

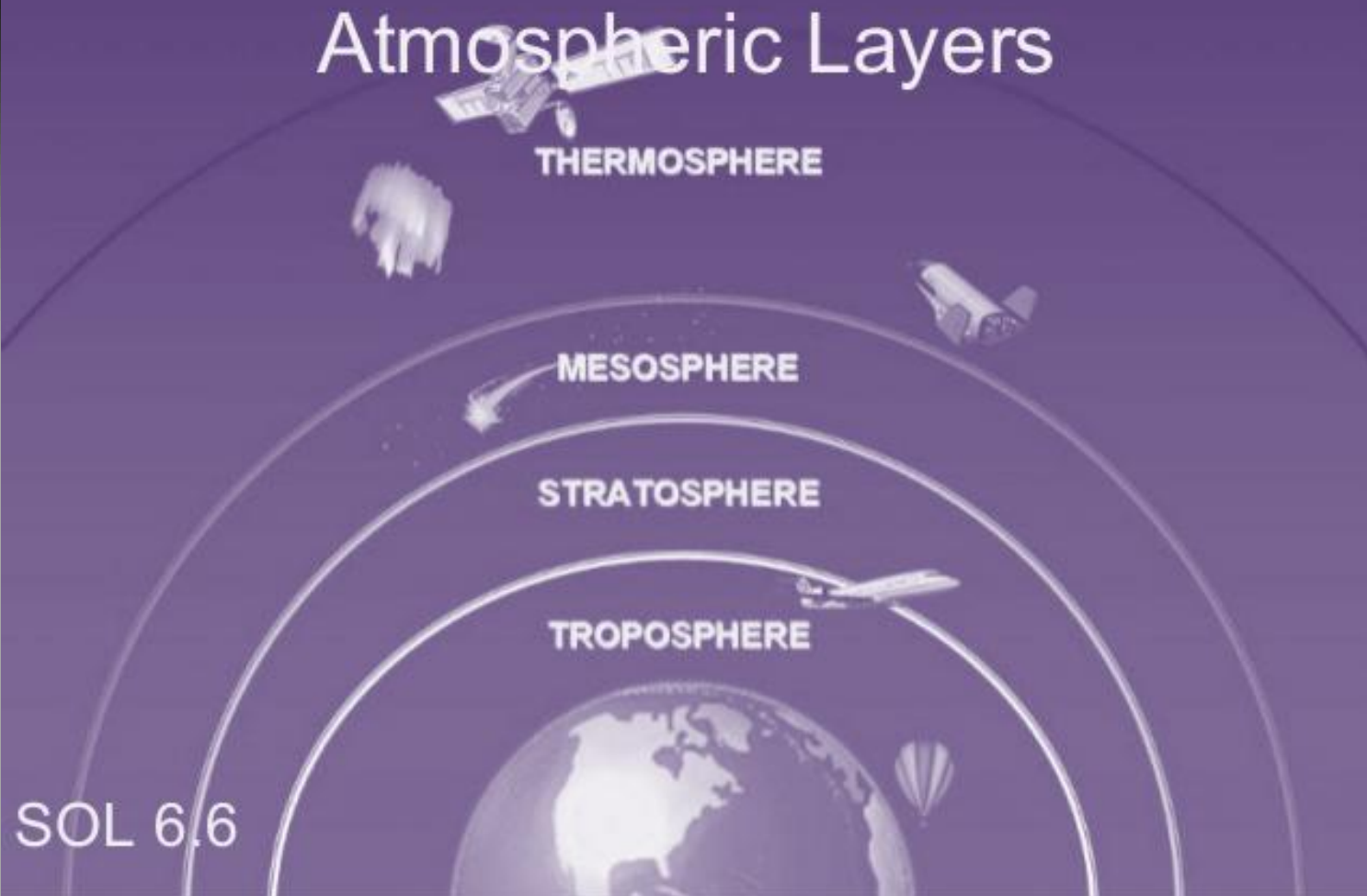
WELCOMES YOU

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THE EARTH'S ATMOSPHERE: Atmospheric Layers



Why is the Atmosphere Important?

- Weather exists because of the atmosphere.
- It makes the Earth suitable for living things.
- The atmosphere is the layer of gas that surrounds the planet.
- The atmosphere traps energy from the sun and keeps the Earth's surface warm enough for water to exist as a liquid.
- It protects the Earth from radiation and meteoroids.

- What gases are found in the atmosphere?

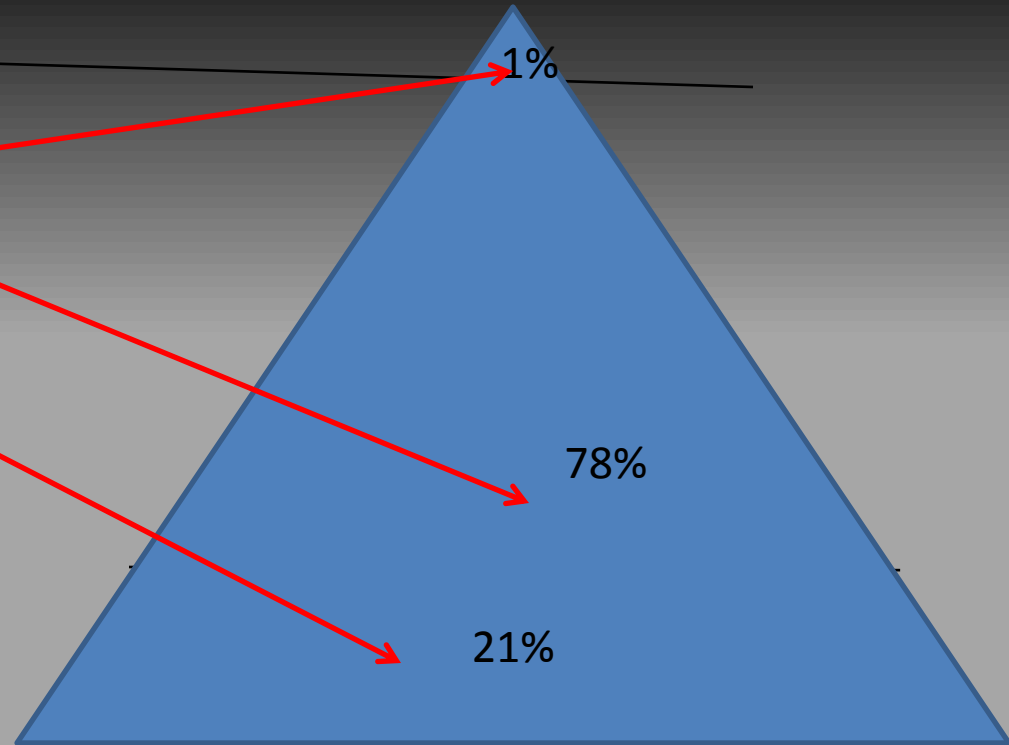
Nitrogen, Oxygen, Water Vapor, Carbon Dioxide,
Ozone, Other gases

- Why is the earth divided into four layers?

Because of the change in air temperature!

