

Climate
African climate
Ocean Explorer
Module 6



Bayworld Centre for Research & Education





Overview

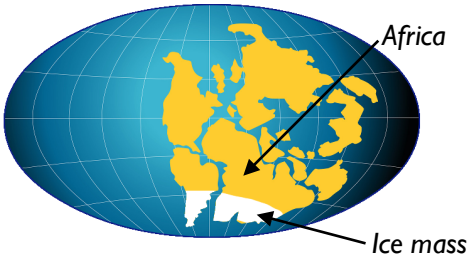
- 1 - Previous Eras
- 2 - Africa's current climate
- 3 - The role of Oceans in climate control
- 4 - El Niño and La Niña
- 5 - Activity : Climates and Adaptations



1 - Previous Eras

The African continent went through a range of different climates. Most of these past conditions are recorded within the sedimentary rocks of Africa. It is part of a Palaeontologist's duty to establish, thanks to these past remains, what were the ancient living conditions at a specific time in the past on Earth.

250 million years ago



200 million years ago



150 million years ago



100 million years ago



50 million years ago

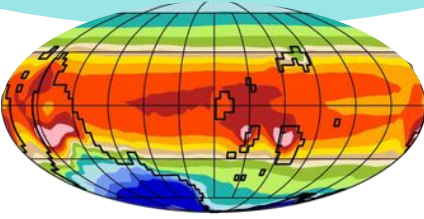


Present



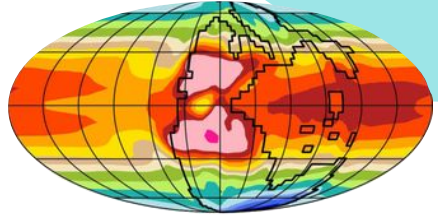
Continental drift is happening as tectonic plates move, with earthquakes and volcanoes often occurring around their edges. The Earth's continents were once joined together, but gradually moved apart over millions of years. The climate on the continents also varied according to their location on Earth.

445 Ma - Ordovician



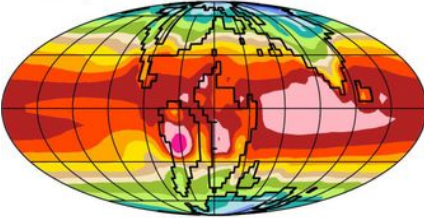
Climate was very hot due to high concentration of CO₂ in the atmosphere, which gave a strong greenhouse effect.

250 Ma - Permian/Triassic extinction



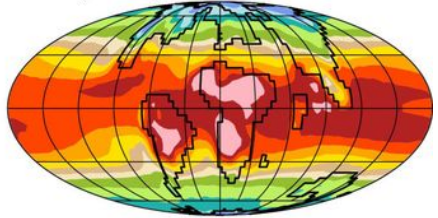
The temperatures rose by around 6°C and the climate became much dryer than before.

100 Ma - Cretaceous



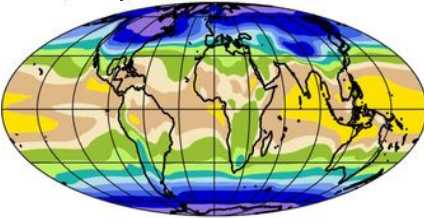
This was the age of dinosaurs and giant reptiles, a wet and warm climate throughout the globe.

55 Ma - Paleocene-Eocene Thermal Maximum



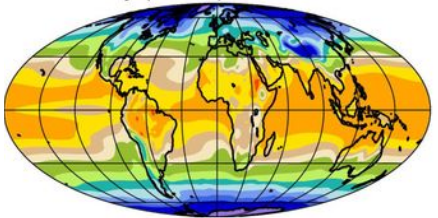
During this period, no ice caps were present on the poles and the sea level was at its highest.

