

EST 206

- * Meteorological station equipments and their uses.
- * Maintenance of a standard meteorological station equipment.
- * Rain evapotranspiration equipment.
- * Climate factors.
- Rain & sunlight.

METEOROLOGICAL STATION EQUIPMENTS

Meteorological station: Also called Weather station. A place or facility that contains equipment or instruments used to forecast or predict the weather. It contains computerized equipments.

Equipments used in a meteorological station:

- 1) Rain gauge → Used to measure the amount of precipitation or rainfall.
- 2) Anemometer → Used to study or record the speed of wind.
- 3) Vane → for measuring the direction of the wind.

4) Barometer → It is used to measure atmospheric pressure.

5) Hygrometer → used to measure relative humidity in the atmosphere.

6) Thermometer → used to measure temperature.

7) Grometer → used to measure drop size distribution.

8) Cielometer → It is used to measure the height of cloud base.

9) Balloons → Launched at 05:00 - 12:00 hrs in different parts of the world having in-built sensors for pressure, Temperature & humidity.

10) Radio balloons → They are carried by balloons and are used to measure pressure, Temperature and humidity.

11) Remote Sensing Instruments.

12) Ozonodes.

Instrumented aircrafts are sophisticated machines used in space orbits to measure ion concentration, mass spectrometers etc.

13) Pyranometer: Broad band solar radiation.

Remote sensing is a system of collecting information from a remote location not easily reachable.

Remote sensing instruments are the instruments used as radars, lidar, satellite using to collect information concerning the precipitation and wind from remote data condition.

14) Instruments for RST

15) Radar: This is used to collect information concerning precipitation & wind.

16) Satellites: To get information.

Maintenance of a standard meteorological station equipment;

There are only two ways namely;

- Local maintenance chores,

- Technical maintenance chores.

Local maintenance chores: If it is the maintenance chores that you can do on your own.

Technical maintenance chores: It involves cleaning of the sensors.

Maintenance chores by a trained personnel.

N.B.: Most important maintenance chores is the solar radiation.

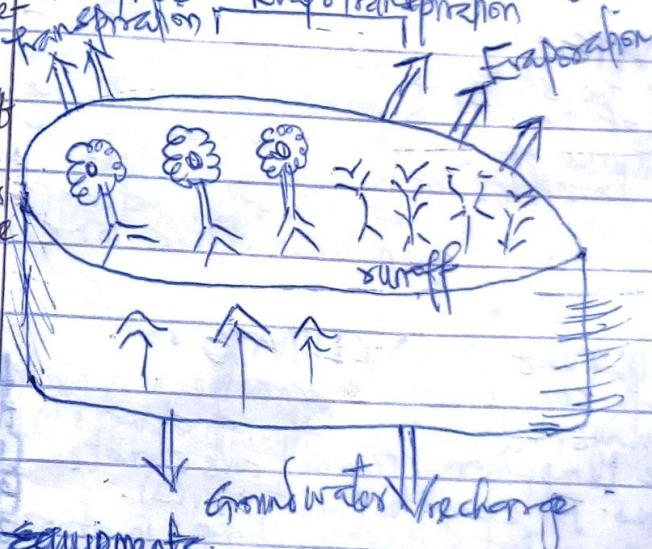
N.B.: The parts should be changed 12-18 months.

EVAPOTRANSPIRATION EQUIPMENTS

Evaporation is the loss of water from the surface of the earth in form of water vapour.

Transpiration: This is the loss of water through the stomata of the leaves into the atmosphere.

Evaporation + Transpiration = Evapotranspiration



EVAPOTRANSPIRATION EQUIPMENTS

Evaporation pan: This is used to measure the amount of water loss in a day. An evaporation pan is a pan which is usually covered with a chain link to take the reading of that evaporated water.

Sunken Colorado Evaporation pan.

Lysimeter: Used for evapotranspiration.

i) Green's lysimeter.

ii) Weighing lysimeter.

Green's lysimeter is used to measure potential evapotranspiration.

iii) Weighing lysimeter.

14/06/2018

Relationship between Agriculture & climate
With reference to Crops, Livestock, Irrigation,
Pest & diseases. (Agric in relation to climate)
* Release of gases (green house gases)

- Natural gases produced by plants & animals such as CO_2 , O_2 etc. Methane, O_3 .
- Artificial gases e.g. Nitrogen, CFC etc. which are trapped & affect the agric sector adversely which led to global warming.

