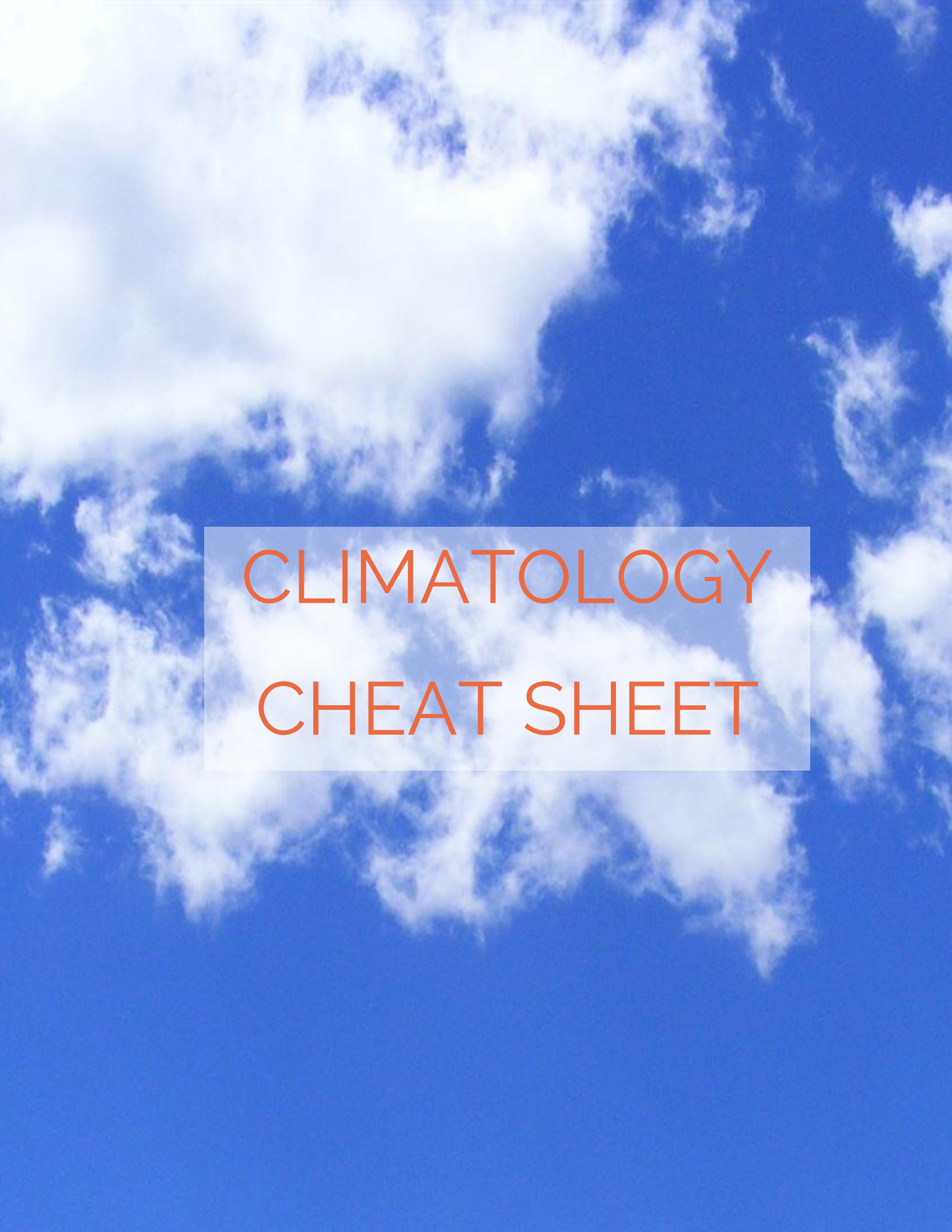

CLIMATOLOGY CHEAT SHEET

TheGeoRoom

CLIMATOLOGY CHEAT SHEET

This cheat sheet is a summary for Core Climatology topics. You can use this mainly for quick reference & revision, but strongly encourage to revert back to full notes for complete understanding.