21 000 y - Last Glacial Maximum



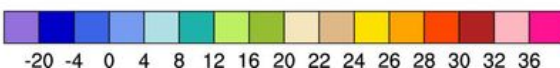
The temperatures at this stage were so cold that half of the continents were covered in ice !

Present



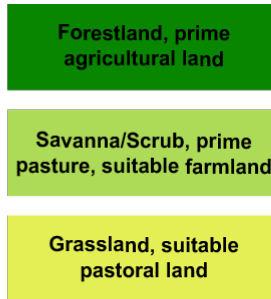
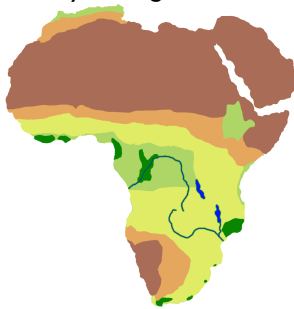
Temperatures get warmer each year. Thanks to the study of past climates, we know how our current climate will evolve.

°C Surface Air Temperature

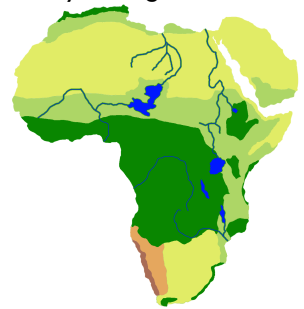


As the climate is changing, species also evolve in order to adapt to new environmental conditions, such as temperature and humidity levels. Each species is adapted to survive within a specific environment. This is the reason why it is possible to describe past climates simply by studying the flora and fauna that is preserved within past sediments.

14 000 years ago - Palaeolithic



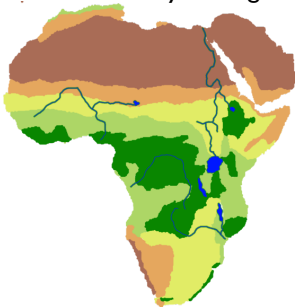
7 000 years ago - Mesolithic



Dry and cold period. The climate grew even drier over time until the small ice age called the "Big Freeze" (13 000 to 9 000 years ago). Humans were hunter-gatherers.

Wet period. Deserts, including the Sahara, became grasslands. These very good conditions led to the development of agriculture by early humans.

From 3500 years ago



End of the wet period. The Sahara gradually became a desert again. Agriculture allowed for the development of cities and empires.

Info +

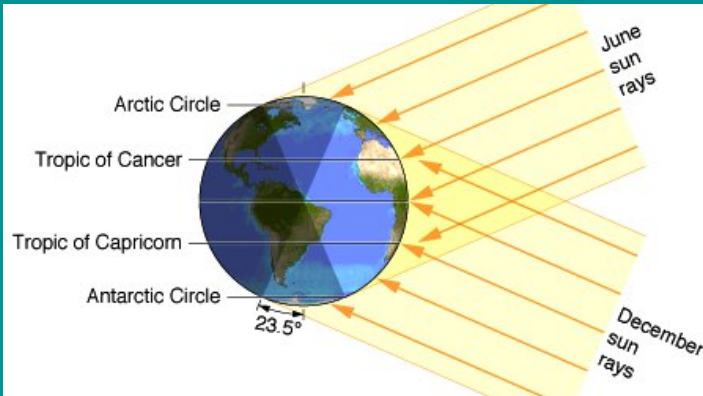
Humans almost got wiped out during the last ice age (13 000 to 9 000 years ago)! They only survived by taking refuge in the Arabian peninsula. When the ice sheets receded, people living in Arabia dispersed outwards, repopulating Africa and the rest of the world.



2 - Africa's current climate

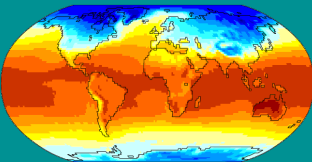
Temperatures at a specific point on Earth depend on the amount of solar radiations received. Locations near the Equator are the warmest. But the temperatures are also dependant on the Earth rotation around the Sun.

