

78TH INAUGURAL LECTURE OF THE UNIVERSITY OF CALABAR, NIGERIA



THE 3Bs OF LIFE: THE BLACK, BRACKISH AND BLUE WATERS: AN ECOLOGICAL SCENARIO MISUNDERSTOOD

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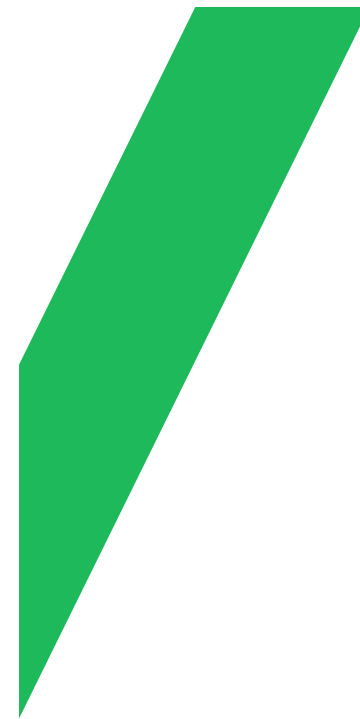
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PREAMBLE

*“Tell me not in mournful numbers,
Life is but an empty dream!
For the soul is dead that slumbers,
And things are not what they seem.
LIFE is REAL, LIFE is EARNEST!
And the grave is not its goal,
Dust thou art, to dust returnest,
Was not spoken of the soul.....”*



Longman
Psalm of
Life

❑ Longman here emphasizes that LIFE is real and must be lived.

❑ The human heart is a perfect system and it supports the LIFE WE LIVE.



❑ But when the heart is DISTORTED, its rhythm changes and the heart automatically malfunctions.

❑ **And such is the WATER or aquatic environment**

THE FACT OF THE MATTER

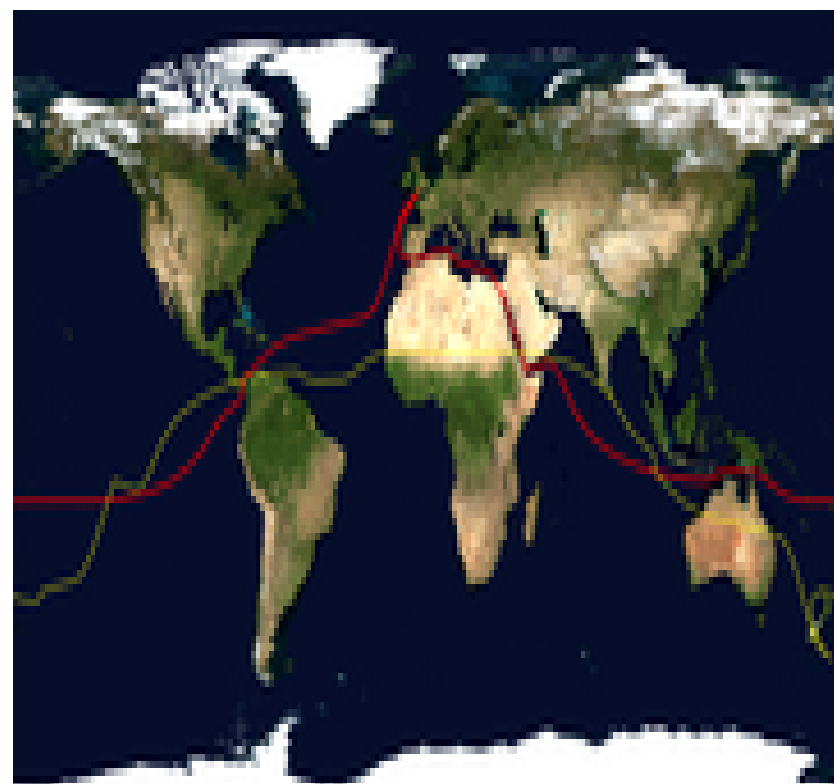
- The water ecological system has been distorted due to HUMAN ACTIVITIES.**
- When the status and quality of water are altered, (BY MAN) automatically WATER becomes WORTHLESS OR GOOD FOR NOTHING.**
- This calls for the need to RESTORE OUR WATER ECOLOGICAL BALANCE.**

- Humans are often prejudiced by what happened YESTERDAY forgetting about what is going on NOW.
- There is a life to live and sincere efforts to contribute to make life meaningful.
- The Oceans sustains Life and has got to be protected and guarded jealously.
- For the grave is not the goal of life.

EARLY BEGINNINGS OF OCEANOGRAPHY

The early beginnings of Oceanography's is about *people and sea voyages*, not just oceans and test tubes.

1000	Leif Ericson crossed the Atlantic Ocean to Canada
1492	Christopher Columbus crossed the Atlantic to West Indies
1500	Pedro Alvares Cabral discovered Brazil



1513

Juan Pounce de Leon described the Florida current

1515

Peter Matyr discussed the origin of the Gulf Stream

**1519 –
1522**

Ferdinand Magellan circumnavigated the earth and attempts the deep sea soundings in the Pacific Ocean

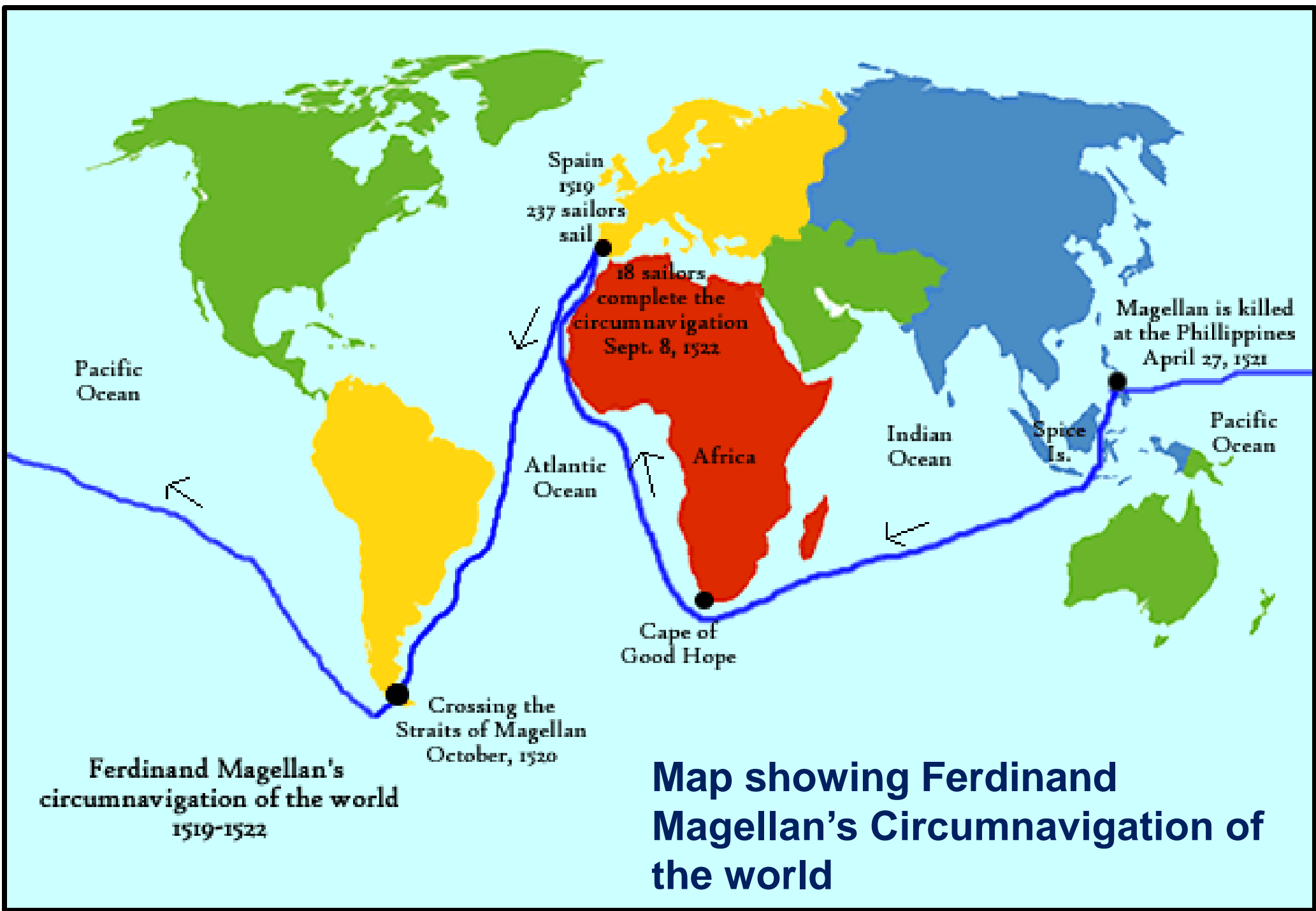
Why did they get involve – BECAUSE THEY FOUND OUT THAT WATER COULD SERVE AS SEA ROUTE FOR COMMERCE AND INDUSTRY AND OTHER BENEFITS.

1843

Alexander Dallas Bache became the superintendent of US Coast and Geodetic Survey

1865

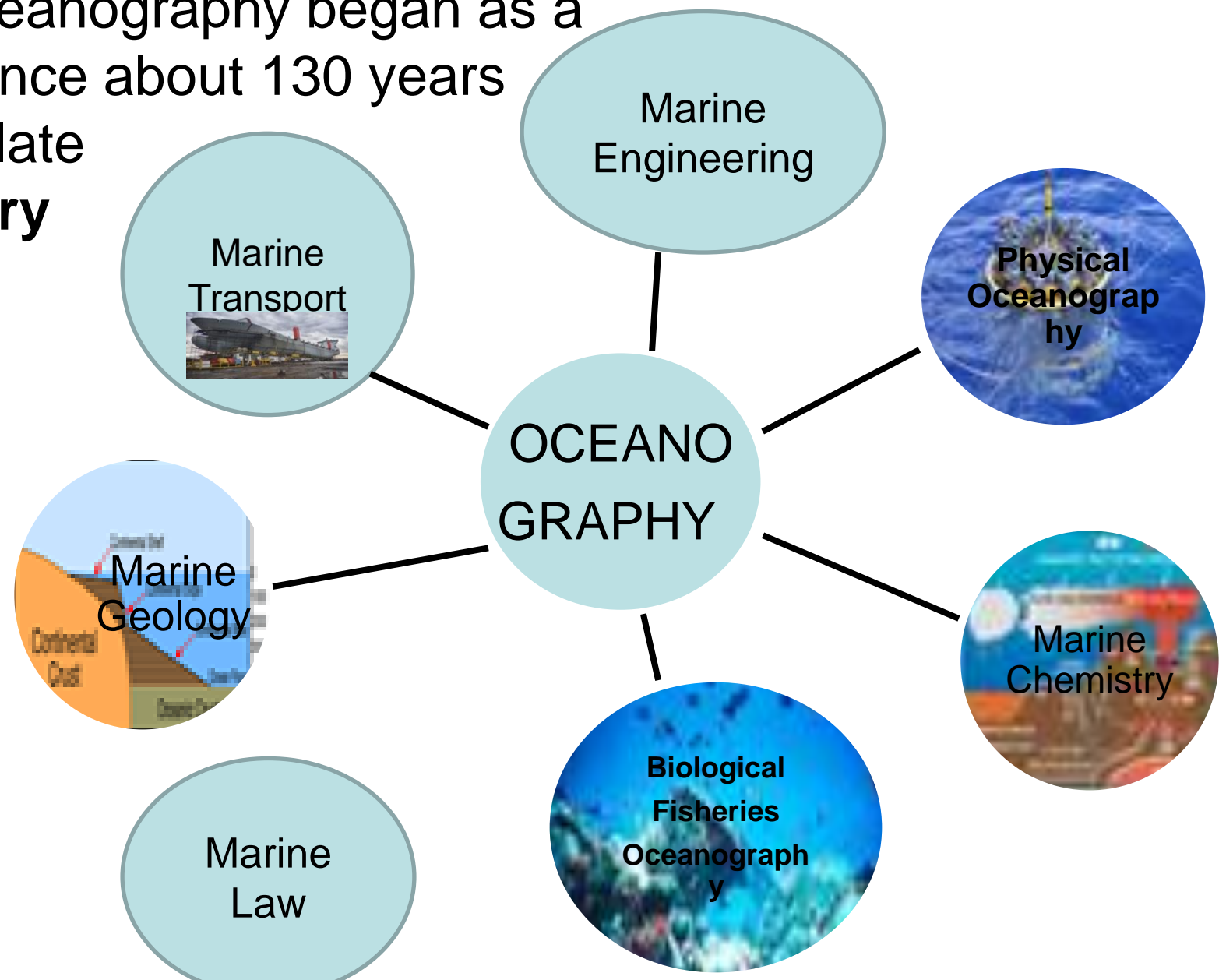
Johann George Forchhammer analyzed samples and discovered that the ratios between ocean major ions are nearly constant from ocean to ocean



