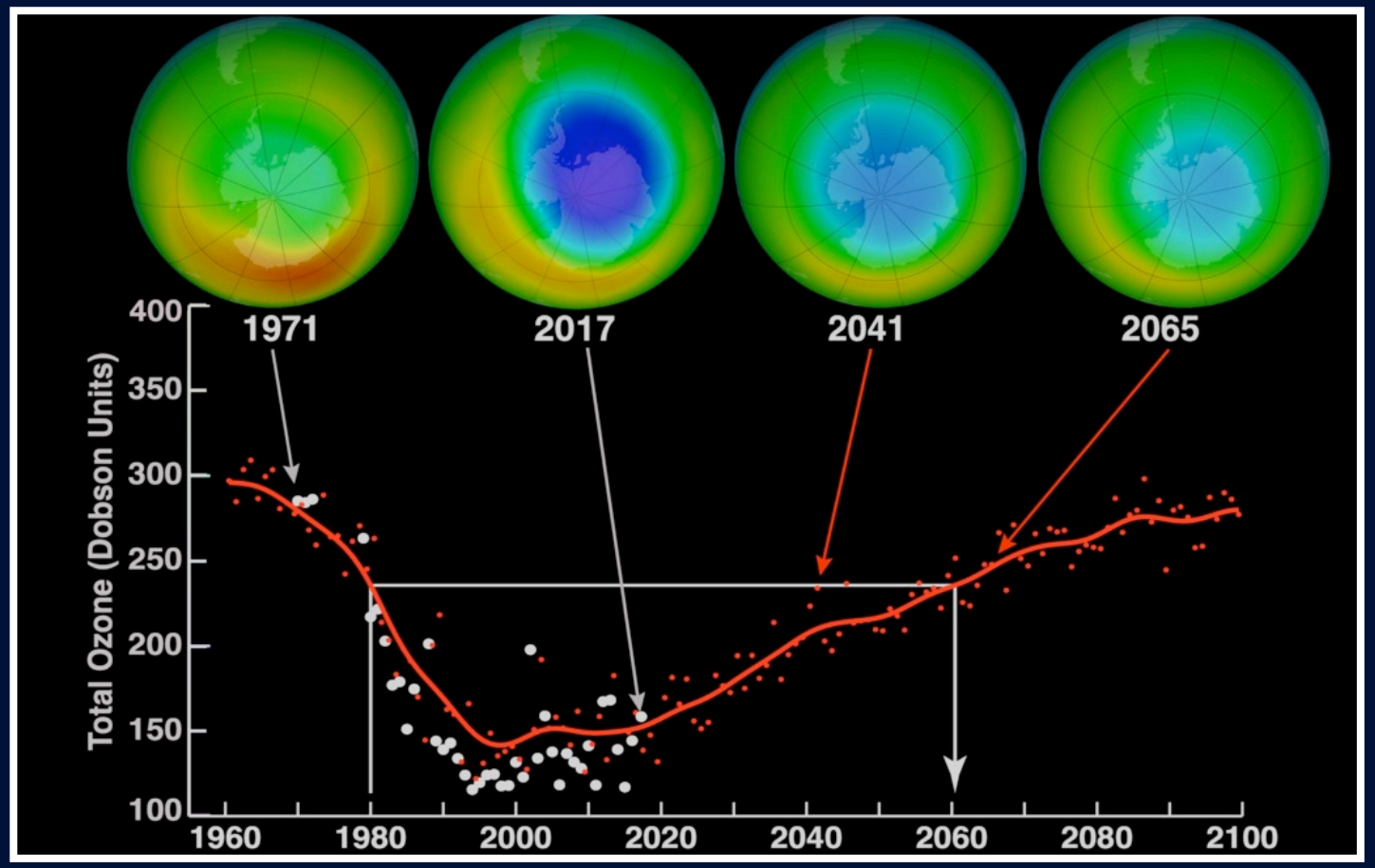

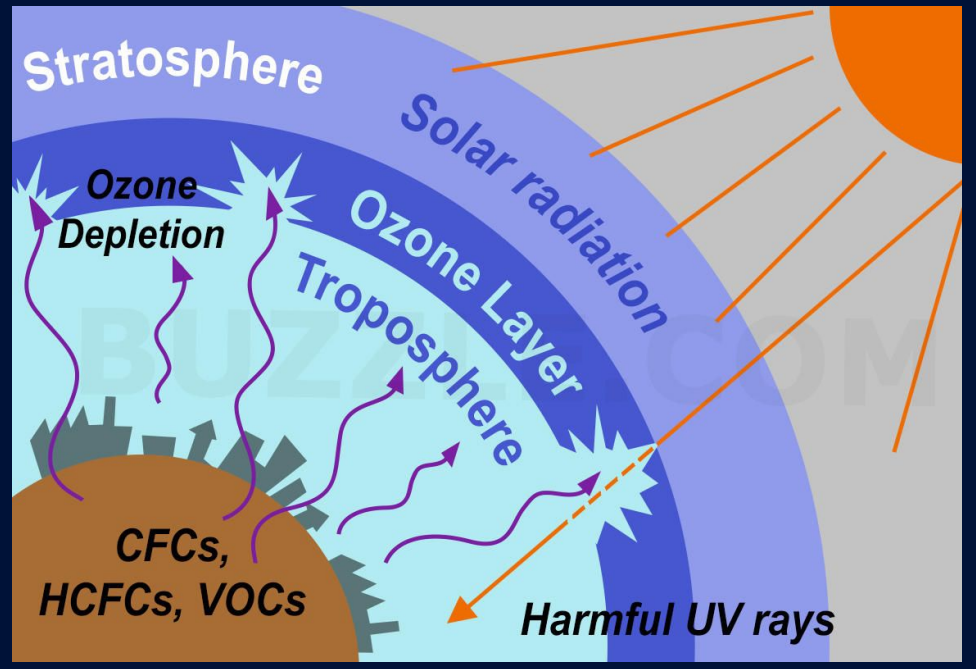

~ Scientists discovered the problem and international ***laws*** were ***established*** to ***control*** the ***pollutants*** that destroy O_3.

Vertical extent and structure of the atmosphere

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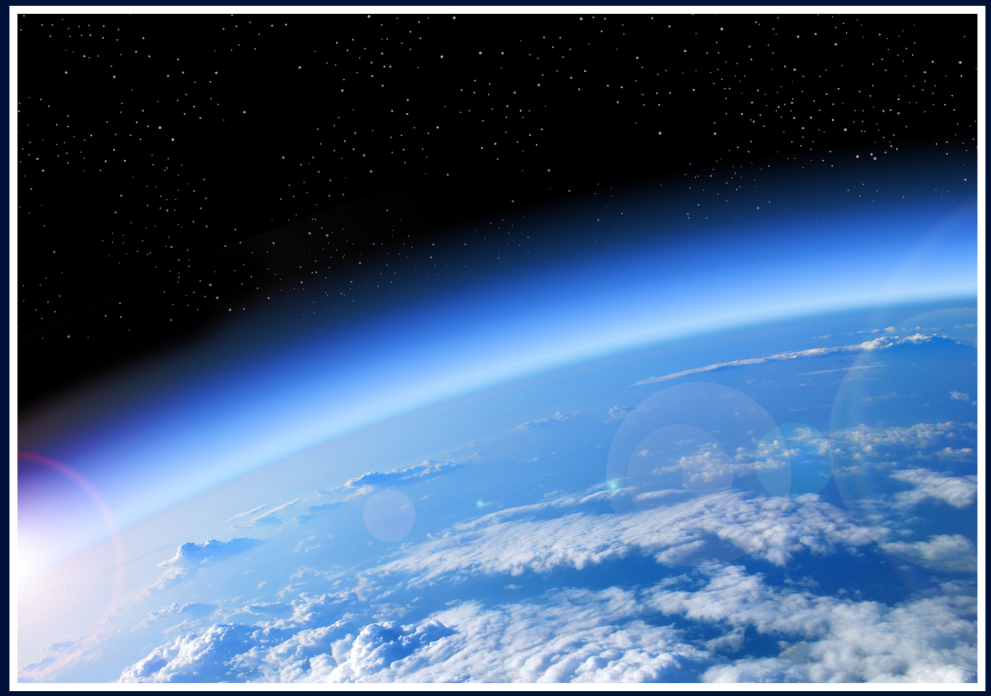

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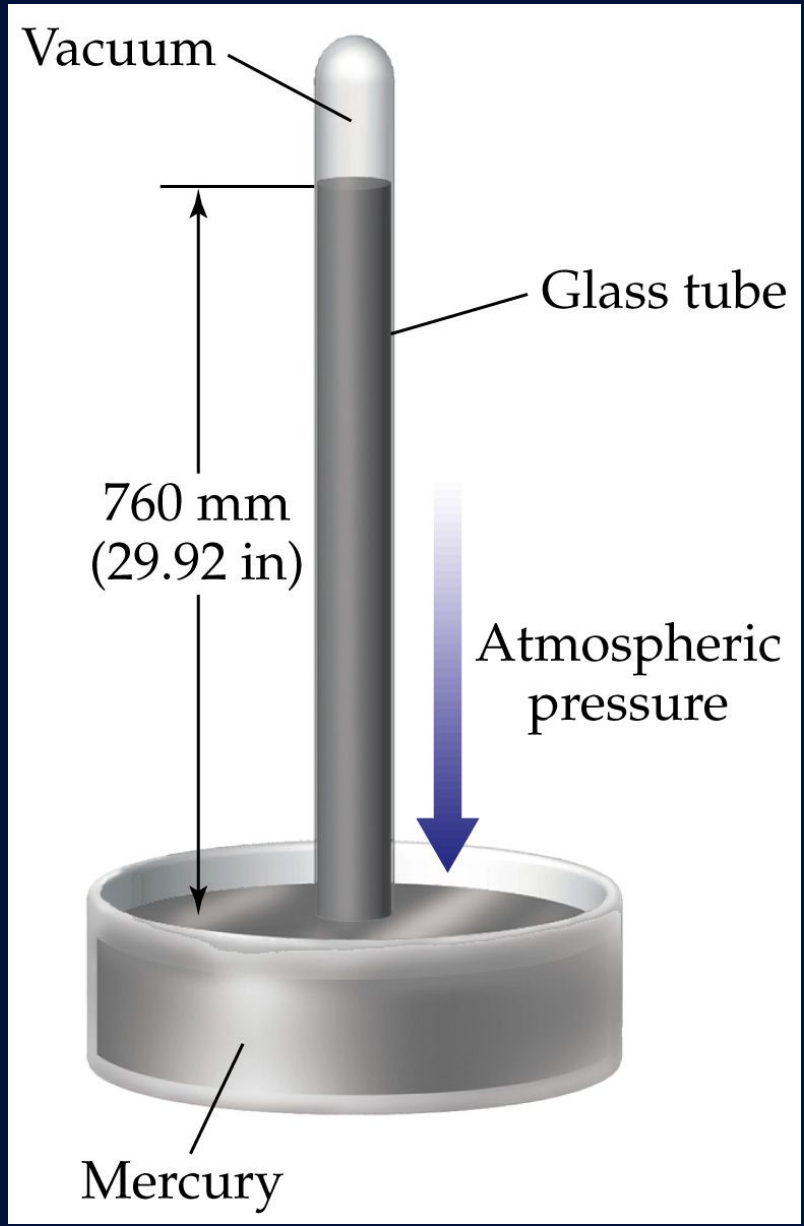
~ One way to explore the extent of the atmosphere is through examining ***how*** atmospheric ***pressure changes with height***.