Seasonality : Because of Earth's axial tilt (**obliquity**), our planet orbits the Sun on a slant which means different areas of Earth point toward or away from the Sun at different times of the year. Around the June solstice, the North Pole is tilted toward the Sun and the Northern Hemisphere gets more of the Sun's direct rays. This is why June, July and August are summer months in the Northern Hemisphere and winter months in the Southern Hemisphere.

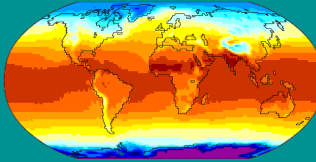


Temperatures around the year

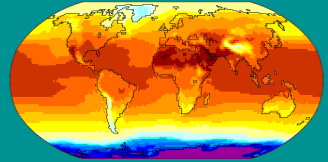
January



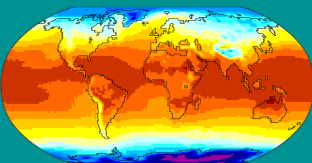
April



July



October



Temperature range

-50°C

0°C

35°C



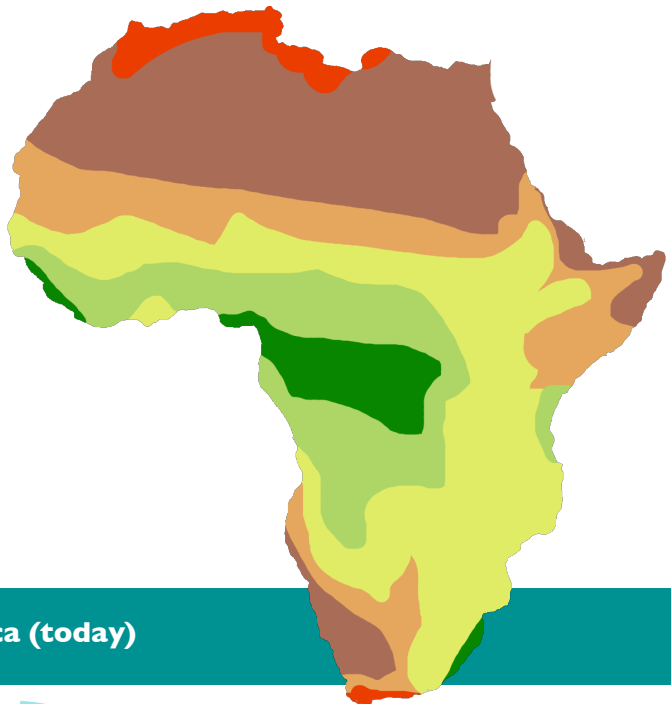
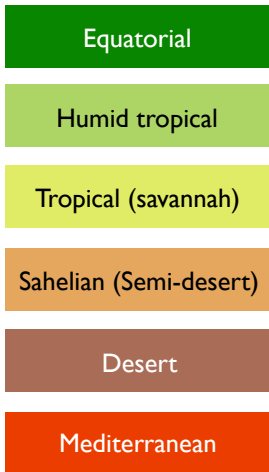
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A climate region is an area with similar temperature and rainfall.

Africa's position is relatively unique in the sense that it almost has a mirror image of climate zones to the north and South of the Equator with regard to latitude. The six main climate zones of Africa are found to the north and south of the equator, namely, **Equatorial**, **Humid Tropical**, **Tropical**, **Semi-desert** (Sahelian), **Mediterranean** and **Desert**.

There are several factors that influence the climate :

- Latitudinal position
- Altitude
- Distance from the sea
- Prevalent pressure belts
- Ocean currents



Climate zones of Africa (today)

Record temperatures

The highest temperature recorded anywhere in the world was at Al’Aziziya, Libya, which reached 57.8°C on the 13/09/1922.

The lowest recorded temperature in Africa is -24°C at Ilfrane, Morocco, on the 11/02/1935.

In the following table, we identify the different types of climates within Africa. Take a look at the picture above to see where these climate zones are located.