OCEANOGRAPHY AS A MULTIDISCIPLINARY SCIENCE

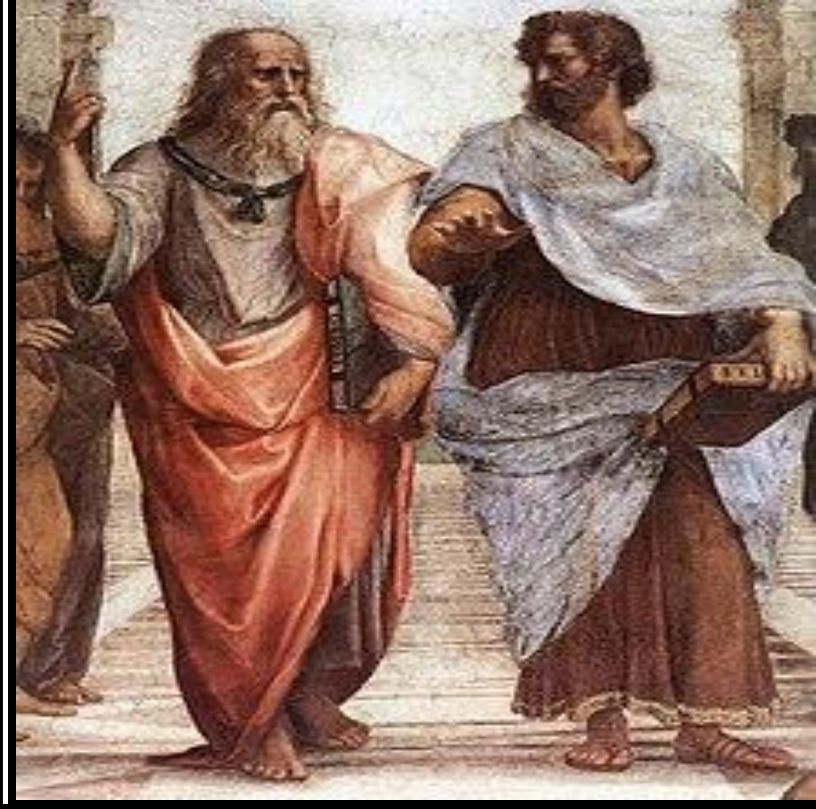


Modern Oceanography began as a field of science about 130 years ago, in the late **19th century**



Our focus today is on 'The 3Bs of life

- ❑ What are the 3Bs and how are they related to life?
- ❑ How is water related to life?
- ❑ The Ancient Greek philosophical perspectives on the meaning of life are numerous such as Platonism, Aristotelianism, Cynicism, Cyrenaicism, Socraticism, Epicureanism and Stoicism.
- ❑ They all thought about life and came out with their isms

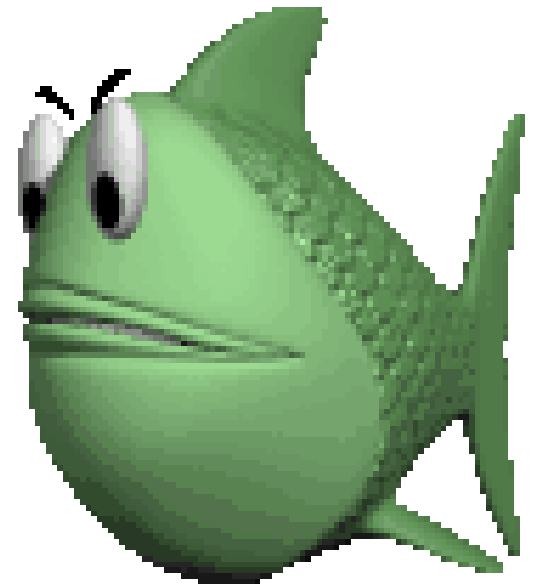


Plato and Aristotle in THE SCHOOL OF ATHENS pondering about LIFE. **Plato** - pointing heavenwards to the sky, **Aristotle** pointing to the world, certainly mixed ideas.

Until humans fully comprehend the essence and significance of living or life, it will be difficult to appreciate and respect the value of **WATER AS A LIFE GIVING RESOURCE.**



Do you know that your body requires 60% of water to survive and babies in the womb are surrounded by water (amniotic fluid) for them to live?



❑ Do you that new born babies need about 80% of water in their bodies, that is why exclusive breast feeding is made compulsory for nursing mothers as breast milk contains a lot of water (88%)?

❑ Do you know that water drops onto the earth in 6 forms: dew, mist, fog, rain, hail and snow

The magnanimity of GOD



Dew



Mist



Fog



Rain



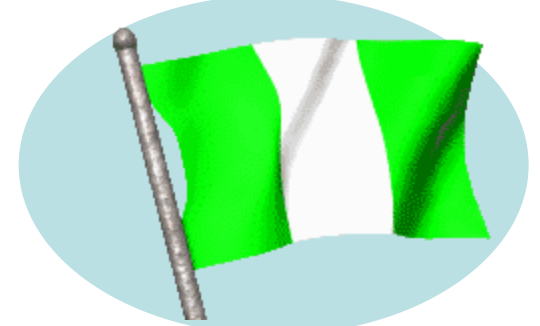
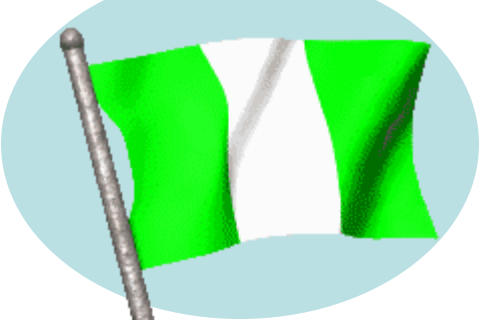
Hail



Snow

- Do you know that liquid *water* requires a small temperature range (not high temperature) and a pressurized atmosphere to remain liquid?
- Do you know that liquid *water* is not abundant in the solar system, but is a prerogative of the Earth?
- Do you know that with the drastic climate change scenario, your body requires much fluid (water) to be taken daily for you to function maximally?

- ❑ WHO's classification scheme of countries by population using improved water sources in 2015 identified Nigeria to belong to the low class, 50%.
- ❑ This non-recognition of the importance and benefits of water is reflected in the way issues concerning water and its programmes are handled by various institutions and Governments in Nigeria.

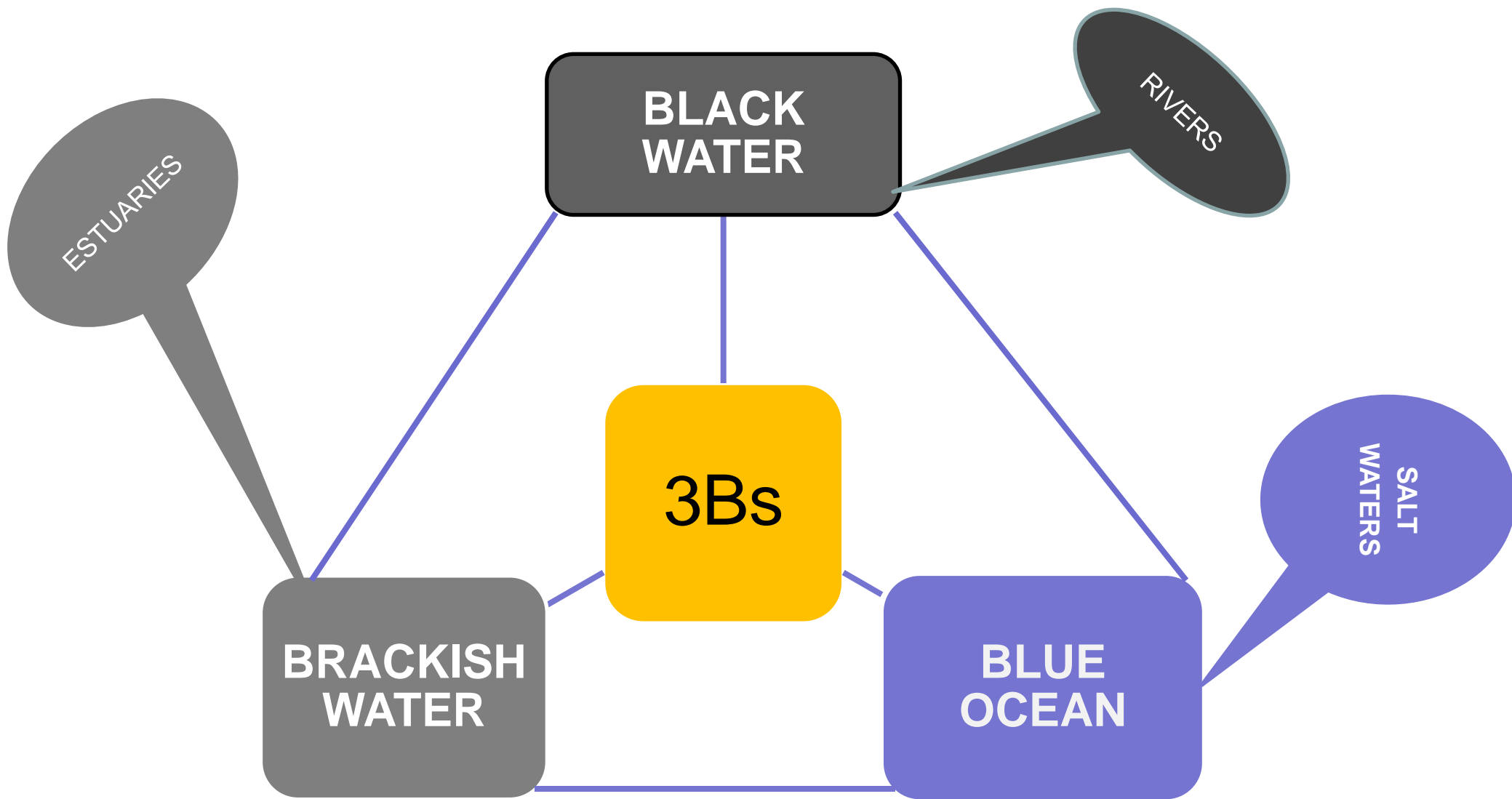


But I must commend the initiative of our previous Vice Chancellors and the present administration in the University of Calabar for the bold step in establishing the Institute of Oceanography, some 30 years ago and presently a full fledged Faculty of Oceanography, the first of its kind in sub-Saharan Africa with the mandate of teaching and research in ocean sciences.

THE 3Bs CONCEPT

- Nature, in recognition of the paramount role water must play in nourishing and lubricating the earth, has supplied water to the earth in diverse ways and forms.**
- What water does to the earth is what lubricating oils do to automobile engines**

- The 3Bs refer to the Black or fresh water (streams, rivers, underground waters),**
- Brackish or the estuarine water (estuary, deltas, lagoons) and the**
- Blue waters or open ocean or sea water.**



**Fig.1: Life's tripod balance or
The tripod of life**

Water in its tripartite form:

- Black or fresh water,**
- Brackish or the estuarine water**
- Blue water (open ocean or sea)**

constitute the 3Bs of life which is synonymous to the 3 waters of life. This concept is hereby ascribed as Life's Tripod Balance (LTB) as it is the pivot where every living thing spins