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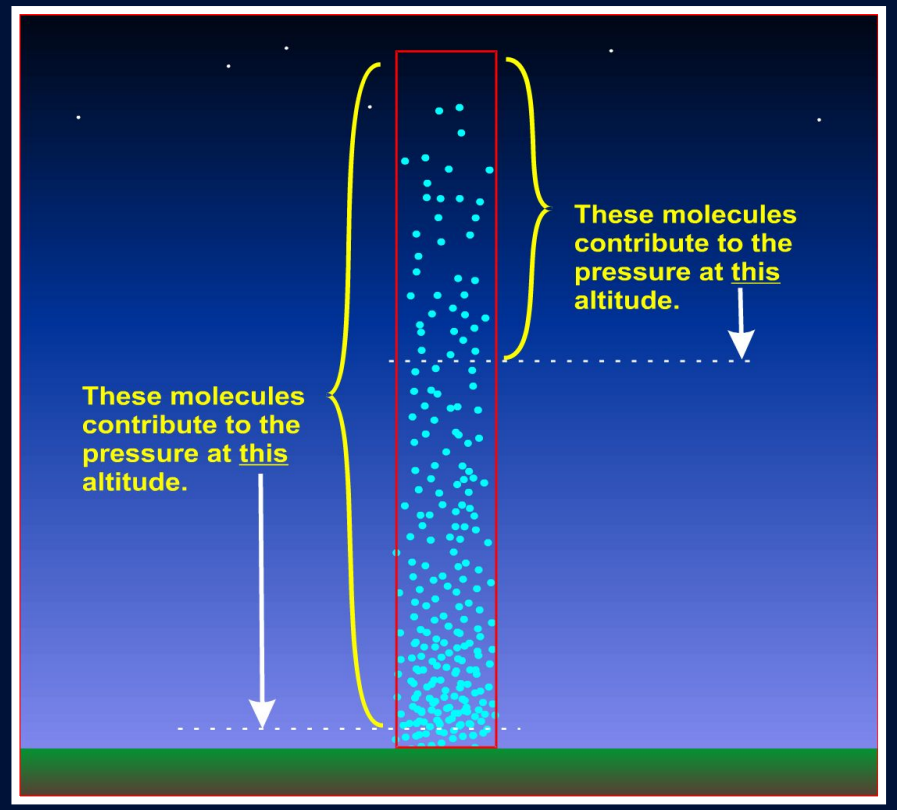

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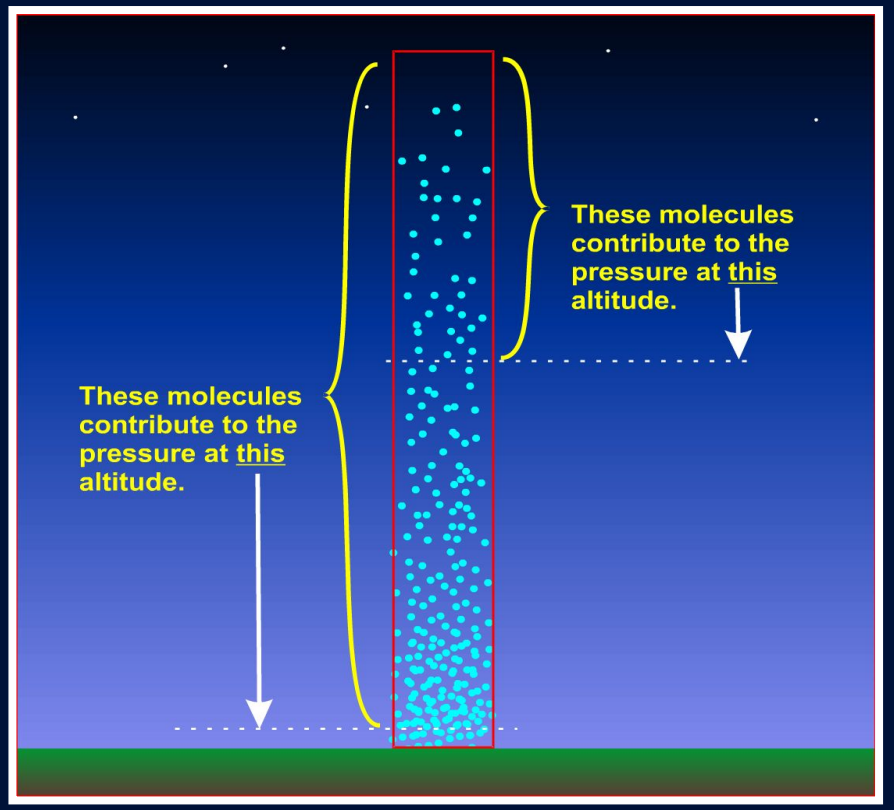

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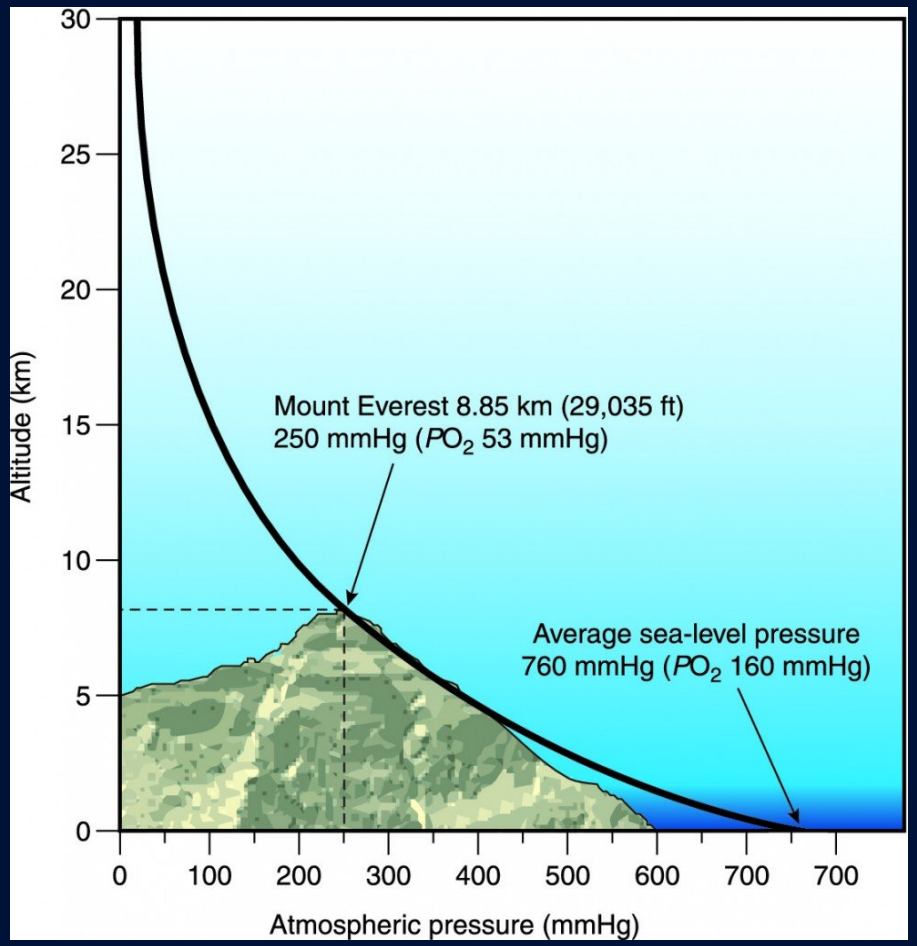