Composition of the Atmosphere

- Nitrogen: 78%
- Oxygen: 21%
- Other Gases: 1%
 - Argon 0.93%
 - Carbon Dioxide 0.036%
 - Neon 0.0018%
 - Helium 0.00052%
 - Methane 0.00015%
 - Krypton 0.00011%
 - Hydrogen 0.00005%



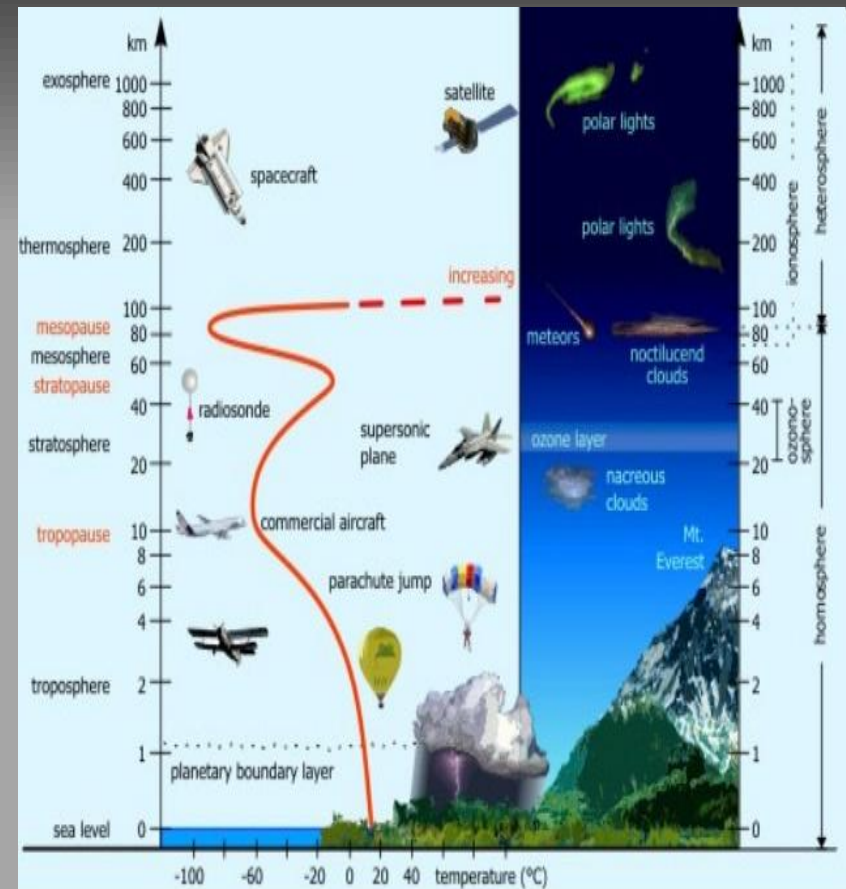
These layers are the...

- troposphere,
- the stratosphere,
- the mesosphere,
- and the thermosphere.

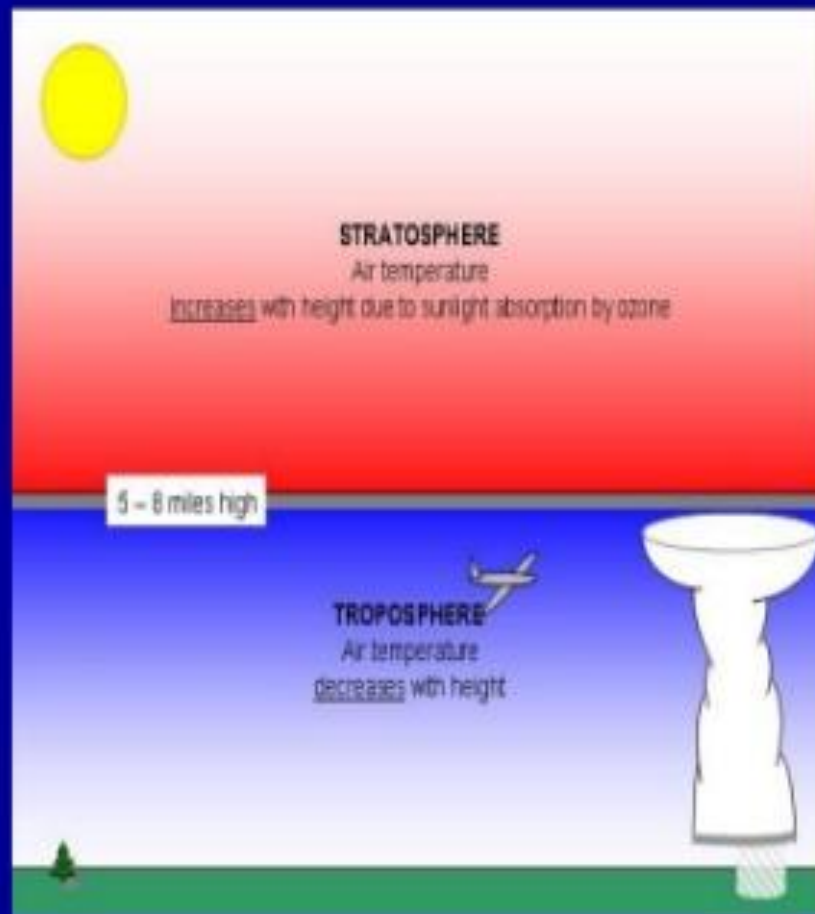
- Ionosphere
- Exosphere

THE TROPOSPHERE

- This is where all living things live
- It is the most important layer for living things because it contains over 80% of all the air in the atmosphere!
- It contains almost all the water vapor in the atmosphere, and water vapor produces **WEATHER** (like rain and clouds) and determines climate
- Varies in thickness (9-16 km) and temperature
- As the altitude increases in the troposphere, the temperature decreases.



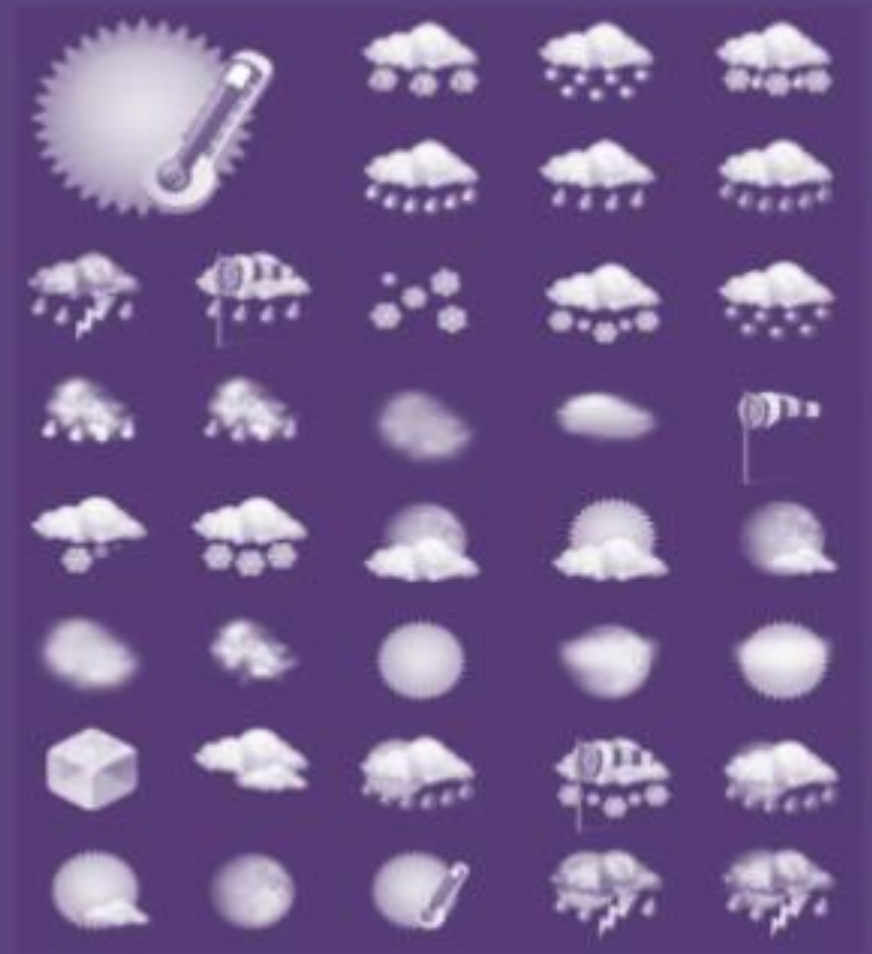
Troposphere



- As you **move up** into the troposphere the **temperature decreases**.
- At the **top** of this layer the **air temperature is about - 60°C (-76° F)**.