Nth relationship to crops.

AGRICULTURE

Agriculture is the cultivation of land and breeding of animals to provide food, fibre, medicinal, plants and other products to sustain life.

After Agriculture in Nigeria can help reduce poverty, raise incomes, and improve food security for 80% of the world poor who live in rural areas & work mainly in farming related activities.

CLIMATE

It is the statistics of weather over a long period of time. It is measured by accessing the patterns of variation in temperature, humidity, atmospheric pressure, wind, precipitation, atmospheric particle count and other meteorological variables in a given region over a long period of time.

AGRICULTURE AND CLIMATE

Climate change affects agriculture in a number of ways, including through changes in average temperature, rainfall, and climate extremes. For example (heat waves).

Changes in pest & disease, changes in atmospheric carbon dioxide, and ozone level, ozone characteristics, concentrations, changes in nutrient quality of some foods.

Climate changes can disrupt food availability, reduce access to food and affect food quality. Projected increases in temperatures, changes in precipitation patterns, changes in extreme weather events and reductions in water availability all result in reduced agricultural productivity.

Agriculture both contribute to climate change affected by climate change through the release of green house gases such as CO_2 etc. into the atmosphere; however, agriculture also contribute to green house mitigation

by reducing gas emission and by sequestering carbon while maintaining food production.

Emissions of several important green house gases that results from human activities (agriculture). Have since increased large scale industrialization began in the mid 1800s. Most of these human caused green house gas emissions will be of Carbon Dioxide (CO_2) from burning fossils.

Concentrations of CO_2 in the atmosphere are annually regulated by many processes that are part of the global carbon cycle. The flux or movement of carbon between the atmosphere and the earth, land & oceans is dominated by natural processes like photosynthesis. Although these natural processes can absorb some of anthropogenic CO_2 emissions produced each year standing about 1950s, emissions each began exceeding their capacity of processes to absorb carbon.

These imbalance between green house gas emissions and their ability for natural processes to absorb those emissions has resulted to a continuous increase in atmospheric concentration of green house gases such as CO_2 .

Assignments reflect the impact of climate on agriculture or vice-versa. A blessing or curse discuss. Not less than 3 pages.

21/06/2018
Relationship between agriculture & climate as it affects

- 1) Crop production
- 2) Irrigation
- 3) Pest & diseases
- 4) Livestock production

Global food security by climate change is one of the most important challenges in 21st century to supply sufficient food supply for the increasing population while sustaining the already stressed environment (Cal et al (2005)).

Climate variability is one of the most significant factors influencing year to year crop production even in high yield and high technology agricultural areas.

The changes in crop production relate climate variability with possibly major influence in regard as well as the global food production.

The impact of climate change on crop yield can needs to be taken account. On one hand, warmer temperature lowers the effectiveness of some pests and diseases, but on the other hand, it favours insect carriers of many diseases. Thus, depending on the pest or pathogen, elevated CO₂ may act in a synergistic or opposing manner with higher temperatures - result of such interactions are difficult to be anticipated, thus, one is obliged to

be more sensitive to precipitation and temperature. If water availability is reduced, Elevated CO₂ levels and temperatures will keep changing in composition and duration of the infecting

in the future, cost of high water holding capacity will be better to reduce. The frequency of drought and causes of pests & diseases.

improve the crop yield.

With climate change, the growing period will reduce

and the planting days also leads to change of

higher crop production. Climate change can cause

the rotation period so farmers need to consider

sowing dates, crop densities and fertilizers

when planting crops.

The positive effects of climate change on agriculture

are concerned with the CO₂ concentration,

crop growth increases in higher latitudes

and montane ecosystem. The negative effects of air pollution causes atmospheric circulation

includes the increasing incidence of pest & disease of winds.

and soil degradation owing to temperature change.

climate change impact of water balance

can represent changes in soil water storage,

groundwater levels, soil moisture status and its

influence on irrigation. The water

balance will change with respect to evapotranspiration and precipitation and resultant fluctuation

in soil moisture status.

The rising level of CO₂ and temp- are having a significant effect on pest and diseases in crops.