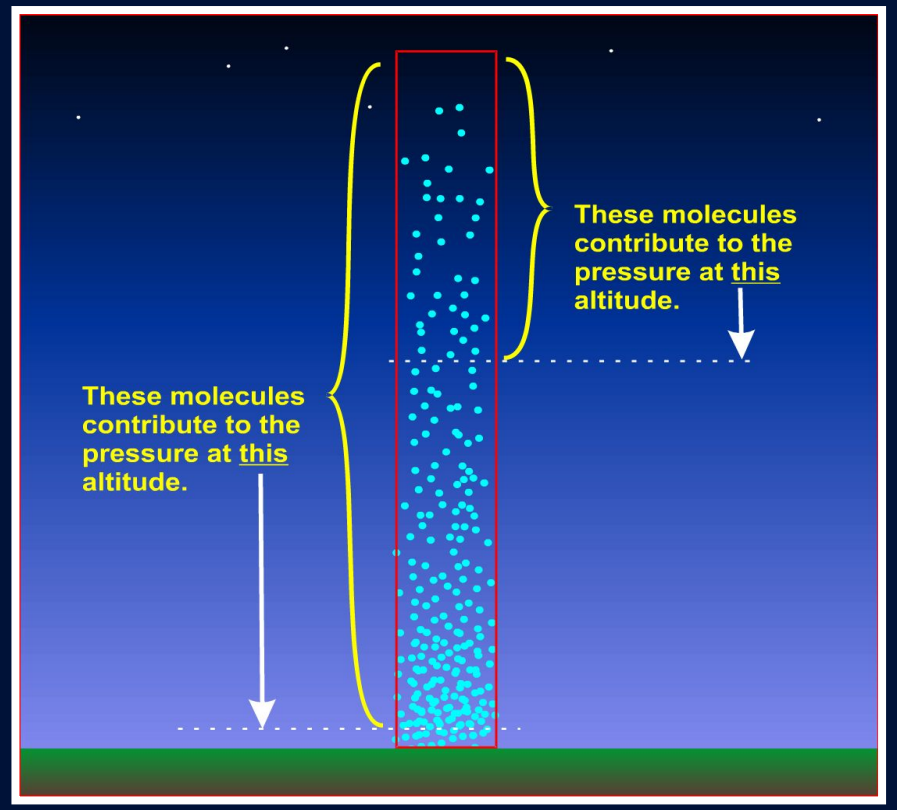

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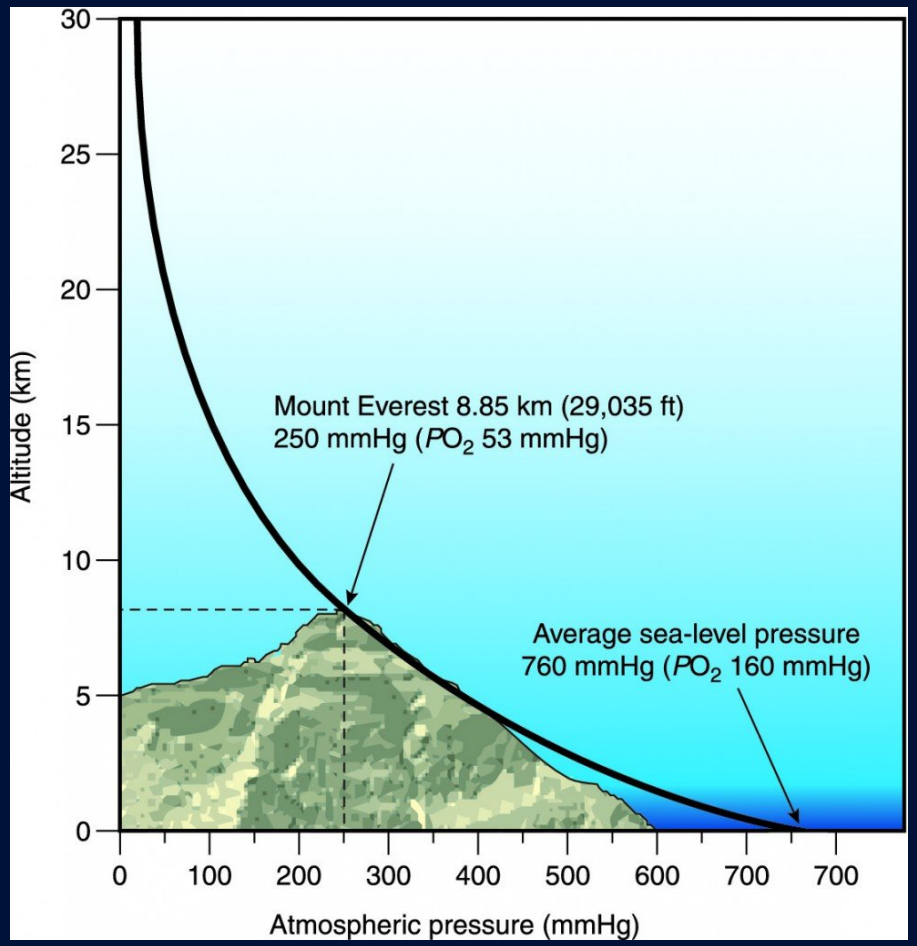

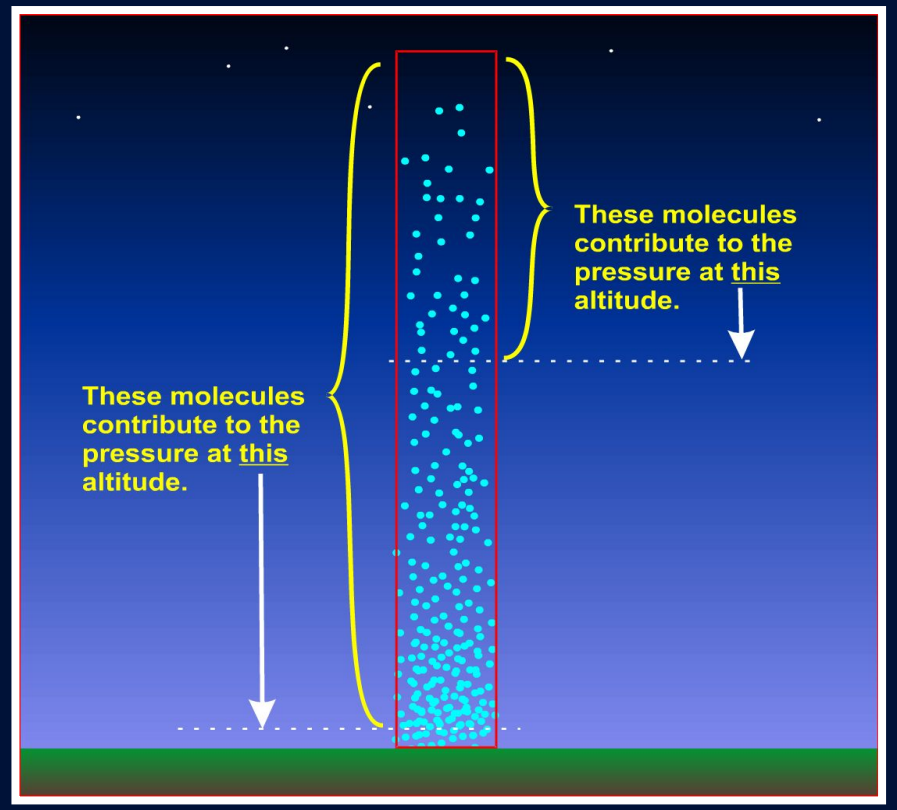

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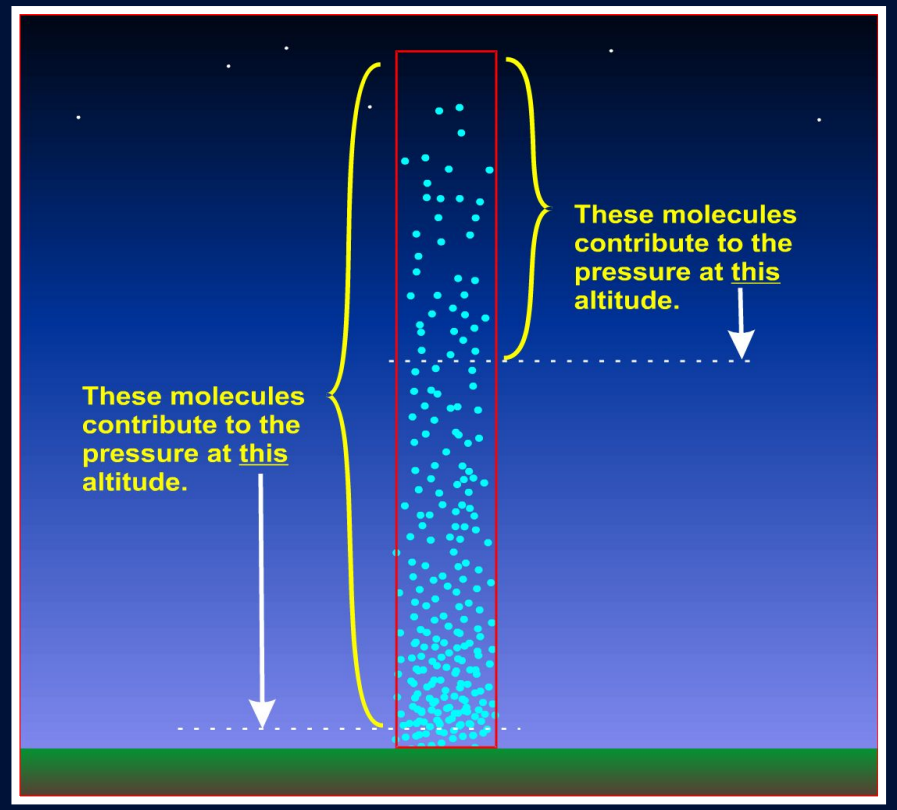
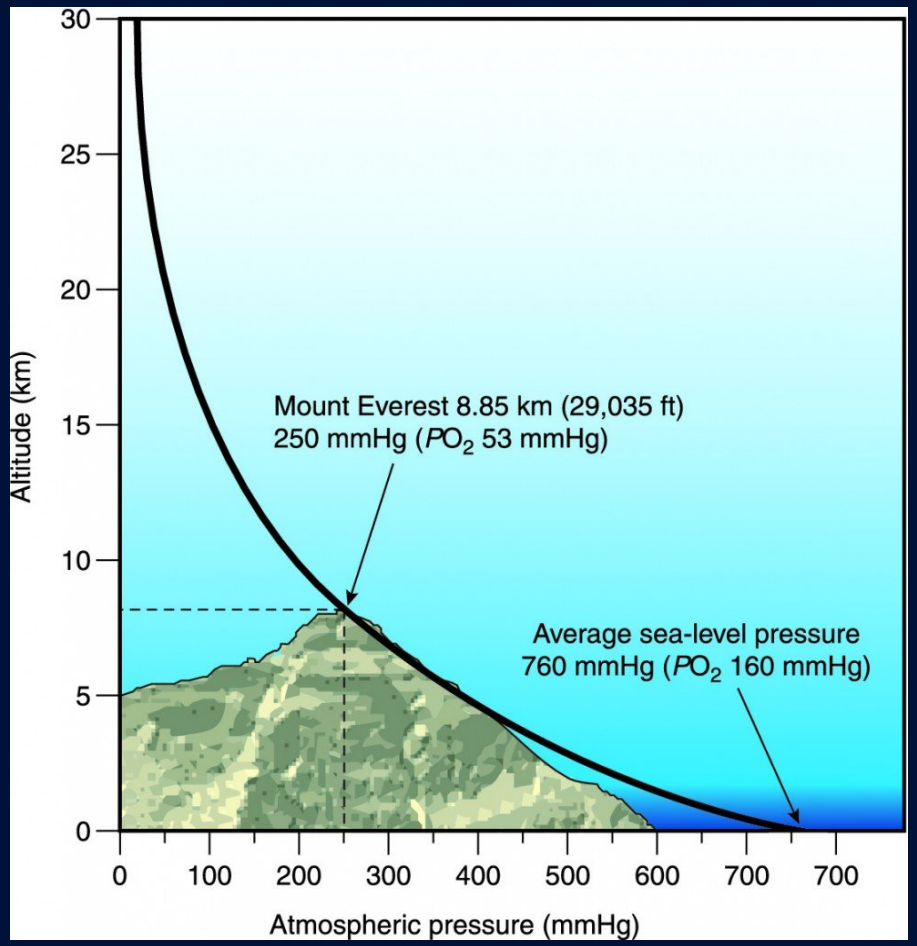
~ This compressibility means ***50%*** of the ***air*** molecules in the atmosphere lie ***below 6 km*** and ***90% below 16 km***.





