Course: Basics of Environmental Engineering (Climatology)

Main topic: Temperature

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Interactive quiz

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a, latitude

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5 what is importance of temperature

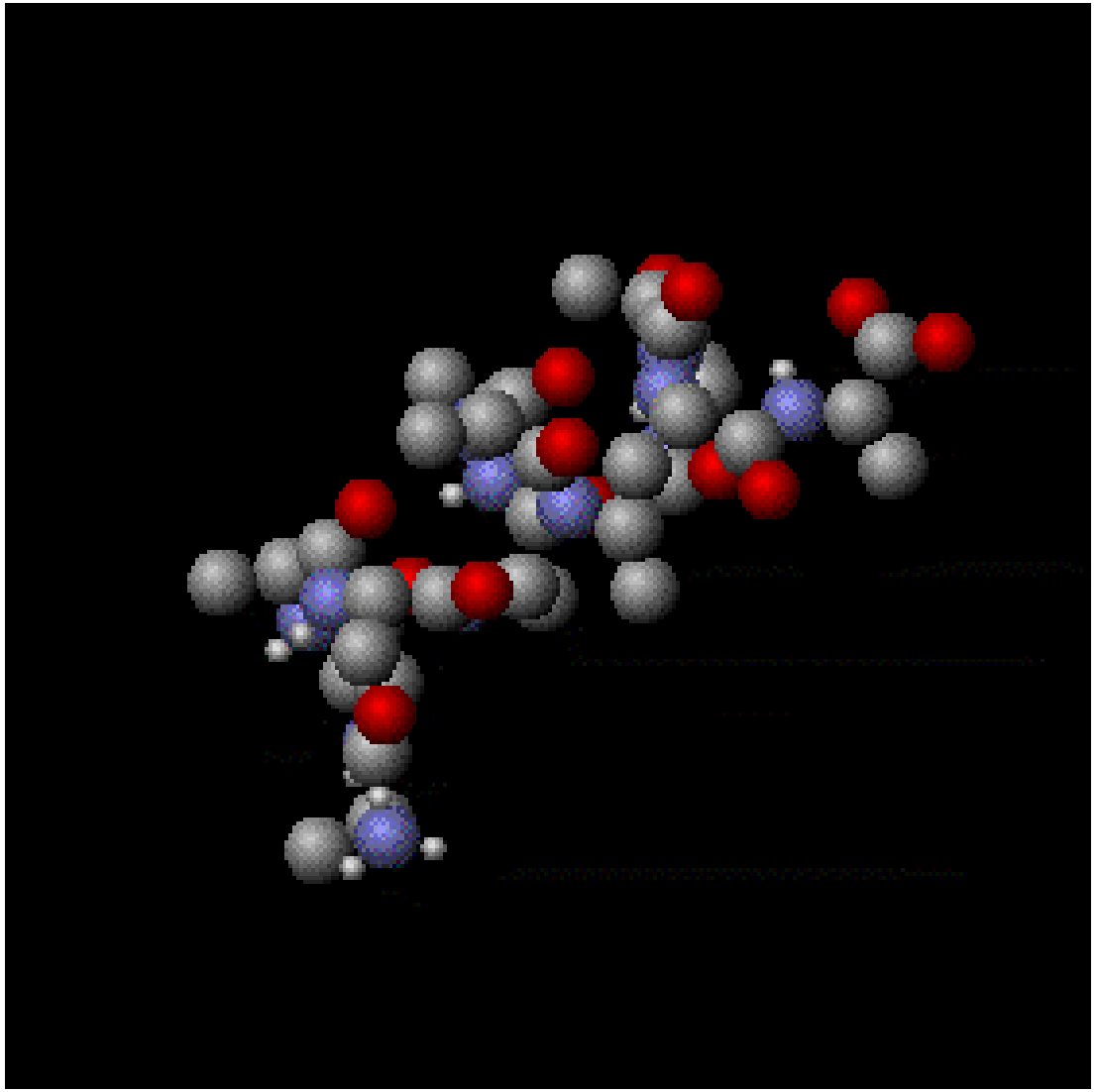
Introduction to temperature

A physical number known as temperature may be used to quantitatively indicate the hotness or coolness of anything. With a thermometer, one may measure temperature. It represents the mean kinetic energy of the constituent atoms of a material as they vibrate and collide.