Elevated CO₂ can increase the level of simple

signs in leaves and lower their N content.

It can increase the damage caused by many

insects who will consume more leaves to meet

their metabolic requirements of N. Thus, any

attack with more severe.

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Faster temperatures from global warming, will mean that horizontal variations in pressure

because of elevated CO₂, will mean that horizontal variations in pressure

more numbers of pests will survive. GHTG.

Elevated CO₂ will help in easier overwintering of pathogens while higher temperatures will favor

the thermophilic fungi. Higher temperatures will lead to the following increase of pests &

diseases in both hemispheres. This will lead to more attack over longer period in temperate

climate.

Other possible effects of climate change

28/6/2018 DYNAMICS OF PRESSURE AND WIND SYSTEMS

Atmosphere even though it appears to weigh nothing has considerable weight at the earth surface. This pressure can be measured across the surface of the earth. The variation includes the increasing incidence of pest & disease of winds.

pressure; Atmospheric pressure is sometimes called

atmospheric pressure. This is the pressure within the atmosphere of the earth. As the elevation increases, there is less over the atmospheric mass

so that the atmospheric pressure decreases with increasing elevation.

pressure measures $\text{N} \cdot \text{m}^{-2}$ and Pa with

1 Pa = $1 \text{N} \cdot \text{m}^{-2}$ unit of Pascal ($1 \text{Pa} = 1 \text{N} \cdot \text{m}^{-2}$)

Vertical variations in pressure:

Atmospheric pressure decreases with altitude e.g.

Mountain - At the top of the mountain, the pressure is much compared to the bottom.

2) Airplane; There is less oxygen per unit air with altitude.

Horizontal variations in pressure:

Atmospheric pressure decreases with altitude e.g.

Mountain - At the top of the mountain, the pressure is much compared to the bottom.

2) Airplane; There is less oxygen per unit air with altitude.

Thermal variations in pressure:

Gases expand and become less dense with higher

temperature. At the equator, air is heated, air

expands, become less dense and rises causing

a drop in pressure -

In polar regions with lower temperatures, air is denser and tends to sink causing high pressure.

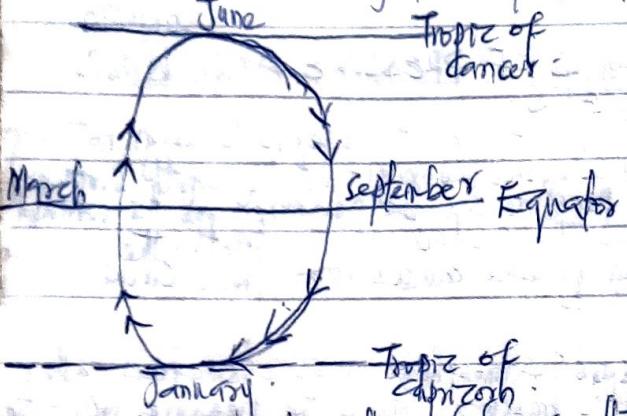
Dynamic variations in pressure:

The change in temperature, as the TIR rises and the rotation of the earth causes dynamic radiation in the circulation of the atmospheric air.

This dynamic variation in pressure is more complex than the thermal variation & creates a pattern of belt of pressure variation.

ISOBARS:

These are lines connecting points of equal pressure.



Apparent movement of the midday Sun through the year.

The Apparent movement of the sun and its effect

on the seasonal changes in West Africa.

