BSC1222: Basics of Environmental Sciences

Unit: Climatology

Week 1: Atmosphere and weather

What you should know at the end !!

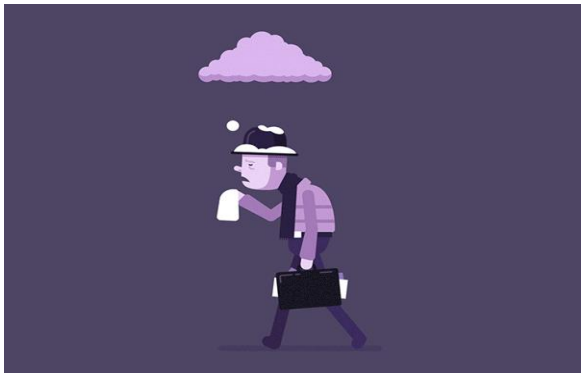
- Understanding the atmosphere will equip you with the knowledge and skills needed to sustainably manage agricultural systems in a dynamic and changing environment.

- Understand weather phenomena and forecast to mitigate risk by optimizing sustainable farming practices

Terminologies	Meaning
Troposphere	The lowest layer of the Earth's atmosphere, where most weather phenomena Occur
Stratosphere	The atmospheric layer above the troposphere is characterized by the presence of an ozone layer.
Mesosphere	The layer above the stratosphere and below the thermosphere.
Thermosphere	The outermost layer of Earth's atmosphere, where temperature increases significantly with altitude owing to the absorption of solar radiation.
Greenhouse Effect	The process by which certain gases in the Earth's atmosphere trap heat, leading to the warming of the planet's surface
Ozone Layer	A region of the Earth's stratosphere containing a high concentration of ozone molecules, which absorb and scatter ultraviolet radiation from the sun.
Ultraviolet Radiation	Electromagnetic radiation with a wavelength shorter than that of visible light but longer than X-rays, which can cause damage to living tissues and DNA.
Aerosols	Particles suspended in the atmosphere, such as dust, pollen, smoke, and pollutants
Atmospheric Pressure	The force exerted by the weight of the air above a given area affects weather patterns and the behavior of air masses.

Climatology field:

Meteorologists: focus on **forecasting** weather.



(Behance, n.d.)

Climatologists: Take a much larger view of the whole climate

(*Virgin Earth Challenge*, n.d.)

Week I
Day I
Chap I: Atmosphere

Interactive quiz 1

1.What exactly is the biosphere, then?

a) The layer of water that surrounds the Earth.

b) The layer of rocks that surround the Earth

c) The zone on Earth where life may be found.

d) The layer of gasses that surround the Earth

Answer:?

2. Why is it vital to consider the spheres of the Earth?There are three reasons why they are significant.

a) They are not important.

b) They are only relevant for scientists; and

c) Understanding them assists in providing solutions to environmental problems and anticipating natural catastrophes.

d) They are irrelevant to humans and the activities they engage in

Answer:?

3. If warm, moist air rises swiftly, resulting in the creation of towering clouds and maybe thunderstorms, what is the name of the meteorological phenomena that takes place?

a) tornado;

b) blizzard

c) Hurricane

d) Convection

Answer: ?

4. Which kind of gas contains the greatest proportion of the Earth's atmosphere in terms of volume?

a) Nitrogen

b) Oxygen (O_2)

c) The gas carbon dioxide

d) Argon

Answer: ?

What is an atmosphere

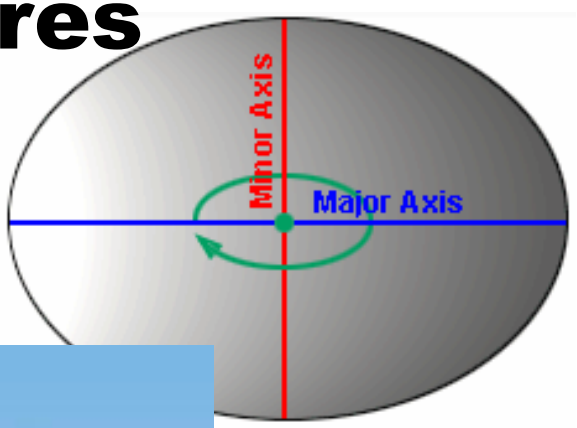
Everything (living)or (lifeless) lives in the universe.

Atmosphere:

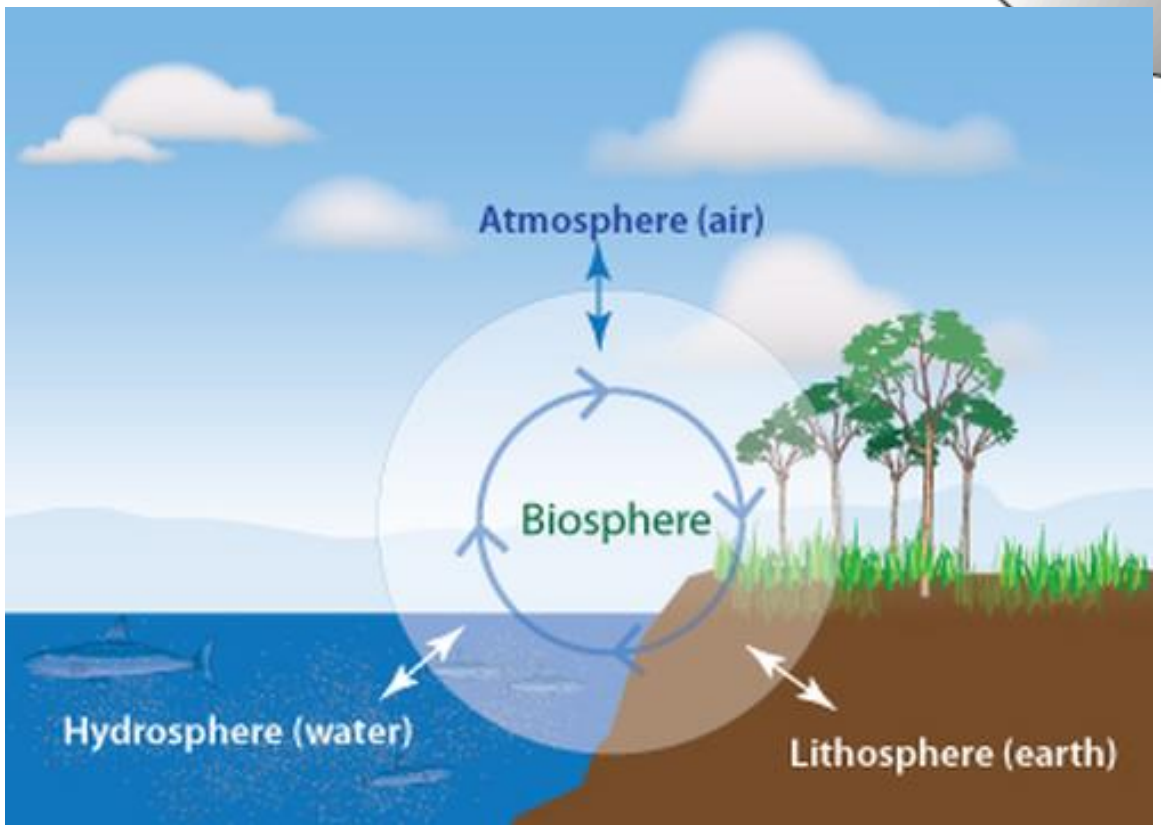
- Colorless and tasteless
- Physical mixture of gases