Climate zone	Where	Description
Desert	18° - 36°N & S of the Equator	<ul style="list-style-type: none"> • Sub-tropical High Pressure zone • West coast and Continental effect • Cold Canary current and Cold Benguela current
Equatorial	10°N & S of the Equator	<ul style="list-style-type: none"> • ITCZ • Continental mainly with west coast warm current
Tropical (Savannah)	15° - 20°N & S of the Equator	<ul style="list-style-type: none"> • Sub-tropical High Pressure in winter • Summer rainfall prone to droughts and tornadoes • Large temperature ranges
Mediterranean	30° - 40°N & S of the Equator	<ul style="list-style-type: none"> • Situated on the further north and south west margins of the African continent • Winter rain
Sahelian (Semi-desert)	20°N of the Equator	<ul style="list-style-type: none"> • Transition between Monsoon and desert zones • When ITCZ moves north it provokes the summer rainfall • Mainly continental effect
Humid Tropical	Transition between Equatorial and Tropical	<ul style="list-style-type: none"> • Rainfall throughout the year, more in summer • Small variations in temperature (20° to 25°C) • High temperatures due to tropical location



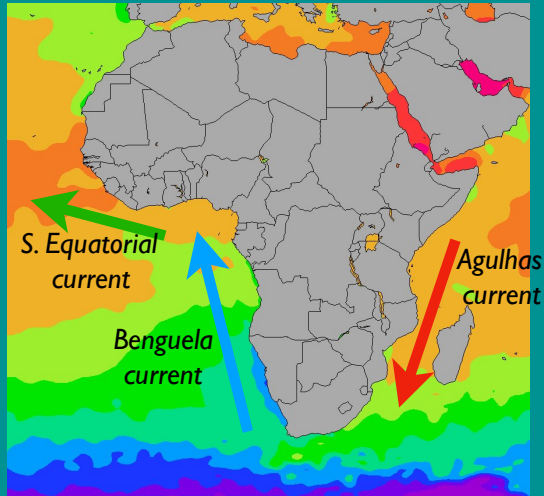
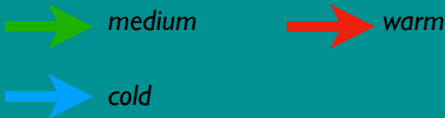
3 - The role of oceans in climate control

The ocean covers more than 70 % of the Earth's surface. It plays a major role in regulating the weather and climate of the planet.

Oceans in general have a great influence on rainfall on a continental basis and an influence on temperatures along coastal margins.

Isotherm map showing ocean temperatures around Africa.

If the ocean currents are superimposed on this map, there will be a striking correlation between the cold ocean currents and colder waters and warm ocean currents and warm waters.



Temperature

The effect of the ocean with regard to temperature is Maritime in effect. Generally, when looking at temperature of oceans and currents around the coast of Africa, there is a dominance of warm water around the continent. The exceptions are the North West and the South West coastlines, (Cold Canary and the Cold Benguela currents respectively, see lesson 3 for a map of the currents around Africa).

Both Mediterranean areas are cooler than expected due to cloud cover in winter as cold fronts move through and lessen insolation. Since South Africa is surrounded by water masses, all coastline temperatures are moderated and have small temperature ranges.