Go to The Geo Room for full Notes on Climatology

You can also click the links below each topic,

Notify corrections on *admin@thegeoroom.co.zw*

Shortcut reference

Deg = degrees

Temp = temperature

HP = high pressure

LP = low pressure

SH = Southern Hemisphere

NH = Northen Hemisphere

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Atmospheric Structure

5 Atmosphere Layers

Troposphere

- 1st layer up to 11km
- Temperatures decrease (6.5deg/km Environmental lapse rate) as we ascend up
- High water vapour.
- All weather phenomena occur here.
- Boundary; tropopause

Stratosphere

- 2nd layer up (11km-50km)
- High temperatures as we ascend
- Ozone present
- Boundary; stratopause

Mesosphere

- 3rd layer up
- Stretches from 50-80km
- very low temperatures as we acsend
- high wind speeds
- Boundary; mesopause

Themosphere

The 4th layer up (80km & beyond) characterised by high temperatures.

No themopause as there's no other layer after this

Exosphere

- Outer space

atmospheric-structure

Heat Budget

- Balance of income & outgoing radiation
- Equator=> surplus radiation. Polars=> deficit

Vertical transfers of heat to address the imbalance

- Convection
- Radiation
- Conduction

Horizontal Transfers of heat to address the imbalance

- Sensible heat transfers (air masses)
- tropical storms
- ocean currents
- trade winds
- ITCZ movement

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Local Day & Night Energy Transfers

6 Day Energy Transfer

- short wave radiation
- longwave radiation
- surface absorption
- sensible heat transfers
- evaporation (latent heat)
- reflected solar radiation

4 Night Energy transfers

- longwave radiation
- Subsurface supply
- condensation
- sensible heat

Day & Night Models

Factors affecting temperature variations across the Globe

Long term

- sun's altitude
- ocean currents
- prevailing winds
- specific heat
- land altitude

Short term

- seasonal changes
- length of day & night

Local factors

- (urbanisation) urban heat island
- aspect (face of slopes)
- cloud cover

factors affecting temperature variations

Moisture in the Atmosphere

Humidity

Absolute Humidity

The ammount of water vapour in the air eg 6grams in a cubic metre of air.

Specific Humidity(Mixing Ratio)

- The mass of water vapour contained in a unit mass of dry air.

- Formula: **mass of water vapour in grams/mass of dry air in kg**,expressed as g/kg.

Relative humidity

- The amount of water vapour present in the air to its potential water vapour capacity at a given temperature.
- **saturated air=100% relative humidity**. Warm air is able to hold more water vapour than cold air

Humidity types

Lapse rates

Dry Adiabatic lapse rate

The decrease in temperature of a dry unsaturated parcel of air (9.8deg/ km) as it ascends.

Saturated/ Wet Adiabatic Lapse Rate

The decrease in temperature of a saturated parcel of air (5deg/ km) as it ascends up.

Environmental lapse rate

The decrease in temp of the atmosphere with height (6.5deg/ km)

Lapse Rates

Condensation

Factors needed for condensation

- uplift mechanization (convection, orographic, frontal, convergence)
- condensation nuclei
- dew point temp to cool the air parcel (advection cooling, radiation cooling)

Condensation Factors

Atmospheric stability & instability

Stability

Atmosphere cools slower than the rising parcel of air (stable conditions)

Instability

Atmosphere cools faster than the rising air parcel (unstable weather conditions)

Conditional Instability

Atmosphere cools slowly than the air parcel, but cools faster after condensation of the air parcel.

Stability & Instability

Precipitation (rainfall, snow, sleet, hail)

Types of rainfall

- orographic (over a mountain)
- convection rainfall
- frontal rainfall
- convergence rainfall

Snow

aggregated (joined) ice crystals forming a hexagonal snow flake.

Sleet

Mixture of snow and freezing rain

Hail

Formed from **accretion** of ice crystals with water as they're dropped down in a cumulonimbus cloud forming shells of ice upon freezing.

Precipitation

Rainfall Formation Theories

Collision coalescence

The merging of falling large droplets with small droplets as they collide becoming more large, and then ripped apart by air friction splitting into raindrops.

Bergeron Fiendesen

- The transfer of supercooled droplets (high vapour pressure) to the ice crystals (low vapour pressure) causing ice crystal growth.
- The heavy ice crystal falls and melts forming raindrops

Rainfall Formation Theories

Factors Affecting Rainfall Intensity & Duration

- Uplift mechanism
- Condensation nuclei
- Cloud type
- Degree of stability
- Time of the day
- Wind

factors-affecting-rainfall-duration-and-intensity.php

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Precipitation on Ground Level

Hoar frost:

Deposition of **water vapour** into ice crystals on a freezing object

Rime:

Freezing of **supercooled** droplets onto a freezing object

Glaze

Freezing of **rainfall** on a freezing object

Precipitation on Ground

Temperature Inversion

Warming up of the atmosphere with height.