Earth shape and spheres

Earth is elliptical in shape

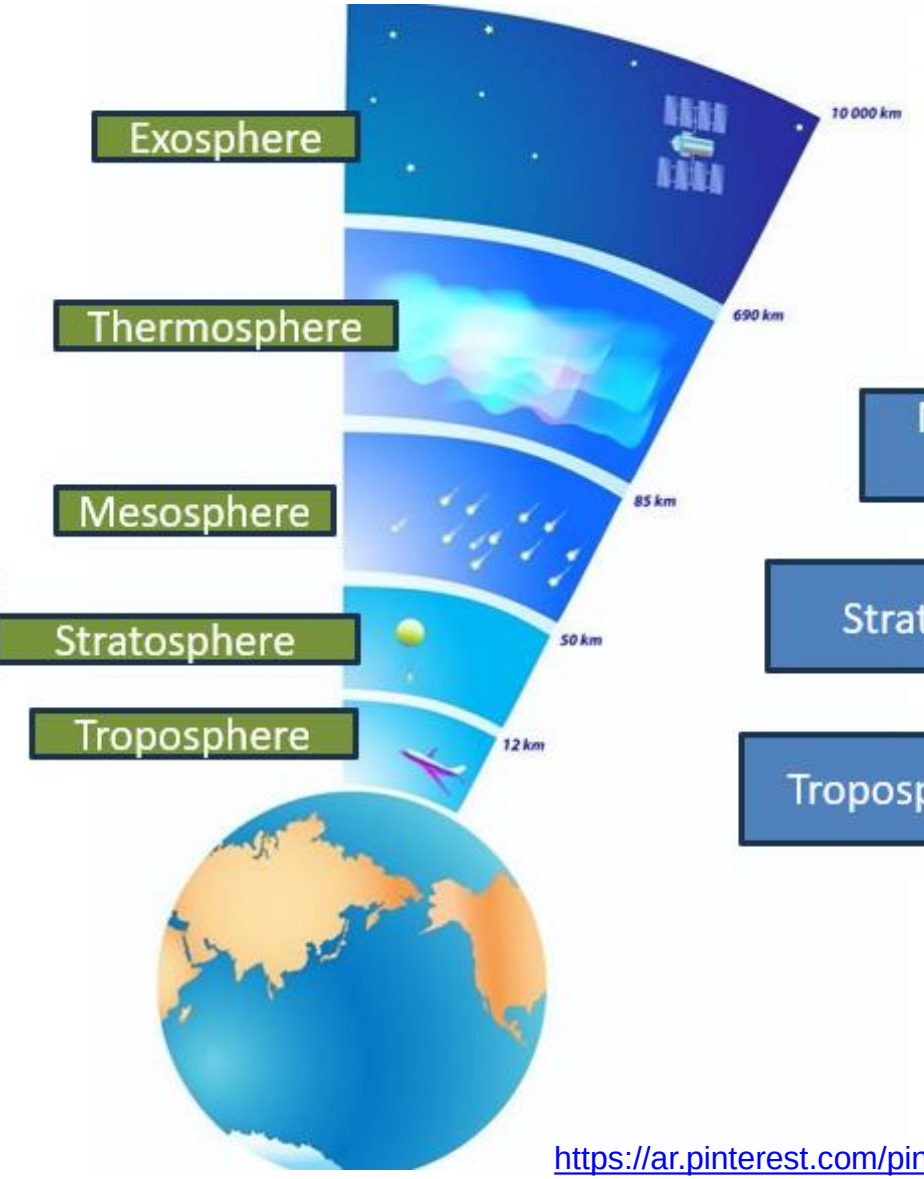


Earth spheres



https://aditiiguptaa99.medium.com/learn-about-earth-spheres-8b71c27a78fb, Learn about Earth Spheres

Atmospheric layer characteristics



Stratosphere and thermosphere is the outermost layer

Mesosphere protects Earth's surface from being hit by meteoroids

Stratosphere contains ozone layer

Troposphere is where weather occurs

https://ar.pinterest.com/pin/5840674507378622/, Curious Kids: is the sky blue on other planets?

Atmospheric layer characteristics

Troposphere 1

- The word "tropo" means mixing or turbulence "sphere" means region.

- The average height of this lower most layer is 14 kilometres above the mean sea level.

- At the equator is 16 kilometers ; 7-8 kilometers at the poles.

Atmospheric layer characteristics

Troposphere 2

- Under normal conditions the height of the atmosphere changes from place and season to season.
- Various types of clouds, storms, cyclones, and anticyclones occur in this sphere because of the concentration of almost all the water vapor and aerosols in it.
- The layer is called the "**Seat of weather phenomena**".

Atmospheric layer characteristics

Troposphere 3

- Wind velocities increase with height and attain the maximum at the top.
- There is a decrease in temperature with increasing elevation at a mean lapse rate of about 6.5 ◦c per km
- 75 % of total gases and moisture and dust particles are present

Atmospheric layer characteristics

Troposphere 4

- Radiation received from the sun is absorbed by the earth's surface.

- On top of the troposphere there is layer separating it from the stratosphere which is known as "tropopause"
- The tropopause layer is thin and its height changes according to the latitude.

Atmospheric layer characteristics

Stratosphere 1

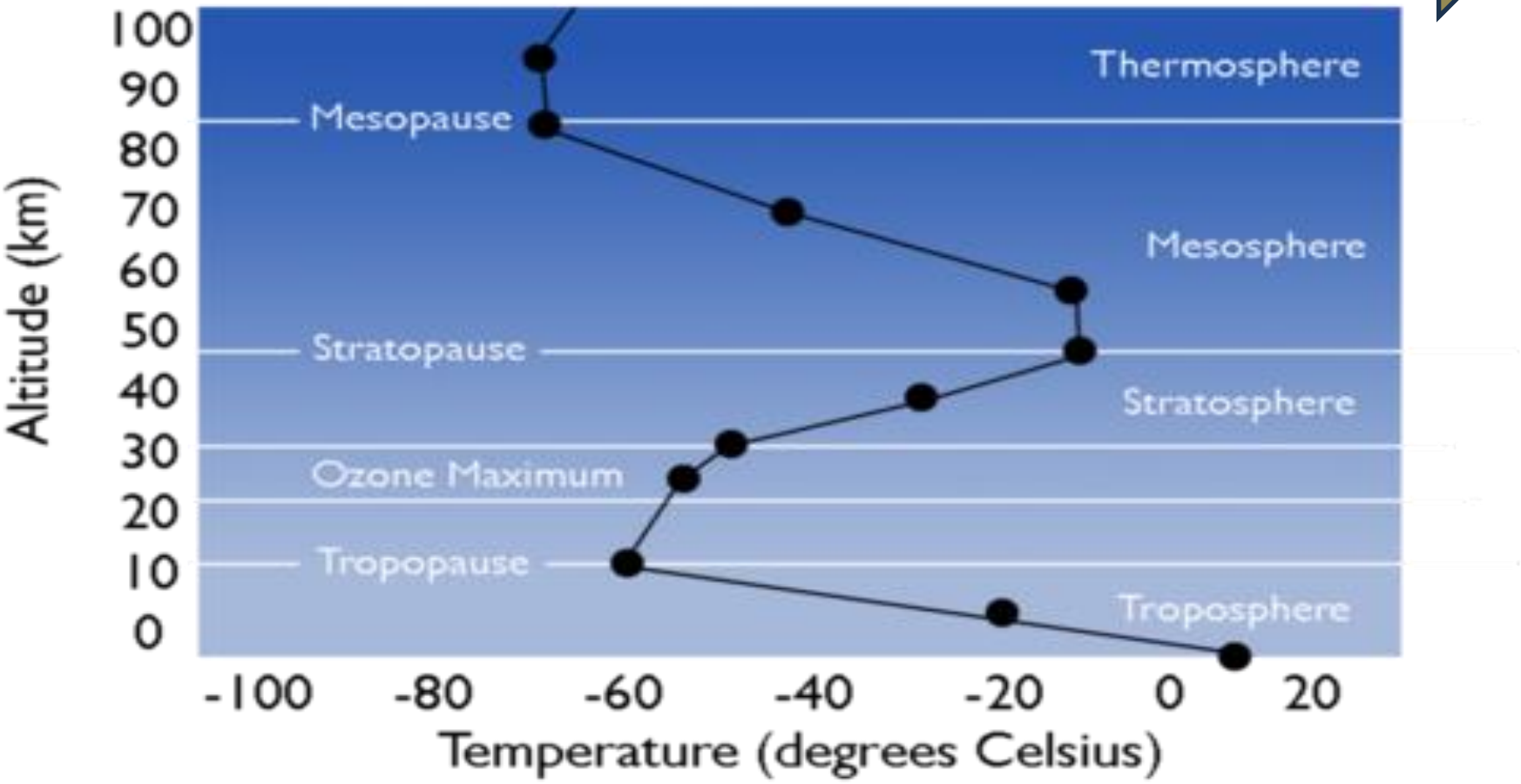
- The exists above the tropopause (around 20 kilometres onwards) and extends to altitudes of about 50-55 kilometres

- Temperature remains practically constant at around 20 kilometres.