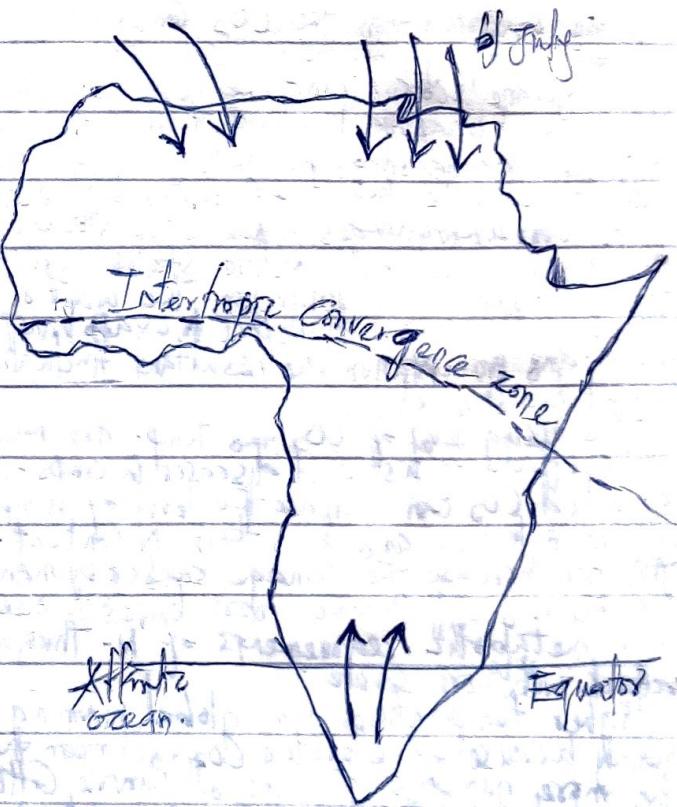
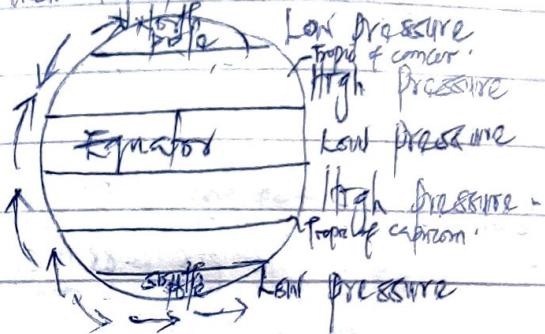
The whole of the West Africa is situated in the tropics. i.e. the area of the earth's surface lying between the tropic of Cancer and the tropic of Capricorn.

The tropics are regions of high pressure while the equator is a region of low pressure. Since differences between pressure of one area and another e.g. Cancer (wind) blow from the tropical high pressure belt to the equatorial low pressure belt. These are called Trade winds.

As the Sun moves towards the North, the area south of its zone will be subjected to the influences of the South West Trade winds.

Pressure, which blows from the Atlantic ocean and are laden with moisture. The release of the moisture supplies rain. The early part of the rainy season is generally accompanied by lightning & thunderstorms, due to the sharping action of the wind of the North East and South West.

Winds
As the Sun moves southwards at the first Cancer towards the equator from late June onwards the influence of the North East trade wind will increase - this winds which are dry and dusty from the Sahara Desert cause the humidity to increase in the North East. The greater under the influence of these winds has then dry season.



WIND

Wind is the horizontal movement of air in response to the differences in pressure. Winds are the means by which the atmosphere tends to bring the even distribution of pressure over the earth's surface.

pressure gradients & Wind

Wind varies widely in intensity, direction & speed. Much of this variation depends on pressure gradients. The greater the pressure gradient, the greater the wind. Winds do not flow directly from higher pressure to lower pressure because of the rotation of the Earth. Winds get deflected. This reflection is called the Coriolis effect.

In the Northern hemisphere, the Coriolis effect deflects the wind to the right. In the Southern hemisphere, the Coriolis effect deflects the wind to the left.

Geostrophic Wind

At the earth surface, friction has little effect on the wind direction. At this level, the wind responds to the pressure gradients and turns. In response to the Coriolis effects, this is called the geostrophic wind.

CYCLONE

A cyclone is a close system of atmospheric pressure whose center serves as a focus for convergent wind circulation. Examples are:

- Tsunami
- Hurricane

The centre of an anti-cyclone serves as a focus for divergent wind circulation.

WINDWARD: This refers to the direction from which the wind blows.

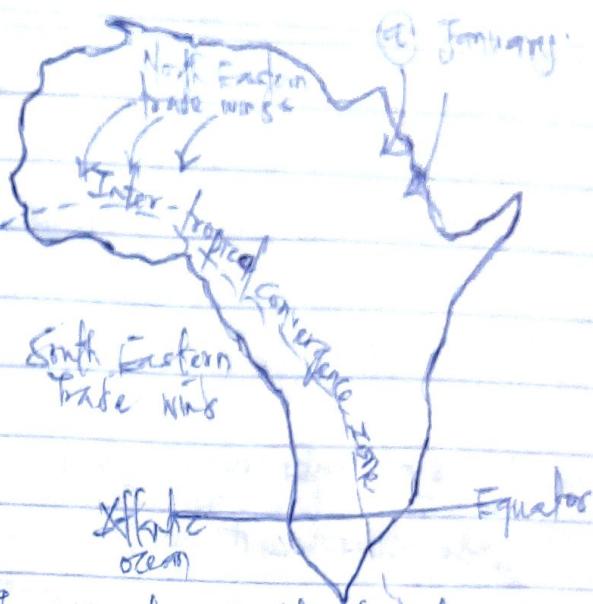
LEEWARD: This refers to the direction the wind is blowing.

