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Influence of Cloud Optical Depth on the Intensity of the Solar Radiation: Case Study Makerere Hill in Kampala, Uganda.

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Abstract: *This study examined the Influence of Cloud Optical Depth on the Solar Radiation to establish the impact of clouds on the intensity and strength of the solar beam radiation propagated on earth's surface from the sun in Kampala area at Makerere University using CMP6 pyrometer, UV daily dose and NILU-UV instrument. The data was gotten from the records Department at Makerere University from the Physics Department. The Pyrometer data which is used in this study is from 2018 to 2020, and this Data gives the irradiance. MATLAB Code is used to help sort out and remove all repeated data within the Pyrometer data and then another code to work on the NILU UV data to sort out and pick column of interest. The radiation measured from the pyrometer is used for analysis in this study. The result shows a negative correlation of, -0.4537, -0.4027, -0.3692 for global irradiance, direct irradiance and UV daily dose component respectively with cloud optical depth.*

Keyword: Pyrometer, Radiation, Solar, Intensity, Irradiance

1. INTRODUCTION

Over the last five years Kampala has seen changes in its weather because of global warming as a result of increase in human activities particularly fossil fuel burning which increases greenhouse gas levels in earth's atmosphere thus raising the average surface temperature. Human activities are estimated to have increased Earth's global average temperature by about 1 degree Celsius Since the pre-industrial period, this number is currently increasing by 0.2 degrees Celsius per decade. The human-produced temperature increases are usually referred to as global warming however Natural processes can also contribute to climate change. Observations by scientist from the ground, space and air along theoretical models have been used to study past and future climate change. Climate change is a long-term change in the average weather patterns that have come to define Earth's local, regional and global climates. These changes have a broad range of observed effects especially to human health i.e. Skin cancer, in recent years these effects have become more dangerous due to greenhouse effect which increases the intensity of radiation on the earth's surface. Fine solid or liquid particles which reside for days and weeks in the atmosphere contribute toward trapping the heat between the earth's surface and the atmosphere. In this study, the influence of the vertical thickness between the top and the bottom of the cloud commonly known as the Cloud optical depth on the radiation intensity is examined.

2. METHODOLOGY

Data is obtained as global Irradiance from the Pyrometer, RMF (Radiation Modification Factor) from the NILU UV (Norwegian institute of air research Ultraviolet), and cloud properties from the space monitoring satellite. The Pyrometer data available is from 2018 to 2020 and NILU UV data is from 2019 to Early 2020 but this study is based on the Pyrometer data, which gives irradiance. A MATLAB Code is used to help sort out and remove all repeated data within the Pyrometer data and then another code is used to work on the NILU UV data to sort out and pick column of interest (RMF). The values are combined into one independent data having common year and thereafter graphs are plotted to study the relationship between Cloud Optical Depth, Direct Irradiance, Global Irradiance, and Integrated UV dose. The results are then used to analyze and draw conclusion regarding the study.

Fig.1. Instruments used during the study

3. RESULTS

The Data collected is used to plot graphs showing the relationship between Cloud Optical Depth against Direct Irradiance, Global Irradiance, and Integrated UV dose, the correlation coefficient of the plotted Data is also obtained for each graph as shown below.

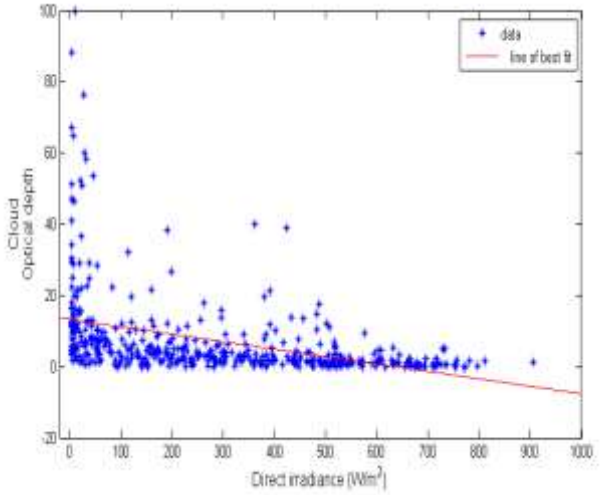

Fig.2. A graph of Cloud optical depth against Direct Irradiance
Correlation coefficient = -0.4027

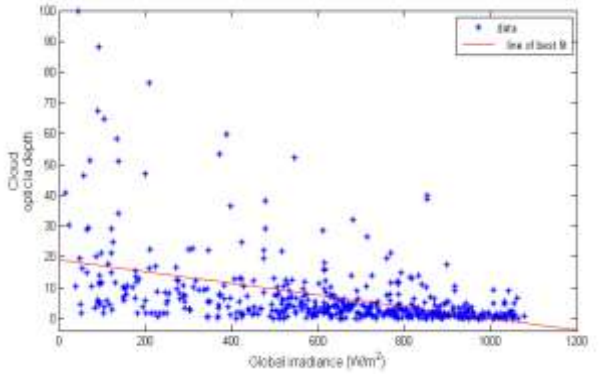

Fig.3.A graph of Cloud optical depth against Global Irradiance
Correlation coefficient = -0.4537

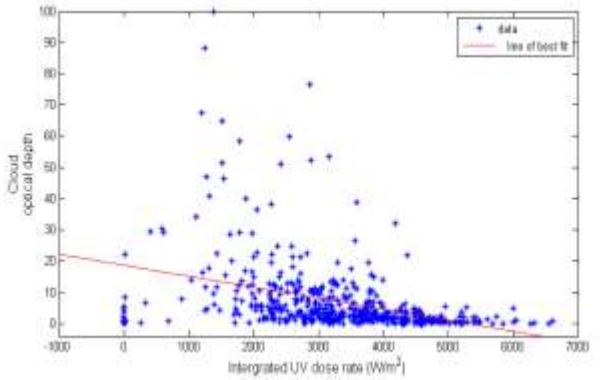

Fig. 4. A graph of Cloud optical depth against Integrated UV dose
Correlation coefficient = -0.3692

4. CONCLUSION

The comparison between the direct irradiance, global irradiance and integrated UV dose with cloud optical depth yields negative correlation coefficients of -0.4027, -0.4537, and -0.3692 respectively. This means an increase in cloud optical thickness acts to reduce the irradiance received on the surface with the global component of solar irradiance affected most.

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