- The layer is called as “seat of photochemical reactions”.

Atmospheric layer characteristics

Stratosphere 2



https://courses.lumenlearning.com/earthscienceck12/chapter/atmospheric-layers/

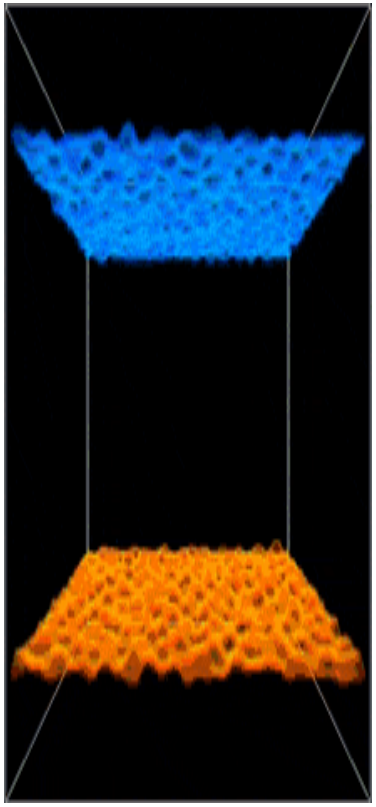
Atmospheric layer characteristics

Stratosphere 3

- The temperature of this stratosphere increases with height.
- Upper parts of the stratosphere the temperatures are almost as high as those near the earth's surface
- The fact that ultraviolet radiation from the sun is absorbed by ozone in this region.

Atmospheric layer characteristics

Stratosphere 4



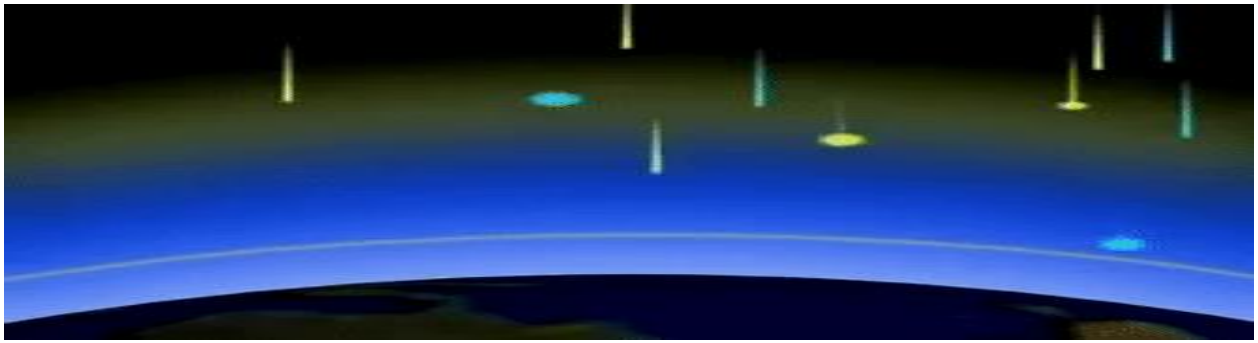
- Less convection takes place in the stratosphere because it is warm at the top and cold at the bottom
- Persistence of circulation patterns and high wind speeds
- The upper boundary of the stratosphere is called the stratopause and above this level, there is a steep temperature rise.

https://taylorsciencegeeks.weebly.com/blog/thermal-energy-transfer, Convection: Warm air/liquids rise and colder air/liquids sink creating a cycle of movement

Atmospheric layer characteristics

Mesosphere/Ozonosphere1

- Concentration of ozone is between 30 and 60 kilometers.
- A property of ozone is to absorb ultra-violet rays
- The temperature of the ozonosphere is high(warm) due to selective absorption.

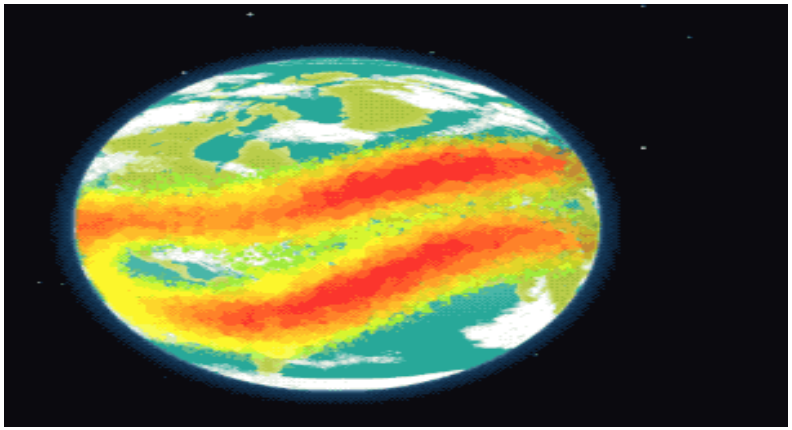


https://liceoagb.es/fisquim/reac12.html, what are ozone layer

Physical structure of the atmosphere

Ionosphere/Thermosphere 1

- The atmosphere in the ionosphere is partly ionized.
- The ionosphere reflects the radio waves because of one or multiple reflections of shortwave radio beams from the ionized shells
- Long-distance radio communication is possible due to this layer.

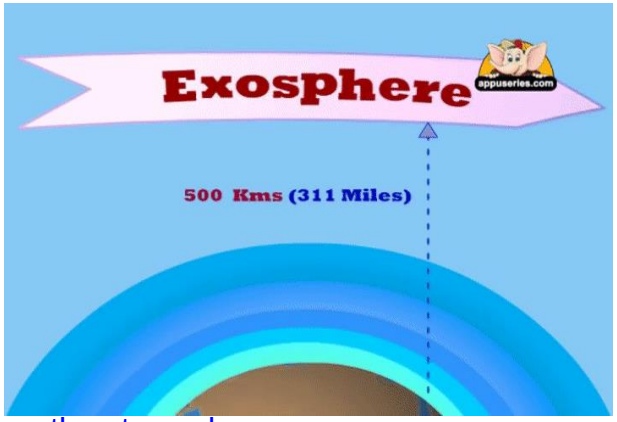


("Ionosphere," 2024).