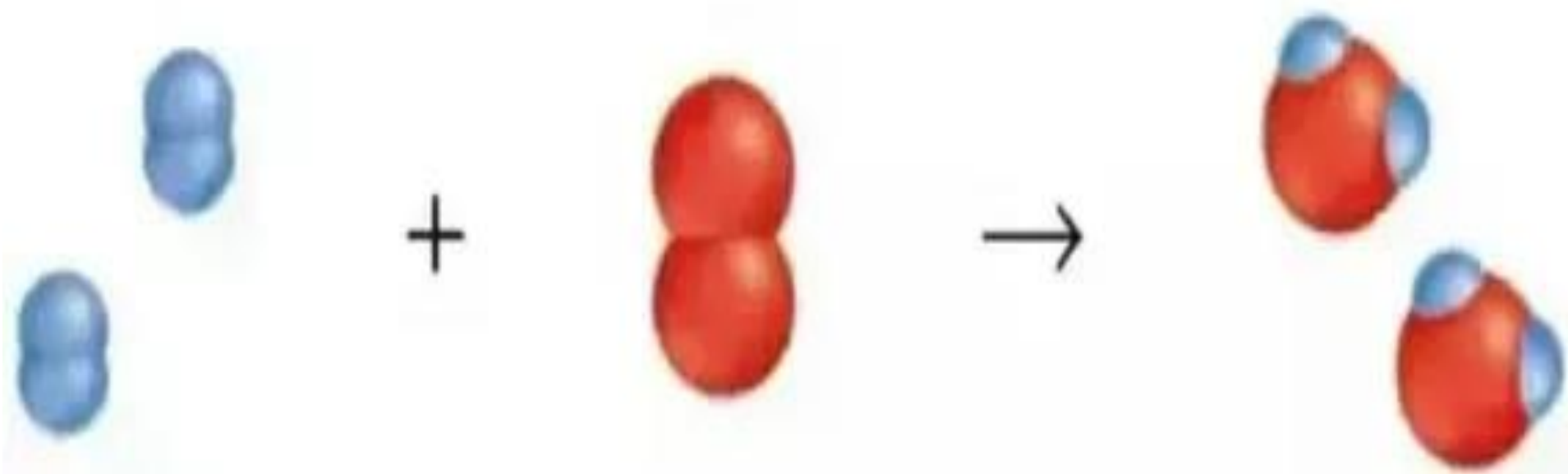
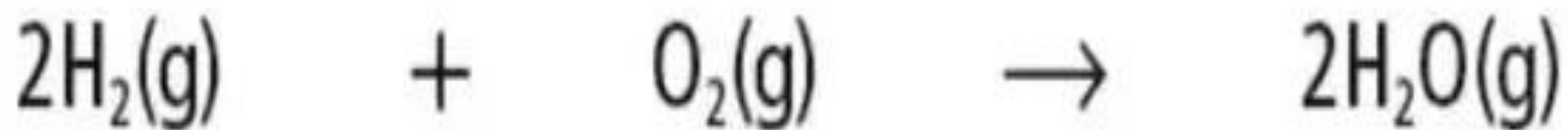
FROM CHEMISTRY TO LIFE (WATER)

- According to Richard Feynman: *all things are made of atoms – little particles that move around in perpetual motion, attracting each other when they are a little distance apart, but repelling upon being squeezed into one another.*”

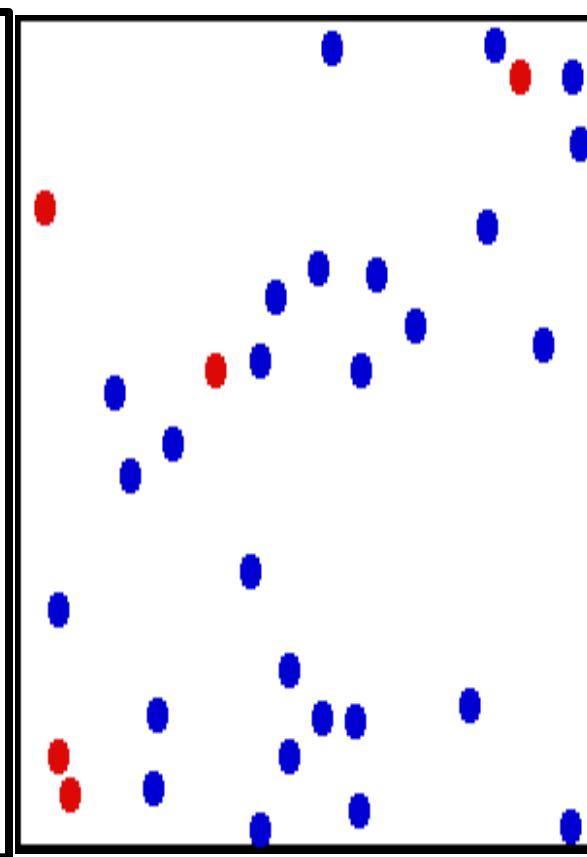
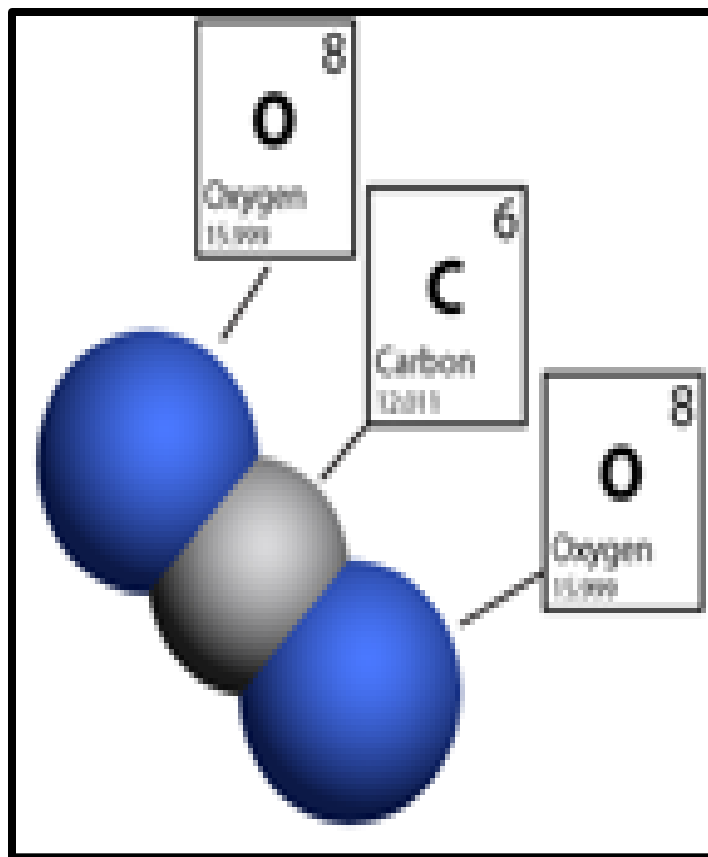
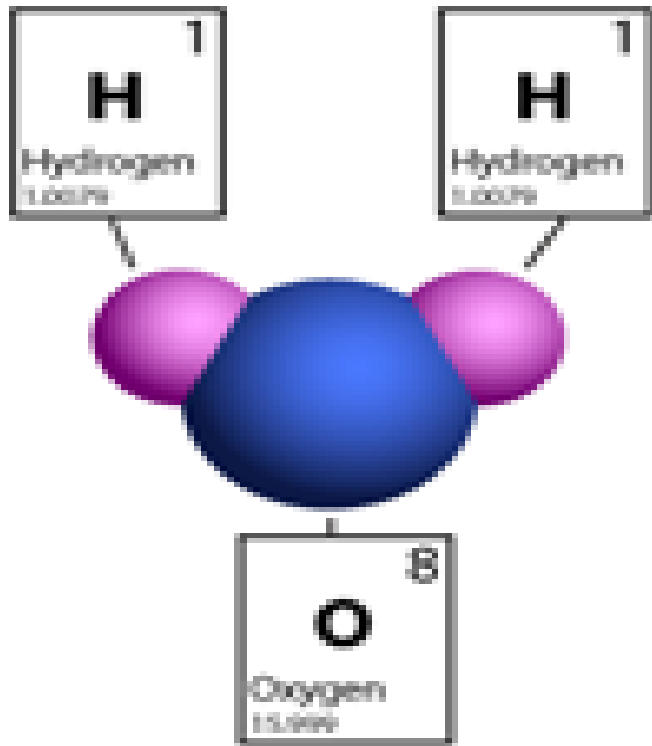
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- Oxygen (O_2) and it occupies 21% composition in AIR;
- Hydrogen (H_2) has about 0.000053 %;
- Two gases combine in a ratio of 2: 1.



Atomistic representation of the formation of water molecule



- Water exhibits an angular or V-shaped configuration*
- Carbon dioxide and other gases are linear in shape*

- Non-linear arrangement of the O and H atoms, gives water many unique molecular characteristics it possesses.**

THE WORLD OF WATER

- Hundreds of thousands of **water molecules** ($n\text{H}_2\text{O}$) associate together through a force of attraction called hydrogen bonding to form liquid water.
- **BUT THERE IS NO AMOUNT OF WATER MOLECULES FROM THE LABORATORY OR CHEMISTRY ALONE THAT COULD HAVE FORM THE OCEAN**

- ❑ Therefore, one of the first creations of God was water, because of its significance to life. WATER IS LIFE
- ❑ **THE CREATION:** ..AND DARKNESS WAS UPON THE FACE OF THE DEEP (OCEAN) ... AND THE GATHERING TOGETHER OF THE WATERS CALLED HE SEAS” ..Genesis 1:2b, 10b (KJV).

Therefore, the only programmes fully acknowledged by God, is firstly Oceanography (Genesis 1:10; and secondly Medical Sciences (Numbers 21:8-9).



World Water Resources by Types

Quantity of Water in Hydrosphere

<i>Water</i>	<i>Quantity (km³)</i>	<i>Quantity (in percentage)</i>
<i>Total Water (Pure and Saline)</i>		
Oceans	1,348,000,000	97.39
Snow caps, Icebergs, Glaciers	227,820,000	2.01
Groundwater and Soil Moisture	8,062,000	0.58
Lakes and Rivers	225,000	0.02
Atmosphere	13,000	0.001
<i>Total</i>	<i>1,384,120,000</i>	<i>100.00</i>
<i>Pure Water (2.6 % of total water)</i>		
Snow caps, Icebergs, Glaciers	27,818,246	77.23
Groundwater up to 0-0.8 km Depth	3,551,572	9.86
Groundwater up to 0.8-4 km Depth	4,448,470	12.35
Soil Moisture	61,1234	0.17
Fresh Water Lakes	126,070	0.35
Rivers	1,080	0.003
Aquatic Minerals of Earth	360	0.001
Atmosphere	14,408	0.003
Life	1,081	100.00
<i>Total</i>	<i>36,020,000</i>	

□ A look at **WORLD WATER RESOURCES** reveal that more than a quarter of the world's population (about 2,1 billion people) lack access to clean water (WHO, 2017).

□ **Africa has 4000 cubic km/ year of river runoff (about 9.5%) of the total river runoff in the world.**



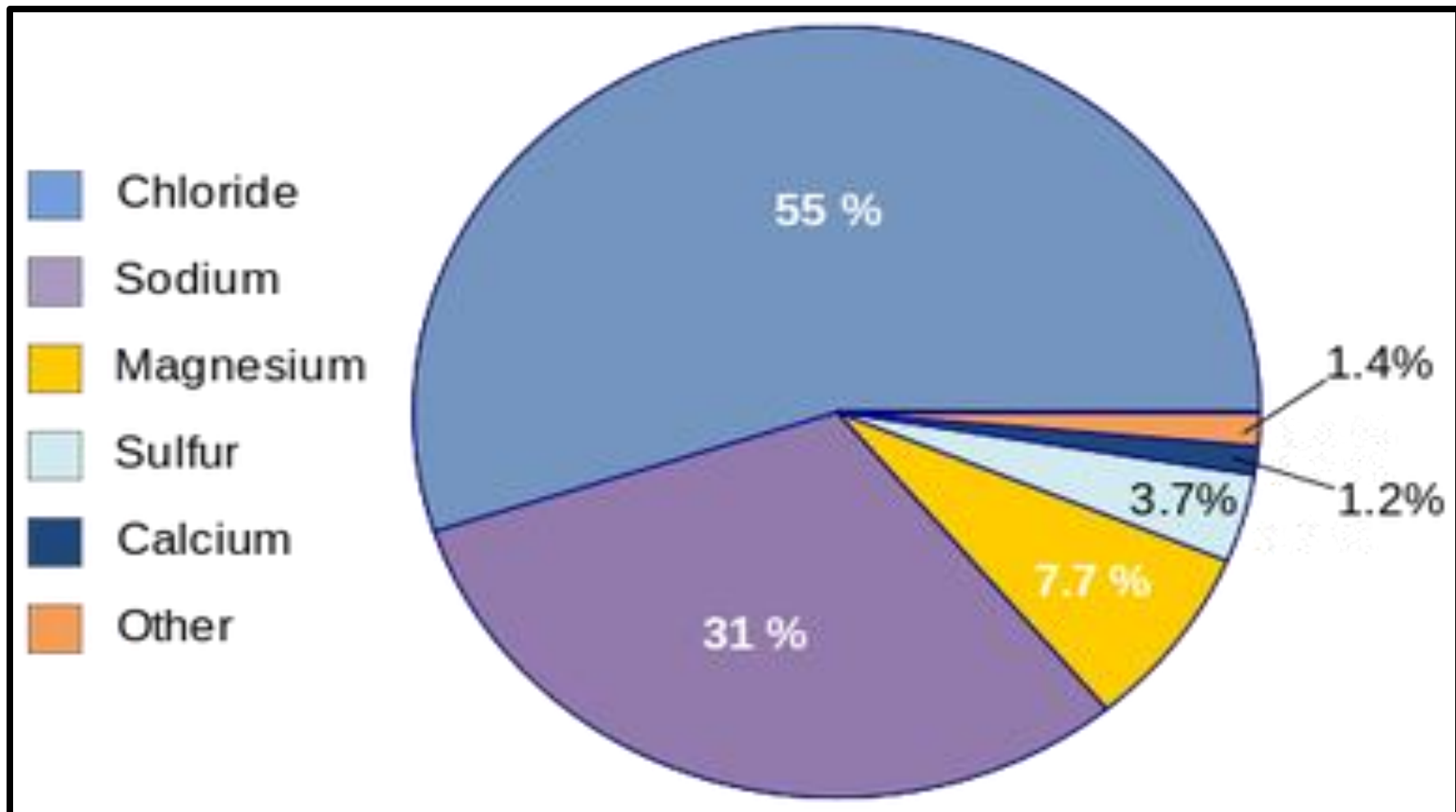
❑ But HOW WELL IS IT MANAGED BY AFRICANS?