Troposphere

- It extends to about 14 kilometers (around 9 miles) above the Earth
- and is where virtually all weather takes place.



THE STRATOSPHERE

- Approximately 40km thick
- Located just above troposphere
- Large planes travel through this layer, just above cloud layer? DO YOU KNOW WHY?
- **Because air is thinner at this altitude and so planes encounter less friction there and can therefore fly faster and use less fuel.**

Ozone Layer

- The ozone layer is found there. WHAT IS THE OZONE LAYER?
- It is a layer of gas that absorbs the ultraviolet rays coming from the sun. It protects us from these rays, which cause skin cancer.
- The ultraviolet rays heat the atmosphere, the farther from earth the higher the temperature.

A HOLE IN THE OZONE LAYER

- The thickness of the Ozone Layer is shrinking because of CFC's (Chlorofluorocarbons) and aerosol products.
- Why would the thinning of the ozone layer worry us?

Because it protects us from UV rays. It can increase skin cancer.

- If the ozone increases at low altitudes (like the troposphere) it can also cause health problems. The increase in ozone at low altitudes is caused by pollution.

THE MESOSPHERE

- It is the third layer of the atmosphere
- It is approximately 40km thick.
- There is a wide variety of temperatures because there aren't many air molecules and so they do not absorb a lot of warmth from the sun. (Minimum= -120 degrees Celsius, Maximum from 0-27 degrees Celsius)
- The mesosphere protects Earth's surface from being hit by most meteoroids (chunks of stone and metal from space).

Mesosphere

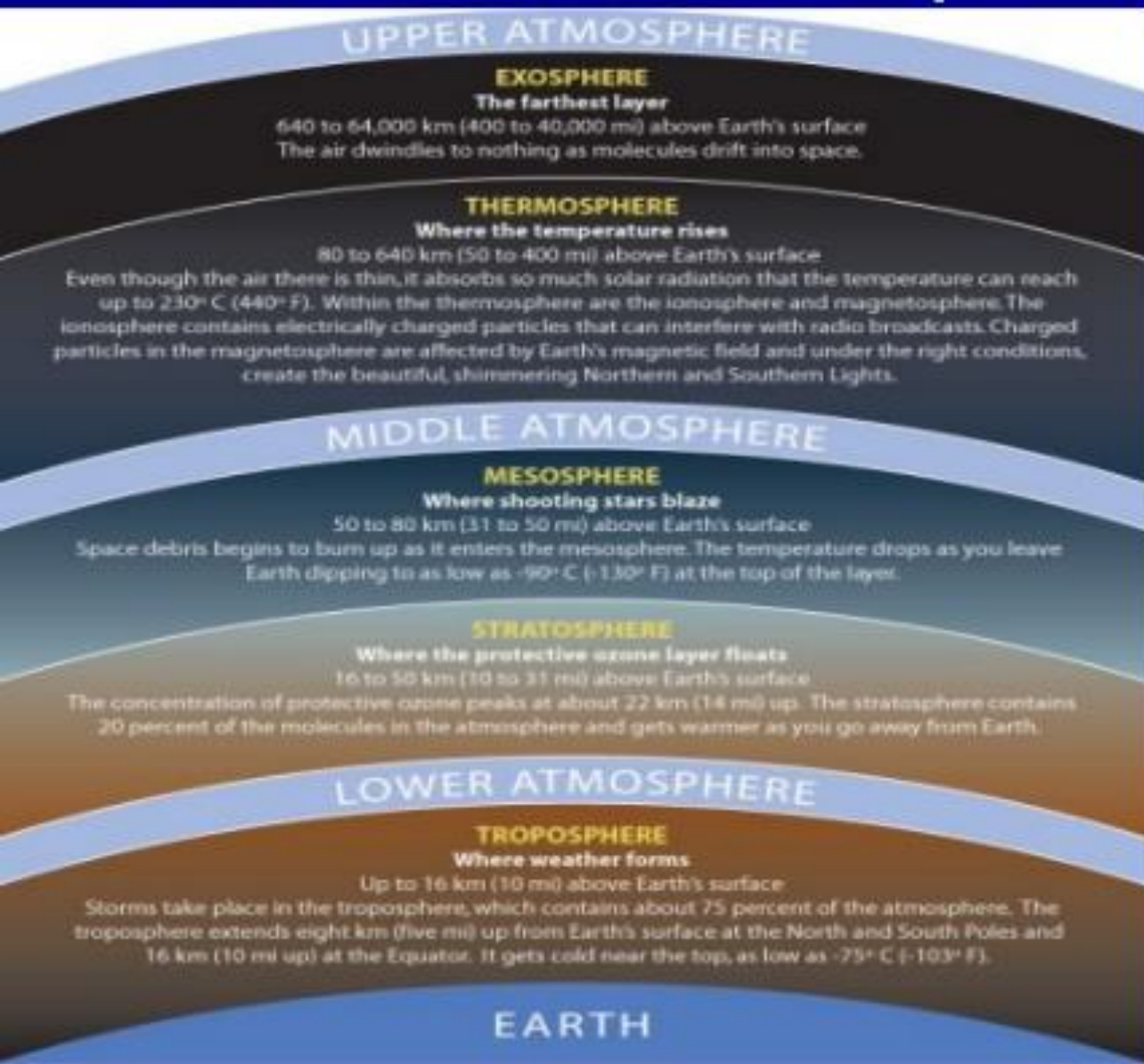
- Has anyone ever seen a shooting star?
- This is the mesosphere protecting us from a meteor. The trail of hot, glowing gases is the meteor burning up in the mesosphere layer.



THE THERMOSPHERE

- The fourth and last layer
- The thickest layer
- Measures over 90km
- Sun's rays are strong in this zone, and create high temperatures that exceed 1000 degrees Celsius.

Thermosphere



- It begins at 80 km (50 miles) above the Earth and extends outward into space.
- Sometimes the thermosphere and exosphere are listed as separate layers.

Thermosphere

- This is also where the space shuttle orbits the Earth!



Divided into two layers

- Ionosphere
- Exosphere

Ionosphere

- At an altitude of 90 to 400km the IONOSPHERE is found.
- It is useful from earth's communication system because it contains a lot of electrically charged particles. These particles bounce radio waves.
- The Northern Lights (Aurora Borealis) occurs in the ionosphere.
 - The aurora borealis is caused by particles from the sun that enter the ionosphere near the North Pole. These particles strike oxygen and nitrogen atoms in the ionosphere causing them to glow.