Atmospheric layer characteristics

Exosphere 1

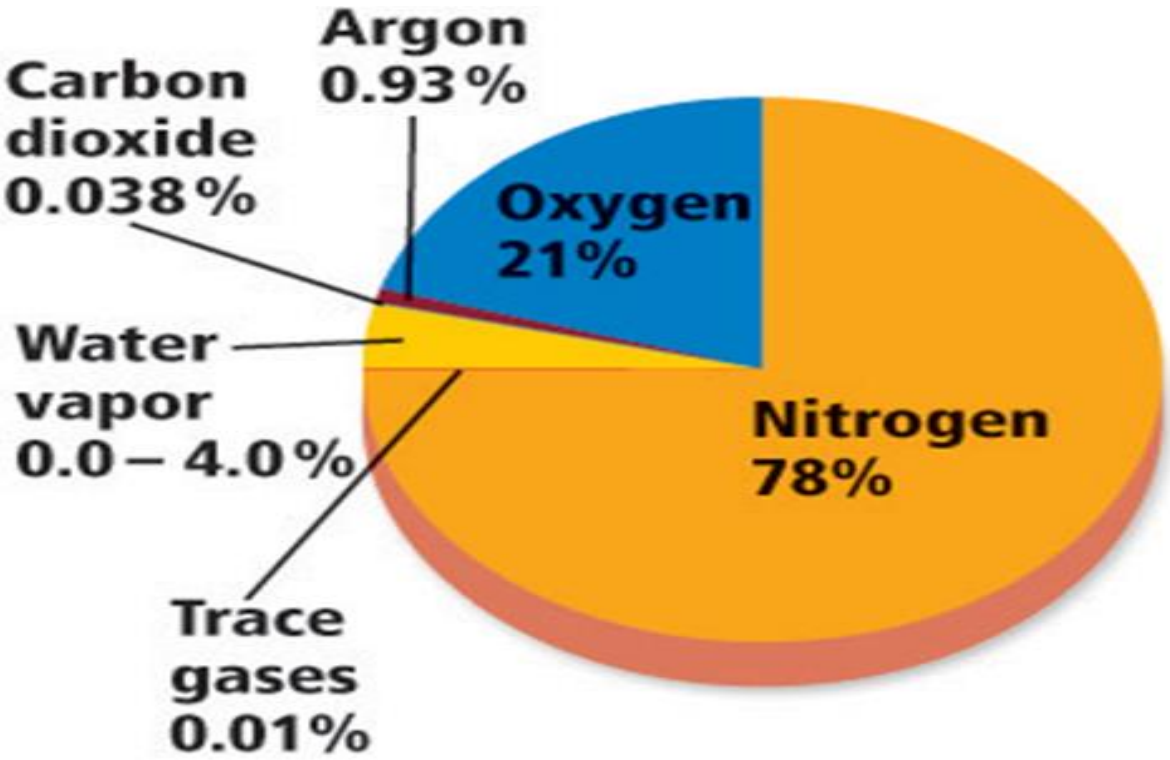
- The outermost layer of earth's atmosphere "exosphere, 400 - 1000 km"
- The density of atoms in the atmosphere is extremely low.
- At 500 to 600 km becomes so low that collisions between the neutral particles become extremely rare.



https://makeagif.com/gif/learn-about-planet-earth-earths-atmosphere-3zXMiP, Learn About Planet Earth - Earth's Atmosphere

Principal gases in the Lower Atmosphere

Chemical Composition



Principal gases comprising dry air in lower and water vapor atmosphere

(*Atmosphere*, n.d.)

Interactive quiz 1 (answers)

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Answer:c

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a) tornado;
b) blizzard
c) Hurricane
d) Convection
Answer: d

4. Which kind of gas contains the greatest proportion of the Earth's atmosphere in terms of volume?
a) Nitrogen
b) Oxygen (O_2)
c) The gas carbon dioxide
d) Argon
Answer: a

Week I

Day II

Chap I: Weather

Interactive quiz 2

1. When it comes to disaster preparation, why is it so important to have accurate weather forecasts?

a) There is no correlation between the weather and the occurrence of natural disasters.

b) Weather predictions are a useful tool for predicting and preparing for natural catastrophes such as hurricanes and floods.

c)The weather has no bearing on the occurrence of natural catastrophes.

d) Plans for disaster preparation do not take into account weather predictions.

Answer: ?

2. How does the weather influence agricultural practices?

a) The crops are unaffected by it in any way.

b) The development of some crops is contingent upon the presence of certain aspects of the weather.

c) When it comes to planting, farmers do not depend on predicted weather conditions.

d) The weather conditions do not have any impact on the yields of crops.

Answer: ?

3. Which of the following are the most important variables that affect the weather?

a) Only human activities;

b) Only natural processes; and

c) Both human actions and natural processes.

d) The weather

Answer: ?

4. How do meteorologists make forecasts about the weather?

a) By tossing a coin.

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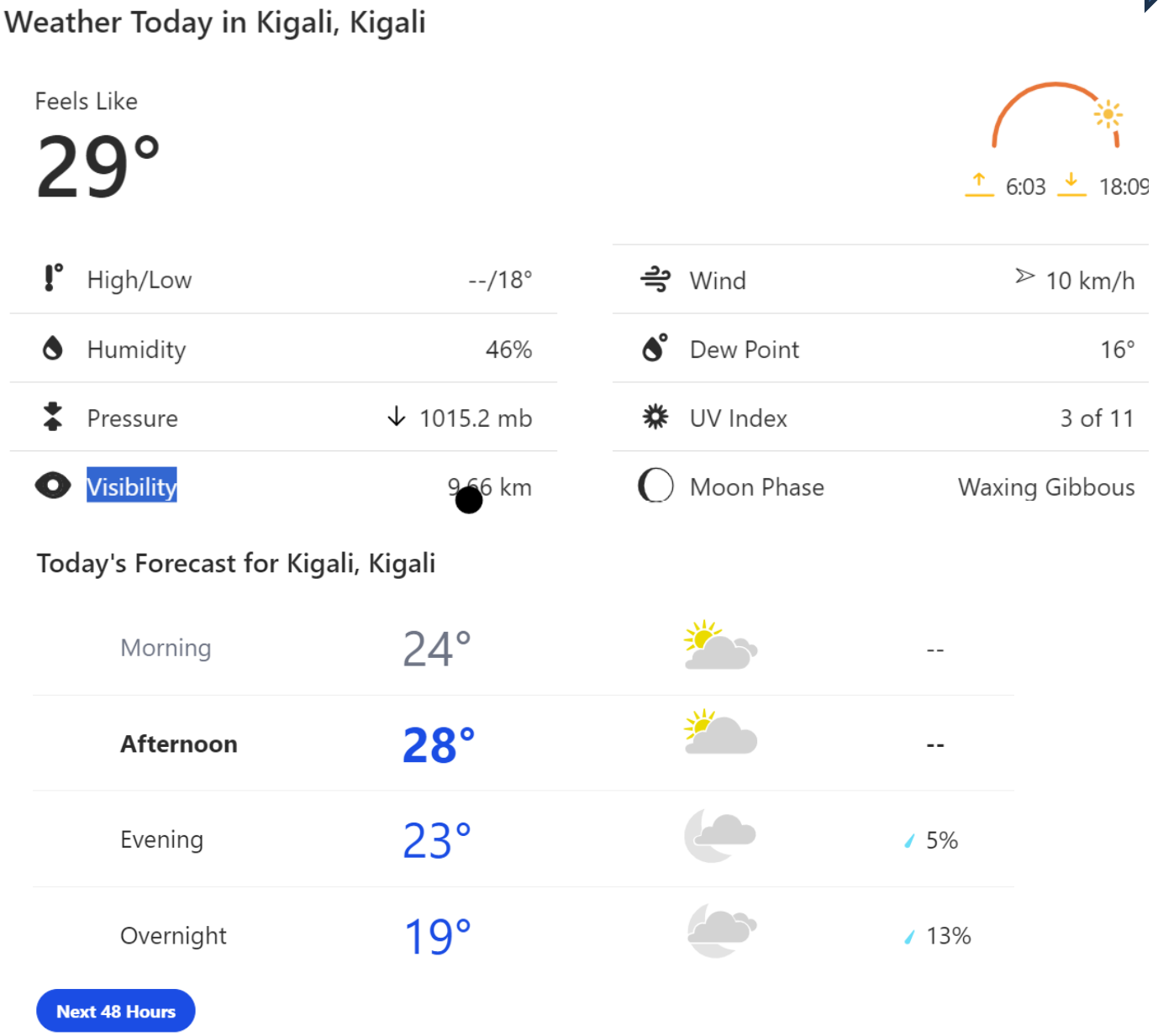
d) Consult with astrologers.

Answer: ?

What do you see in this image



(*Weather Forecast and Conditions for Kigali, Kigali - The Weather Channel | Weather.Com*, n.d.)

Weather

Definition

1-A state or condition of the atmosphere at a given place and at a given time.

2- The daily or short-term variations of different conditions of lower air in terms of

temperature, pressure,

wind, rainfall, etc.