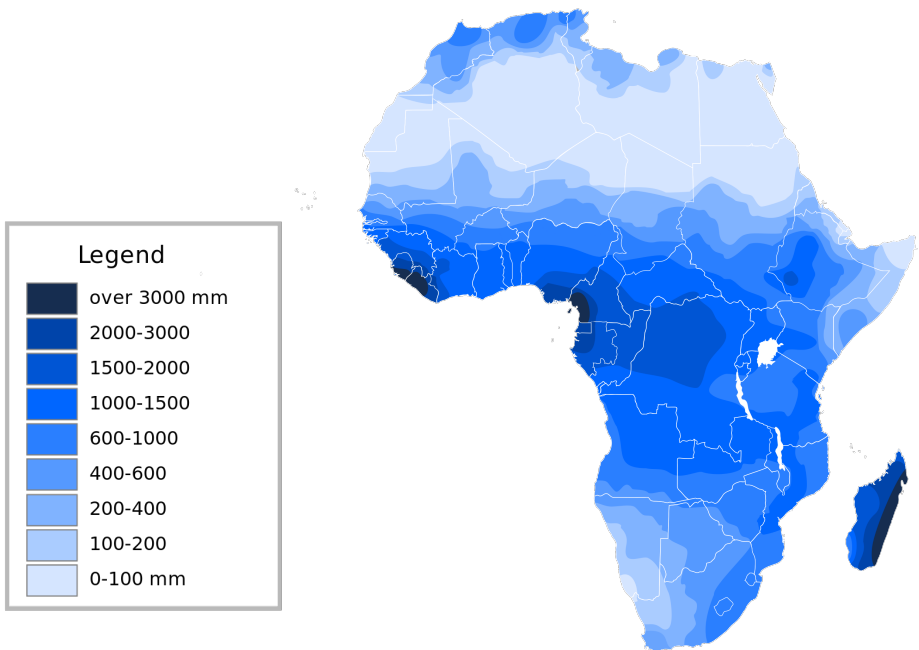
Rainfall

Rainfall varies dramatically across Africa. The northern half of the continent contains large areas of arid desert, where annual rainfall can be just 50mm. But in central areas of the continent, tropical rainforests can receive over 4,000mm each year !

Ocean temperatures and currents have a maritime and continental effects. This together with the migration of the "heat Equator" presents a rainfall pattern of considerably more rainfall over Sub-Saharan Africa.

Heat Equator migration

Each year, the rain-belt moves northwards up into sub-Saharan Africa (by around August), and then moves back southwards into sub-central Africa (by March). Equatorial Africa remains in the rain-belt throughout the year, which is why this region is the wettest part of the continent.



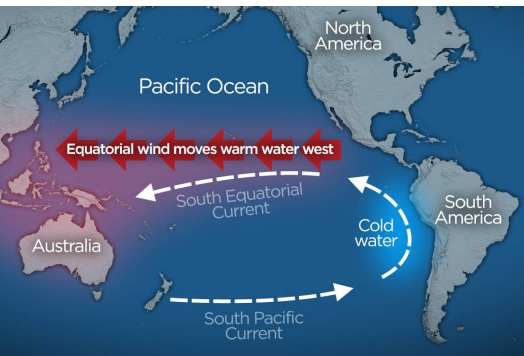
Average annual precipitation for Africa

The map of average rainfall over Africa shows a similarity to the climate map.

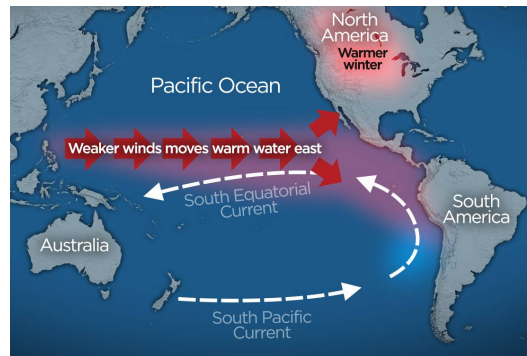
4 - El Niño and La Niña

The effects of La Niña and El Niño are part of what is called the Southern Oscillation (ENSO). In Africa, dry areas receive more rainfall, while the wet areas receive less rainfall.

The Southern Oscillation originates over the Pacific Ocean. La Niña is described as cooler-than-normal sea surface temperatures in the central and eastern Pacific Ocean, near the equator off the west coast of South America. El Niño is the totally opposite. This is described as warmer-than-normal sea surface temperatures in the same area of the Pacific Ocean.