Source1:https://commons.wikimedia.org/w/index.php?title=Special:CiteThisPage&page=File%3AMax_Min_Thermometer.JPG&id=733527088&wpFormIdentifier=titleform

Introduction to temperature

Temperature



Source2: https://commons.wikimedia.org/wiki/File:Thermally_Agitated_Molecule.gif

Introduction to temperature (cont'd)

Temperature Scales

Three temperature scales are commonly used today:

Fahrenheit (°F): used in the United States and a few other English-speaking countries.

Celsius (°C): Standard in most countries that have adopted the metric system, widely used in science.

Kelvin (K): An absolute temperature scale recognized as the international standard for scientific temperature measuremen

2 Types of Temperature

Heat energy is measured using three primary temperature scales: Kelvin, Celsius, and Fahrenheit.

- Fahrenheit Scale: Invented by Daniel Gabriel Fahrenheit, this scale is widely utilized in the US and some Caribbean regions.

- At 32 degrees Fahrenheit, water freezes, and at 212 degrees, it boils. At -459.67 degrees Fahrenheit, absolute zero is the lowest temperature that can exist.

2 Types of Temperature

The Celsius Scale was developed by Anders Celsius and is a commonly used measurement system outside of the United States. Water boils at 100 degrees Celsius and freezes at 0 degrees.

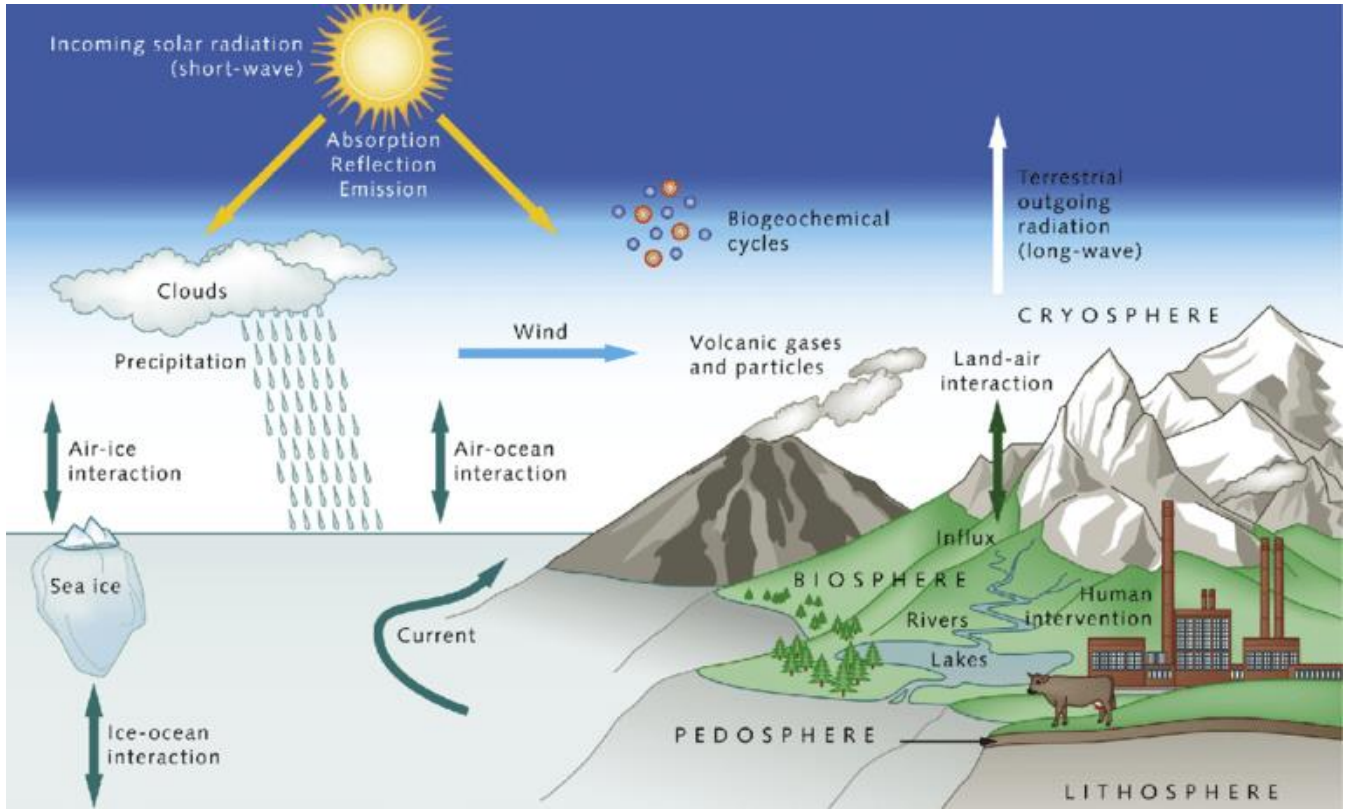
At -273.15 degrees Celsius, absolute zero is reached.Kelvin Scale: Developed by Lord William Kelvin, this scale places zero at the very bottom. The temperature of absolute zero is 0 Kelvin. Water freezes at 273.15 Kelvin and boils at 373.15 Kelvin.

