Report on COMSATS' International Thematic Research Group on Mathematical Modelling (January-December 2017)

Prof. Benjamin O. Oyelami
Team Leader of the ITRG, National Mathematical Centre, Abuja, Nigeria

Introduction

The COMSATS' International Thematic Research Group (ITRG) on 'Mathematical Modelling' is domiciled in the National Mathematical Centre (NMC) Abuja, Nigeria. The group members are working on joint research project entitled: Mathematical modelling and Simulation of Air and Water pollution: Effect and Remedies.

In the period under review, the ITRG scientists on mathematical modelling have been working on the assignments given to them and some appreciable successes made.

Some Research Findings

*Professor B O Oyelami (NMC) and Dr. Buba Wufen (Plateau State University, Bokkos Nigeria) modelled the Carbon dioxide emission from the liquid fuel supplied in Nigeria by the Nigerian National Petroleum Corporation (NNPC) from 2009 to 2013.The emissions and CO_2 emission per capita within the given period were computed and CO_2 projected emission from 2013 to 2025 made.

Research findings

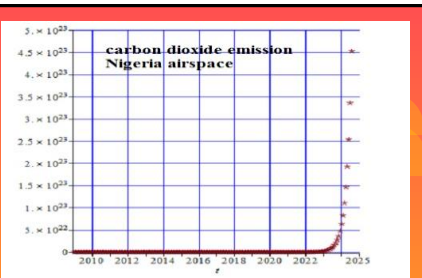


Fig.1;Carbon dioxide emission into Nigeria air space

The paper was published in the American Journal of Mathematical and Computer Modeling.2017, 2(1), 29-38. DOI: 10.11648(j.ajmcm.20170201.15).The researchers are now working on possibility of extending the result to emission of other greenhouse gases into Nigeria airspace.

Professor B O Oyelami (NMC), Dr. Lugano W and Mrs David L., from the Tanzania Industrial Research and Development Organization (TIRDO) have developed models for computing random emission and random spread of the gases into the environment using emission data from Tanzania. The scientists noted that large quantity of gases are being emitted by the small and medium size generators sets into the environment .They found that it will serious effects on the air quality in the remote environment where small and medium size generator sets are being used for generating electricity. The paper has been published in the American Journal of Modelling and Optimization 2018, 6(1), 1-17. DOI: 10.12691/ajmo-6-1-1

Biodiversity in a polluted environment

Two ITRG members from NMC, Professors B O Oyelami and J A Ogidi studied the population of zooplankton–fish using nonlinear difference equations with noise. They developed pollution risk metric for measuring the effect of ocean pollution on the biodiversity. Simulations were made for the dual populations when the ocean is polluted with chemical substances or oil spillage using Gaussian noise.

Biodiversity in a polluted environment

The noise accounts for pollution of the ocean that may lead to species migration from the pollutants source. It was observed that the risk factor increases with time and the species are endangered which leads to chemo taxis effects experienced whereby the survived species tend to migrate to region with lower concentrations of pollutants. IOSR Journal of Mathematics (Accepted)

Zooplankton and Phytoplankton in a polluted environment

The Ocean's food-chain

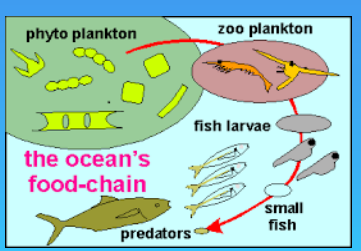


Fig.2: Marine niche containing phytoplankton, zooplankton and fishes

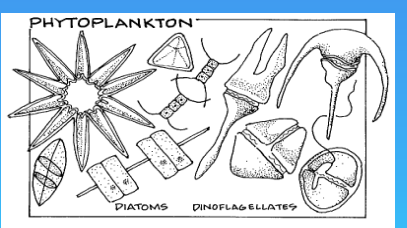
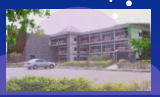


Fig.2: Diatoms, phytoplankton and dinoflagellates



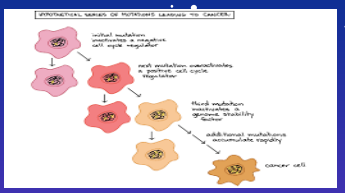
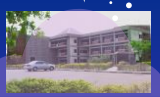


Fig.3:Developmental processes of Cancer cells

Treatment or eradication of malignant cancer is one of the topmost challenging medical problems in the world today. The reason is anchor on that fact that when cancer reaches metastases it spreads through the circulatory and lymphatic systems and cannot easily be rooted out. Professor Oyelami B O. Proposed five models to study the dynamic evolution of cancer cells in the presence of immune cells.