Formation of the Ionosphere

SUN

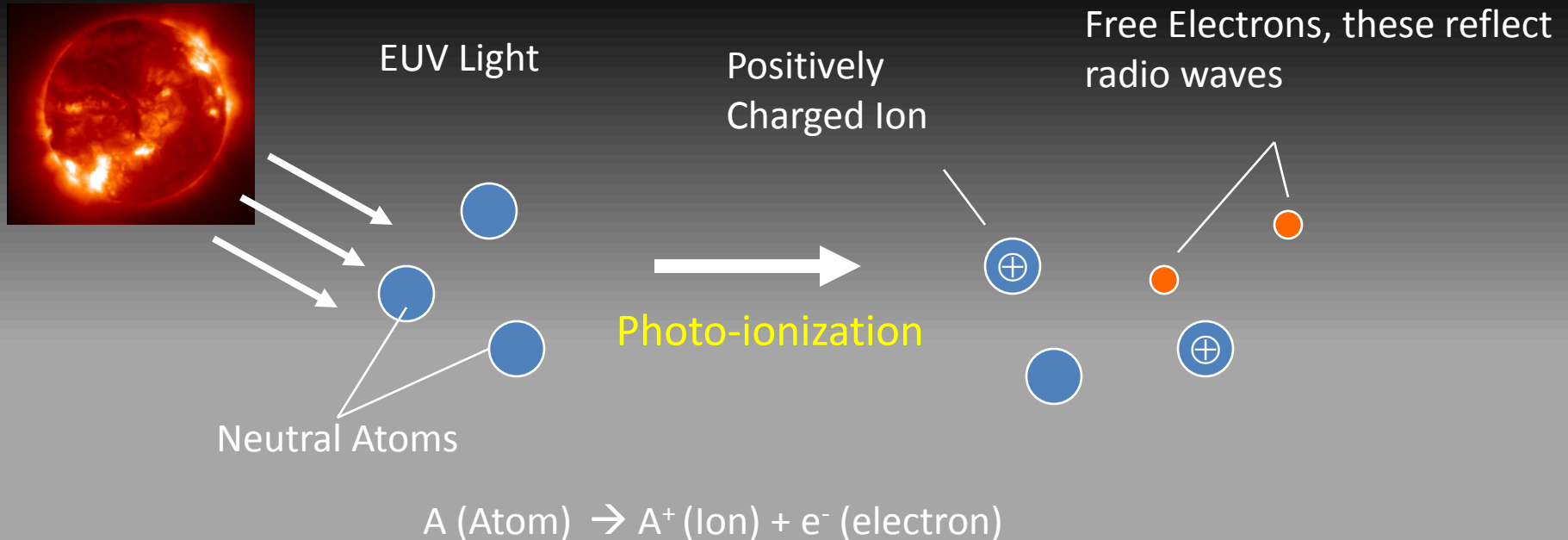


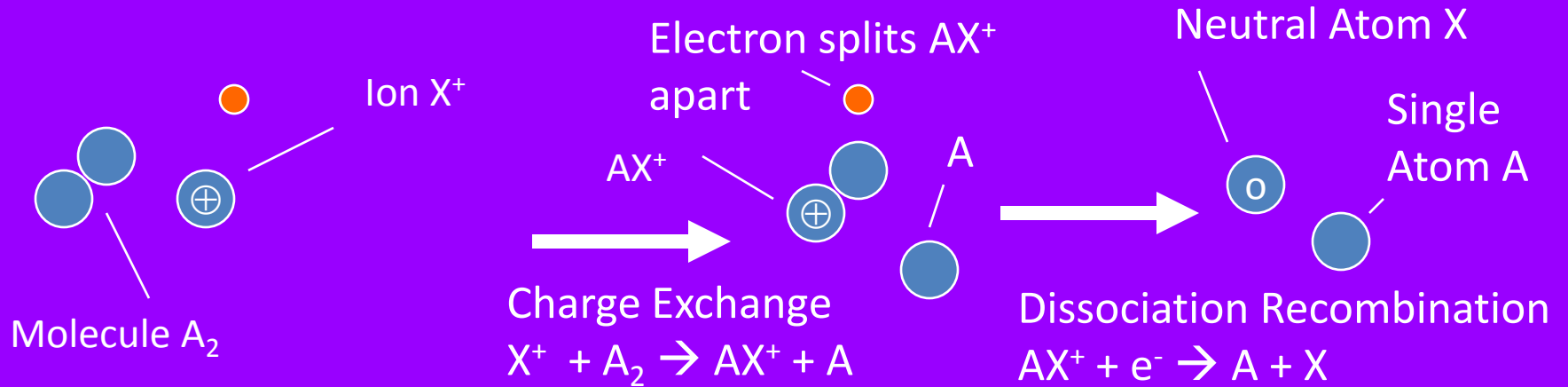
Photo-ionization occurs when Extreme Ultraviolet (EUV) from the Sun strikes neutral atoms to produce positively charged ions

Types of Atoms: primarily Oxygen & Nitrogen

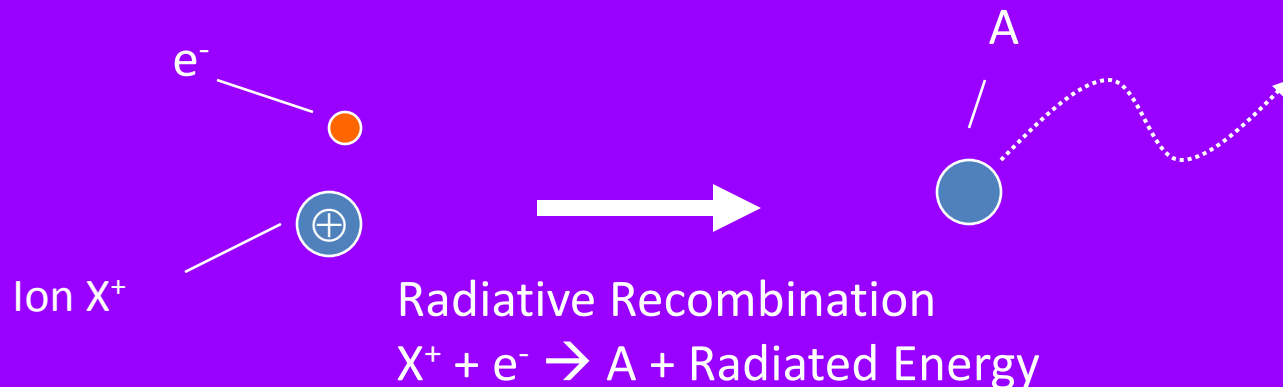
Types of Molecules: O_2 , N_2 , NO

Two Types of Recombination:

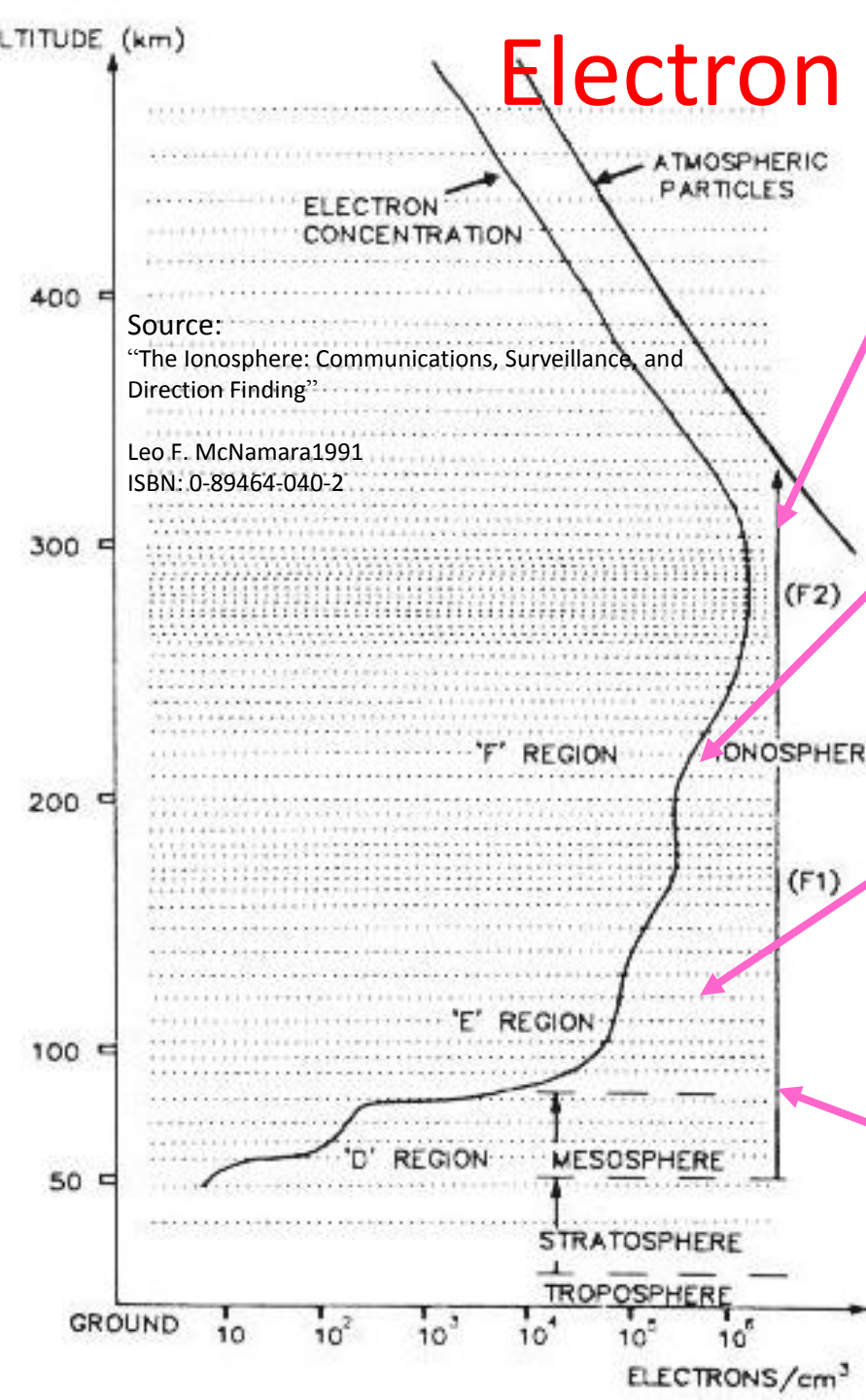
Dissociation recombination, 2 steps:



