Modeling of Methane Emission Distributions in Nigeria using Neural Network Model

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Introduction

- Several chemical mixtures found in the troposphere act as greenhouse gases. The greenhouse gases allow light to enter the troposphere freely. Some of the light reflects back towards space as infrared radiation (heat) when the solar radiation strikes the earth's surface.
- Greenhouse gases absorb some of the energy trapped in the lower atmosphere and less heat radiates into space due to radiative forcing and the earth becomes warmer.
- This study assesses the distributions of greenhouse gas (methane) concentration over Nigeria with neural network model.

Materials

- **The Study Area** : The study areas used in this work are thirty six (36) points stationed over Nigeria

- **Sources of Data:** The methane data used in this work were gotten from www.gmes-atmosphere.eu/data between 2009-2012**.** Satellite data was used for this study because there is adequate spatial distribution of satellite measurements across Nigeria. Ground based measurements are sparse or non-existent in Nigeria. The data obtained were originally in NetCDF format. They were extracted and binned spatially into grid points that are separated by about 1.5 degrees in both longitude and latitude.

Method

- Equations (1) and (2) are respectively the mathematical models of the neural network used to transfer the input layer neurons to the hidden layer neurons and from the hidden layer neurons to the output layer neurons.
- $H_{vm} = \text{tansig}(I_{wm} * I_m + B_1)$ 1
- $O_m = L_{wm} * H_{vm} + B_2$ 2

- where O_m depicts the output matrix, I_m is the input matrix (consisting of the year, day of the year (DOY), latitude and longitude), I_{wm} is the inputs weight matrix, B_1 is the input bias vector, H_{vm} is the hidden layer variable matrix, L_{wm} is the hidden layer weight matrix, B_2 is the hidden layer bias vector and tansig is hyperbolic tangent sigmoid transfer function used between the input and the hidden layers as activation function. The purelin ($linear_f$) function is the transfer function used to go from the hidden to output layer.

Result

- The variation of methane reveals that higher concentration occurs in the South in dry season than the North, while slightly higher concentration occurs in the South in wet season in comparison to the Northern part of Nigeria.
- It was noted that the methane concentration was greater during the wet season across the country. This could imply influence of weather conditions on methane and several anthropogenic sources of methane during the wet season such as rice farming, decomposition of some plants, high moisture content, wetland, termites etc
- The similarity in the trace of the estimated and observed signatures shows good performance of the Neural Network model used in this study.

Conclusion

- The study reveals that the rise in the contributions of methane emission in Nigeria if left unchecked will increase adverse effects on livelihoods, such as crop production, livestock production, fisheries, forestry and post-harvest activities, because the rainfall regimes and patterns will be altered, floods which devastate farmlands would occur.
- It will also result in increase in temperature and other natural disasters like floods, ocean and storm surges, earth tremors which not only damage Nigerians' livelihood but also cause harm to life and property.
- The study show that neural network model can be use to model greenhouse gases.