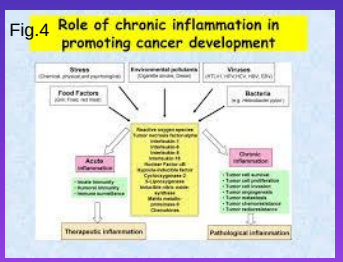


Results from the cancer models

Through numeric simulation it was found cancer cells display out of control growth and hence unstable in nature and depreciated the immune cells to the point of immune collapse.

By the use of energy potential method it was established that staving of cancer cells of oxygen, nutrients and vital enzymes will prevent metabolic activities of the cancer cells to take place and hence this could be a strategic way of combating cancer disease. Accepted for publication in the Transylvanian Review journal. Furthermore,more research being undertaken are on multi-agents modeling,global optimization of immunotheraphy and control through suppliments and finite element analysis of benign cancer.

Fig.4



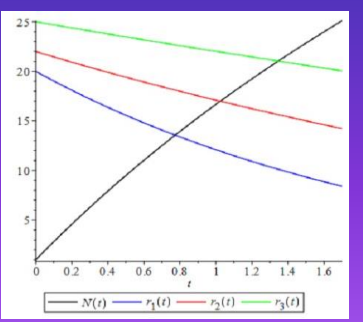


Fig.5: Growth cancer (Black colour), the depletion of immune cells of different types (other colour)

Nitrogen circle and fixation Phytoplankton

Phytoplankton is a major player in biogeochemical cycling of major elements like carbon, nitrogen, phosphorous and minor elements like iron, zinc and carbon dioxide in the ocean.

The researchers investigated for the conditions for coexistence and persistance of the species in a polluted environment and intersting results obtained.

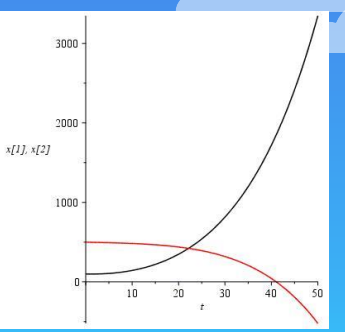


Fig.6: Pollution of zooplankton (red colour) and that of phytoplankton (black colour)

Pollution of environment greenhouse gases

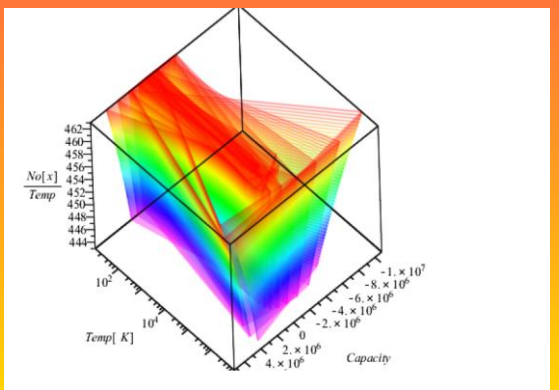


Fig.7:Ratio of Nitrogen oxide to exhaust temperature electricity generator set with given capacity

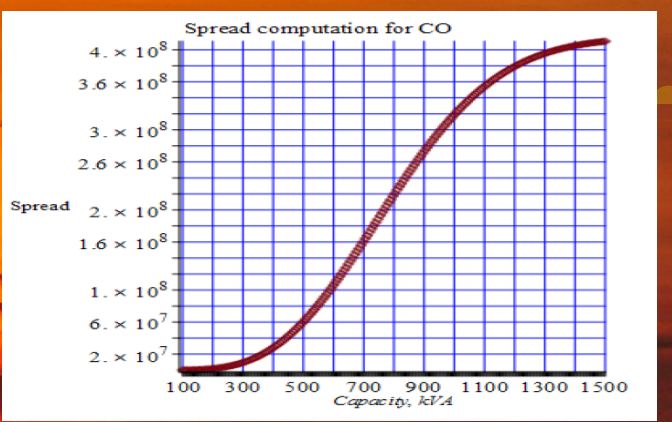


Fig.8: Emission of carbon monoxide from generator set and spread to environment