❑ Nigeria is number 3 on the list of the countries with worst drinking water services.

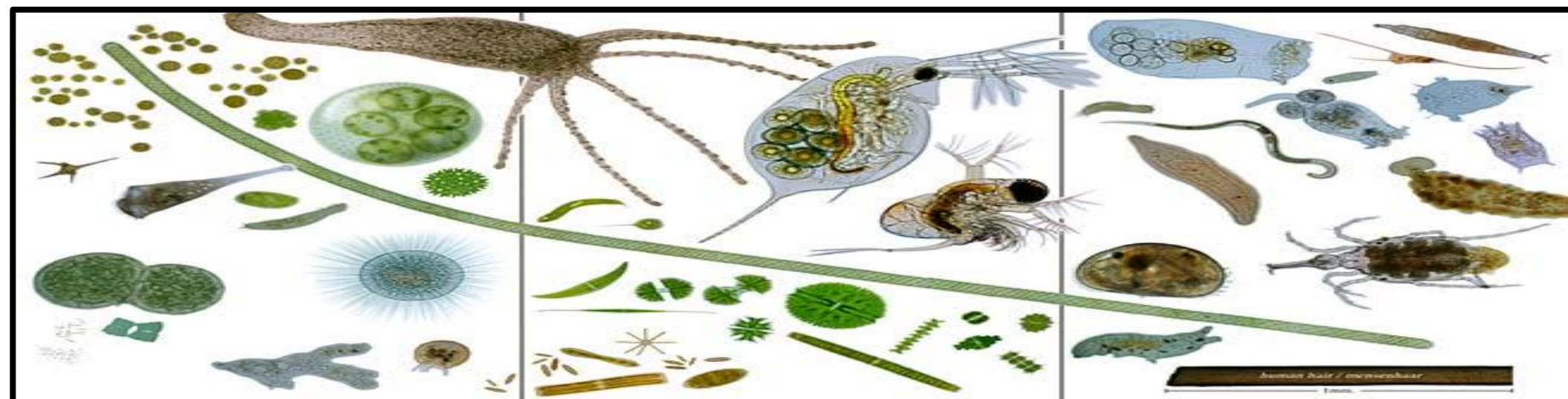


FIRST B OF LIFE: BLACK OR FRESH WATER SYSTEMS

□ 3 types: **Black/grey/ white** waters eg. River Niger, Great Kwa river, Agbokim water falls, Obudu Cattle ranch water etc. Fresh waters can be lotic (flowing) and lentic (still water).



Fresh water Fish/ Microbial Population



SECOND B OF LIFE: BRACKISH OR THE ESTUARINE SYSTEMS

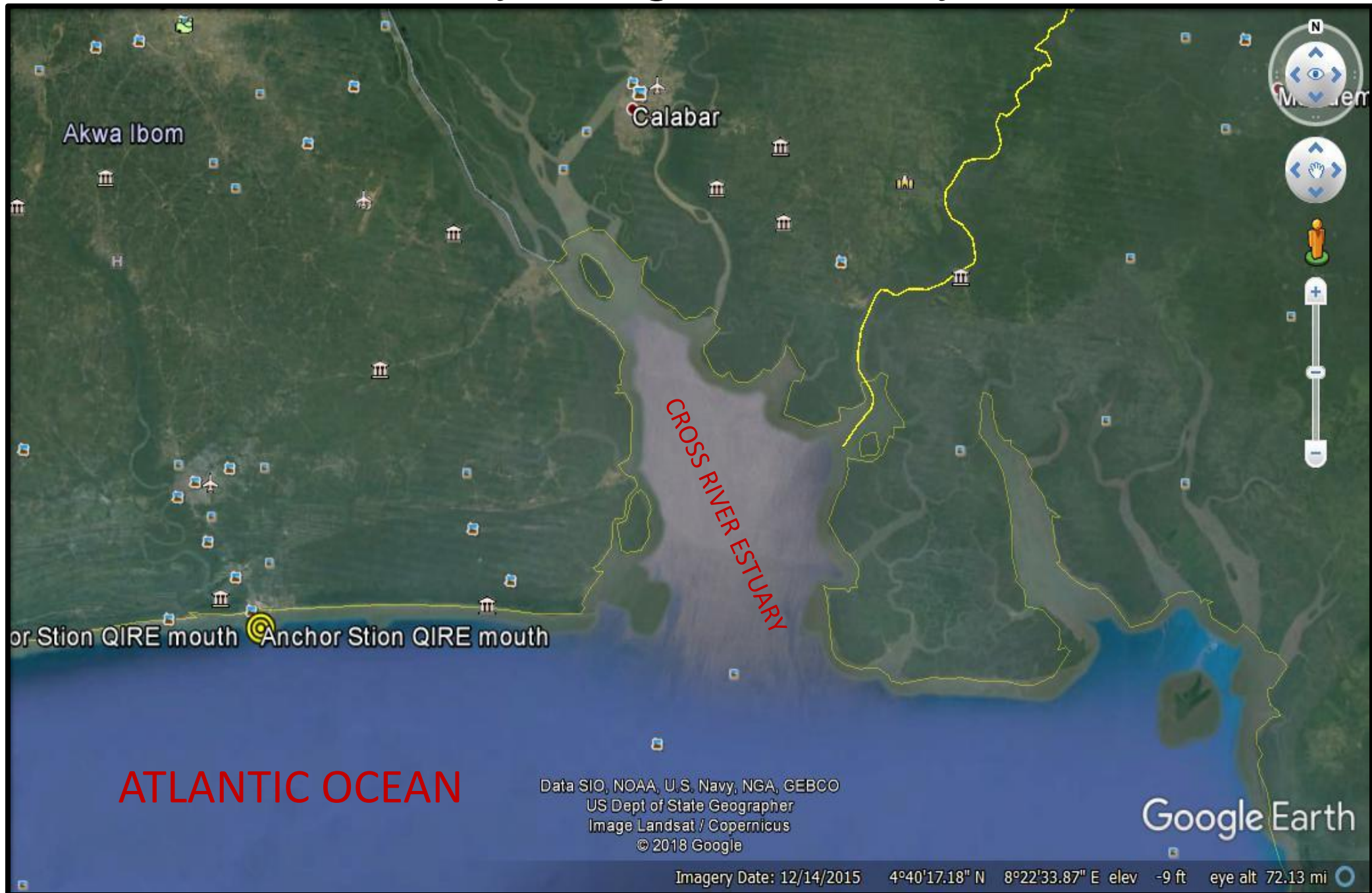
□ Brackish waters represent estuaries, deltas

□ eg In Africa, we have the Nile delta

- Niger delta,
- Volta estuary,
- Congo estuary,
- Lagos lagoon,
- Cross river estuary etc.

Estuary contains about 0.5 to 30 gms of salt per liter.

Cross river estuary , largest estuary in W. Africa



Ecological Role of an Estuary

Estuaries are naturally productive areas and in some countries they serve as “state nature preserve”

In Nigeria, the NCF in partnership with the AKS government have set aside the Stubb Creek Forest Reserve of Qua Iboe river estuary;



Why should the government bother to preserve an estuary :

- ❑ Estuaries serve as breeding grounds for many important animals
- ❑ Estuaries are “endangered ecosystems.”
- ❑ Estuaries serve as buffer zones to filter pollutantsetc

THIRD B OF LIFE: THE BLUE WATERS OR MARINE ECOSYSTEM

As one approaches a typical coastline, you are being greeted by the sound of breaking WAVES wa-a-a-a-ah, wa-a-a-a-ah, wa-a-a-a-ah, wa-a-a-a-ah.



- ❑ There is one Ocean, one world.
- ❑ Oceanographers recognize the existence of five major oceans: the Pacific, Atlantic, Indian, Arctic, and Southern oceans



With average salt content of 35 grams of salt per litre, the Ocean serves as a

- ❑ means of recreation and sporting events
- ❑ a source of sea food to humans i.e. fisheries resources
- ❑ Source for Sand extraction, solid mineral extraction

- ❑ Coastal ocean serves as sea ports, jetties, military bases, Naval and immigration posts, dockyards
- ❑ Coastal ocean serves as a dumping ground for homes and coastal industries , do we agree?

WHY NOT SAVE THE OCEANS TO SERVE YOU

DISTINCT PECULIARITIES OF WATER

Water as potent Medicine

- ❑ Water is a therapy for healthy living. Water is a part of our bodies, and we simply cannot live without it.
- ❑ The Japanese Medical Society has reported that water therapy is a **100% cure** for disease like bronchitis, tuberculosis, arthritis, epilepsy, meningitis, diarrhea, sore throat and many other ailments.

Can Water Wash Away Disease?

YES

NAAMAN story in the Bible (**2 Kings 5: 10, KJV**).

Not only in the Biblical times.....

Today, our medical practitioners (doctors and nurses) will give you an infusion of dextrose saline and/or normal saline and you are reinvigorated/ revived

MAGIC POWERS (MIRACULOUS POWER) OF WATER

- ❑ Drinking water early in the morning immediately upon waking up has amazing therapeutic effects.
- ❑ This therapy began with the Sanskrit in India called ***Usha Paana Chikitsa*** meaning “early morning water treatment.”

❑ In a separate development, Dr. Batmanghelidj of Iran, used the only medicine available to him - *which was water* - to successfully treat 3,000 fellow prisoners who were suffering from stress-induced peptic ulcers.



Water as a therapy has many health benefits which include

- body rehydration,
- speeds up brain processing power,
- clears the colon,
- boosts metabolism,
- refreshes the skin,
- minimizes headache occurrence,
- stimulates your appetite for breakfast,
- stimulates bowel movement,
- rids the body of wastes and
- improves body immunity against diseases.

Water as potent Medicine

Mr. Vice Chancellor, Sir, clean water has all these magnificent benefits, I strongly advocate that we should **DRINK AND PROTECT** it rather than contaminate and destroy it.

There is a song, our advocacy song that goes like this:

Drink! Drink!! Drink !!! Drink!!!!
If you wanna LIVE

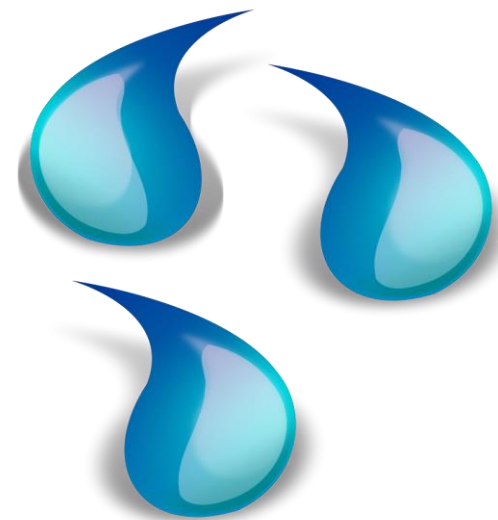
Drink! Drink!! Drink !!! Drink!!!!
If you wanna GROW

Drink ! Drink !! Drink !!! Drink!!!!
If you wanna SUR-VI-I-I-I-I-IVE
DRINK !!!!! ---2X