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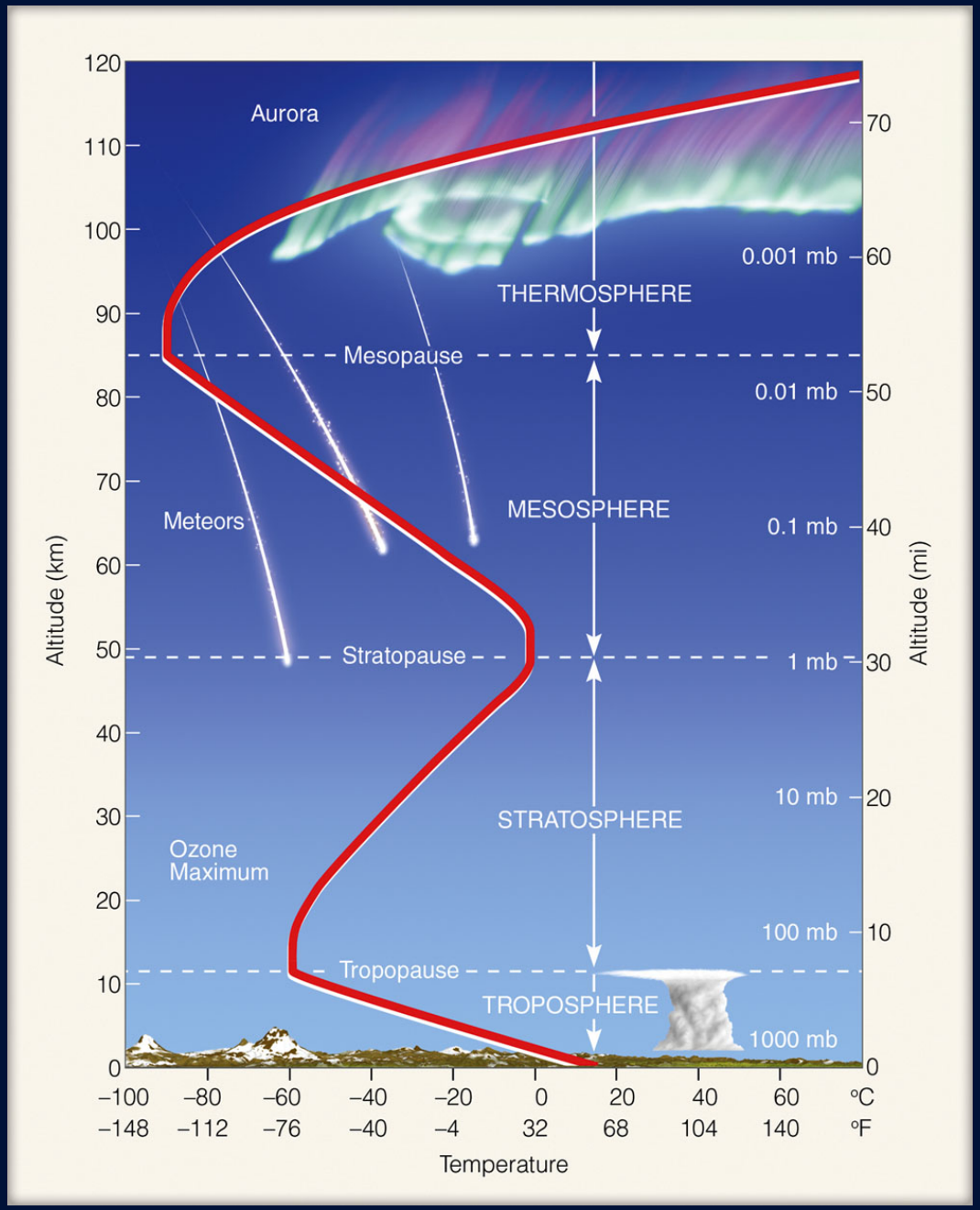

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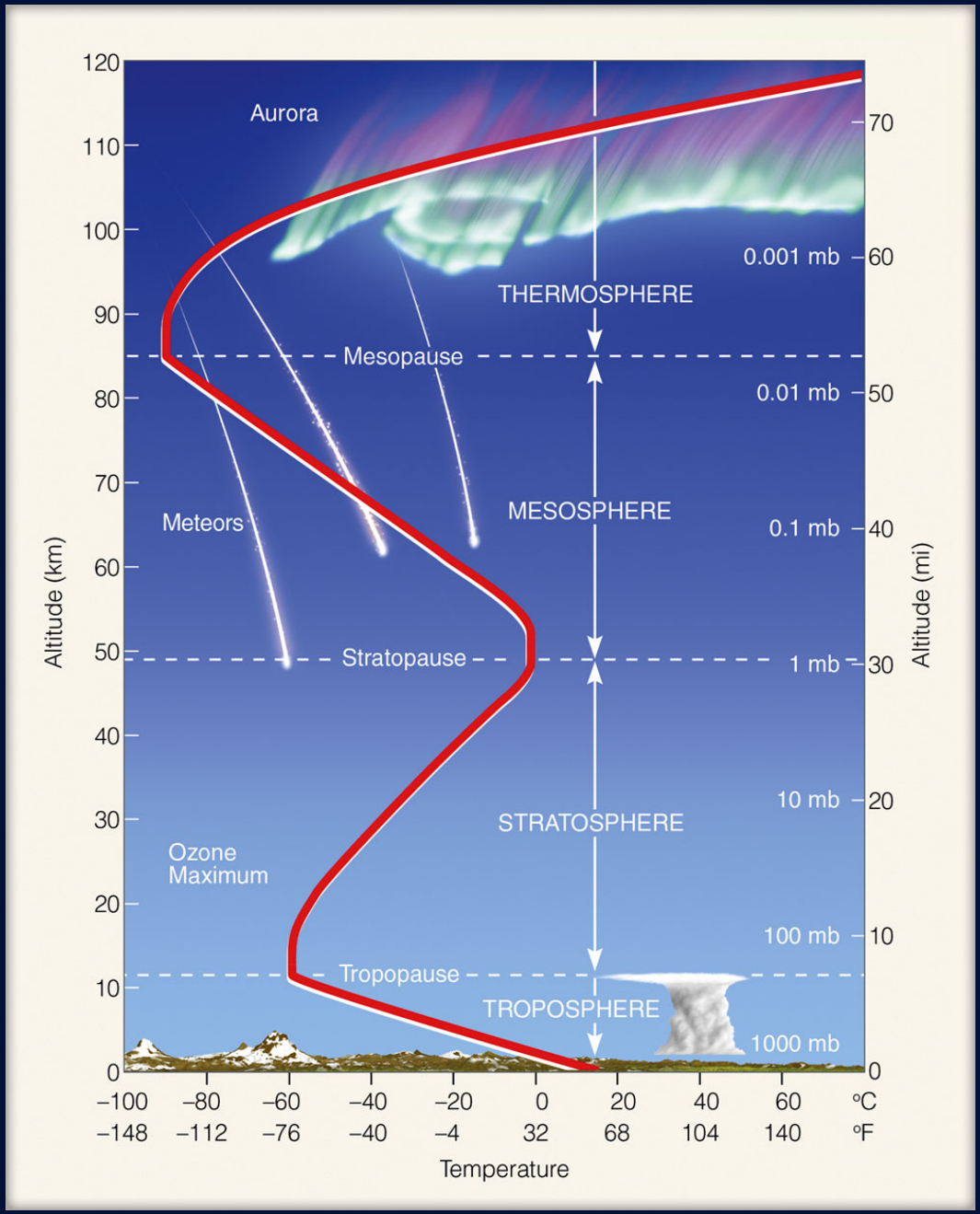

~ We can also ***quantify*** the vertical ***structure*** of the ***atmosphere*** by its distribution of ***temperature***.

~ Studies reveal ***four*** distinct ***thermal layers***, the bottom of which, where ***temperature decreases*** with height, is called the ***troposphere***.

~ This ***decrease*** in ***temperature*** with ***height*** is called a ***lapse rate***.

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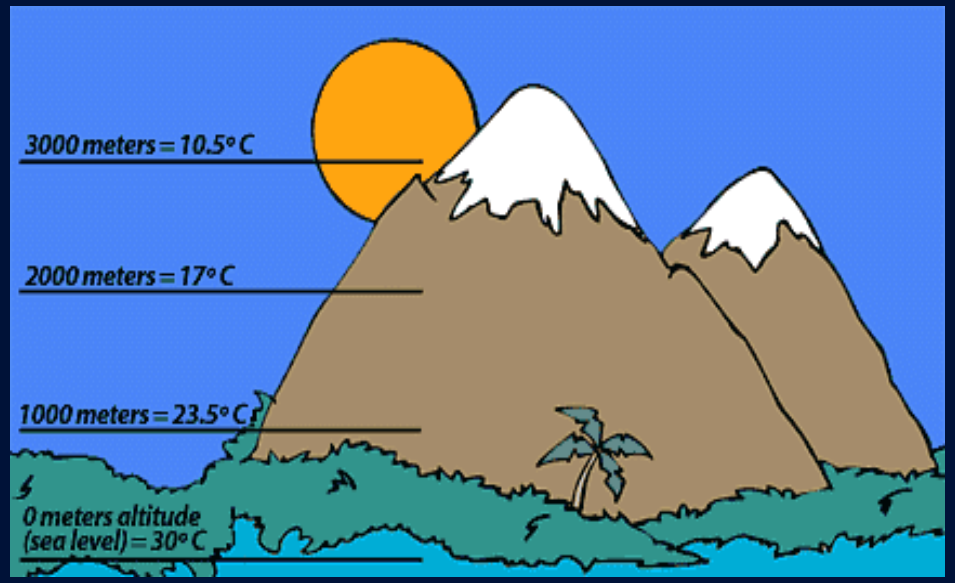

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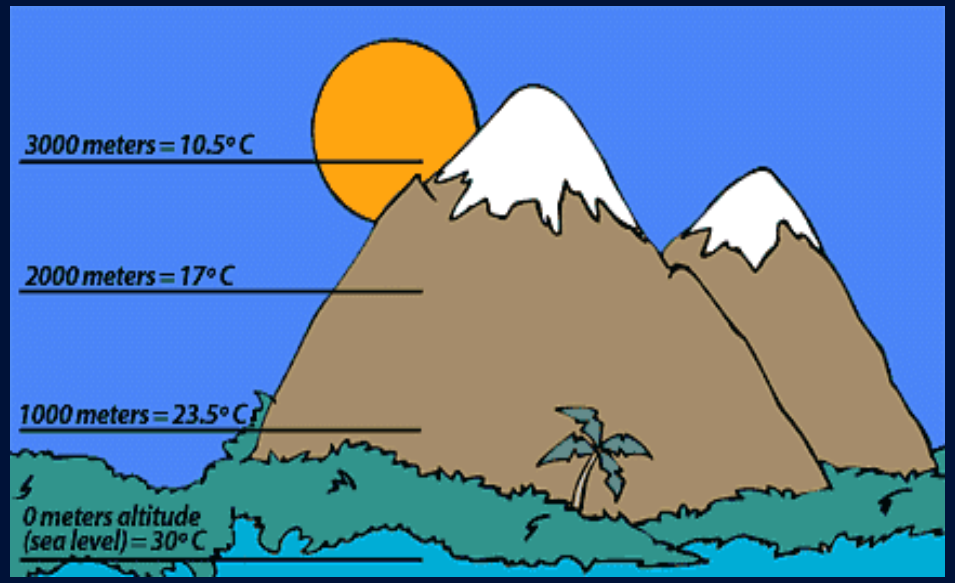