3 Factors Influencing Temperature

Latitude: The influence of latitude on temperature is substantial. The angle at which the sun's rays strike various latitudes changes due to the tilt of the Earth on its axis. Temperatures are greater near the equator because of the direct sunlight. On the other hand, temperatures drop toward the poles due to more indirect light.

3 **Factors Influencing Temperature**

Altitude: Altitude also affects temperature. Generally, as altitude increases, temperature decreases. This is because the atmosphere is heated mainly by conduction from the Earth's surface. The lapse rate, which is the rate of temperature decrease with height, varies but can be estimated at around 1°F per 300 feet or 0.6°C per 100 meters.



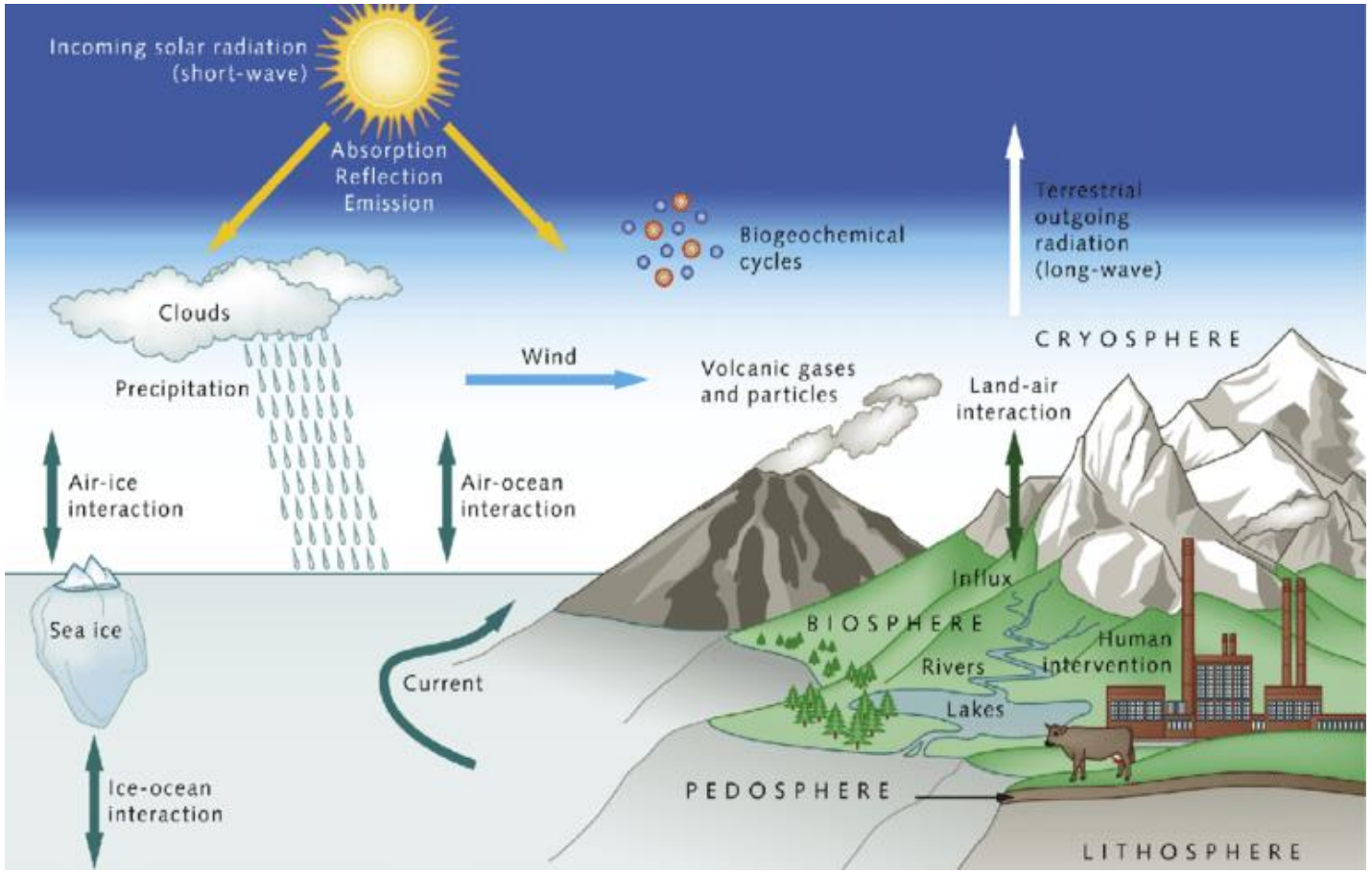
Source 3: https://www.researchgate.net/figure/b-The-global-climate-subsystems-and-relevant-interactions_fig12_279313086