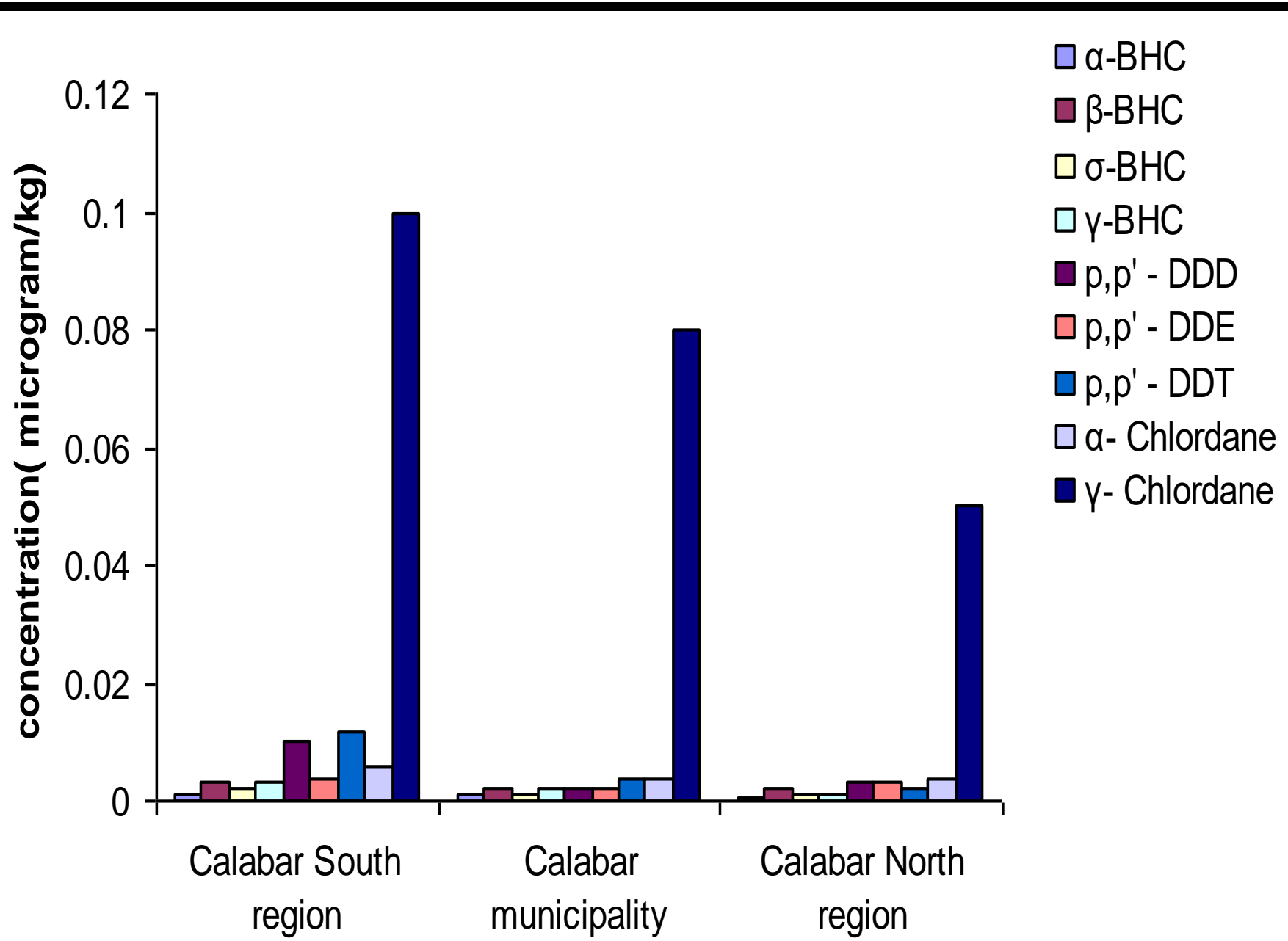
OUR MODEST RESEARCH EFFORTS AND CONTRIBUTIONS TO SCIENCE

- **Water Quality and Health:** Water clear and clean as it appears to the eyes, may not be PURE after all.
- Every bottle of water contains hundreds of dissolved chemical substances in concentrations that should be permissible for human consumption. We have analyzed and compared the water qualities of Eva, Swan, Pime, UNICAL water, Global, Tropical, Nestle, Blue Rose etc. These waters are of good quality.

- But regrettably, most bottle waters in Nigeria do not display their quality status on the bottle just like they display NAFDAC numbers, as it gives the consumer the assurance and confidence that drinking the water is **SAFE**.



PESTICIDES AND NITRATES IN WATER - DANGER



Water Quality in Fish Pond

□ Water quality should be favourable for pond fish production. Our work on fish pond water quality indicates that fish farmers do not pay attention to the quality of water in their ponds until fishes begin to die.

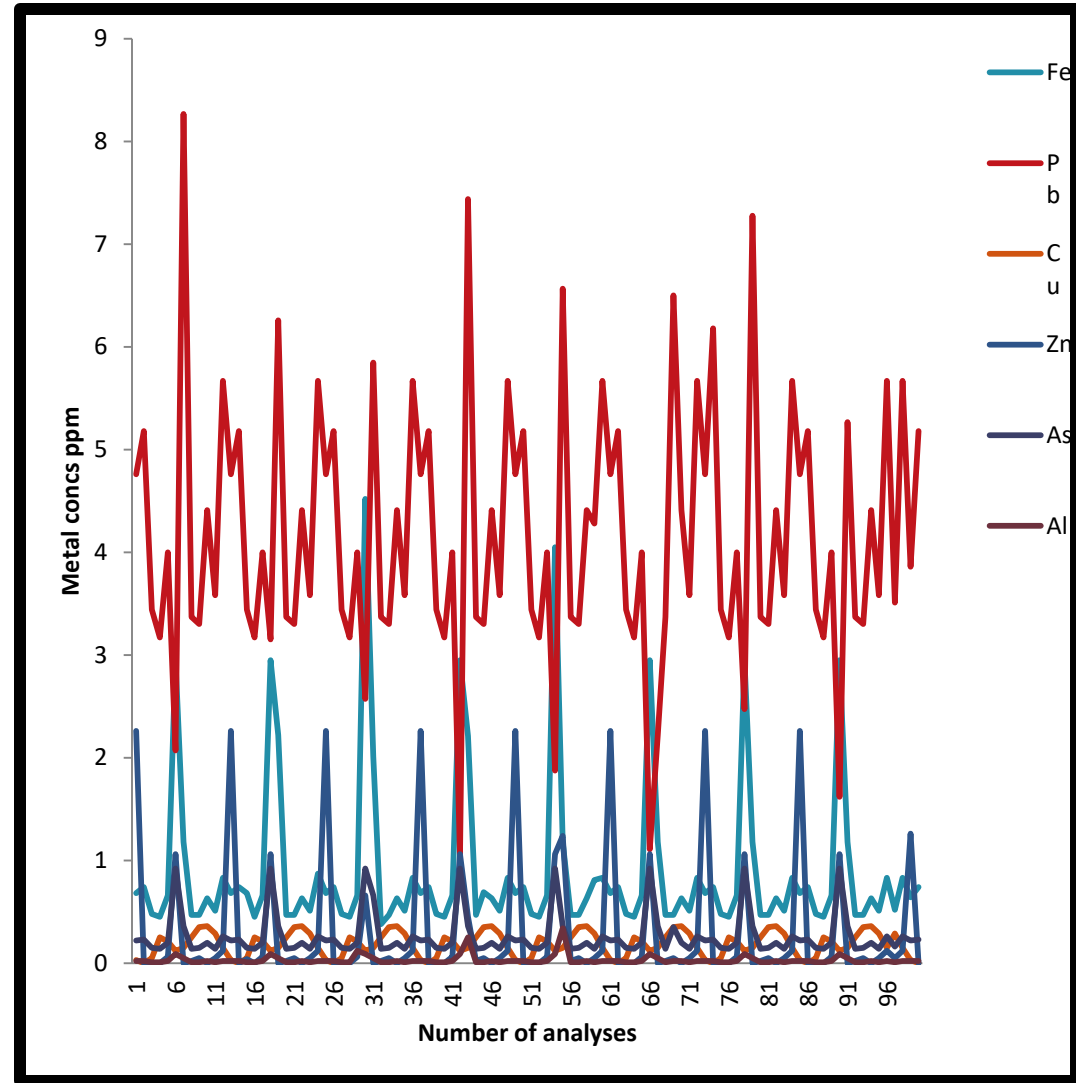
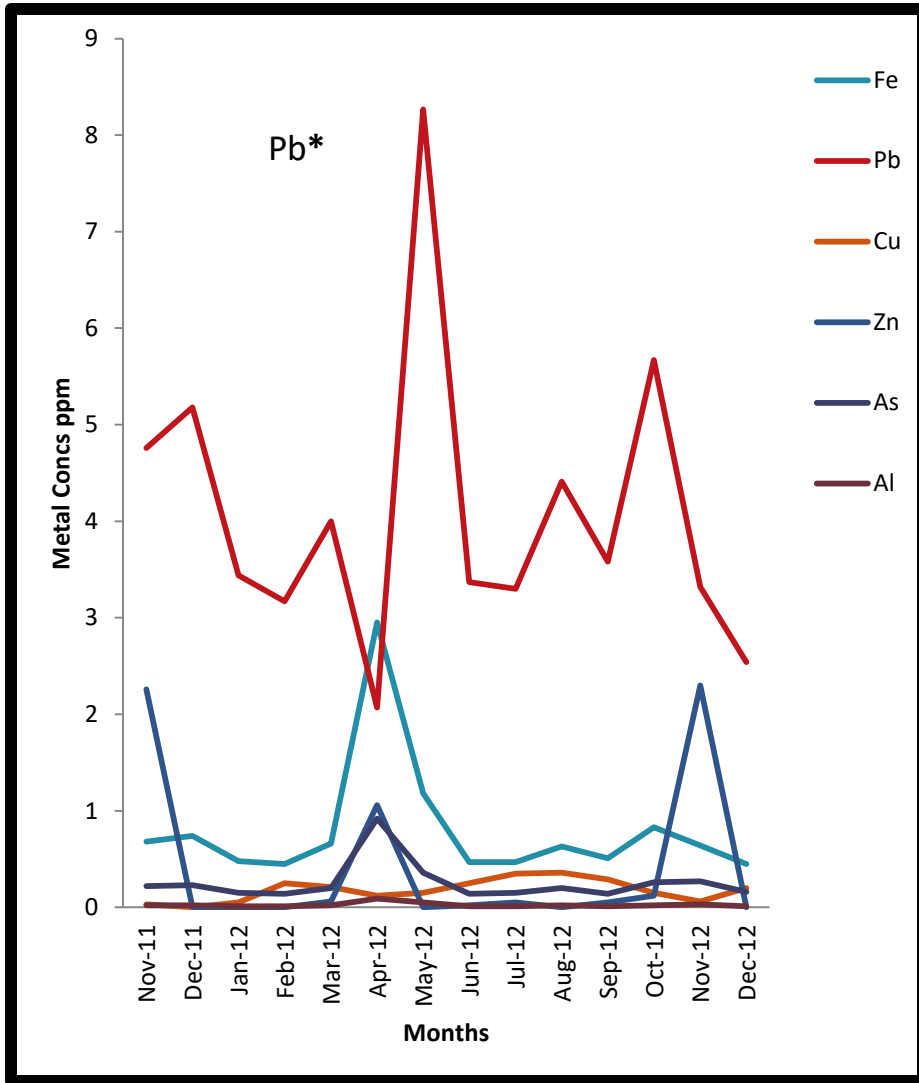


❑ For a healthy fish, you need good quality water devoid of contaminants like ammonia and nitrite, these are poisons to fish.

❑ Water Quality Ratios (WQR) are determinant factors of fish pond with good water quality.

Water Quality Parameters	Calabar river (mg/l)	University of Calabar Fish Farm (mg/l)
Na	18	20
Cl	23	28
SO ₄	48	42
Ca	35	37
Mg	110	120
HCO ₃	109	116
pH	6.6	6.8

Water Quality of Ibeno Atlantic Coastline



Water Quality of Ibeno coastline shows Pb as the most abundant heavy metal in water and sediment of the marine environment.

Pollution of water, sediments and fish by hydrocarbons and heavy metals

- On January, 12 1998, a 24-inch crude oil pipeline belonging to one of the oil multinationals ruptured and released over 40,000 bbl of Nigerian crude oil into the sea.
- Benthic communities showed no significant population changes, but shell fishes caught in the area one week after the spill recorded high accumulation of petroleum hydrocarbons in their tissues.

Heavy metals and hydrocarbons in fishes and shell fishes from Cross river

Fish Species	Cd	Pb	Zn	Fe	Mn	Cu	THC
<i>C. Nigrodigitatus</i>	0.8 ±1.8	3.0±4.1	30.8± 11.2	131± 75.2	17.3± 6.7	1.8± 2.7	17.3± 2.4
<i>Tympanotonus</i>	ND	ND	63.1± 16.1	243± 23.8	18.5±2.1	1.0± 1.7	12.17± 13.5
<i>E. Fimbriata</i>	0.55± 0.78	3.8±5.3	16.9± 3.6	99± 63.6	12.0±4,2	ND	42.2±32
<i>P. Elongatus</i>	0.18± 0,3	10±8.7	11.3±3.0	161± 86.7	10.5±6.4	3.0±5.2	39.8±27.1
<i>O. Niloticus</i>	0.55± 0.8	3.8±5.3	16.4±4.2	91.5± 31.8	ND	ND	55.1±9.4
<i>Portonus sp</i>	0.18± 0.3	7.5±0	35.6±3.3	109.5 ±82.7	53.0±22. 9	0.18±0. 3	39.4±37.7
WHO STD (1998)	1.0	0.5	50	300	100	0.02	25*

Marine Pollution studies of Nigerian Beaches by Tar balls

- ❑ Our studies have established that tar balls or solid oil residues are ubiquitous along the Nigerian coastline.
- ❑ Tar balls or beach tar are indicators of ocean pollution by oil.