E.g: The air temperature of KGL 27.6 ℃

Weather Phenomena

Temperature

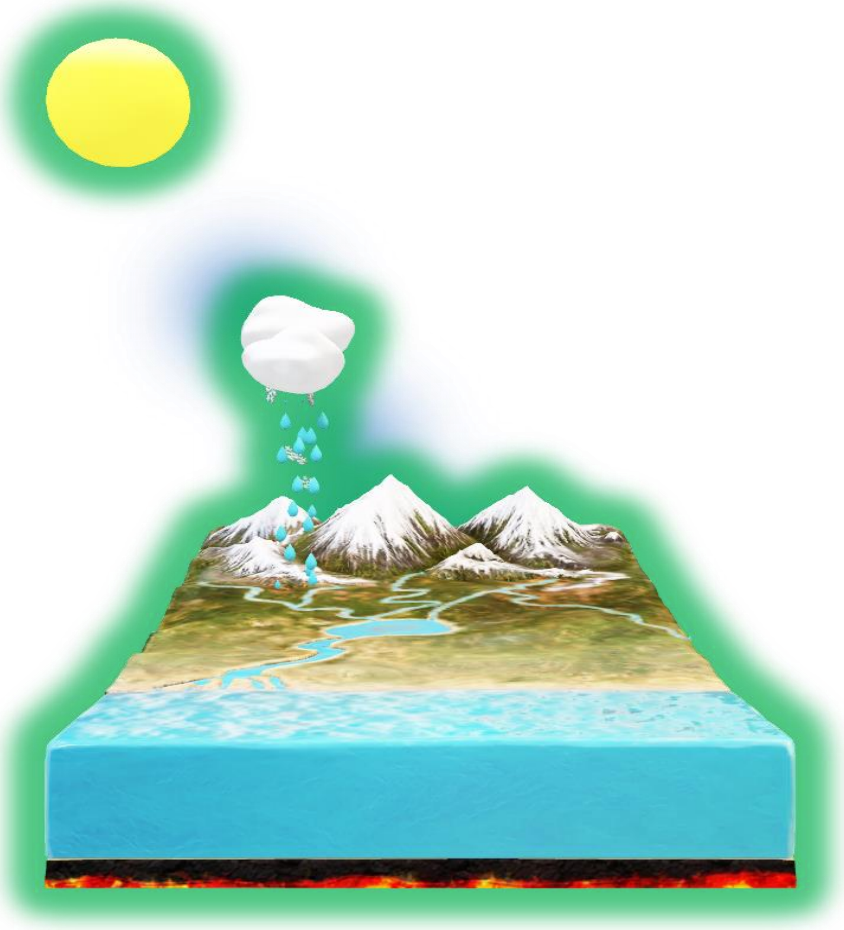
Humidity

Precipitation

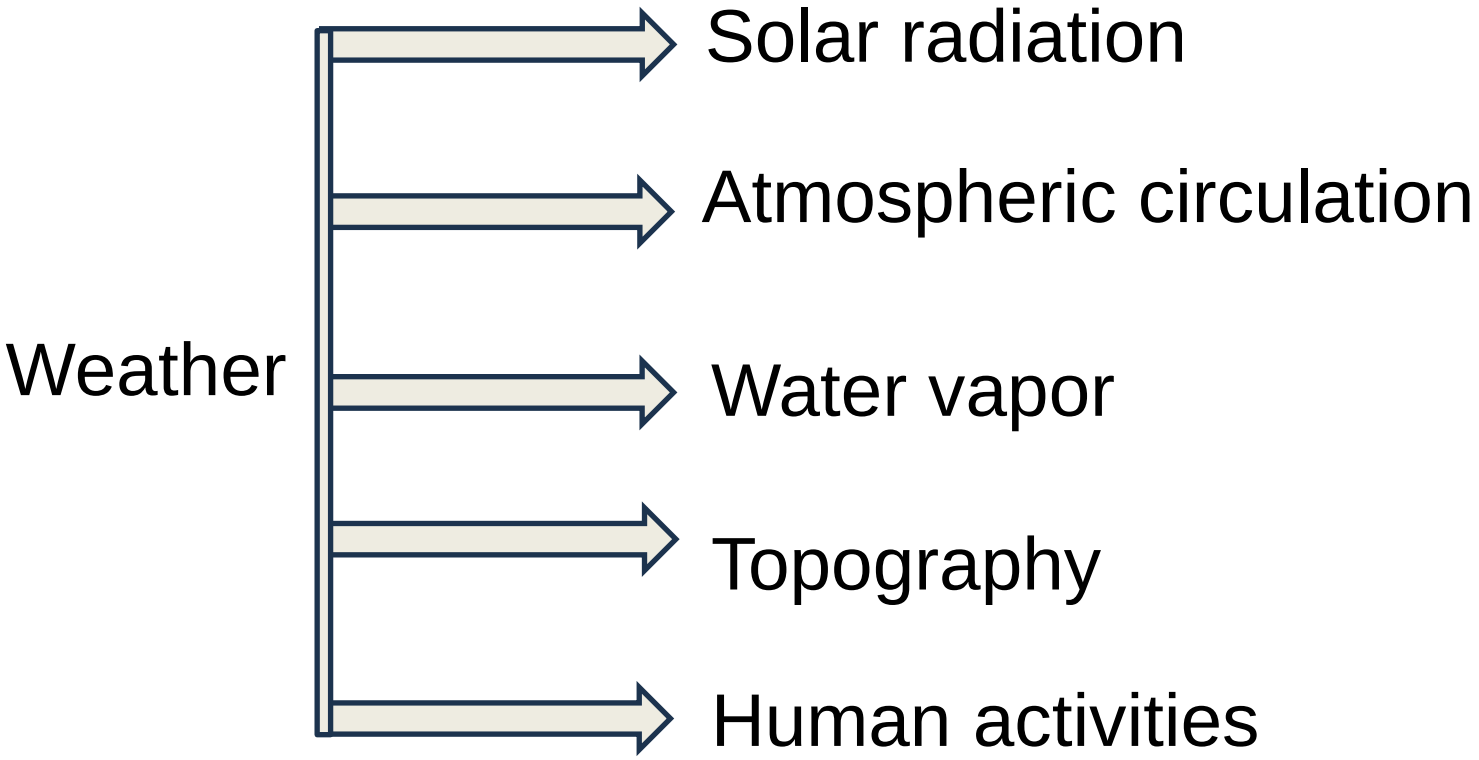
Clouds

Wind

Atmospheric Pressure

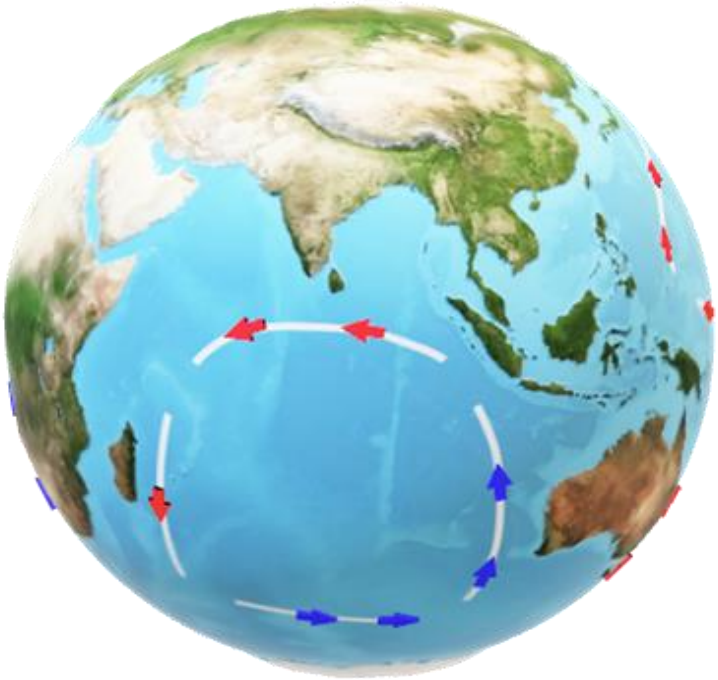


Factors affecting weather



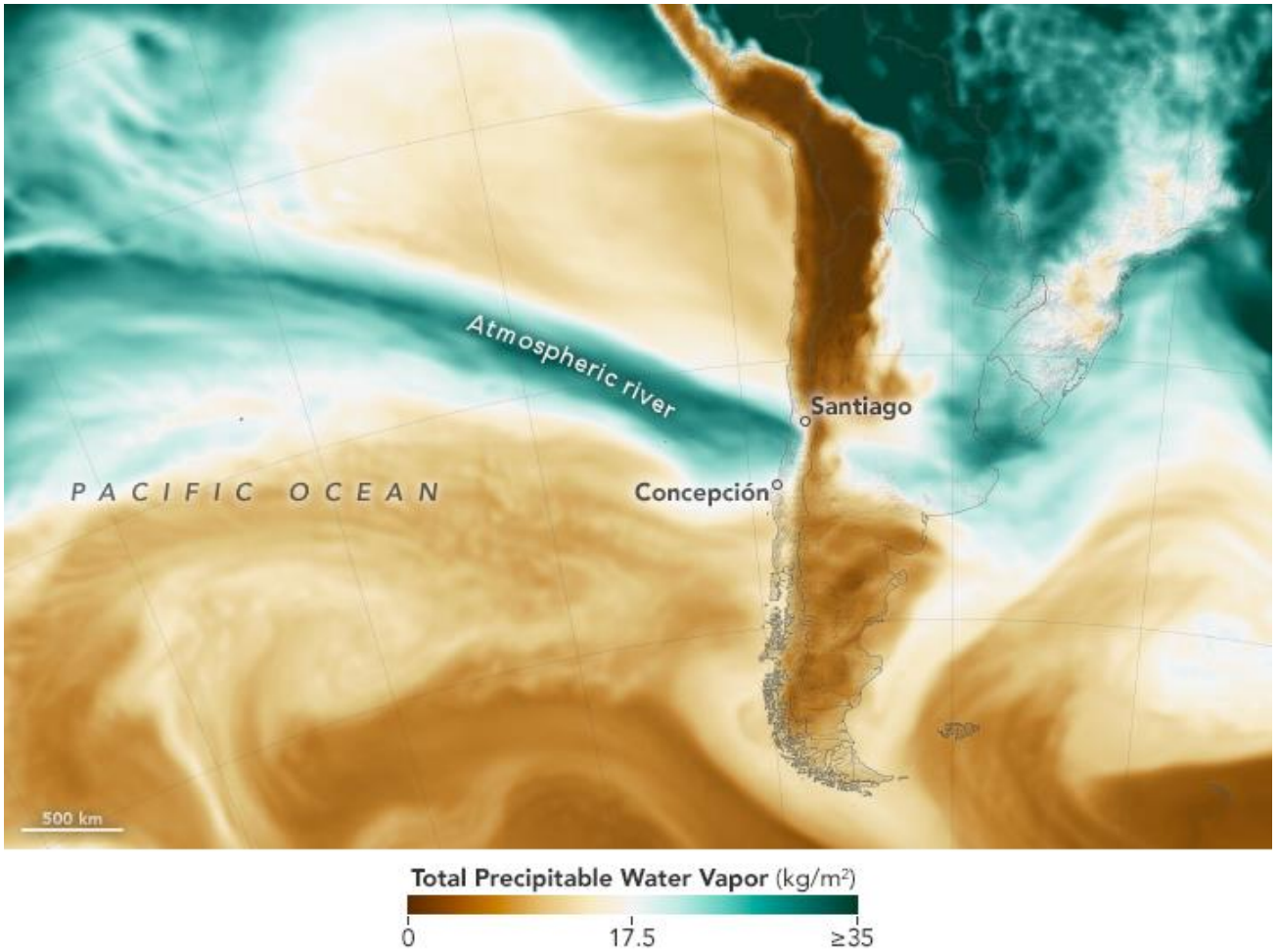