Radiative recombination, 1 step:



Electron Density vs. Height



F2 - Region

- 300 Km
- 10⁶ N_e/cm³ (noon)
- 10⁵ N_e/cm³ (Midnight)

F1 - Region

- 200 Km
- 2.5 × 10⁵ N_e/cm³ (noon)
- Absent at night

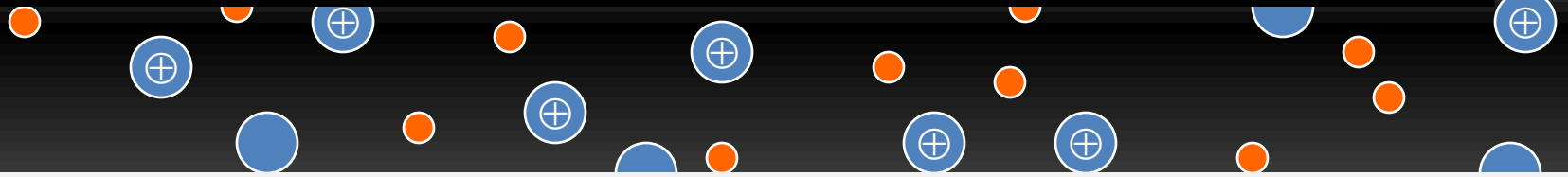
E - Region

- 110 Km
- 1.5 × 10⁵ N_e/cm³ (noon)
- 1.0 × 10⁴ N_e/cm³ (Night)

D - Region

- 90 Km, Lower following solar flare
- 1.5 × 10⁴ N_e/cm³ (noon)
- Absent at Night

Reflectivity of the Ionosphere



When ions are “let go” they oscillate in simple harmonic motion at an Angular Frequency ω

$$\omega^2 = N e^2 / \epsilon_0 m$$

N = Electron Density

e = Charge on electron

m = Mass of an electron

ϵ_0 = Permittivity of free space

Angular Plasma Frequency (maximum usable frequency):

$$f_N = 2\pi / \omega$$

f_N = Plasma frequency in Hertz

$$f_N^2 = 80.5 N$$

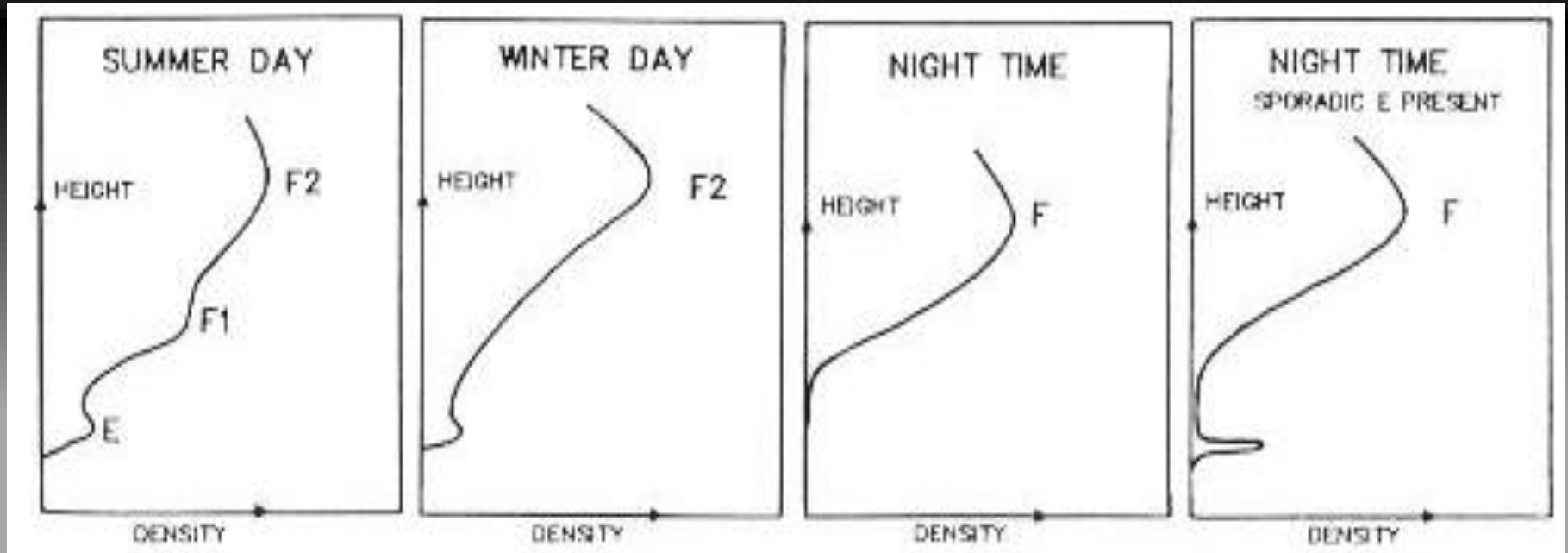
Substituting Atomic Constants

$$f_c \approx 9 \times 10^{-6} \sqrt{N_m}$$

f_c = Critical Frequency,

N_m = Electron density

Variability of the Ionosphere



- Diurnal (Thru the day)
- Seasonal (Thru the year)
- Location (Geographic & Geomagnetic)
- Solar Activity (Solar Cycles & Disturbances)
- Height (at different layers)

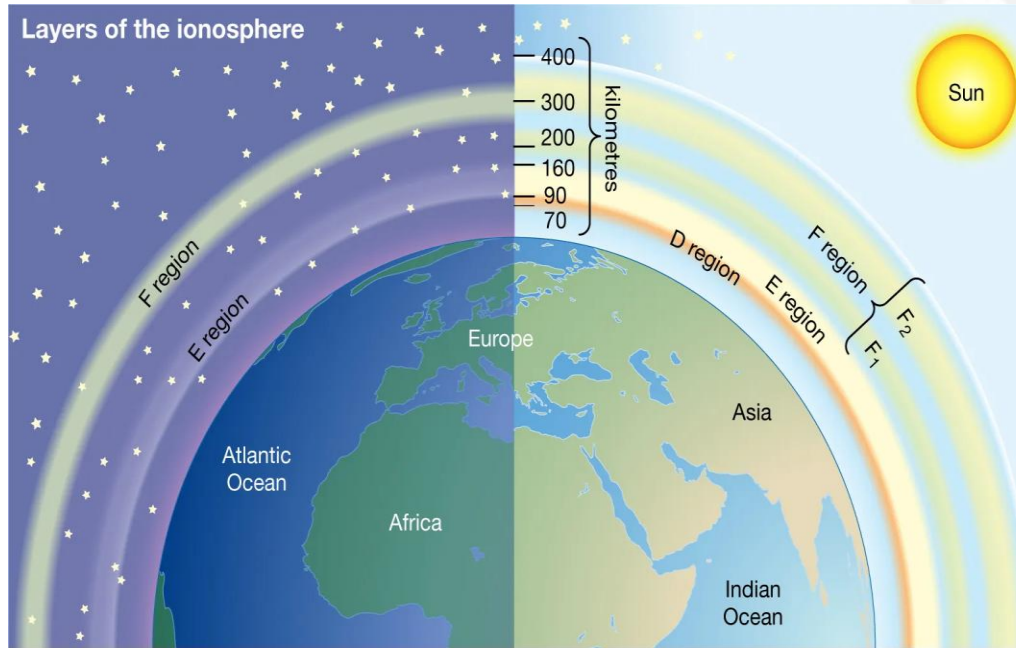
Source:

"The Ionosphere: Communications, Surveillance, and Direction Finding"

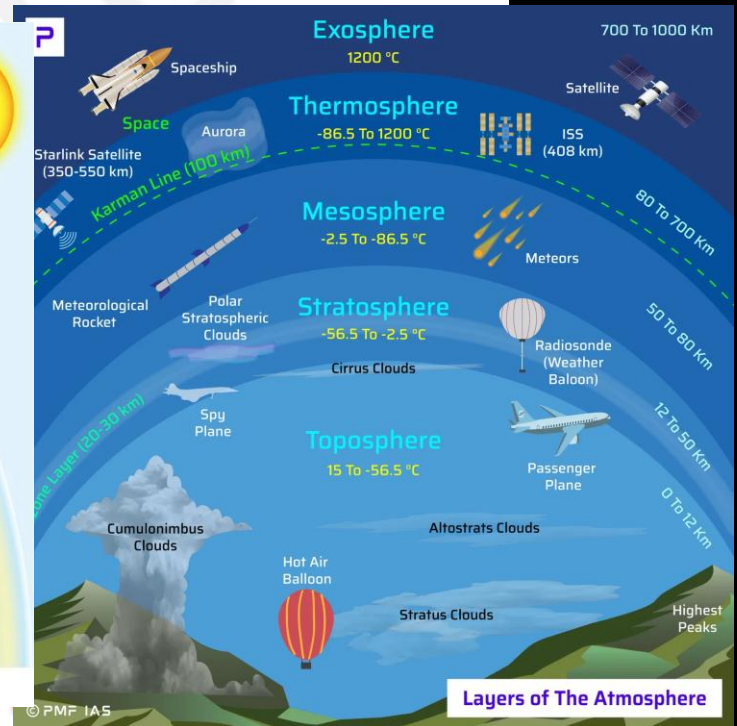
Leo F. McNamara 1991

ISBN: 0-89464-040-2

Outer atmosphere G region

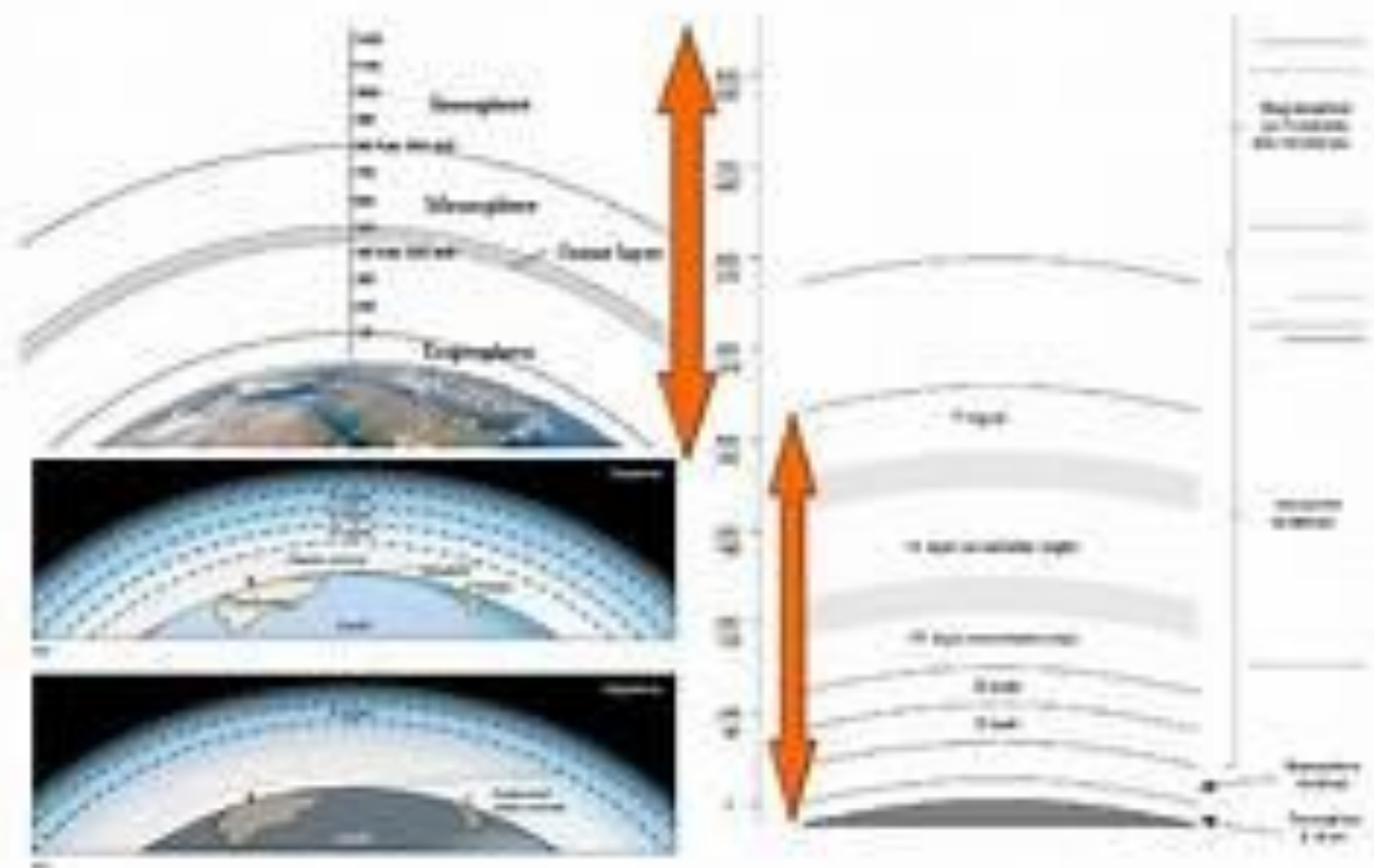