- ❑ The highest concentration of tar ($5.46\text{gm}^{-2}\text{ month}^{-1}$) recorded so far was observed by us in June 1989.
- ❑ Tar balls contain heavy metals Pb, V, Ni, Fe, Mn and Cu in different amounts.
- ❑ V/Ni and V/Ni + V ratios indicates that the beach tars are of foreign origin washed ashore by waves and tides

Other studies on Water pollution and Toxicology

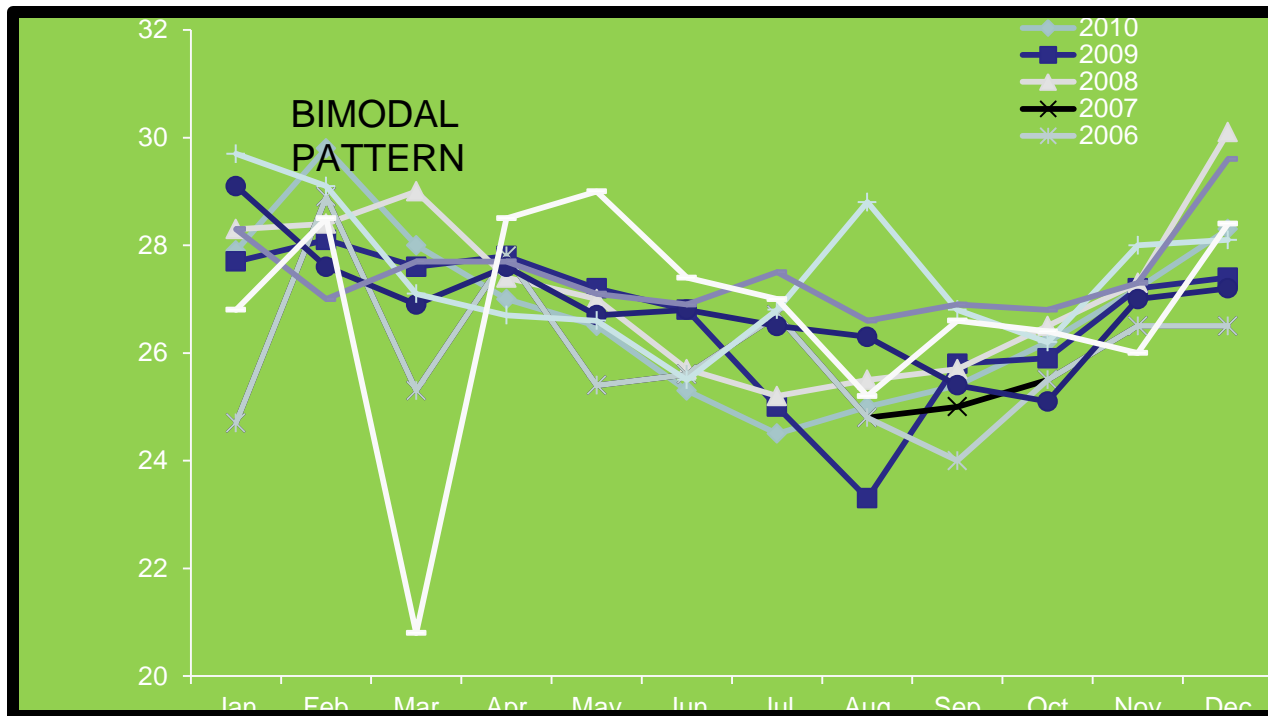
Other studies carried out by me and colleagues include:

- Water pollution studies of the Niger Delta region
- Toxicity of Crude oil to Nigerian fresh water fishes
- Toxicity of commercial bleach to Nigerian fresh water fishes
- Toxicity of rubber effluents to Nigerian fresh water fish species
- Toxicity of crude oil to Nigerian vegetables
- Toxicity of a tropical weed *Justicia extensa* to fresh water fish species

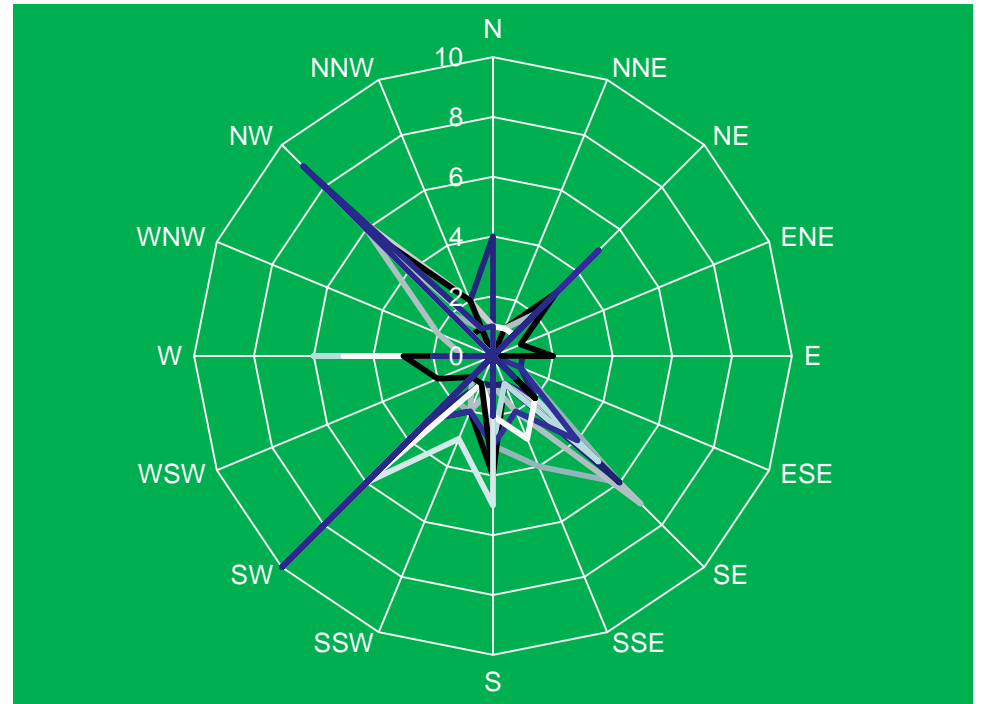
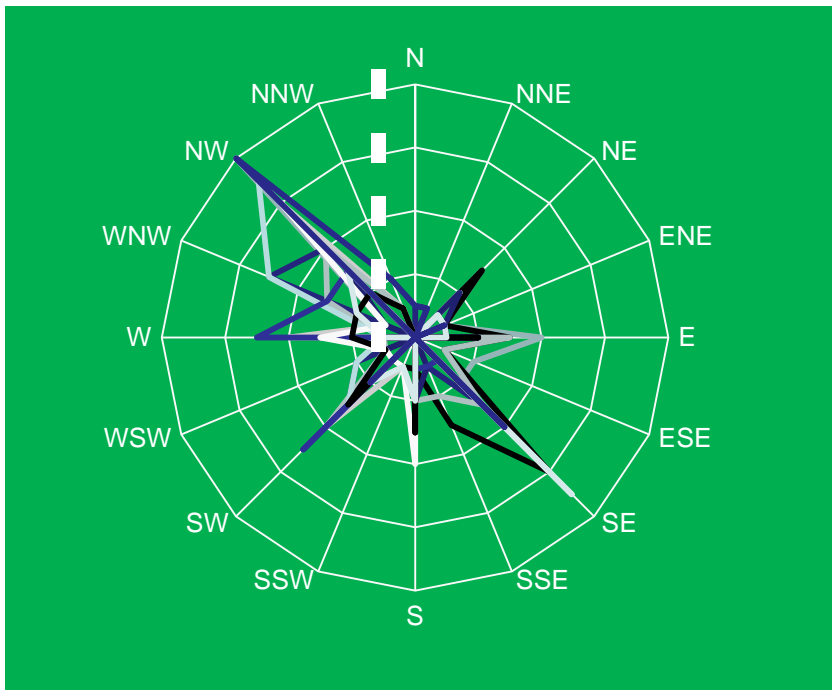
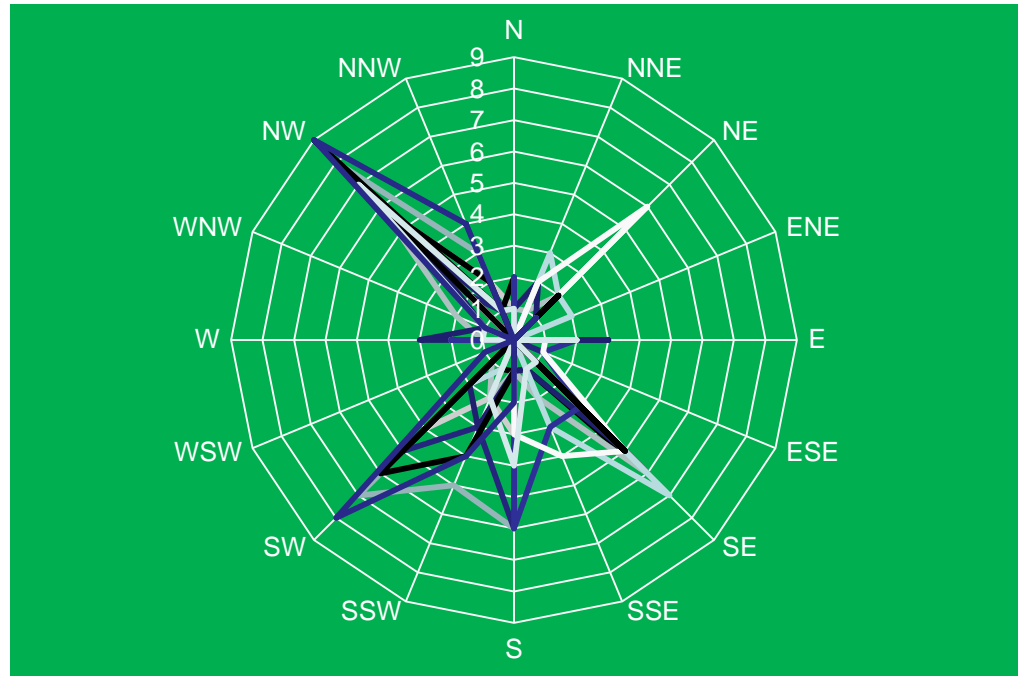
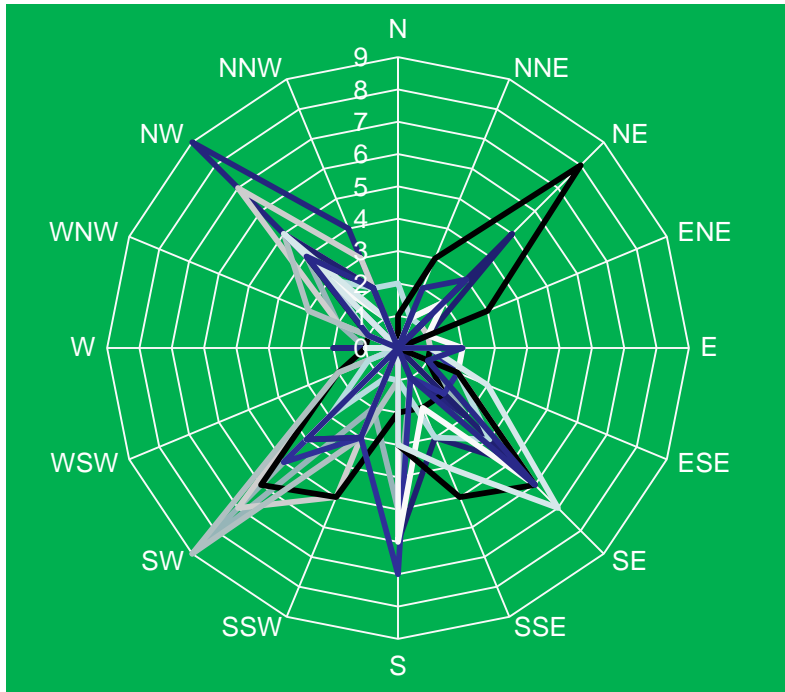