Factors affecting weather

Solar Radiation



Factors affecting weather

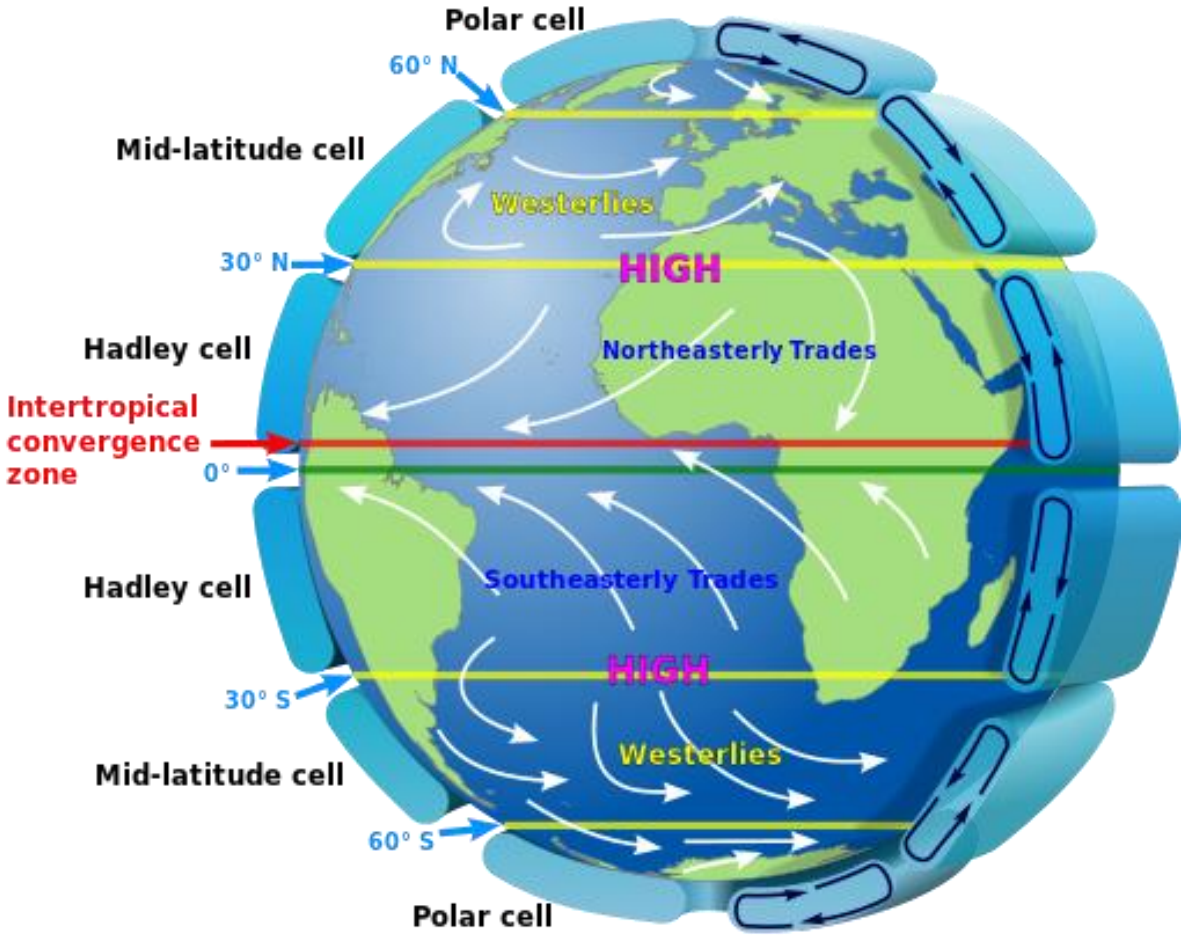
Water vapor



https://visibleearth.nasa.gov/images/151783/atmospheric-rivers-swamp-central-chile/151785l (This image originally appeared in the NASA Earth Observatory story Atmospheric Rivers Swamp Central Chile.)