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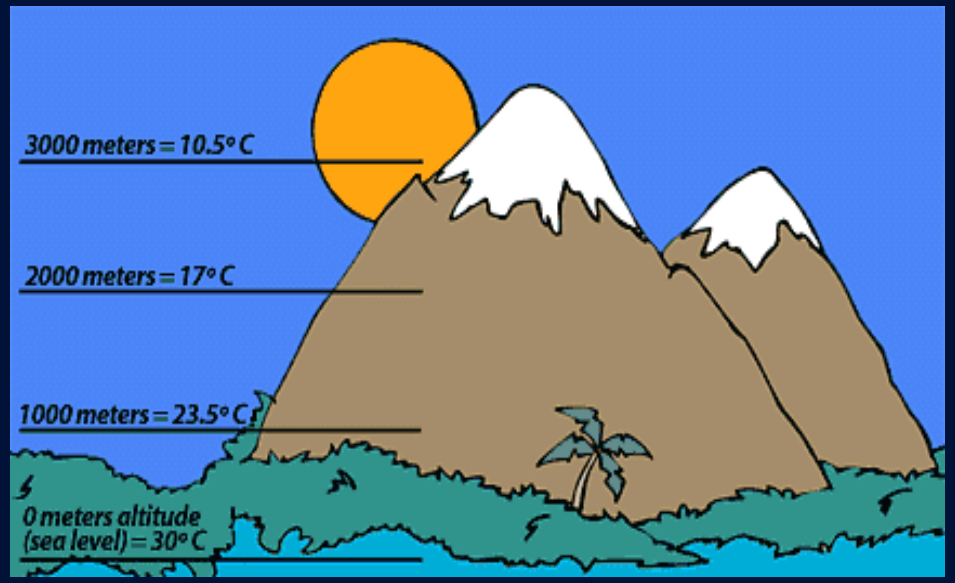

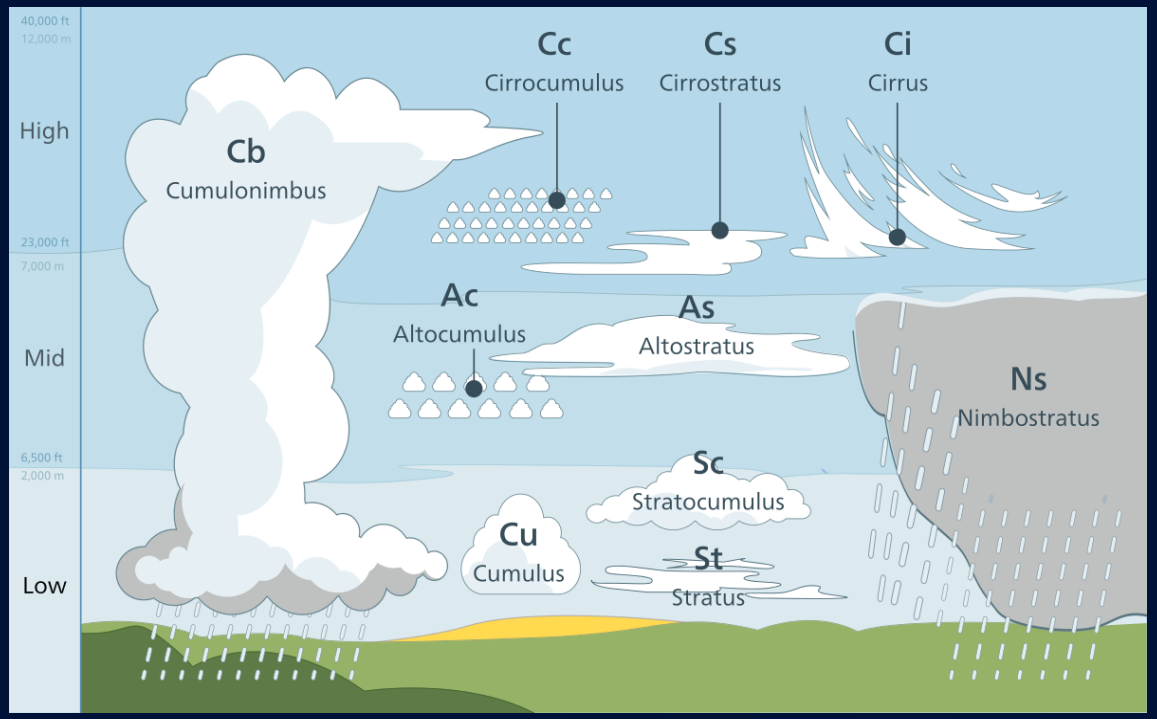

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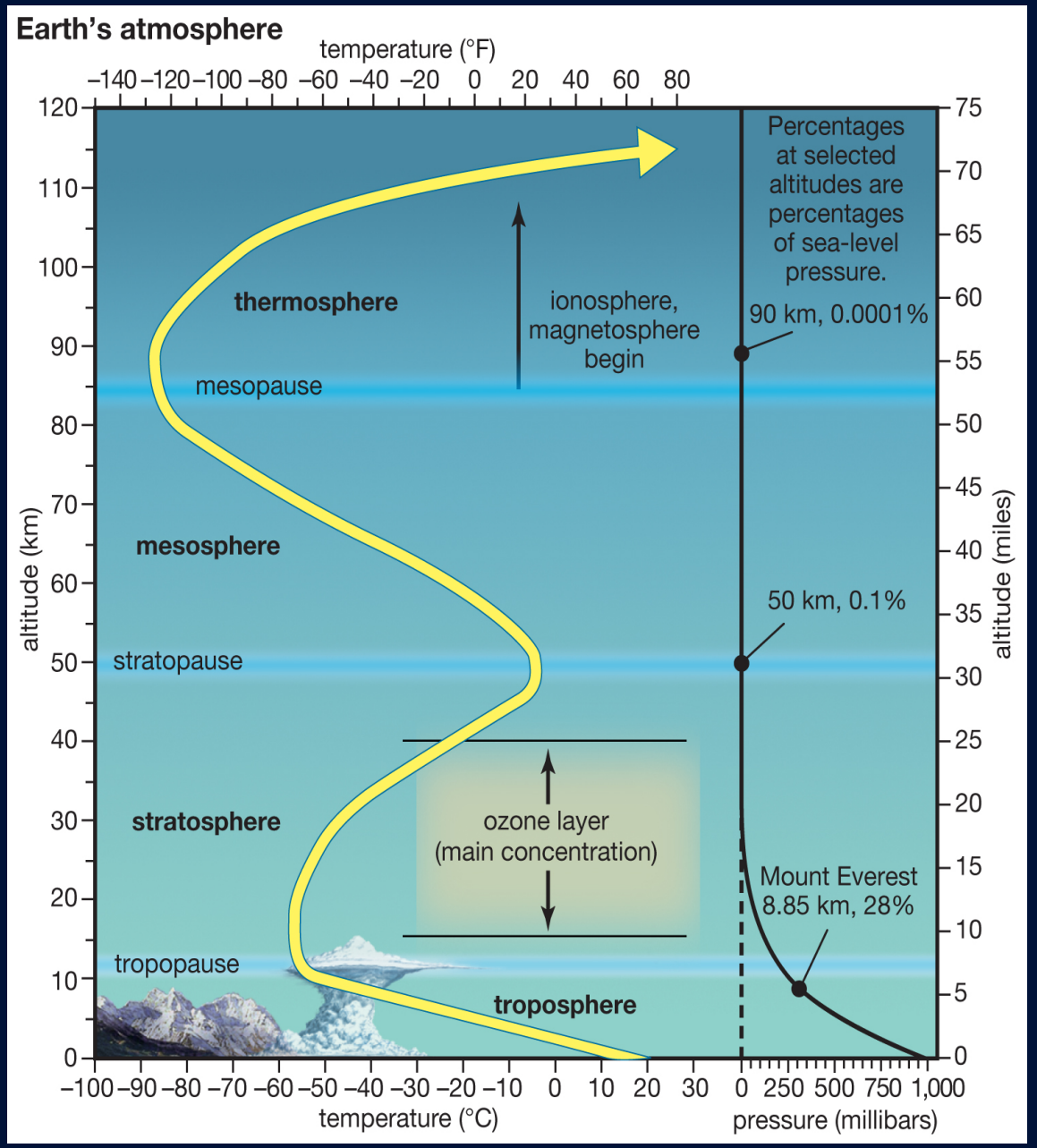
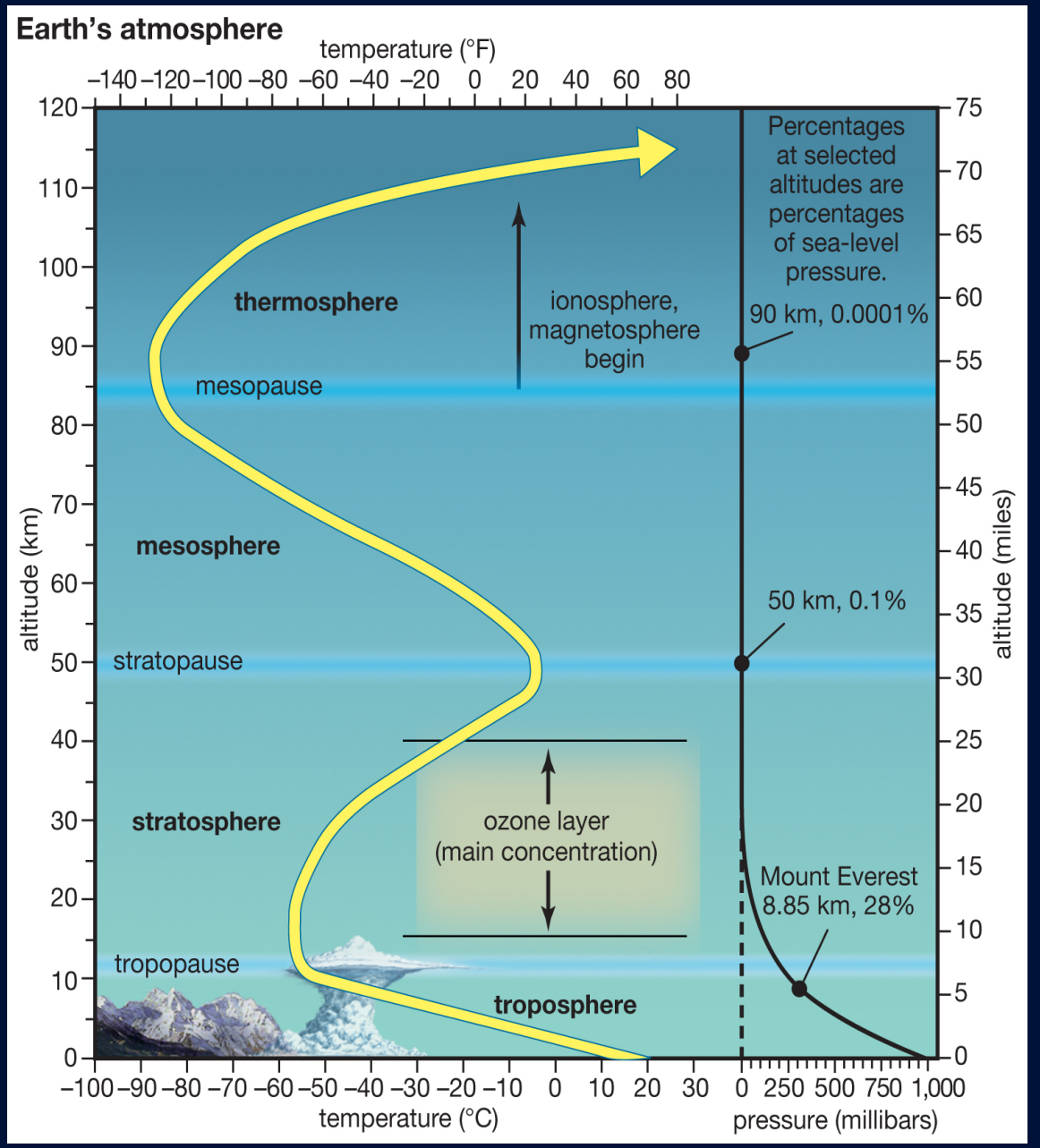