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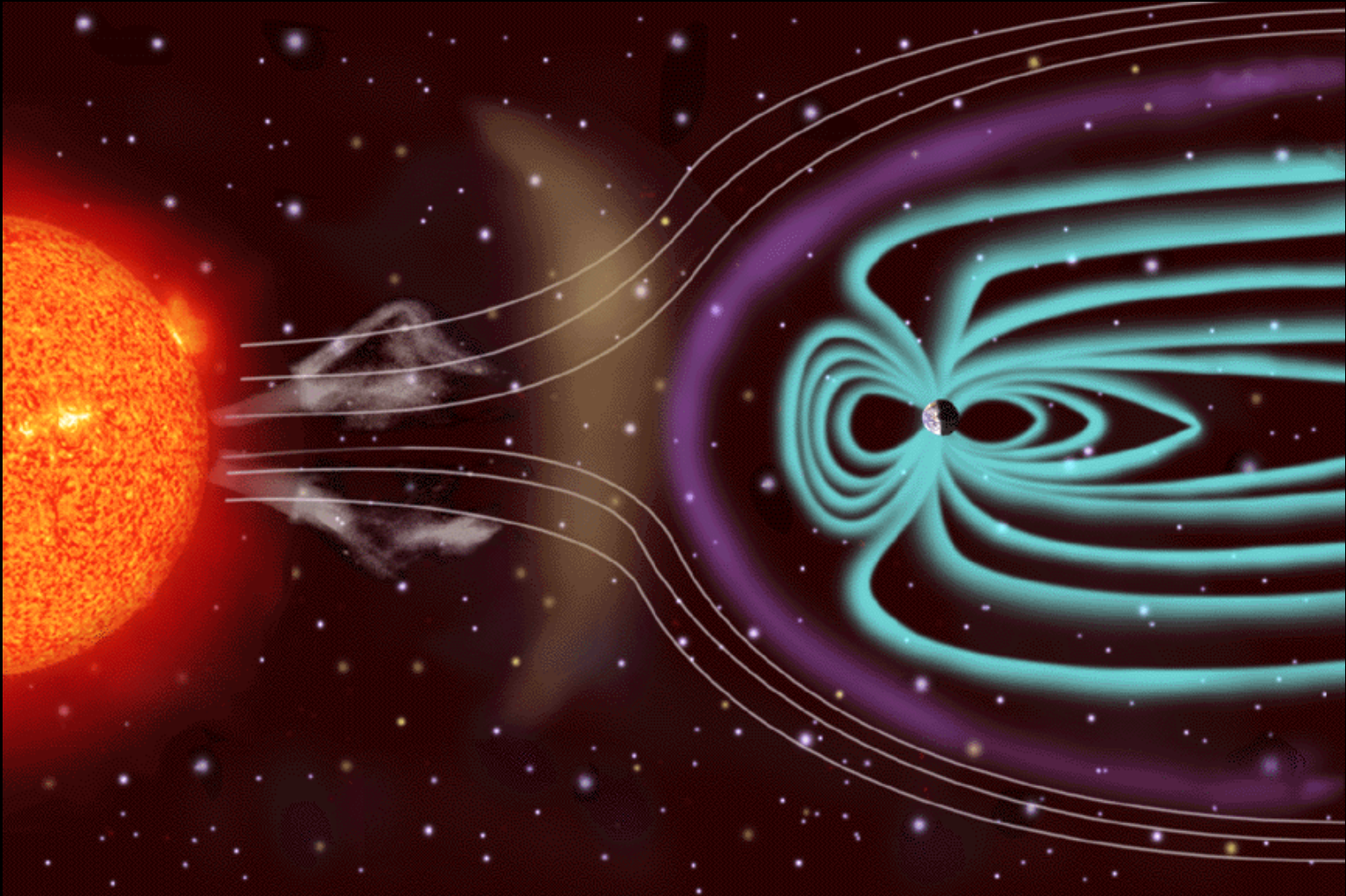


Layers of The Atmosphere

IONOSPHERE REGIONS



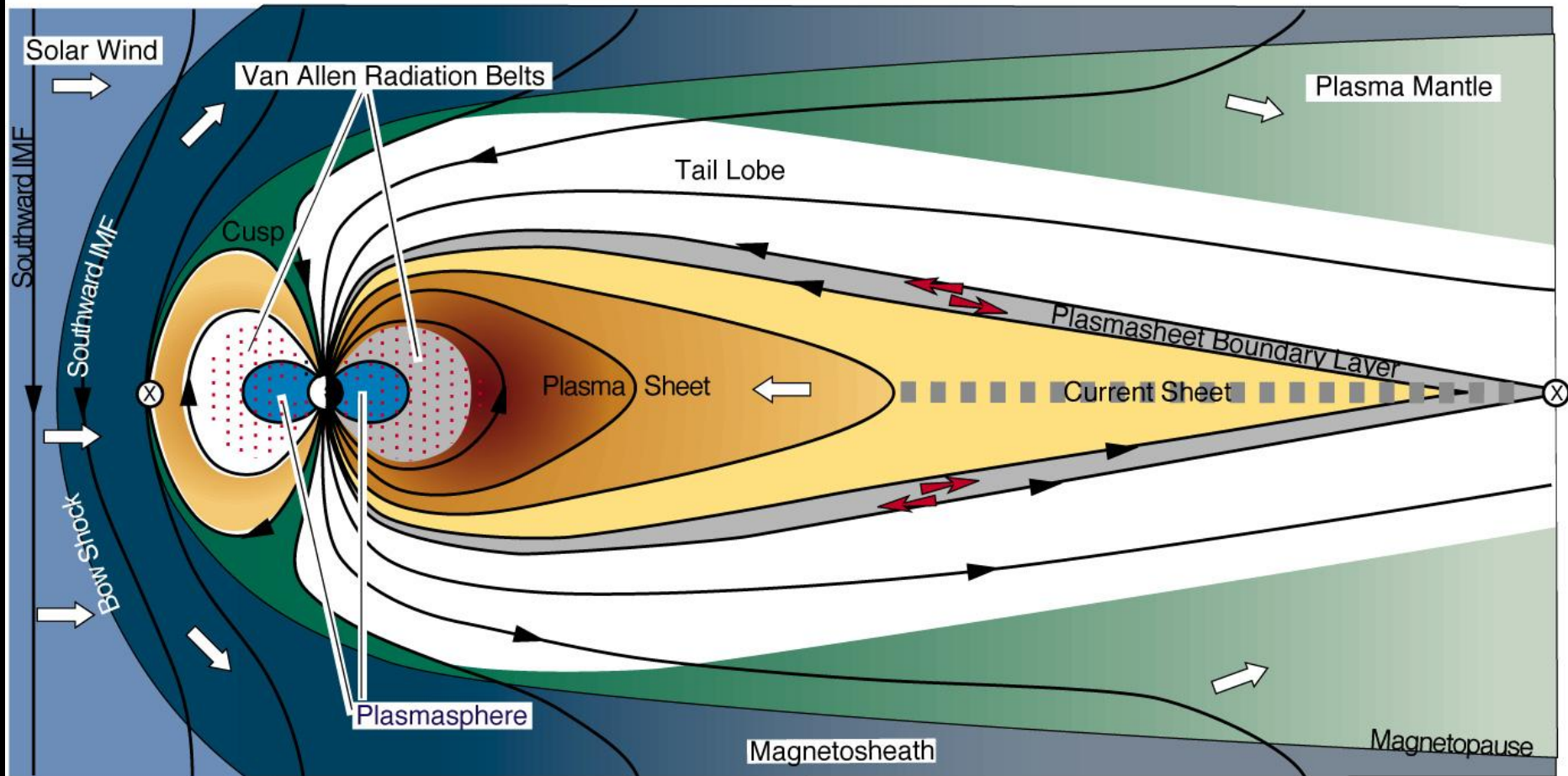
Source of Space Weather / Ionospheric Disturbances: The Sun