LAND SEA BREEZE: The land sea breeze is a day cycle where the differential heating of land and water creates wind.

Upwelling

Upwelling of cold water occurs along the west coast of continents where the wind below the surface water flows out to the sea, allowing cooler deeper water to replace the warm water.

This brings up the warm surface and cool water.



The movement of the Inter-tropical Convergence zone through the year

Atmospheric Pressure

03/07/2018

Water represents 2% of the atmosphere and 4% of its volume. It can vary from nearly zero (0) in hot areas to about a maximum of 3% in middle latitude and 4% in the humid tropics.

The hydrologic cycle is the movement of water within and between the atmosphere and the earth.

Evaporation occurs directly from oceans and water bodies on land surfaces such as lakes, rivers and indirectly through plants via the process called transpiration. The water vapour which rises into the air becomes water droplets or crystals in the form of clouds or fog, while some of the cloud droplets or crystal falls as precipitation, others evaporate back into the air.

Precipitation which falls into the ocean may be evaporated back into the air. Some precipitation falling towards the land may actually fall into vegetation and accumulate as a coating of water source. The water undergoing this process called interception may drip or trickle down the plant to the surface or evaporate back into the air. Once on the land, rainfall falls onto the surface into rivers which then transports the water into a lake or ocean, or it can evaporate

directly back into the atmosphere - When precipitate falls as ice in temperate regions, it might temporarily remain on the ground before melting or it might be locked away for several years as part of the glacier.

Some of the liquid water penetrates into the ground through the process of infiltration. Under gravity, the water is soaked down and collects in the pores of underlying soil or rock as ground water. Much of the ground water eventually seeps into rivers for transport towards the ocean where the cycle continues.

Some Indices of Water vapour content

(1) Humidity: This refers to the water vapour content of the atmosphere. It can be expressed in a number of ways such as the density of water vapour, the pressure exerted by the water vapour, the percentage of the amount of water vapour that can actually exist.

(2) Vapour pressure: This is the ratio of the total atmospheric pressure due to water vapour. It is commonly expressed in millibars (mb) in US, in kilo pascals in Canada (kPa), in Pascal for most scientific applications. Since there is a maximum amount of water vapour that can exist, there is also a maximum vapour pressure. This is called a saturation vapour pressure.

This is an expression of the maximum that can exist and not the common amount of moisture in the air. The vapour pressure of a volume of air depends on both the temperature and the density of water vapour. Saturation vapour pressure depends only on temperature.

(3) Absolute humidity: It is the total mass of water in a given volume of air, expressed in grams per cubic meter of air. It is not widely used because the volume changes whenever air expands or contracts. Specific humidity expresses the mass of water vapour existing in a given mass of air.

Most often, it is expressed as the number of grammes of water vapour per kilogram of air. Specific humidity does not change as air expands or contracts because the mass of air remains the same. Specific humidity is also not temperature dependent therefore it is a good indicator for comparing water vapour in the air at different locations whose air temperatures

might be different from each other. Since there is a maximum amount of water vapour that can exist at a particular temperature, there is also a maximum specific humidity.

Significance of Water vapour to Meteorology and Climatology

(1) The atmospheric precipitation capacity is given by precipitation is influenced by the amount of water vapour in a given volume of air. So water vapour is the source of all forms of condensation and precipitation. Whether its the form of rain, fog & snow.

(2) Water vapour serves as heat regulator within the earth atmosphere system because it can absorb both solar and terrestrial radiations.

(3) The latent energy released when vapour condenses is an important source of energy for atmospheric circulation and the development of atmospheric disturbances.

(4) The quantity and vertical distribution of water vapour in the atmosphere directly affects the stability or otherwise of the air due to the latent heat of the vapour.