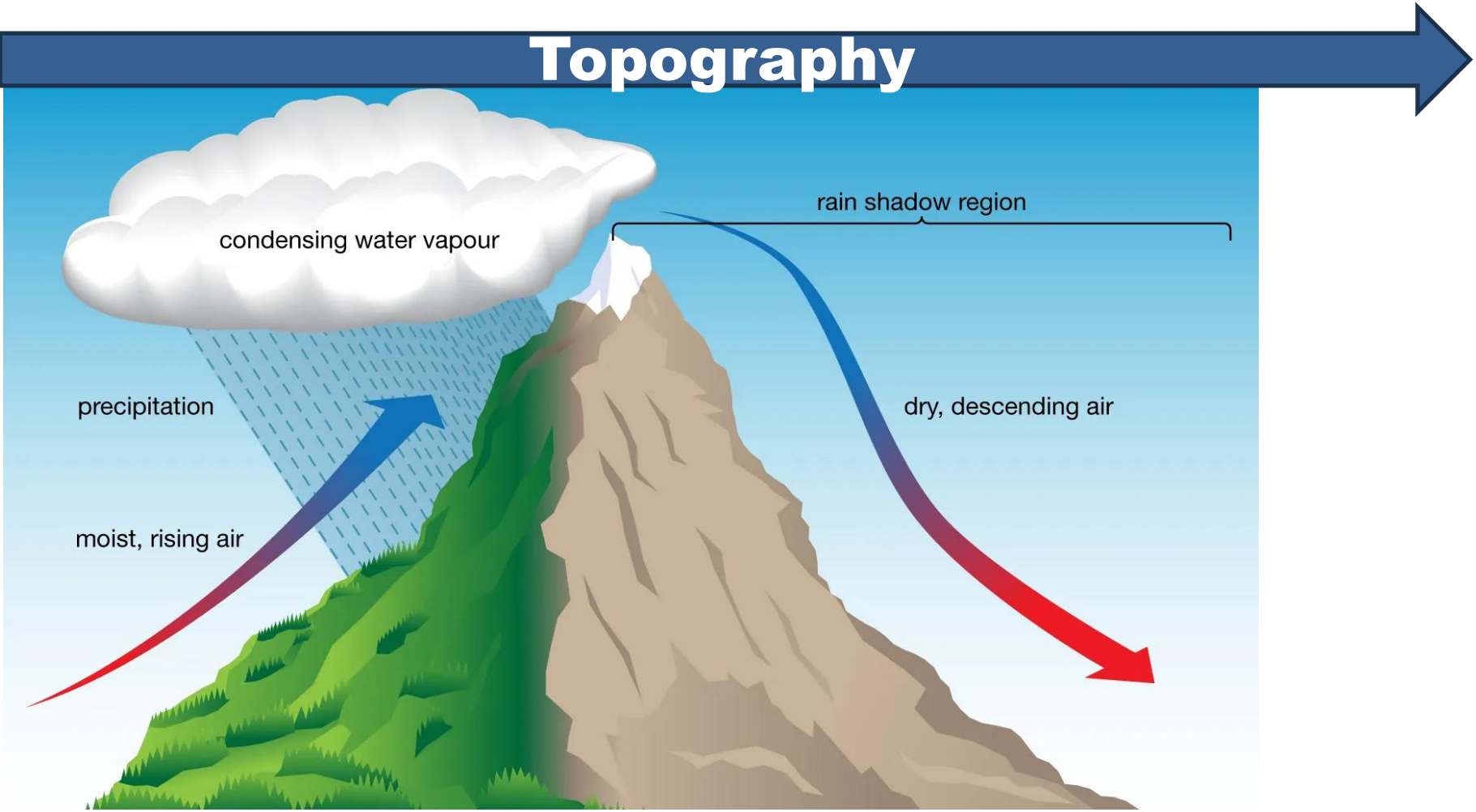
Factors affecting weather

Atmospheric circulation



https://twitter.com/msc_ku/status/1474709666752045058, (Marine Science Club)

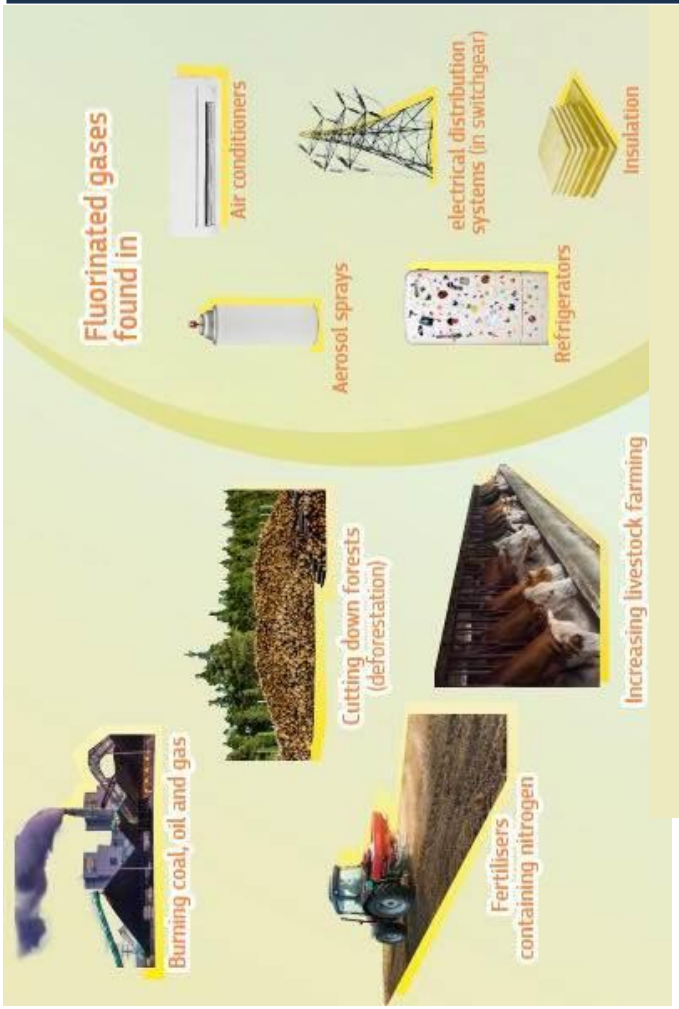
Factors affecting weather

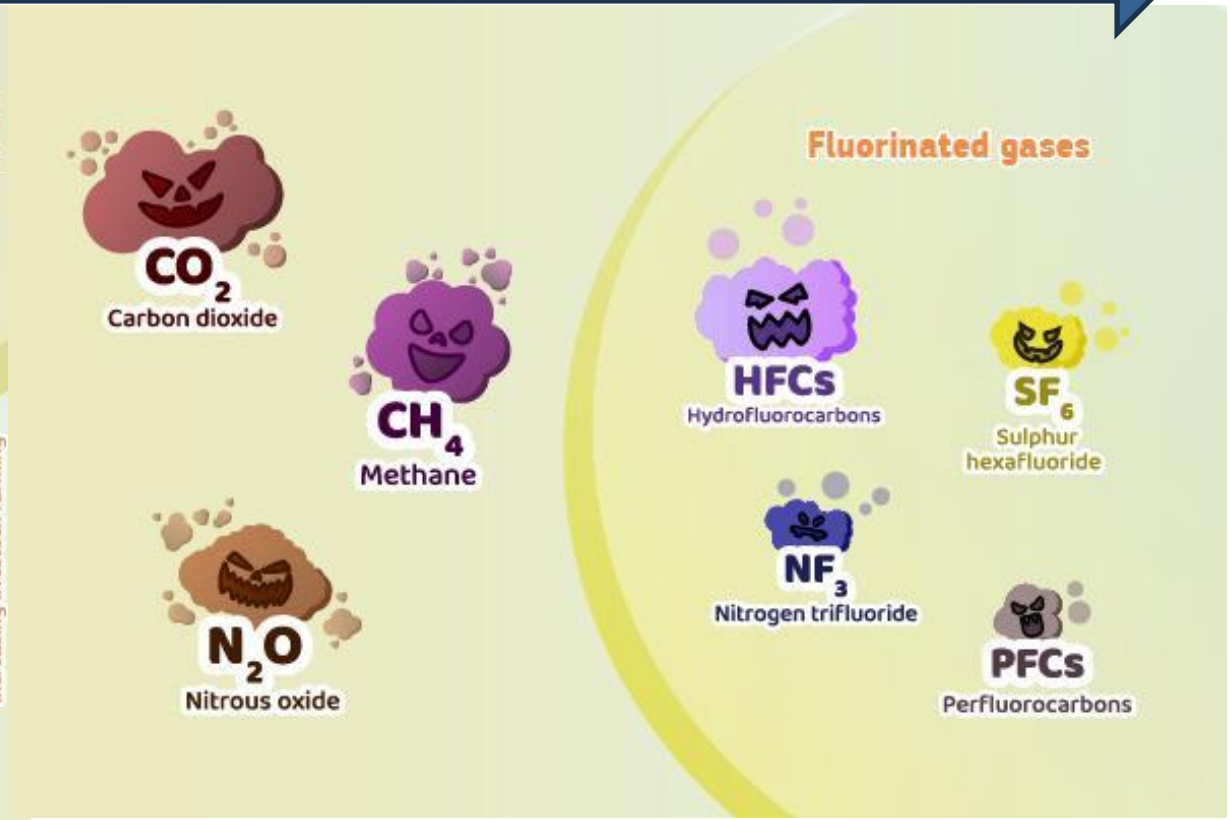


https://www.britannica.com/science/orographic-precipitation, Britannica, The Editors of Encyclopaedia. "orographic precipitation". Encyclopedia Britannica, 7 Jul. 2023, Britannica