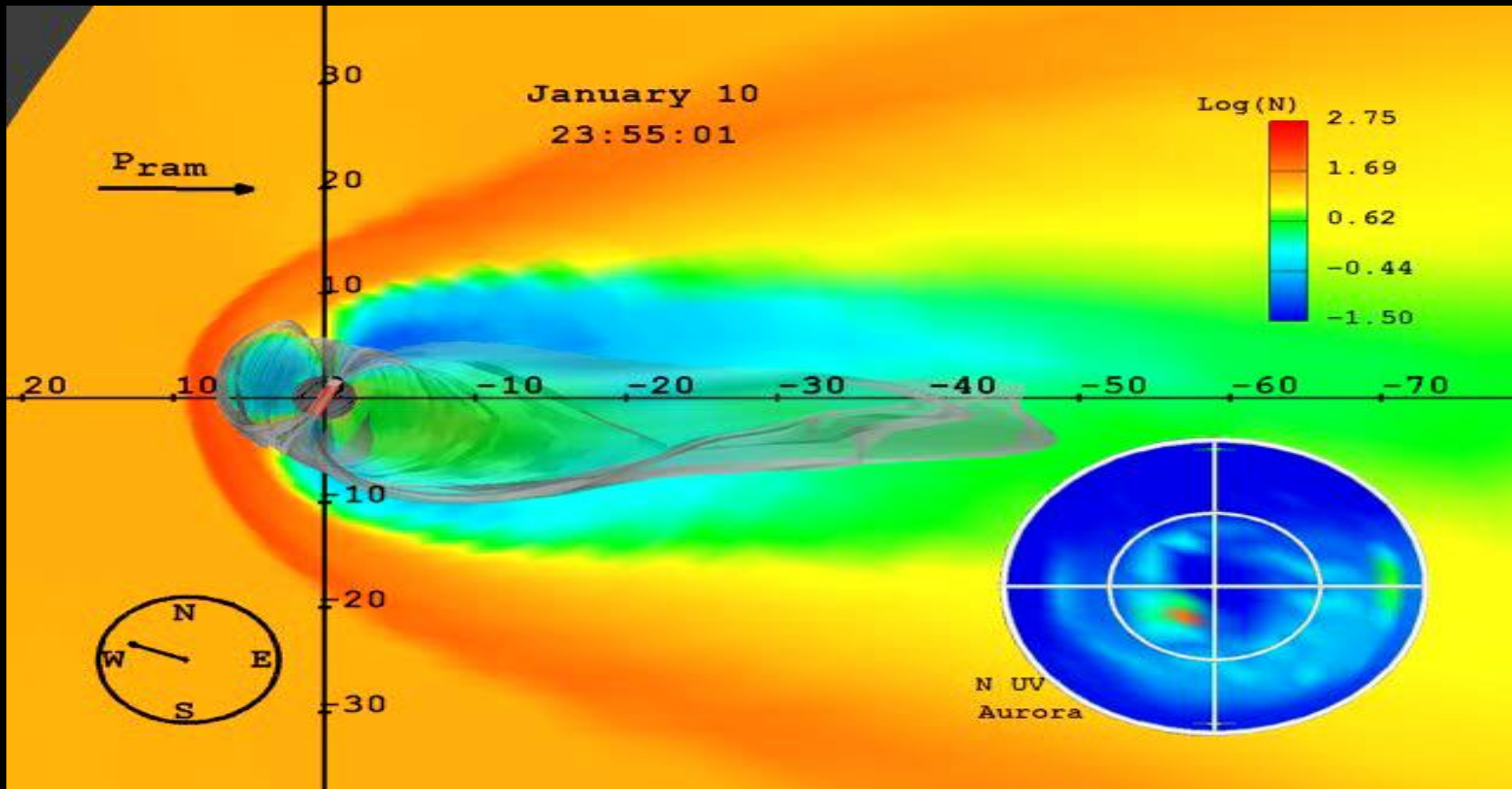
Exosphere

- It is the outer layer of the thermosphere.
- Satellites are found in this layer.

The Magnetosphere



Magnetosphere



Other effects include satellite damage, power outages, GPS errors, radio interruptions, etc.

REFERENCES

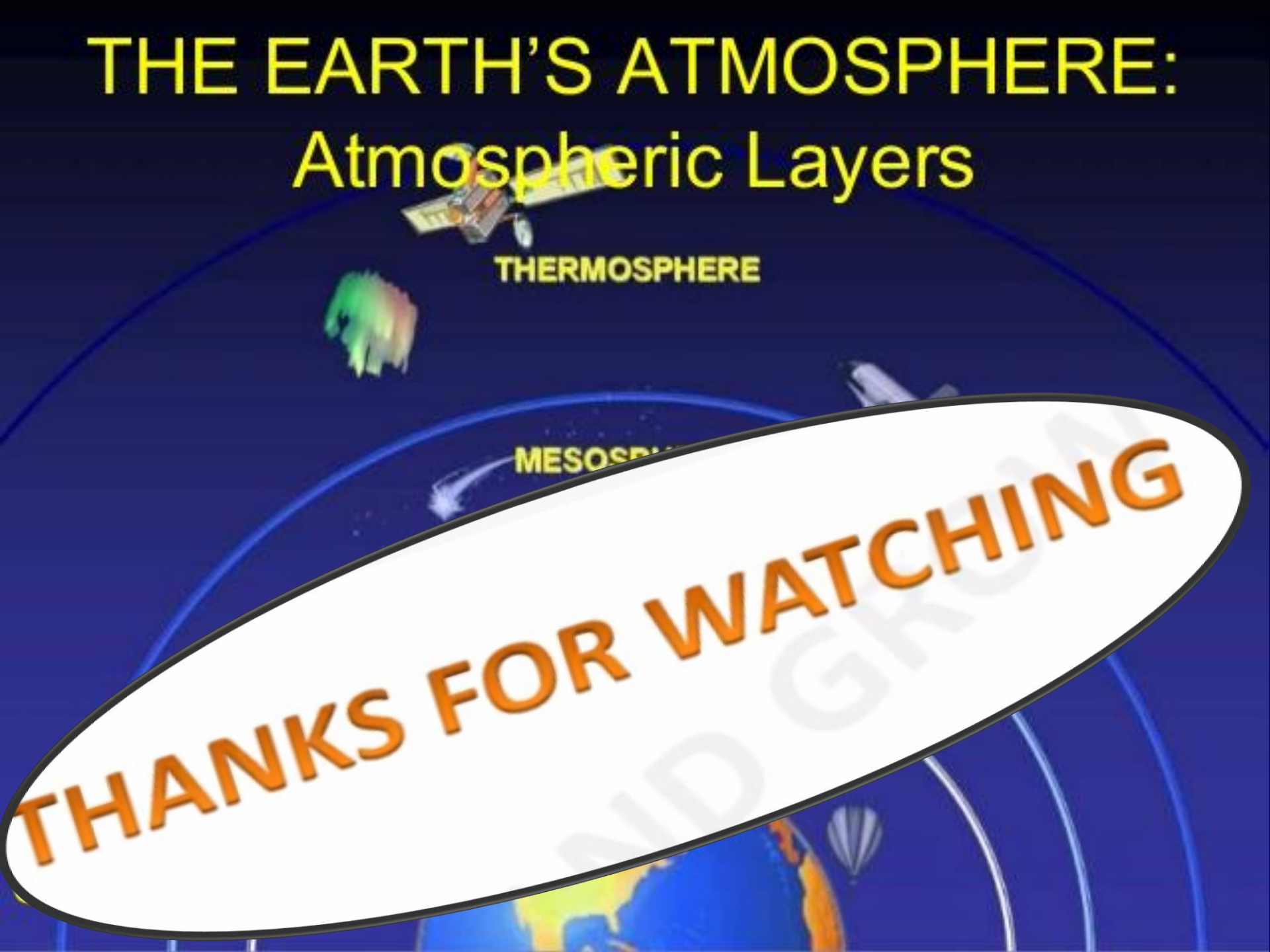
<https://www.slideshare.net/guest6b681228/the-atmosphere-3193194>

https://www.weather.gov/media/shv/education_resource_library/atmosphere/Atmosphere.ppt

<http://www.atms.unca.edu/dmiller/atms103/Chapter%2001%20The%20Earth's%20Atmosphere.ppt>

<https://www.lcps.org/cms/lib/VA01000195/Centricity/Domain/18676/layers%20of%20the%20earths%20atmosphere.ppt>

THE EARTH'S ATMOSPHERE: Atmospheric Layers

A diagram of the Earth's atmosphere showing concentric blue arcs representing the layers. A satellite is in the uppermost layer, a green aurora is in the middle layer, and a hot air balloon is in the lowermost layer. The labels 'THERMOSPHERE' and 'MESOSPHERE' are visible in yellow text.

THERMOSPHERE

MESOSPHERE

THANKS FOR WATCHING