(5) As a result of its influence on the rate of evaporation and evapotranspiration, amount of water vapour in the air is a determinant of the temperature sensed or felt by the human body and hence human comfort.

(6) Unlike gases, water vapour can be changed to liquid or solid form within the range of normal atmospheric temperatures.

RADIATION AND HEATING OF THE ATMOSPHERIC SYSTEM

Radiation: This is any form of energy that can travel through vacuum. All forms of radiation share certain properties:

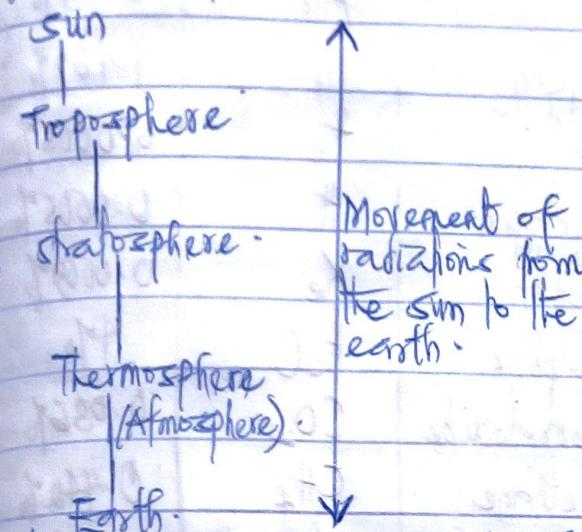
- Ability to travel through a vacuum.

- They can travel at the speed of light.

- They are able to be characterised as waves.

- Gamma rays
 - X-rays
 - UV radiation
 - Visible light
 - Radio waves
 - Radio waves
- Electromagnetic spectrum

All radiations comes from the sun.
All radiations don't travel at the same frequency and wavelength, but they travel at the same speed.



Nitrogen & Oxygen is found in the thermosphere and they are absorbed by gamma rays & X-rays, causing their temperature to increase.

The stratosphere is heated by the UV radiation and the Visible light.

Assignment; Explain greenhouse effect (17g).

12/09/2018.

ATMOSPHERE:
The atmosphere can be seen as a thin layer of air molecules, colourless and tasteless gases held to the earth by force of gravity. It contains a stable mechanical mixture mostly Nitrogen and Oxygen with small amounts of other gases such as water vapour, CO_2 , Argon and ozone.

Components of the atmosphere are;
- Argon
- Nitrogen
- Oxygen
- Neon
- Helium
- Hydrogen

- Water vapour
- Carbon dioxide
- Methane
- Ozone

Particles such as dust, fumes and chlorofluorocarbon (CFC). The percentage of them in a volume of air - permanent gases are gases that does not change while variable gases varies in percentage.

AIR PRESSURE AND AIR DENSITY

Gravity acts as a force which pulls down air above there by squeezing or compressing our molecules together. The more air above a level, the greater the effect of squeezing or compression. The air is compressible.

Since air density is the number of air molecules in a given space or volume, it means air density is greatest at the surface and decreases as it moves up into the atmosphere.

Air molecules have weight which acts as a force upon the earth. The amount of force exerted over an area of surface is called atmospheric pressure or air pressure.

The pressure at any level in the atmosphere may be measured in terms of the total mass of the air above any point. As we climb in elevation, fewer air molecules are above us. Therefore, atmospheric pressure also decreases with increasing height. So, both air pressure and density decrease in height above the earth.

Vertical structure of the atmosphere

Instrumental evidence that the atmosphere is vertically & divided in layers. The lowest layer of the atmosphere is called the troposphere.

Troposphere - This is the region of the atmosphere from the surface up to about 11km. It contains about 75% of the total gaseous mass of the atmosphere and normally all the water vapour and aerosols. Whether, the normal and turbulence are most marked.

It has been described as the weather making layer of the atmosphere. Therefore, it is of most great importance to man. In this layer, temperature decreases in height at an average of 6.5°C per km. The act of temperature decrease is called the lapse rate.

The top of the troposphere is called the tropopause. The height of the tropopause is not constant.

10/07/18

and varies from place to place and time to time over a given area. It is highest at the equator about 16 km and least at the poles about 8 km. Here, air temperature slope decreases with height, but at the tropopause lapse rate is low (zero) but is referred to as the Isothermal zone.