Earth's atmosphere
temperature (°F)
–140 –120 –100 –80 –60 –40 –20 0 20 40 60 80
120
110
100
90
80
70
60
50
40
30
20
10
0
altitude (km)
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
altitude (miles)
thermosphere
mesopause
mesosphere
stratopause
stratosphere
tropopause
troposphere
ionosphere, magnetosphere begin
ozone layer (main concentration)
Percentages at selected altitudes are percentages of sea-level pressure.
90 km, 0.0001%
50 km, 0.1%
Mount Everest 8.85 km, 28%
–100 –90 –80 –70 –60 –50 –40 –30 –20 –10 0 10 20 30
temperature (°C)
0 250 500 750 1,000
pressure (millibars)

~ At the top of the troposphere (the ***tropopause***), ***temperatures*** stop decreasing, and ***start increasing***, in the ***stratosphere***.



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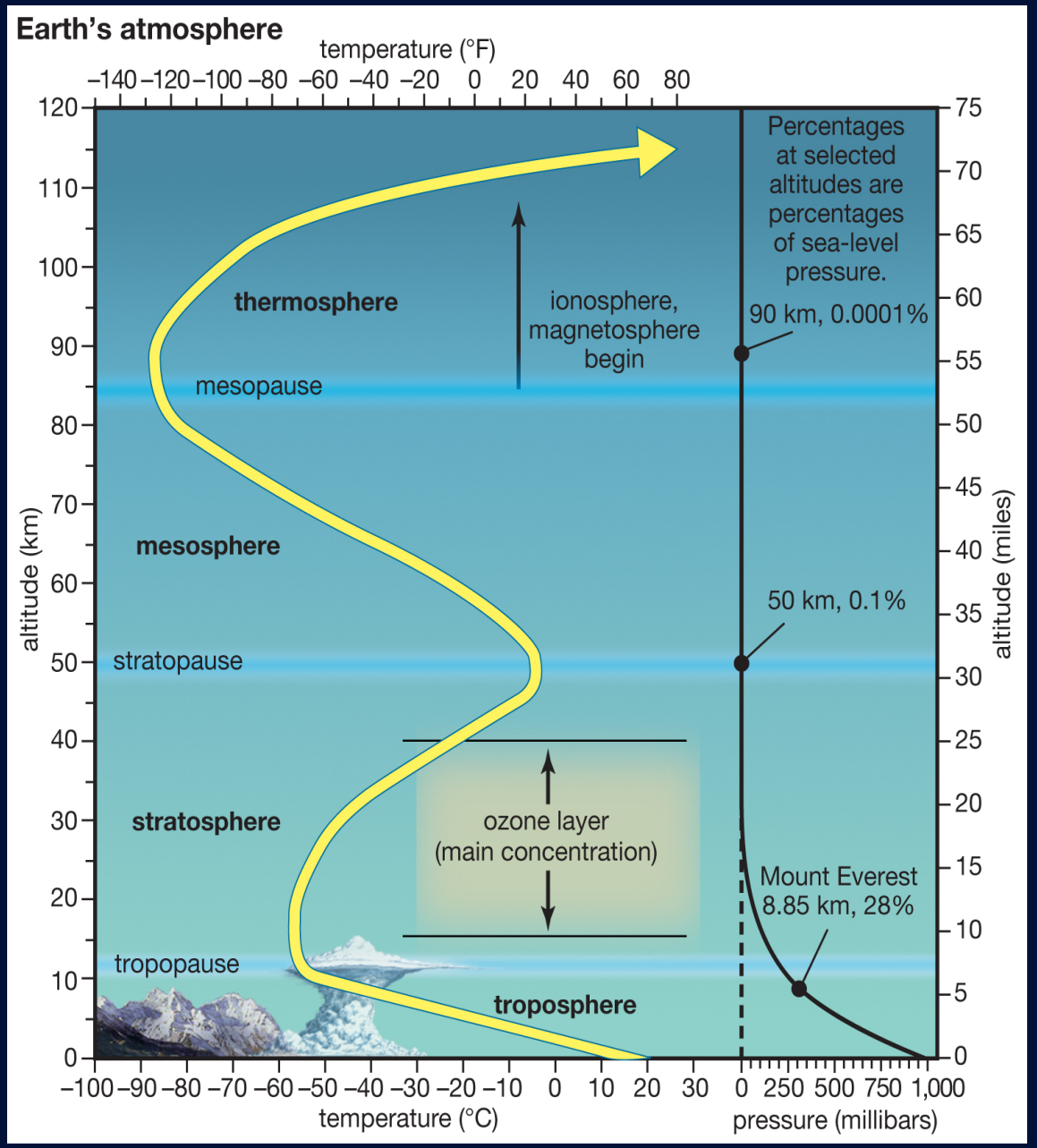
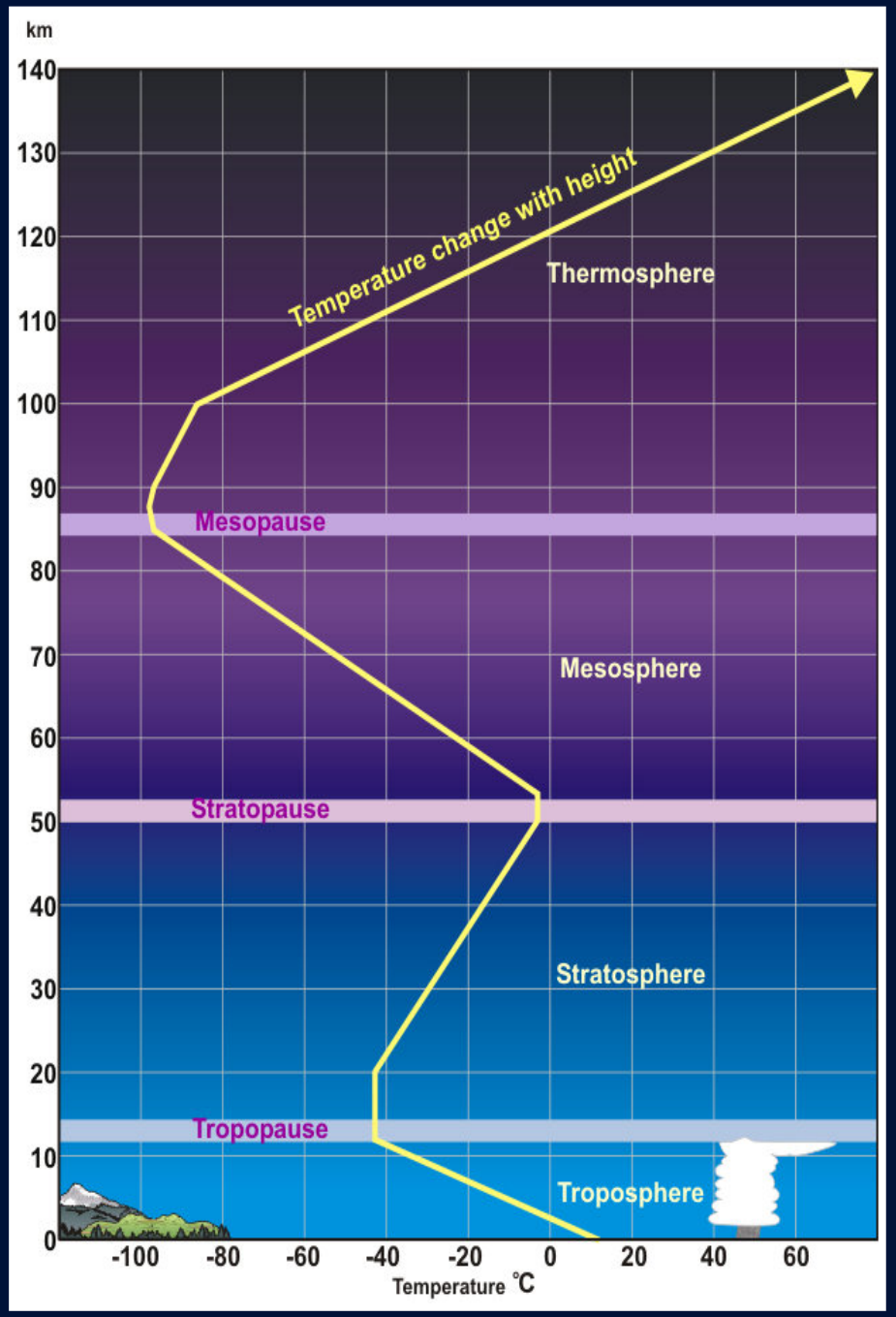
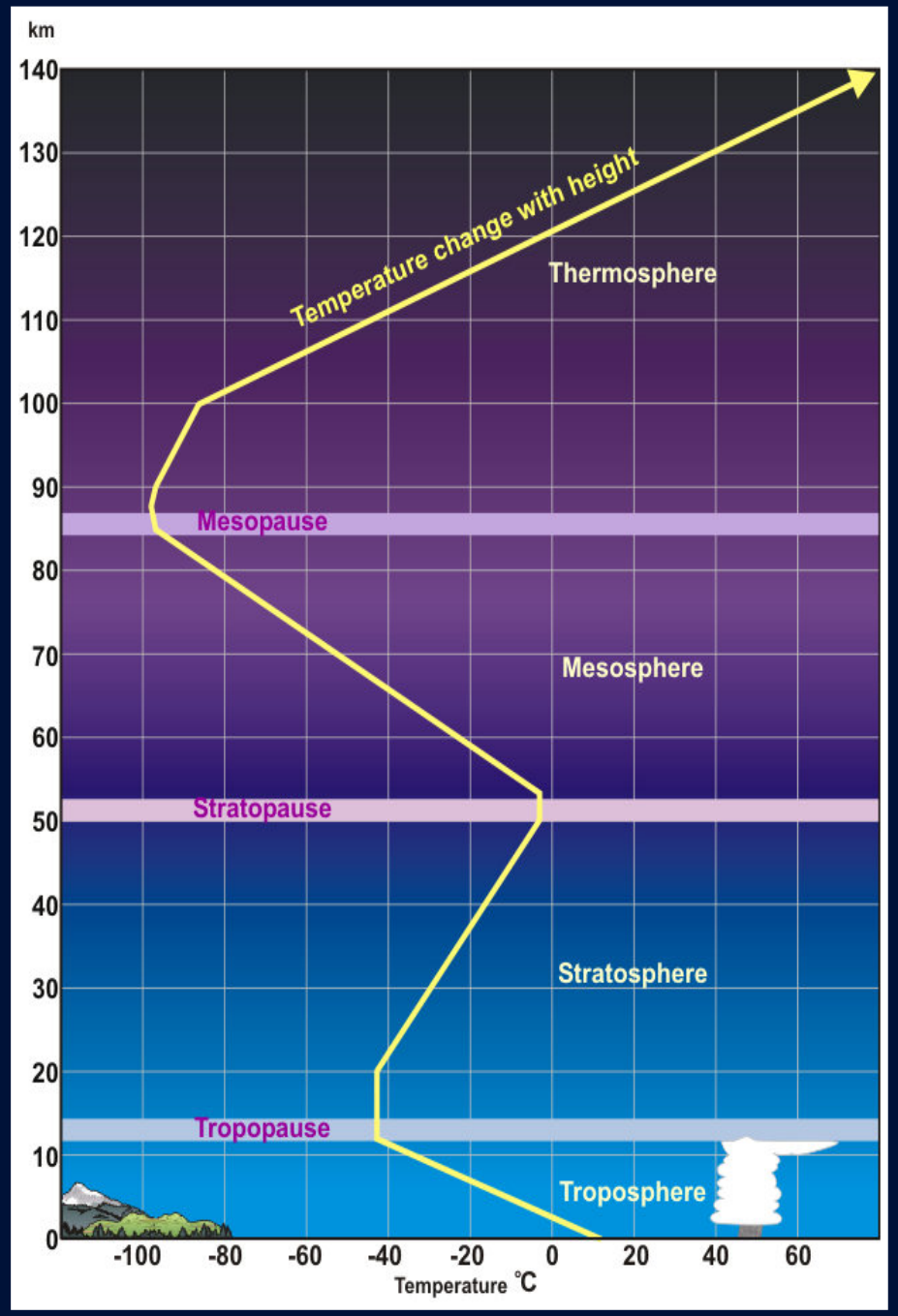
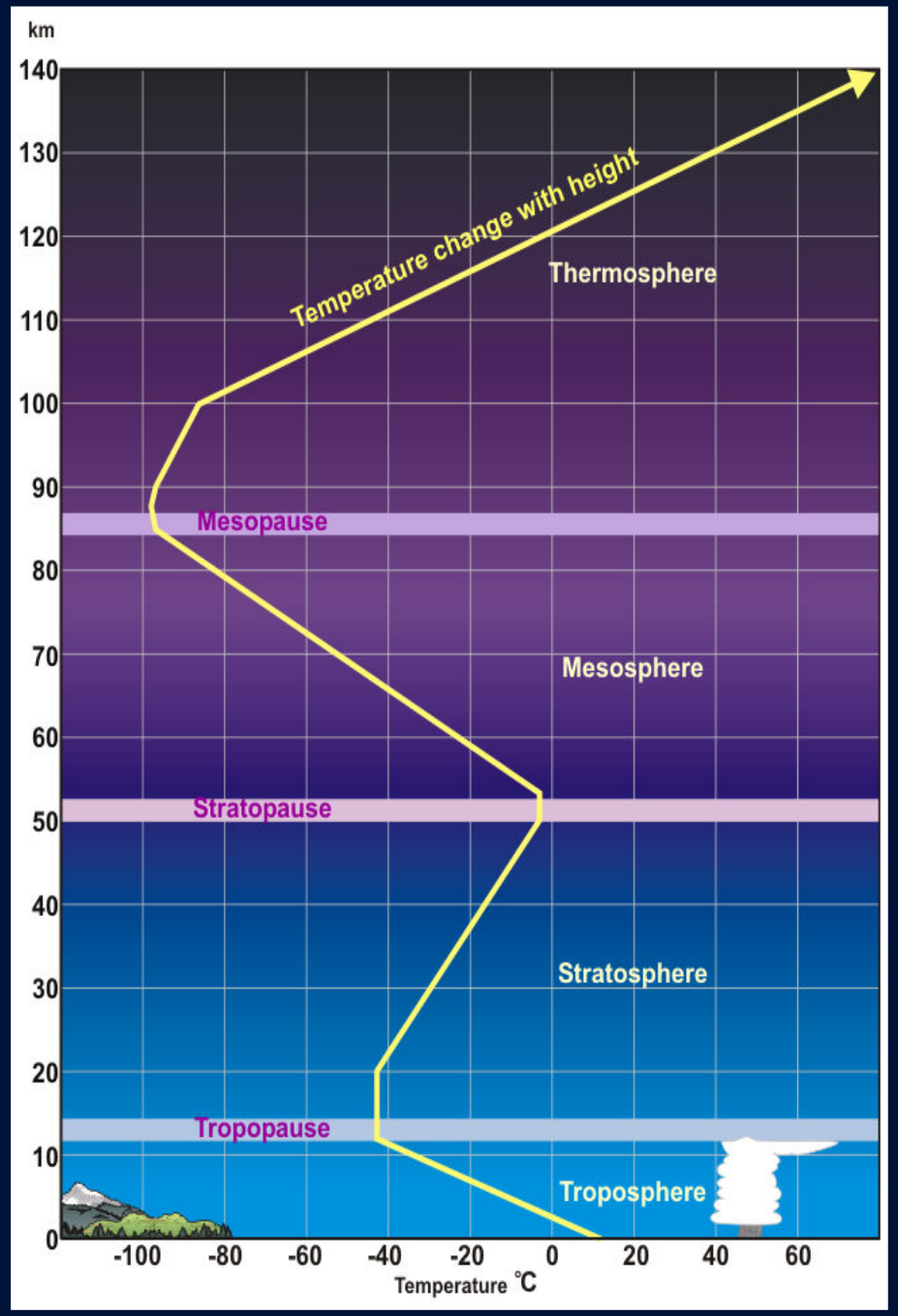
~ ***Temperatures increase*** with height in the ***stratosphere***, located 12–50 km above the Earth, due to ***ozone*** which absorbs UV light from the Sun.