OUR CONTRIBUTION TO CLIMATE CHANGE

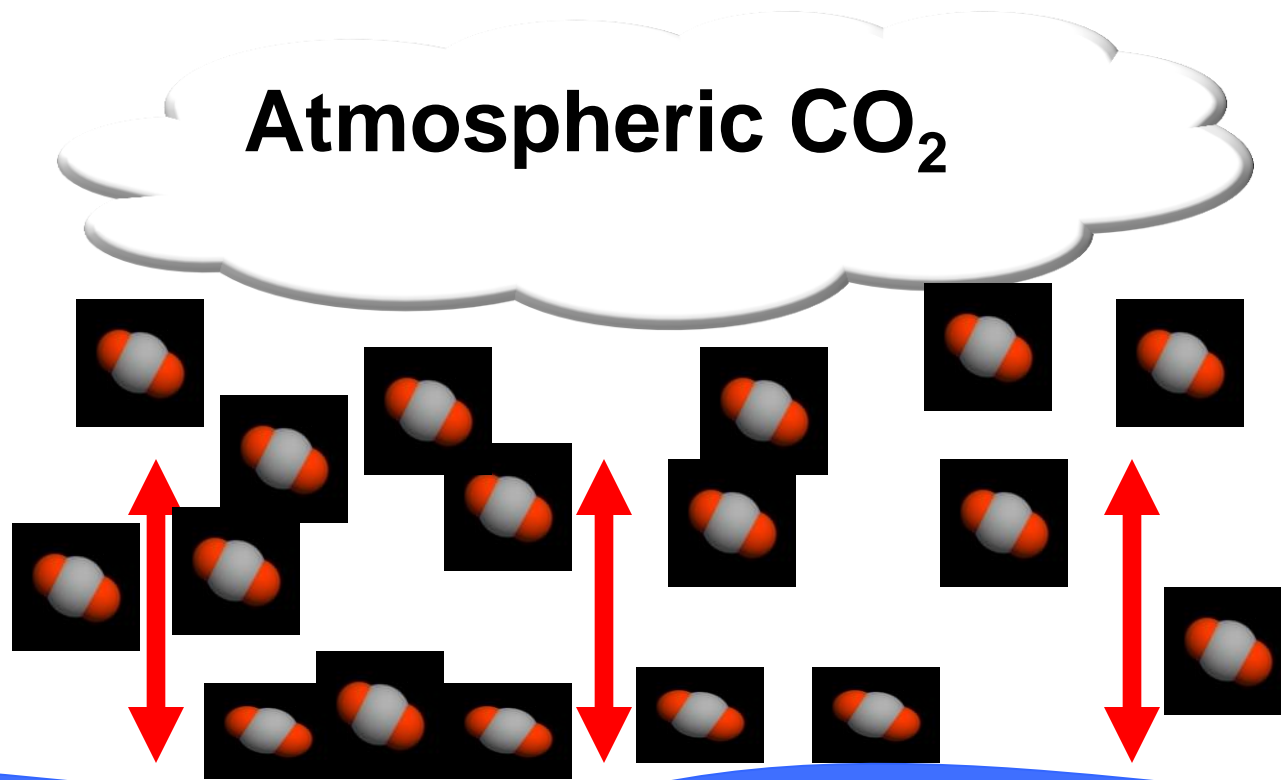
My work has shown that there is interannual and interseasonal fluctuations in temperature, humidity and rainfall patterns in Calabar, Southeast, Nigeria. Rainfall exhibited a unimodal configuration, while temperature a bimodal pattern during the period. The study also reported of the disappearance of periodic August break due to climate influences.



WIND PATTERNS IN CALABAR



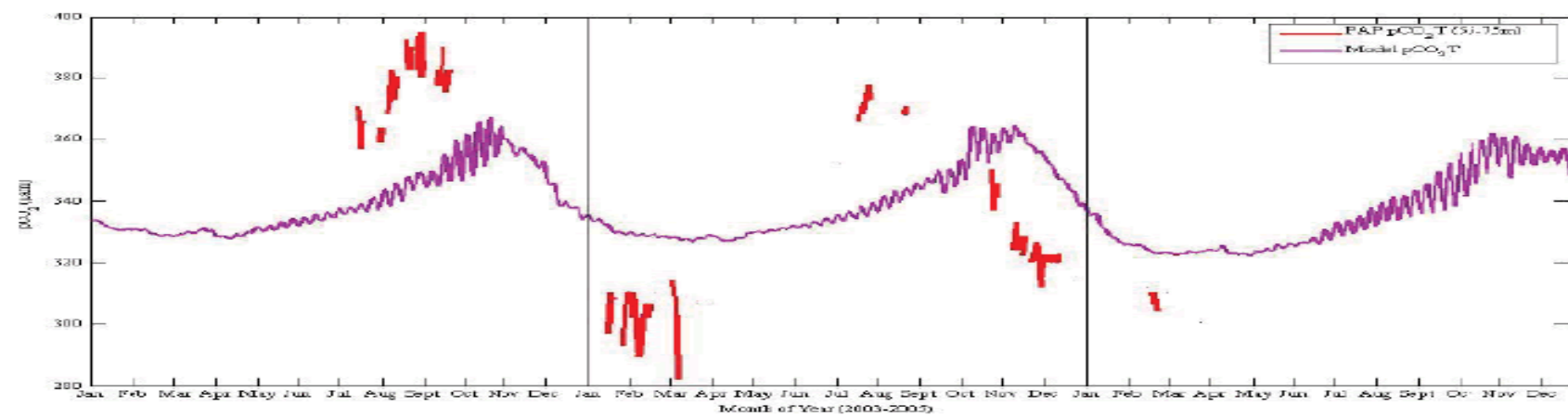
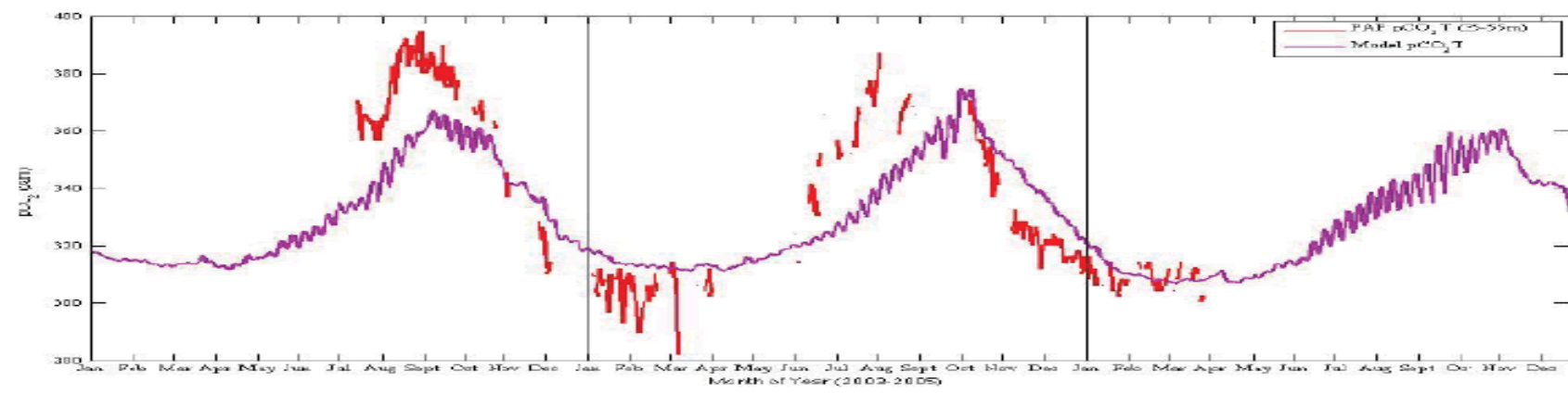
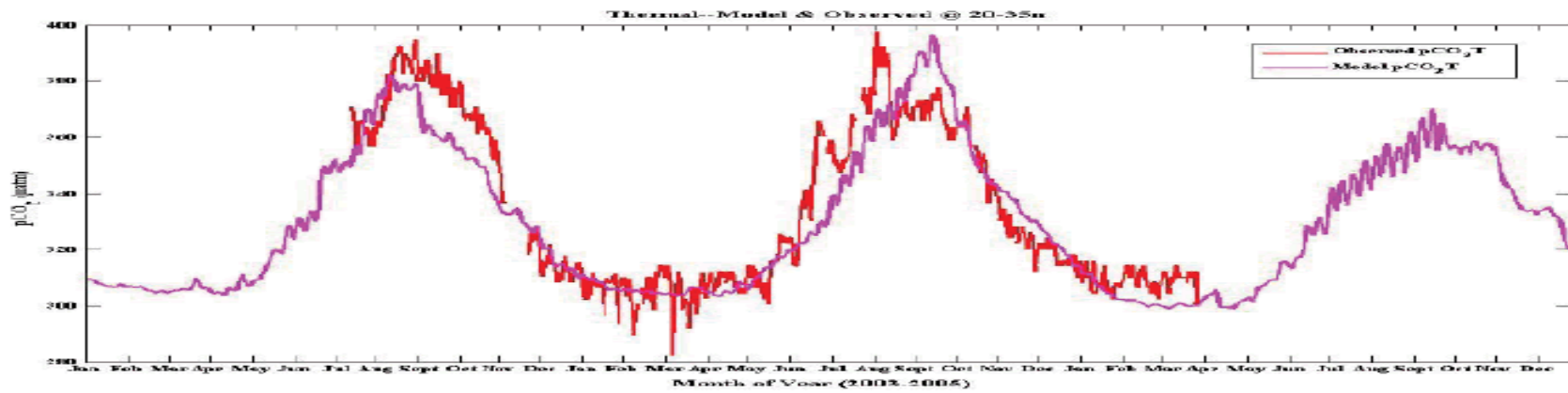
CO₂ fluxes in the biogeochemical process of the global carbon cycle.

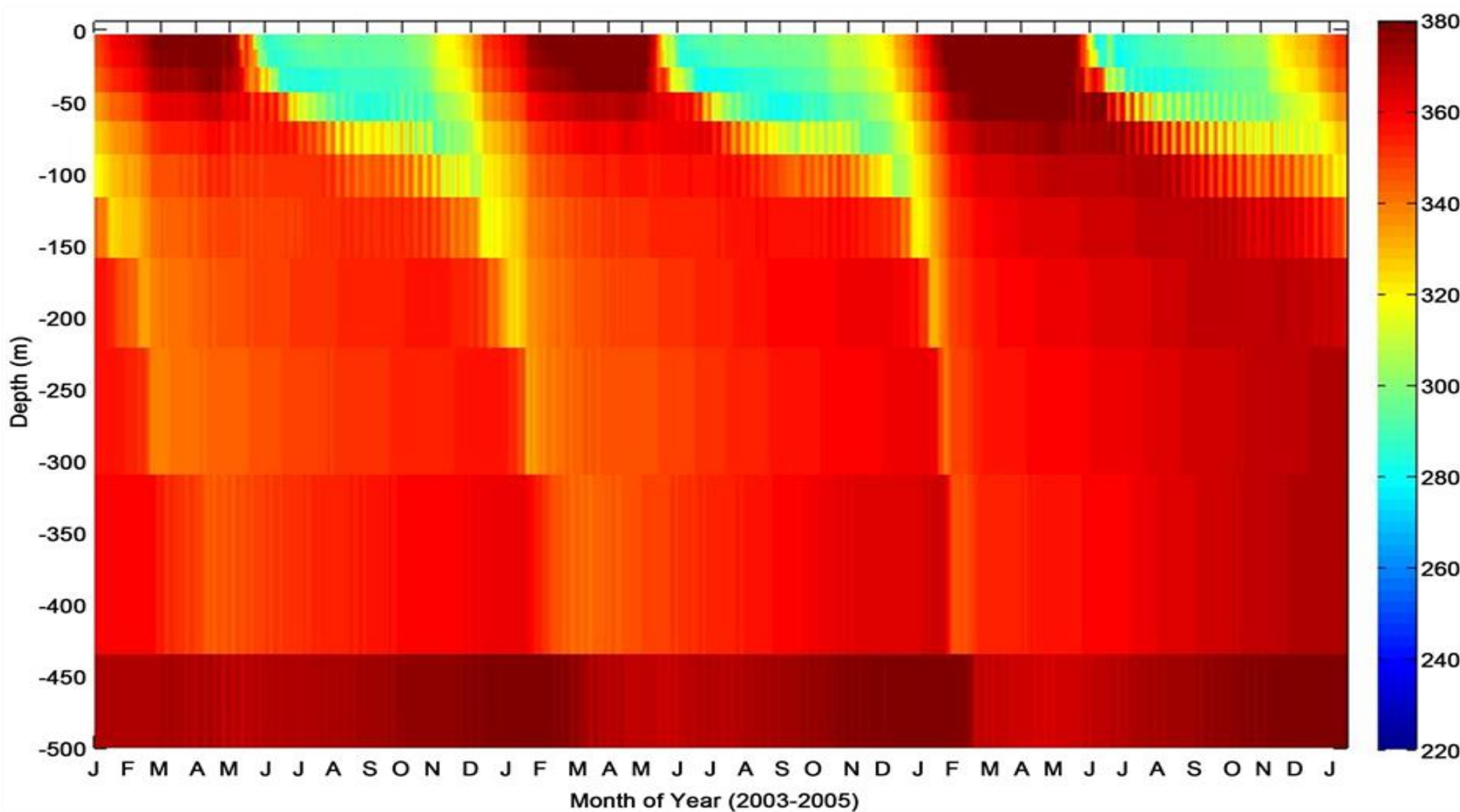


Ocean Dissolved Inorganic Carbon (DIC)

Climate change and the oceanic carbon cycle

- ❑ Our research have unraveled the variability's, influences and consequences of carbon cycle biogeochemistry in the North Atlantic ocean.
- ❑ Numerical models have provided an understanding of the spatiotemporal CO₂ trends, and the characterization of thermal (pCO₂-T) and non-thermal (pCO₂-nonT) components of pCO₂ and air-sea CO₂ flux variability in the Atlantic ocean.