3 **Factors Influencing Temperature**

Altitude: Temperature is also influenced by altitude. Generally speaking, temperature drops with height. This is due to the fact that conduction from the Earth's surface heats the atmosphere primarily. Although it fluctuates, the rate at which temperature drops with height is known as the lapse rate. It is around 1°F per 300 feet, or 0.6°C per 100 meters.

3 **Factors Influencing Temperature**

Continentality: The term "continentality" describes how, as a result of variations in specific heat capacity, land surfaces heat up and cool down more quickly than ocean surfaces. In comparison to marine regions, continental interiors have warmer summers, colder winters, and more drastic temperature swings.



Source 3: https://www.researchgate.net/figure/b-The-global-climate-subsystems-and-relevant-interactions_fig12_279313086

3 **Factors Influencing Temperature**

Ocean Currents and Winds: These two factors are essential for transferring heat or cold into nearby areas. While cold ocean currents can drop temperatures, warm ocean currents, such as the Gulf Stream, can warm coastal regions. Through their ability to transport warm or cold air masses to various locations, winds can affect temperature.

3 **Factors Influencing Temperature**

Natural Soil and Vegetation: Variations in temperature can be influenced by the kind of soil and vegetation present. Shade and greater evapotranspiration cooling may cause temperatures in forested regions to drop. Another factor is the type of the soil; lighter soils radiate more heat than darker soils.

3 Factors Influencing Temperature

Slope, Shelter, and Aspect: Temperature variations are influenced by an area's slope, with steeper slopes seeing more rapid variations. In comparison to north-facing slopes, south-facing slopes receive more sunshine and are warmer. Temperatures can also be greatly impacted by local breezes and natural occurrences like Fohn winds.