km
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
Temperature change with height
Thermosphere
Mesopause
Mesosphere
Stratopause
Stratosphere
Tropopause
Troposphere
-100
-80
-60
-40
-20
0
20
40
60
Temperature °C



~ ***Temperatures stop increasing*** at the ***stratopause*** and start ***decreasing*** in the ***mesosphere*** where the ***coldest temperatures*** are found.



~ ***Temperatures stop increasing*** at the ***stratopause*** and start ***decreasing*** in the ***mesosphere*** where the ***coldest temperatures*** are found.

~ At a height of ~85 km, ***temperatures*** stop decreasing at the ***mesopause***, and begin ***increasing*** as we enter the ***thermosphere***, which extends far ***into space***.

~ ***Temperatures*** increase to ***over 1,000° C*** due to the ***absorption*** of high-energy ***solar radiation*** by the air molecules, but it would ***not feel hot***!

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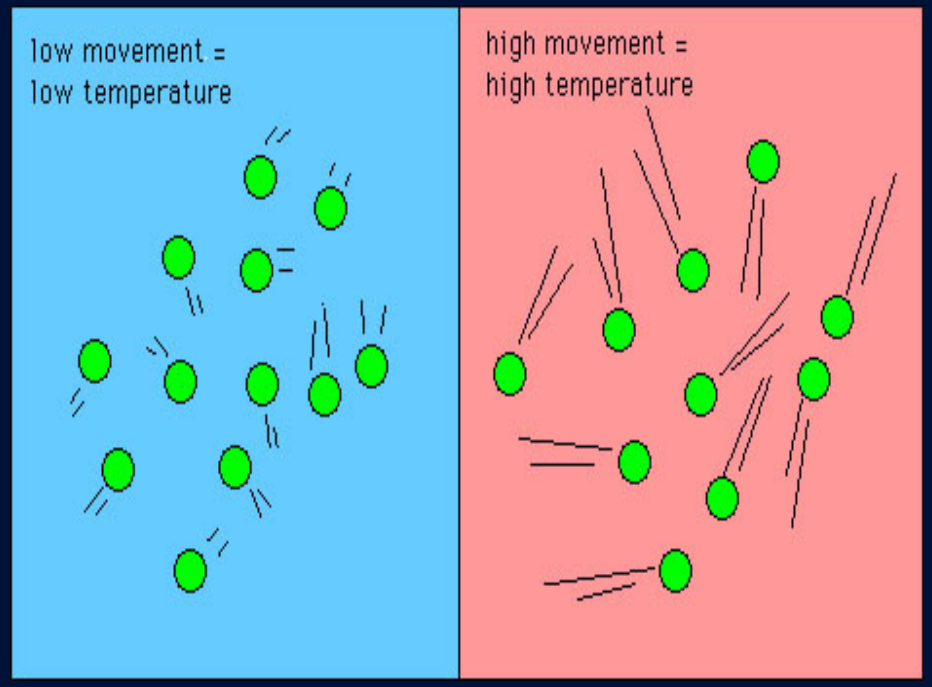

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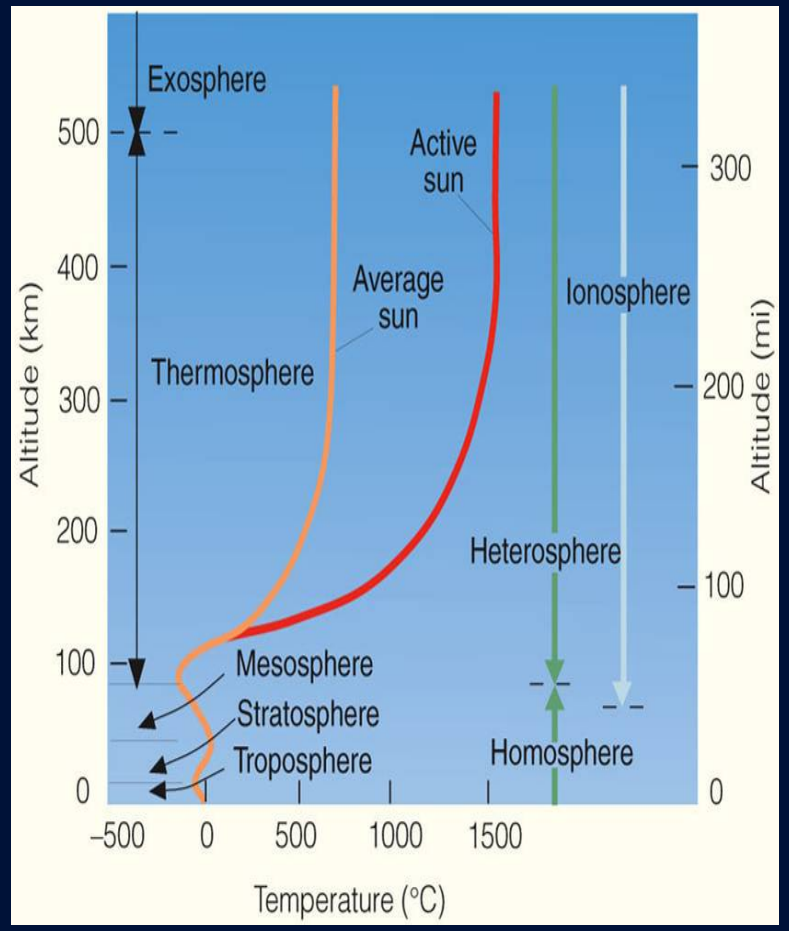