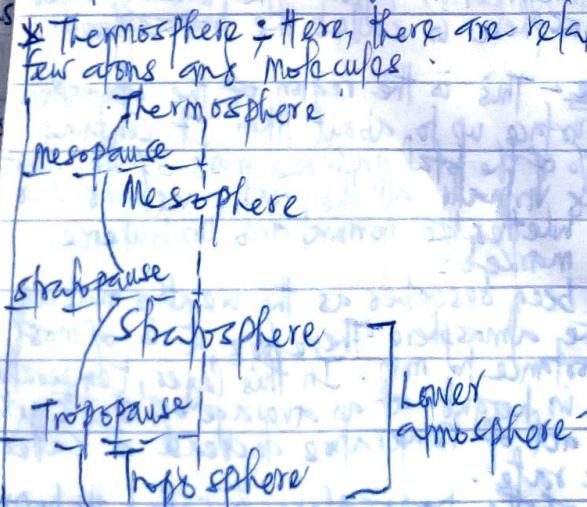
Write the percentage constituents of the atmospheric gases in a volume of dry air and determine if they are permanent or variable gases.

Constituent	Symbol	% by volume
Nitrogen	N ₂	78.09%
Oxygen	O ₂	20.95%
Argon	Ar	0.93%
Neon	Ne	4.469%
Helium	He	0.0005%
Hydrogen	H	0.0005%
Xenon	Xe	0.00009%
Water vapour	H ₂ O	4%
Carbon dioxide	CO ₂	0.036%
Methane	CH ₄	0.442%
Nitrous oxide	N ₂ O	5.4%
Ozone	O ₃	10.2%

Permanent Gases

Gas	Symbol	% volume
Nitrogen	N ₂	78%
Oxygen	O ₂	21%
Argon	Ar	0.9%
Neon	Ne	0.0018%
Helium	He	0.0005%
Methane	CH ₄	0.0005%
Hydrogen	H ₂	0.00005%

Diagrammatic expression of the vertical structure of the atmosphere



Variable gases

Gas	Symbols	% volume
Water vapour	H ₂ O	0.4
Carbon dioxide	CO ₂	0.038
Ozone	O ₃	0.00004
Carbon monoxide	CO	0.00002
Nitrogen dioxide	NO ₂	0.00001
Dusts (dust, pollen)	SO ₂	0.0001

7) storage of harvest or harvested crops

Elements of Weather

These includes;

- (1) Temperature.
- (2) Pressure
- (3) Rainfall.
- (4) Cloudiness.
- (5) Humidity.

Weather - Used to describe the state of the atmosphere at a given point in time over a given location or area.

Climate defines a synthesis or summary of weather over a long period of time in a given area or location. Usually 30 years or more.

Scope and goals of agroclimatology

1) The prediction and control of climatic environment

The protection of crops and livestock from given area or location climatic hazards

3) The prediction and control management of birds and pests

In the last two decades, various

Forecast of weather hazards

Timely amount of irrigation

Control of insects & diseases that affect

crop yield risk.

Selection of suitable sites

Micro climate modification to improve crop yield

Timely planting and harvesting of crops

Nature of climatology

- Micro
 - Meio
 - Macro
- } scopes of climatology

Biogeography - This is a branch of geography that studies the past and present distribution of the world's many species. It is considered to be a part of physical geography. It is the study of the world's biome and

taxonomy. Alternatively, it is defined as the study of the distribution of species and ecosystem in

a geographical space. phytogeography (1) Global production efficiency model (GLO-PEN) a part that studies the distribution of plants whereas zoogeography is the part which studies distribution of animals.

Types of biogeography:

- Ecological biogeography studies the current reefs are dug out and studied. factors responsible for the distribution of plant and animals - climate especially the water *Evolution; the change in genetic composition in area, the more movement of organisms of a population.

that is, the organisms requires an area that is not so cold or hot. It looks at the variations between higher and lower temperatures seasonal temperature.

Climate evapotranspiration - range plants lose water. Tropical areas are moist and allows more water for plants to grow there. In winter, it is simply too cold for the atmosphere to hold enough water.

SPECIATION: It is an evolutionary process in the formation of new and distinct species in the course of evolution, involves the splitting of a single trend with 2 or more species that are different.