Factors affecting weather

Human activities





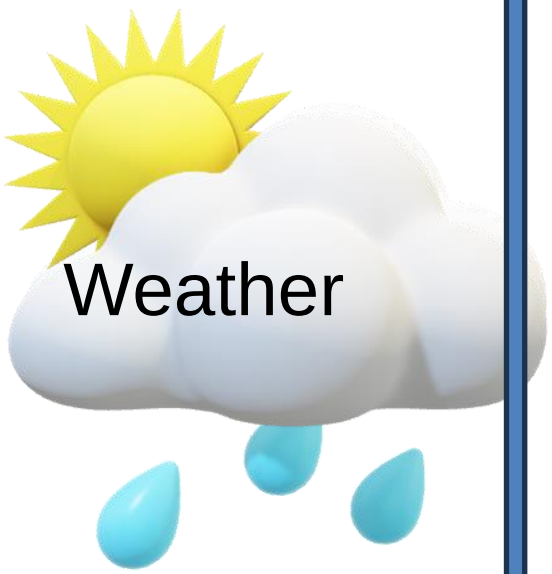
https://climate.ec.europa.eu/climate-change/causes-climate-change_en, **Causes of climate change**

Effects of weather

- Agriculture
- Transport
- Defense services
- Recreation

Effects of weather

Agriculture

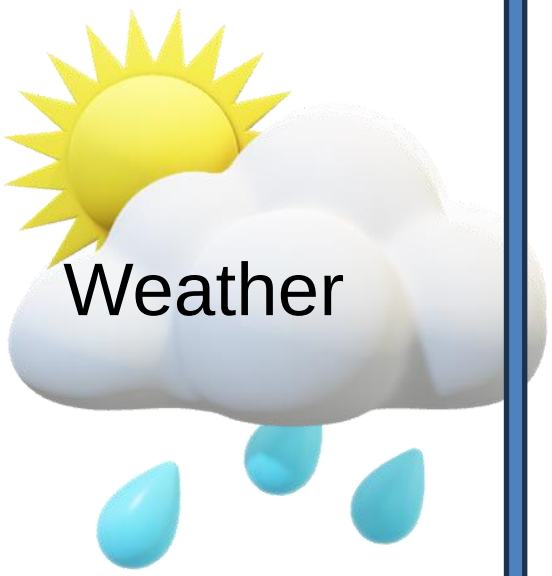


Weather significantly impacts agriculture, affecting

- Crop growth,
- Yields,
- Quality, and
- Productivity.

Effects of weather

Transport



Weather conditions significantly impact transportation systems:

- Reducing visibility,
- Creating hazardous road conditions,
- Causing flight delays,
- Affecting port operations,
- Damaging railway tracks, and
- Affecting public transit.

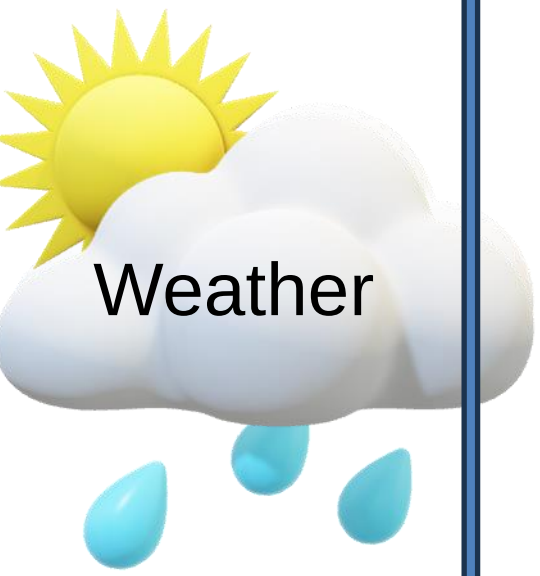
Effects of weather

Defense services

- Weather conditions significantly impact military defense operations, reducing visibility, affecting reconnaissance, aircraft, naval, ground-based, supply chains, logistics, infrastructure, and training readiness.
- They can also disrupt supply chains, logistics, and infrastructure, limiting the availability of training ranges and airspace.

Effects of weather

Recreation



- Weather significantly influences outdoor activities, water sports, winter sports, outdoor events, and natural attractions.

- Favorable conditions for hiking, camping, and sightseeing, while cold temperatures for winter sports, snow cover, and safe conditions for outdoor events.

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Answer: b

Weather forecasting

Weather system influencer:

1. Mereological data

2. Meteorological expertise for accurate forecasts.

Meteorological instruments: satellites, radar systems,balloons to gather data, etc

Today,

Tomorrow

Bibliography of images

1. Behance; Behance. (n.d.). *Feeling Under the Weather—Animated Gif*. Behance. Retrieved March 17, 2024, from https://www.behance.net/gallery/32739675/Feeling-Under-the-Weather-Animated-Gif/modules/207739457
2. *Dribbbble; https://dribbble.com/shots/5722181-Virgin-Earth-Challenge*
3. Medium, https://aditiiguptaa99.medium.com/learn-about-earth-spheres-8b71c27a78fb, Learn about Earth Spheres
4. Printerest, https://ar.pinterest.com/pin/5840674507378622/, Curious Kids: is the sky blue on other planets?
5. courses.lumen-learning; https://courses.lumenlearning.com/earthscienceck12/chapter/atmospheric-layers/
6. Taylor Science ; https://taylorsciencegeeks.weebly.com/blog/thermal-energy-transfer, Convection: Warm air/liquids rise and colder air/liquids sink creating a cycle of movement
7. Liceo AGB; https://liceoagb.es/fisquim/reac12.html, what are ozone layer
8. Weekpedia; Ionosphere. (2024). In *Wikipedia*. https://en.wikipedia.org/w/index.php?title=Ionosphere&oldid=1211877169
9. Make A Gif; https://makeagif.com/gif/learn-about-planet-earth-earths-atmosphere-3zXMiP, Learn About Planet Earth - Earth's Atmosphere
10. *Weeble; Atmosphere*. (n.d.). Retrieved March 17, 2024, from http://hannahparhamdilmanees.weebly.com/atmosphere.html
11. The weather channel; (*Weather Forecast and Conditions for Kigali, Kigali - The Weather Channel | Weather.Com*, n.d.)
12. NASA Earth observation; https://visibleearth.nasa.gov/images/151783/atmospheric-rivers-swamp-central-chile/151785l (This image originally appeared in the NASA Earth Observatory story Atmospheric Rivers Swamp Central Chile.)
13. Marine Club Science Twitter; https://twitter.com/msc_ku/status/1474709666752045058, (Marine Science Club)
14. Britannica; https://www.britannica.com/science/orographic-precipitation, Britannica, The Editors of Encyclopaedia. "orographic precipitation". Encyclopedia Britannica, 7 Jul. 2023, Britannica
15. European Commission ; https://climate.ec.europa.eu/climate-change/causes-climate-change_en, Causes of climate change .