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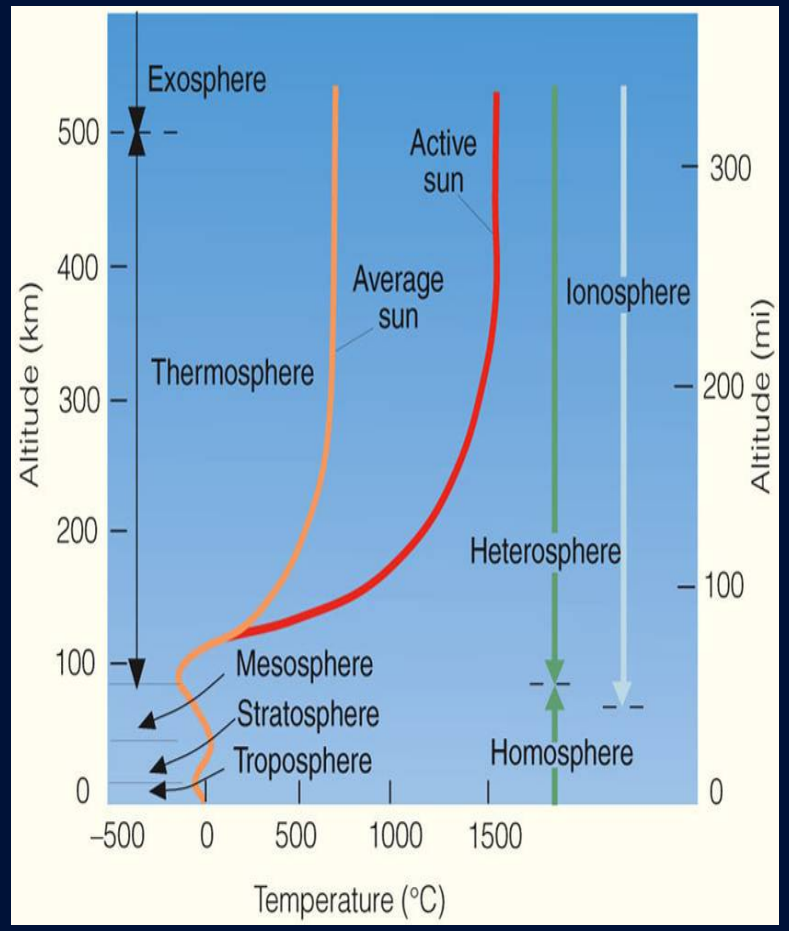
~ The ***homosphere*** has a ***uniform*** composition, following the proportions defined earlier.



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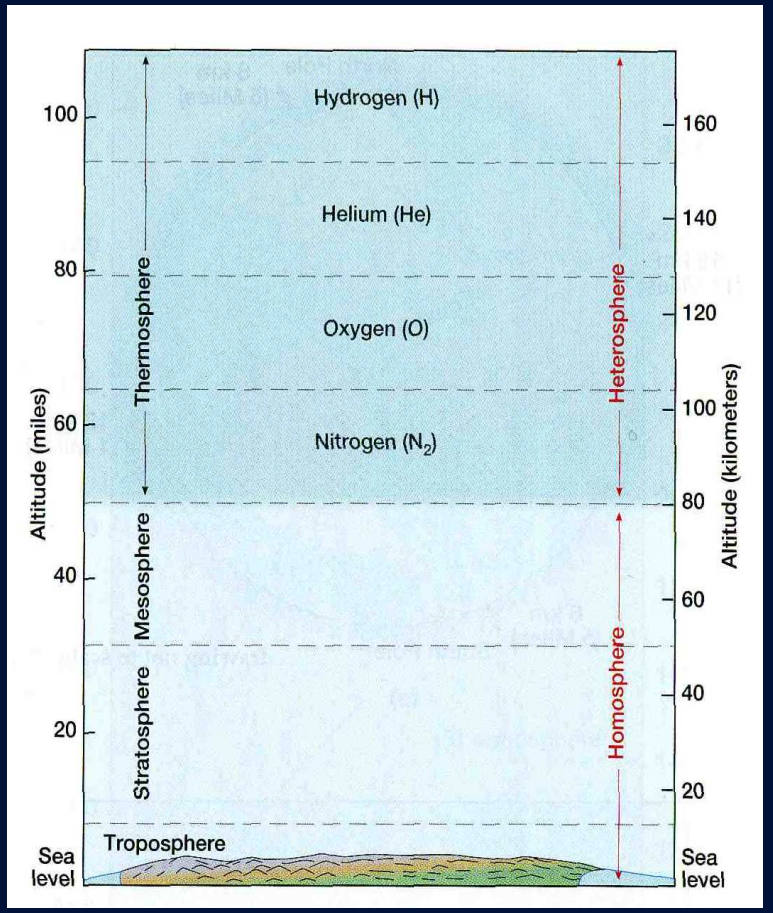

~ In the ***heteorosphere***, the gases are ***stratified*** into ***layers***, with ***nitrogen*** being the ***lowest*** level, then ***oxygen***, ***helium***, and ***hydrogen***; i.e., from the ***heaviest*** ***to*** the ***lightest***.

~ The ***heteorosphere*** is ***electrically-charged*** (the ***ionosphere***), where gases take on a ***positive charge*** as they lose electrons, ***absorbing*** high-energy ***radiation***.

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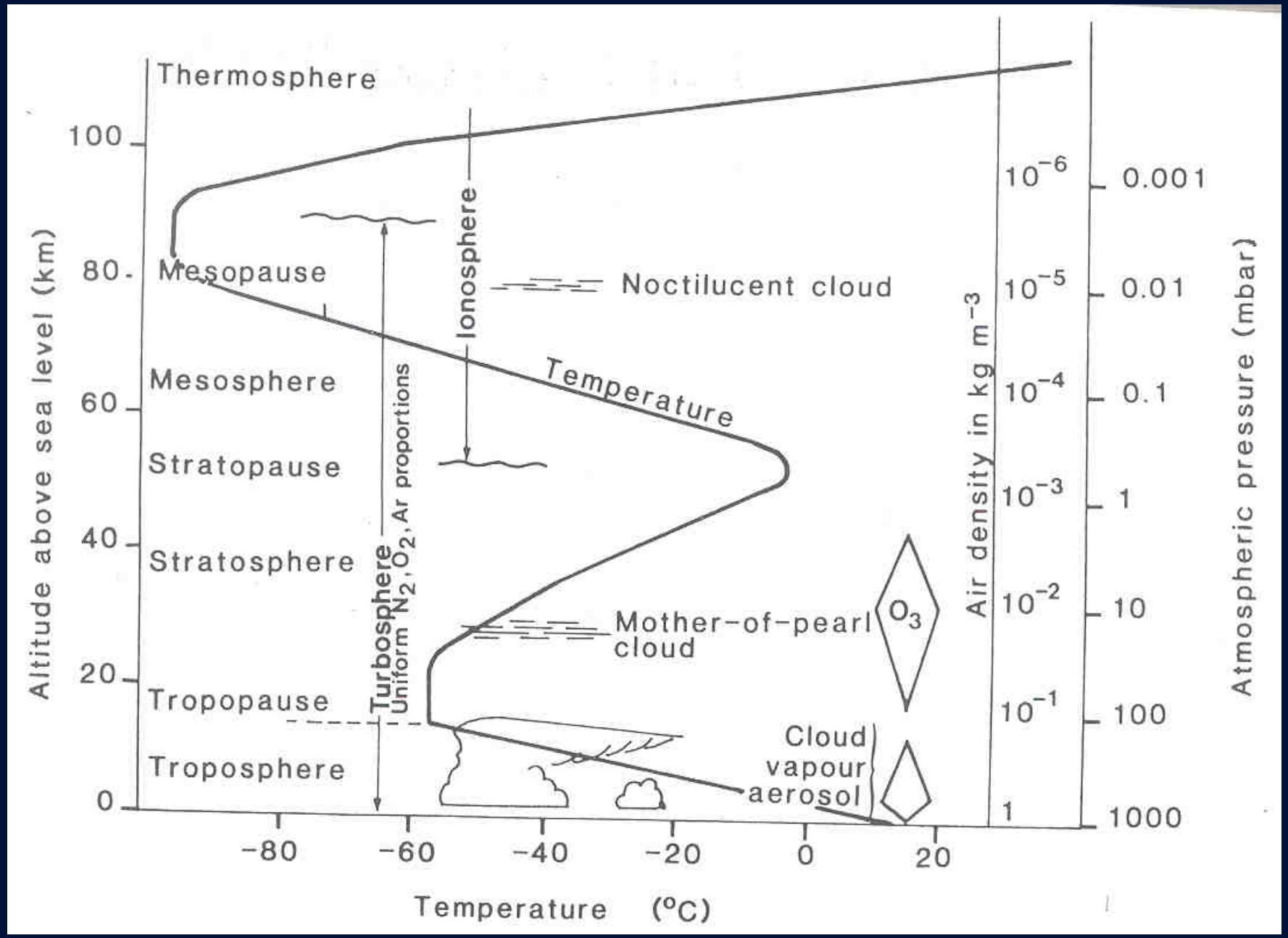
Thermosphere
100
80
Mesopause
Noctilucent cloud
Ionosphere
Mesosphere
60
Temperature
Stratopause
40
Stratosphere
Turbosphere
Uniform N_2, O_2, Ar proportions
Mother-of-pearl cloud
O_3
20
Tropopause
Cloud
vapour
aerosol
0
Troposphere
-80
-60
-40
-20
0
20
Temperature (°C)
Altitude above sea level (km)
Air density in kg m^{-3}
10^{-6}
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1
0.001
0.01
0.1
1
10
100
1000
Atmospheric pressure (mbar)