Survival niche is the location where the survivors are.

(2) General Information Sensing (GIS).

GLO-PEN uses satellite imaging of vegetation on global scale e.g. whale location, sea surface temperature, coral reefs (Bathymetry). The factors

Concepts in biogeography:

*Extinction: Disappearance of species; end

a group of species; the death of the last individual of a species.

*Dispersal: movement of population away from their point of origin.

*Geodispersal: Erosion of barrier. *Vicariance: formation of barriers to gene flow.

SEASONAL VARIATION IN DAY LENGTH
The reason for the changing length of the day on earth.

The tilt of the earth's axis to the solar plane causes the days to change as the earth orbits the sun. In fact, the earth is tilted approximately 23.5° degrees from being straight up and down (picture 1 & 2) changing in season cycle.

(PEN) is due to the fact that earth (its geographic make them susceptible to a light increase. The earth's axis is inclined 23.5 degrees from its vertical. However, in contrast to turkeys, brooder breeders have no seasonal breezes. And as the earth revolves around the sun, it receives different Insolation (incoming up their growth, but also delays the decapitation solar radiation) due to apparent shift of the refractory condition. As a result, they require more like 5 months of short days before sun between two hemispheres.

When the days and nights equal in length they can be successfully stimulated into egg At "equinox" - "equi" - from equal and "no" production with a light increase from Latin word for night. The equinox are generally on March 21 and September 21 each year, plus or minus one day because of the cycle of leap years. The US Naval Observatory has a website for "earth's seasons" at which you can see the precise times of the Solstices and Equinox.

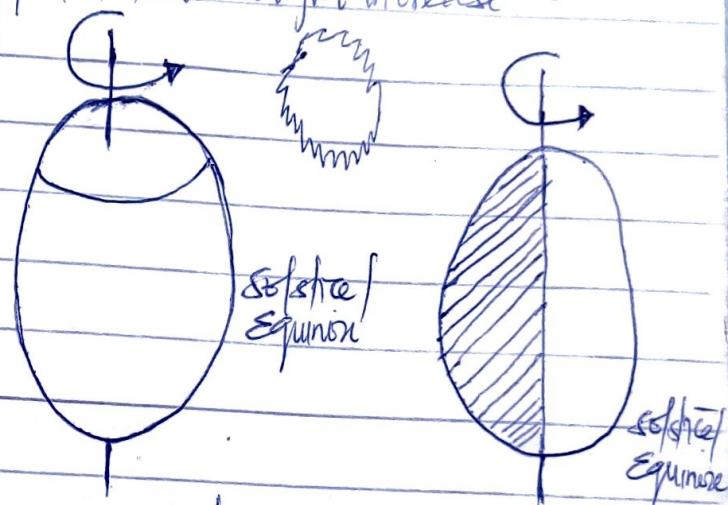
* Days seasonal variations in daylength

affects agriculture

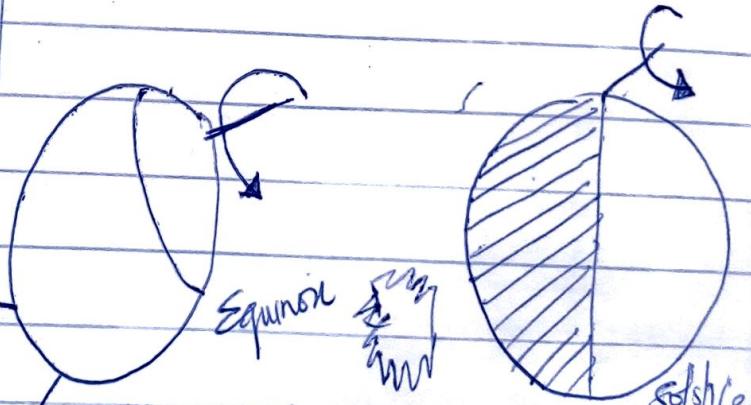
In a plant, Rieger begonias short days delayed flowering but produced no morphological effects. In continuous short days, underground tubers formed, short growth ceased and no flowers developed.

In animals, it has been reported that

turkeys are seasonal breeders and typically laid about 2 months of short days (mimicking winter) at the end of the rearing period to



Picture 1.



Picture 2.