Effects

- Signal destruction
- Can cause haze & smog as particulates cannot escape
- Can trap shockwaves

Temperature inversion

Cyclones and Anti-cyclones

Cyclone (Low pressure)=> air converges and rises up (bad weather)
Anti-cyclone=> Air descends and diverges on the ground (fine weather)

Pressure Gradient

The initial driving force of wind

Coriolis Force

The deflection of winds due to earth's rotation.
SH=> defected to the left
NH=> deflected to the right

Geostrophic wind

A wind blowing parallel the isobars as a result of the balance between Coriolis force & PG.

Pressure gradient, Geostrophic wind & Coriolis force

The Tricellular model

A model showing cells of air movement from the equator to the poles.

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Hadley cell=> air rises from the equator
Ferrel cell=> air descends at 30deg latitude
Polar cell-> air rises up at 60deg latitude
tricelluar-model

Inter-Tropical convergence zone

A belt of low pressure where trade winds (South easterly & North easterly) converge. Shifts according to the **overhead sun**.

Tropic of Capricorn (SH) overhead sun=> ITCZ follows with heavy rains & high temperatures. NH=> low temperatures and rainfall

Tropic of Cancer (NH) overhead sun => ITCZ follows with heavy rains & high temperatures. SH=> low temperatures and rainfall
https://thegeoroom.co.zw/climatology/ITCZ.php

AIR MASSES

- Tropical maritime (mT) => moist and warm e.g Atlantic, Indian ocean , Indonesia, SW Pacific.
- Tropical continental (cT) => dry and warm e.g Sahara, southern Africa, Australia
- Polar maritime (mP)=> moist & cold e.g Canada & Greenland
- Polar continental => dry & cold e.g Canada, Scandinavia
- Arctic=> very cold & dry or moist

Air masses affecting Zimbabwe

- South east trades
- Zaire air (NW monsoons)
- NE monsoons

How Air Masses are modified from their source region

- Surfaces over which they blow (warm & cold surfaces, dry & moist surfaces)
- Barriers such as mountains, buildings
- Distance over which they travel.

Types of Air Masses

Cold, Warm, Occluded & Warm Fronts

Cold Front

Cold air undercuts and lifts up an incoming warm air mass. *Denoted by blue triangles*

Before front:

- Low temp
- Low pressure

- Low humidity
- High & middle level clouds dominate

On Front

- Low temp
- High pressure
- Cumulonimbus clouds with torrential rainfall
- Lightning, thunder
- Moderately high humidity
- Gusty winds

After Front

- Temp increase again
- Low pressure
- Light showers
- Clearing clouds

Warm Front

Warm air catches up a retreating cold air mass and rise on top. *Denoted by red half circles*

Before front:

- Low temp
- Low pressure
- Low humidity
- High & middle level clouds dominate e.g cirrus
- Light showers

On Front

- high temp
- low pressure
- dense low level cloud cover
- poor visibility
- high to moderate rainfalls
- high wind speeds
- high humidity

After Front

- low temp
- high pressure
- Light showers
- Clearing clouds and visibility
- Melted snow

Occluded Front

A warm air mass is trapped between two cold (an oncoming & retreating cold air mass) air mass and is occluded (lifted) from the surface. *Denoted by both blue triangles & red half circles*

Stationary Front

Two same air masses collide and none is forced aloft or where air masses pass side each other. Denoted by *both blue triangles & red half circles.*

Fronts

How urban climate differs from the surrounding climates (The Urban Heat Island Phenomenon)

- Industrial gases
- Domestic pollution e.g dumping
- Vehicular emissions
- Deforestation
- Concrete surfaces & asphalts traps heat
- Skyscrapers trap heat
- urbanisation

Characterisitcs

- High temperatures
- High rainfalls (high condensation nuclei due to pollution)
- Low humidity
- Fog/ smog
- Temp inversions
- Gusty winds

Mitigation

- Carbon tax
- Fining
- Mass transportation e.g buses
- Encourage clean sources of energy e.g solar, wind
- Minimize urbanisation
- Green roofs
- Constructing porous surfaces which cools the surface
- Shade trees
- Reserving water bodies
- Build reflective surfaces/ high albedo