Mixed layer depth profile of $p\text{CO}_2$ during period of consecutive deployments at the PAP site, N. Atlantic Ocean (Benson, Asuquo *et al.*, 2015).

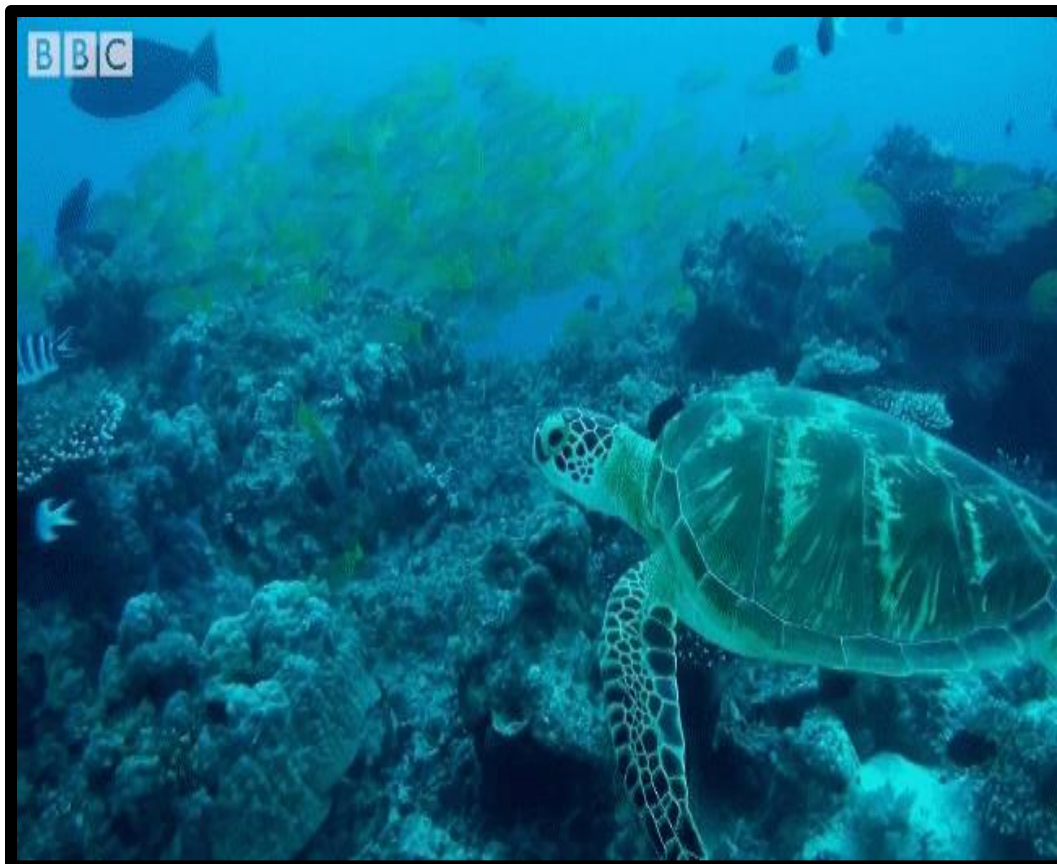
AN ECOLOGICAL SCENARIO MISUNDERSTOOD

Nature in Simplicity

- ❑ A conversation ensued between humanist and a young Christian girl.



God in Simplicity, and he always uses simple things like **WATER** to achieve great things that **SUSTAIN LIFE**

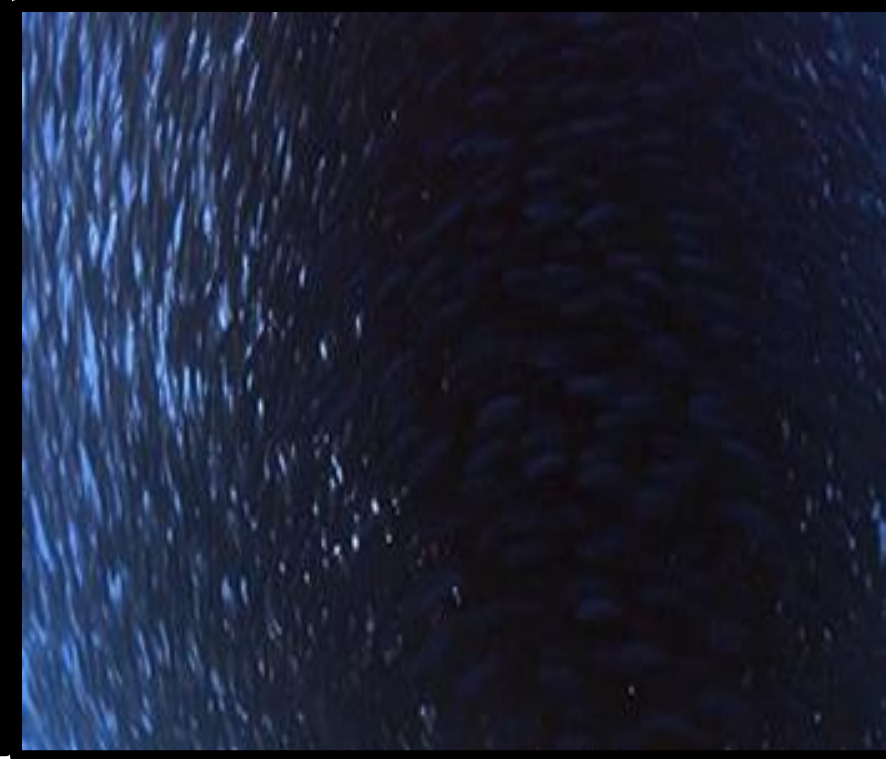


□ Nature in its own wisdom, strategically positioned the 3 Bs: Black, Brackish and the Blue waters to SUSTAIN LIFE,

BE IT HUMAN LIFE, AQUATIC LIFE OR TERRESTRIAL LIFE.

□ But man beholding the enormous availability of water, its scope, the breadth and length, has MISCONSTRUED water to be a WASTE RECEPTACLE AND A DUMPING GROUND FOR UNWANTED MATERIALS

- ❑ Why did God (nature) give to mankind the 3Bs (freshwater, brackish water and the ocean)?
- ❑ God could have decided to make it only One B (only fresh water or only estuary or only the blue ocean).



❑ If it was only fresh water where would the sea food (sharks) and common salt come from? If it was only sea water (where would the drinking water come from?)

❑ But God made it very beautiful, and placed the 3Bs in their places to fulfill the purpose of LIFE SUSTAINABILITY

Assimilative Capacity of Natural Waters

- ❑ The Assimilative Capacity (also known as the receiving, absorptive or environmental Capacity) is defined as ability of the environment to accommodate a particular activity or rate of an activity, such as the discharge of contaminants, without unacceptable impact or effect.
- ❑ My several researches have revealed that while many substances are indiscriminately dumped into water ways and the oceans, some dissolve but many others float because water cannot assimilate, dissolve, break, consume, fragment, exterminate, disintegrate, dilute, or biodegrade them.

The Concept of Marine Pollution

Water has its carrying capacity or holding capacity or climax, and when the holding capacity is reached, water becomes polluted due to the high concentrations of the dumped or added materials.



The state of the worlds' ocean

- ❑ United Nations Environment Programme (UNEP) observed the state of the ocean in 1989, and I quote ‘*man's fingerprint is found everywhere in the oceans. Chemical contamination and litter can be observed from the poles to the tropics and from beaches to abyssal depths* (GESAMP 1990).
- ❑ This was in 1989, what do we think is the state of the ocean today after 29 years.

DEFINITION OF MARINE POLLUTION

- Marine Pollution simply refers to:
"The introduction by man, directly or indirectly, of substances or energy into the marine environment (including estuaries) which results in such deleterious effects as harm to living resources, hazards to human health, hindrance to marine activities including fishing, impairment of quality for use of sea water and reduction of amenities".**

□ The center of the problem is man ... introduction by man into the marine environment, substances that are toxic and harmful, because they believe the ocean will absorb them. How wrong humans are, a misconception of the nature of water... that is the ecological scenario misunderstood.

HEALTH CHALLENGES OF MARINE POLLUTION

- ❑ Alteration in the water quality of coastal ocean
- ❑ Toxicity, death and destruction or complete extermination of vulnerable species such as ocean microbial communities, fries and juveniles of fish
- ❑ Litters on beaches and reduction in recreational and tourism values of beaches
- ❑ Leads to increased pH of ocean waters
- ❑ Influences the global climate change
- ❑ Loss of nations' per capital income

THE WAY FORWARD

Every production process generates waste be it at home or industry.

Steps to the RESTORATION OF WATER ECOLOGY should include:

- Institution of efficient waste collection systems by national governments.**
- Implementation of effective waste treatment technology and alternative means of waste disposal eg Eng land fills**

- Federal and State Governments should be willing to pay the price of towing the path of clean technologies and low carbon emission systems**
- Federal Environmental Protection Agencies must ensure that no price or effort is judged to be too high, and that a factory cannot be built, except it has a well articulate WASTE MANAGEMENT PLAN.**

FUTURE RESEARCH AND WORKPLAN

- In recent times, ocean gliders or autonomous underwater vehicles (AUVs) have been developed that could monitor the ocean parameters with relative ease and comfort.**
- An ocean glider is an autonomous, unmanned underwater vehicle used for ocean science research.**



- ❑ Gliders are often equipped with a wide variety of sensors to monitor temperature, salinity, currents, hydrocarbons, heavy metals and other ocean conditions.**
- ❑ This technology is presently used in South Africa, North and South America, Uk, Asian countries and in Australia.**



Prof. Asuquo (centre) with other colleagues during the 7th EGO conference on the use of autonomous ocean gliders a Southampton, UK.

In November 2017, I was supported by the University of Calabar to participate in the 8th Glider School Training on Ocean Gliders Technology at Oceanic Platform of the Canary Islands (PLOCAN), Spain from 6 - 11th November 2017. This workshop laid the foundation for the University of Calabar to join world oceanographic institutions that are known to be using ocean gliders for ocean monitoring and assessment. I deployed a Slocum glider at the Canary Platform during the workshop, and was recognized as the First Nigerian Oceanography to deploy the ocean glider.

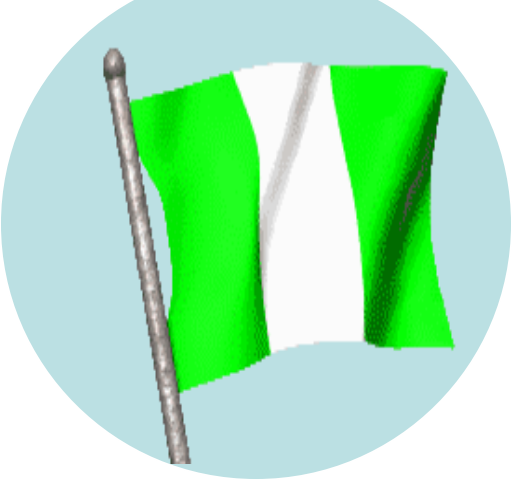
[Teledyne Webb Research](#) is at [Plataforma Oceánica de Canarias](#).

[10 November 2017](#), [Telde, Spain](#)

Francis Asuquo, the first Nigerian to attend [PLOCAN](#)'s Glider school, deploys the Slocum G2 Silbo as part of today's activities in the harbor



APPRECIATION



THANK YOU