Normal Year



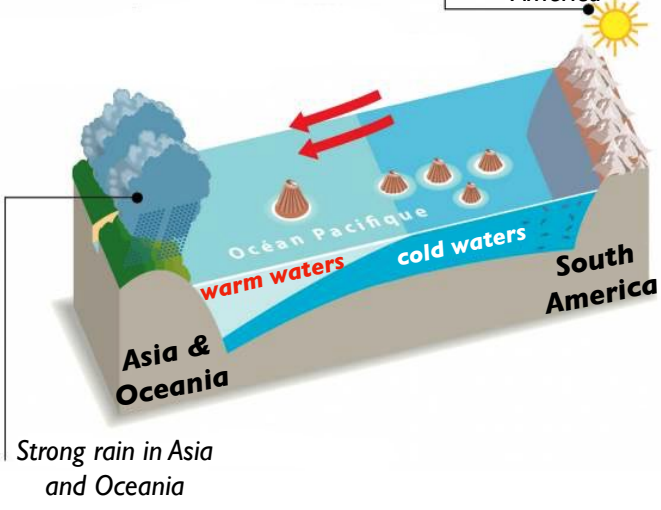
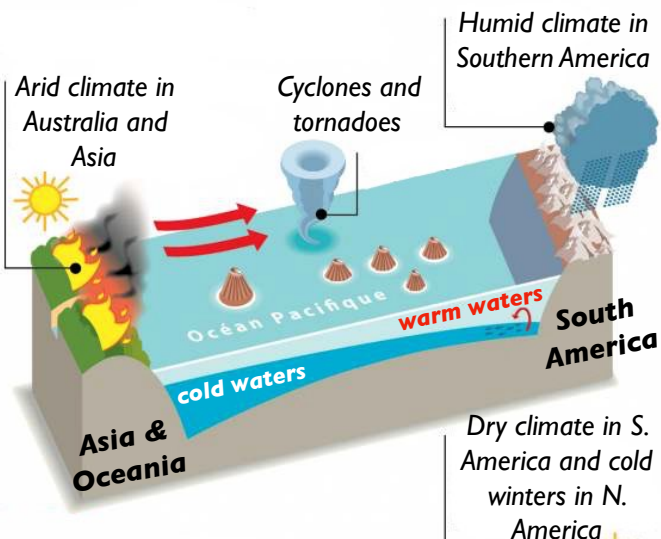
El Niño year

The most affected areas are Northern and Southern America and Asia and Oceania. Africa usually doesn't feel the effect of an El Niño event.

What Causes La Niña and El Niño ?

Easterly trade winds over the equatorial Pacific Ocean are partly to blame for both phenomenon. For La Niña, the easterly trade winds strengthen. This blows more warm water west, and allows cold water below the ocean's surface to push towards the top near the South American coast to replace the warm water.

In an El Niño event, the opposite occurs. The easterly trade winds become weaker, and can even reverse direction. The warm Pacific Ocean becomes nearly stationary or pushes eastward and gains heat.



El Niño

Current that warms up the Pacific Ocean (between 1 and 2°C more). It often creates tornadoes and cyclones in the Pacific Ocean. It happens every 3 to 9 years.

La Niña

Cold current succeeding to El Niño. Waters between South America and Oceania get 1 to 2°C colder than usual.



5 - Activity : Climates and adaptations

Questions

- 1 - Look at the list of animals below and fill in the table for temperature and altitude required for each species. Do some research on the internet if you are not sure of the answer.
- 2 - In which type of climate can this species live ?
- 3 - Is there any other specific requirements for this species to survive ?

Species	Temp (°C)	Altitude	Climate type	Other requirements
African penguin				
Polar bear				
Puff adder				
Zebra mosquito				
Rainbow trout				
African bullfrog				

Every species is adapted to live in a specific environment, with specific weather conditions. Species can adapt to other environments by evolving, but it is a long process that can take up to a few million years depending on the species and the modifications required.