4 Roles of temperature in evaporation

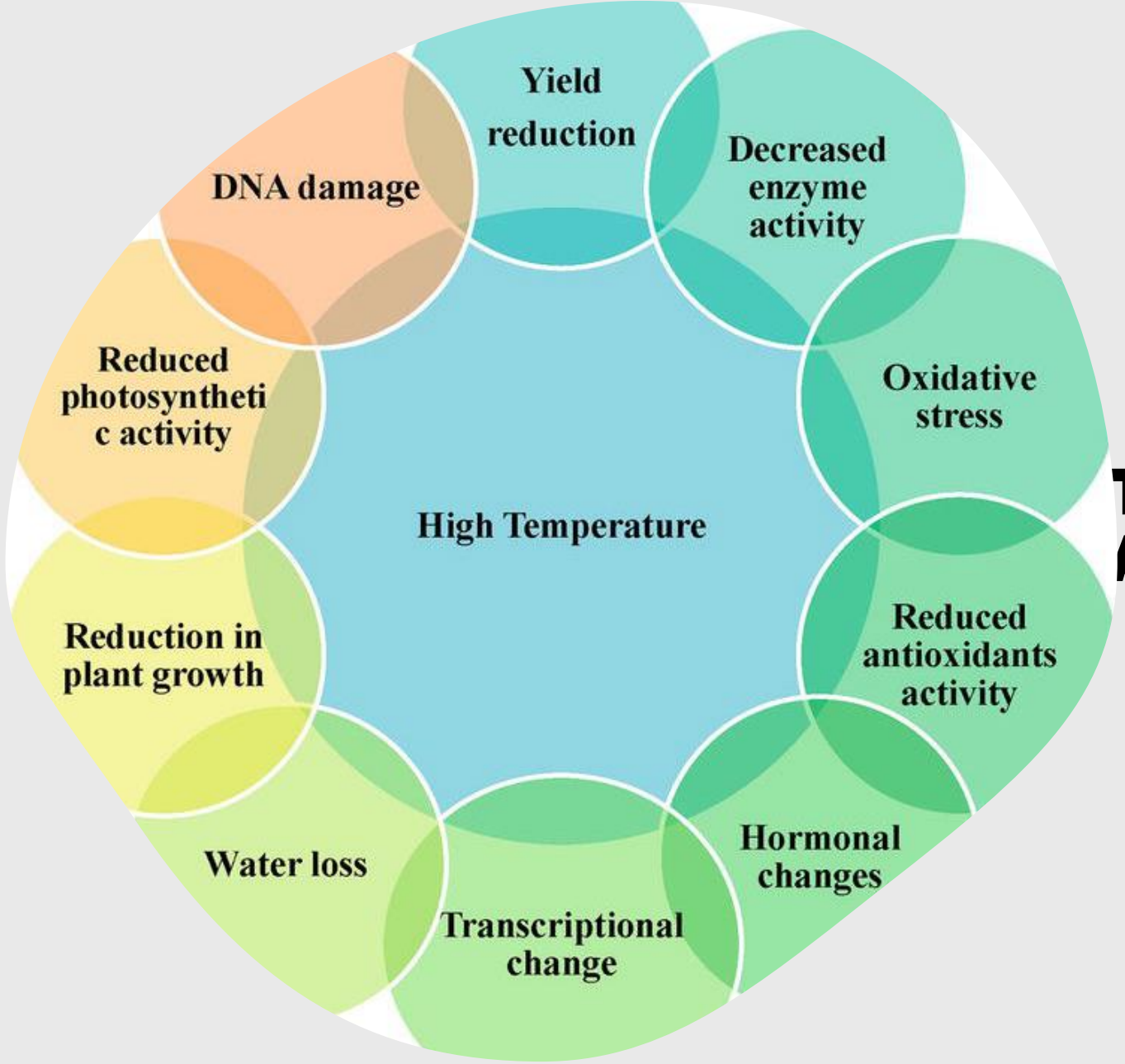
Temperature plays a significant role in the process of evaporation. As temperature increases, the amount of energy required for evaporation decreases, leading to higher evaporation rates..

4 **Roles of temperature in evaporation**

This is because the energy needed to turn liquid water into water vapor is overcome by the heat energy produced by solar radiation. As a result, water evaporates more easily in warmer weather. Warmer air may also store more water vapor, which permits greater evaporation to take place before saturation.

4 Roles of temperature in evaporation

It's crucial to remember that evaporation rates are influenced by more than just temperature. Wind and relative humidity are other important factors. The air becomes drier and the rate of evaporation increases with decreasing humidity. On the other hand, high humidity restricts the quantity of water that can evaporate since it brings the air closer to saturation. Water vapor may be removed by wind, which efficiently dries the air and speeds up evaporation.



Temperature's Role in Agriculture

Source 4 https://www.intechopen.com/chapters/83703

4 **Roles of temperature in agriculture**

1. Influence on Plant Growth and Development:

Temperature directly affects the growth and development of crops. Optimum temperatures are required for processes like photosynthesis, respiration, and nutrient uptake.