Urban heat islands

Land and Sea Breezes

- The differential heating between land & adjacent water bodies.
- Land heats up fast & cools fast
- Sea heats up slowly & retains more heat than land (low specific heat)
- Air movement from sea (HP) to land (LP) at daytime and from land (HP) to sea (LP) at night

Land sea breeze

Mountain Valley Winds

- **Anabatic** winds move from the valley up the mountain & condenses
- **Kanabatic winds** are heavy & cold, hence drops down to valley floor creating dense fogs

muntain valley winds

Fohn Effect

- A dry & hot wind which descends to the leeward side of a mountain.
- Can melt ice
- Can cause brush fires

fohn wind

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Greenhouse and Global Warming

Greenhouse is a layer of gases in the atmosphere which traps outgoing longwave radiation & helps warm the earth
Increase of greenhouse gases lead to global warming

Causes

Anthropogenic causes, e.g

- industrial gases,
- Domestic pollution
- Vehicle emissions
- Deforestation
- Nuclear explosions
- Nitrous oxide from fertilisers
- Chlorofluorocarbons **(C-chlorine, F-flourine,C-carbon)** which mainly comes from refrigerants ,plastic products & aerosols

Natural Causes

- Volcanic eruptions
- Methane from animal (cattle) dung
- Natural veld fires

Effects

- Low rainfalls
- High temperatures
- Heat waves
- Droughts & famines
- Desertification
- Melting ice caps->floods
- Extinction of species
- Social unrest

Mitigation

- Carbon tax
- Fining
- Implement clean sources of energy e.g solar, wind
- Use zeolites in industries
- De-carbonization using ammonia
- Carbon sequestration (burying
- Catalytic converters on cars which separates nitric acids into nitrogen and oxide
- Reducing firewood and biomass burning
- Improving agricultural practices eg reducing fertilizer usage
- Improving land distribution and standards of living especially in LEDCs

Ozone and its significance

- Ozone (O_3) is a blue gas, oxygen molecule containing **three** oxygen atoms

- Helps trap ultraviolet radiation from the sun
- Found in the stratosphere

Increased CFCs => low ozone => high temperatures

Ozone

Tropical Storms

- Violent, fast rotating winds characterized by intense rainfalls and low pressure fueled on warm oceans.
- Born around 20deg South or North of equator for Coriolis force to be effective
- Ocean temperatures must be 26deg or more.
- Air rises & condesnses
- Heavy cold air is drawn back creating an **eye**
- Latent heat adds energy to the storm
- The storm cloud is rotated by the Coriolis force.
- Rotates clockwise in the NH & anticlockwise in SH
- The storm moves in westward direction.

Effects

- Infrastructure damaged (houses, dams, bridges)
- Intense flooding (secondary)

  Road networks are cut-off.
- Electricity shortages
- Crops and livestock are destroyed.
- Financial losses to fix the damage.
- Landslides

Tropical Storms

El Nino

A phenomenon where they're abnormally high temperatures around the South. E Pacific.
Air rises & condenses causing torrential rainfalls around S.E Pacific i*Peru, Chile, Brazil)

Effects

- The South W Pacific, Southern Africa, N Ameriaca is dry & hot
- Melting ice caps in Antarctica
- Droughts
- Malaria, dengue fever
- Heat waves
- Global warming
- Tropical storms can develop
- Flooding & water borne diseases in South. E South America.
- Less impacts in Europe

La Nina

The reverse of El Nino

- Dry conditions (HP) in S. East Pacific (Peru, Chile etc)
- Low pressure around S. West Pacific (Indonesia, Australia, Philippines)
- Rainy in S. West Pacific & S. Africa

El-Nino & La-Nina

Droughts

A phenomenon where abnormally low rainfalls prevail.

Causes

Natural Causes

- El-Nino
- Volcanic eruptions (ash blocking sunlight)

Anthropogenic causes

- deforestation
- Industrial pollution
- Domestic pollution

Effects

Social

- Famines
- Food wars
- Social unrest
- Migration

Economical

- GDP falls

On the environment

- Desertification
- Soil erosion
- Species deplete
- More heat waves
- Brush/ wild fires

Mitigating the Impacts

- Store adequate food reserves
- Use drought resistant crops
- Use irrigation where applicable

Preventing the Causes

- Carbon tax
- Fining pollutive activities
- Use clean energy sources e.g solar
- Afforestation & reforestation
- For mitigating industrial pollution see Mitigating global warming

Droughts