Different crops have specific temperature requirements at various stages of growth. Deviations from these optimal temperatures can lead to reduced yields or even crop failure

4 **Roles of temperature inagriculture**

2. Cardinal Temperature Points: The maximum, optimum, and lowest temperatures required for plant development are known as the cardinal temperature points.

These temperature ranges affect the total yield of various crops and differ from one another.

4 Roles of temperature in evaporation

3. Effect on Crop Health:

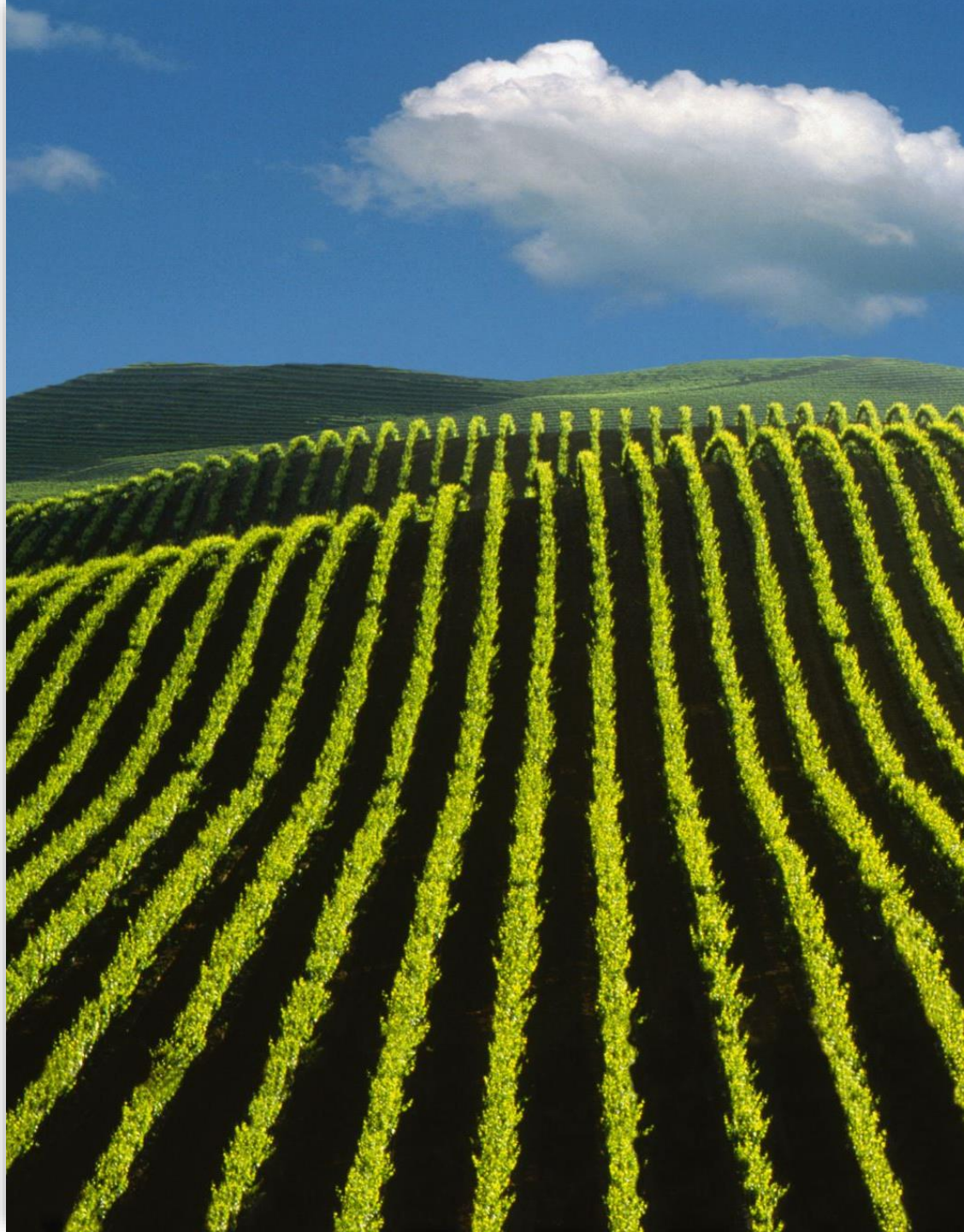
Crops are susceptible to harm from extreme temperatures, both high and low. Temperature-related factors that impact crop health include frost, heat stress, chilling damage, and freezing injury.

Elevated temperatures have the potential to cause heat stress, which can impact plant physiological functions and diminish photosynthesis, the process by which plants make food.

4 Roles of temperature in evaporation

4. Effects of Climate Change: Worldwide temperature trends are changing as a result of rising greenhouse gas emissions and global warming.

Agribusiness operations may be greatly impacted by long-term temperature shifts, necessitating farmer adaptation to changing climatic circumstances.

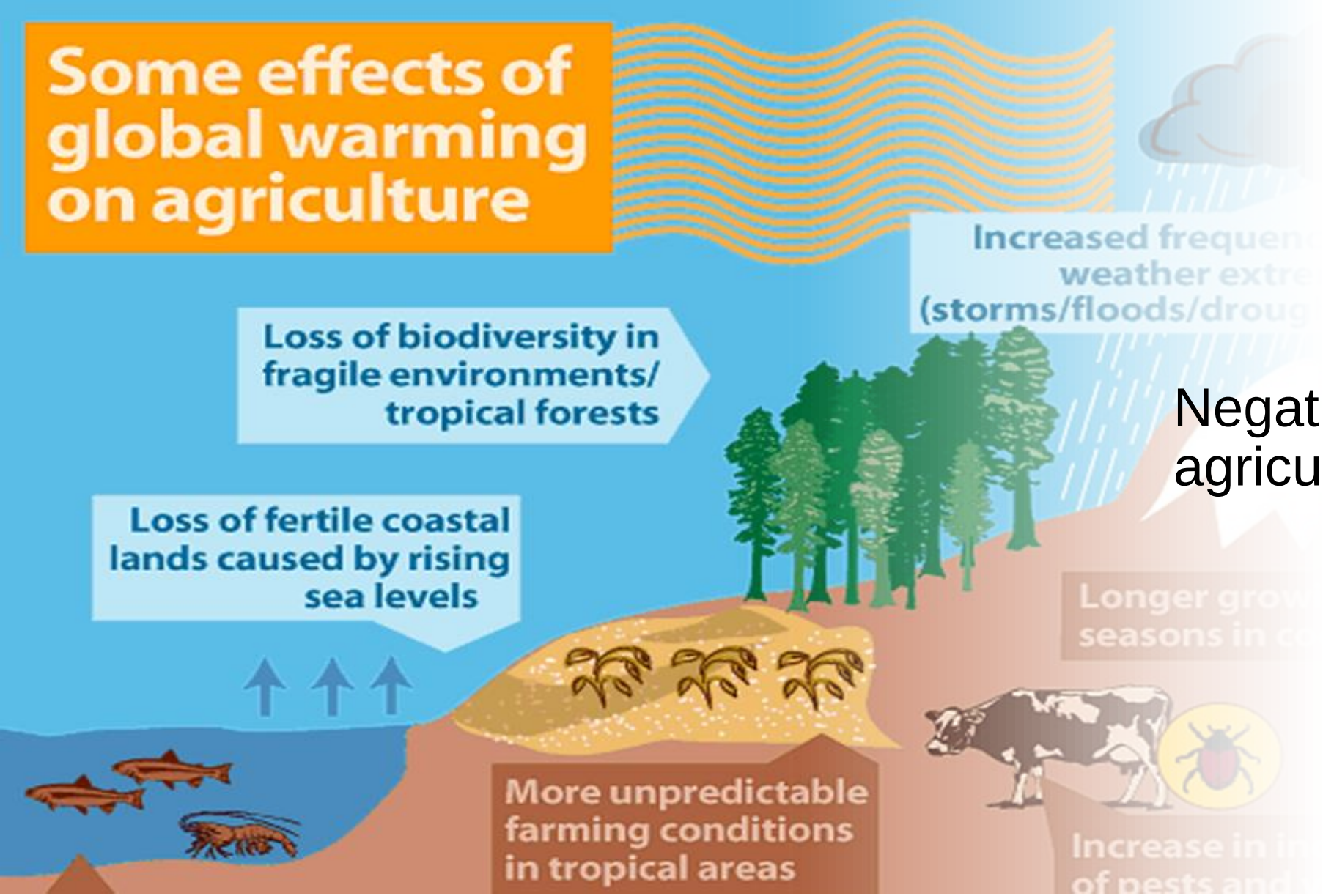


4 Roles of temperature in evaporation

5. Heat Tolerance Mechanisms:

Crop plants have evolved mechanisms for heat tolerance to survive under high-temperature conditions.

Understanding these adaptive thermotolerant mechanisms is essential for developing heat-resistant crop varieties that can thrive in changing climates.



Negative impacts of agriculture

https://www.agrivi.com/blog/climate-change-impacts-on-agriculture/attachment/sl4-26/

How temperature affects agriculture negatively

Yield decline: If temperatures rise over a crop's ideal growing temperature, yields may decrease.

Decreased nutritional value: As temperatures rise and CO2 levels rise, crops may lose some of their nutritious content.

Pest pressure: is higher because of the warmer weather, which makes it easier for weeds, bugs, and fungus to proliferate.

Severe weather event: Frequent severe weather events, such as droughts and floods, can destroy crops and cause havoc with agricultural activities.

How temperature affects agriculture negatively

Impacts on livestock

Heat stress: Increasing temperatures brought on by climate change might directly affect cattle by making them anxious. Long-term exposure to high temperatures can harm an animal's general health, milk production, and fertility.

Effects of drought: Higher temperatures may exacerbate the drought by lowering pasture quality and livestock feed availability.

Disease transmission: The spread of parasites and illnesses that impact cattle may be aided by climate change.

Temperature mitigation measures

Here are some effective ways to help combat rising temperature:

- **Reduce carbon footprint**
- **Support renewable energy**
- **Energy efficiency**

To combat climate change, individuals can reduce their carbon footprint by using energy-efficient appliances, driving less, and opting for renewable energy sources. Transitioning to renewable energy sources like solar or wind power can reduce reliance on fossil fuels and contribute to climate change. Improving energy efficiency in homes and buildings can also help lower energy consumption and emissions.

Temperature mitigation measures

Plant trees to absorb carbon dioxide through photosynthesis. Advocate for climate action at local, national, and global levels. Promote sustainable practices like recycling, composting, and reducing water usage

Temperature mitigation measures

Educating others about simple steps to reduce environmental impacts is crucial for fostering a culture of sustainability.

Benefits of urban green spaces for temperature mitigation

Green spaces provide shade, reducing direct sunlight and lowering surface temperature. They also release moisture through transpiration, cooling the air like sweating. They improve air quality by filtering pollutants and reduce energy consumption by lowering ambient temperatures, thereby reducing building air conditioning needs.

Conclusion

Understanding temperature scales accurately quantifies thermal conditions, emphasizing the importance of climate consideration in successful farming practices. Altitude significantly impacts thermal conditions, emphasizing the need for adaptive strategies to mitigate risks associated with changing climatic conditions.

REFERENCES

1. File:Max Min Thermometer.JPG. (2023, February 18). *Wikimedia Commons*. Retrieved 18:24, April 21, 2024 from https://commons.wikimedia.org/w/index.php?title=File:Max_Min_Thermometer.JPG&oldid=733527088.
2. File:Thermally Agitated Molecule.gif. (2024, March 14). *Wikimedia Commons*. Retrieved 14:38, April 21, 2024 from https://commons.wikimedia.org/w/index.php?title=File:Thermally_Agitated_Molecule.gif&oldid=860373139.
3. Implementing fuzzy decision making technique in analyzing the Nile Delta resilience to climate change - Scientific Figure on ResearchGate. Available from: https://www.researchgate.net/figure/b-The-global-climate-subsystems-and-relevant-interactions_fig12_279313086 [accessed 21 Apr, 2024]
4. Parthasarathi, T., Firdous, S., Mariya David, E., Lesharadevi, K., & Djanaguiraman, M. (2022). Effects of High Temperature on Crops. IntechOpen. doi: 10.5772/intechopen.105945
5. **sl4Climate Change Impacts on Agriculture** By Ines Hajdu 22 Nov 2021, https://www.agrivi.com/blog/climate-change-impacts-on-agriculture/attachment/sl4-26/ [accessed 21 Apr, 2024]