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Relation between Global Radiation and UV Radiation

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Abstract:

In this study, daily UV radiation on ground surface was correlated with daily global radiation on horizontal surface over Chennai using linear least square method. For the study, Daily UV radiation data on a ground surface were taken for the period from August 2011 to December2011. Global radiation data used were computed using Regression equation with sunshine hours. Observed UV radiation during this period was compared with computed UV radiation using linear regression equation. They were in good agreement with each other.

Keywords: Global radiation, Sunshine hours, linear least squares and UV radiation

1.0 Introduction:

The Earth's climate has always been changing. Any change in the energy from the sun received at the Earth's surface will therefore affect the climate. The radiant energy received from Sun is responsible for the development and continuous existence of life on Earth. The radiation is received at the earth's surface in an attenuated form because it is subjected to absorption and scattering as it passes through the earth's atmosphere [1]. Absorption occurs primarily because of the presence of ozone and water vapor in the atmosphere, and to a lesser extent due to other gases (likeCO_2,NO_2,CO,O_2 and CH4) and particulate matter .The scattering occurs due to all gaseous molecules as well as particulate matter in the atmosphere. Solar radiation received at the earth's surface without change of direction ie in line with the sun is called beam or direct radiation. The radiation received at the earth's surface from all parts of the sky's hemisphere is called diffuse radiation. The sum of direct radiation and diffuse radiation is referred to as total or global radiation. The study of solar Ultraviolet radiation has received considerable attention in the past few years (Al-Aruri (1998), Khogali and Al-Bar1992) because of its biological, ecological and physical effects produced by short-wave radiation received at the surface of the earth.

Ultraviolet radiation is a specific part of the sun's total spectrum of wavelength. Ultraviolet (UV)

radiation which composes 8.73% of the solar spectrum (3) in the outer space is generally classified into three wavelength regions namely Ultraviolet A (315-400nm), Ultraviolet B (280-315nm) and Ultraviolet C (100-280nm)[2]. UV A radiation is normally reflected back from atmosphere. Presence of ozone and oxygen in the stratosphere results in the absorption of nearly all UV-C radiation (200-280nm) and Solar UV-B radiation (280-315nm) significantly. Solar UV-B radiation that reaches the ground is after complicated scattering and absorption process in the atmosphere and at the earth surface. The main geophysical variables that affect surface UV radiation are clouds, ozone, surface albedo and aerosols.[4] UV radiation intensity is gradually increasing in the world due to depletion of Ozone layer[7]. Ozone layer depletion is due to release of gases like CO2 , CO and Chloro flora Carbons. While it is essential to reduce the release of these gases into atmosphere, it is also important to measure and project UV exposure on earth.

2.0 Data and Methodology:

In the present paper a correlation between the ultraviolet (UV) and the global solar radiation(G) over Chennai were computed. Sunshine data of Chennai have been obtained from Regional Meteorological centre, Chennai. Daily data were obtained for the period of August2011 to December 2011. Using sunshine data in the Regression equation (Sivamadhavi &Samuel Selvaraj (8), the global radiation were computed daily for the same

period. Data were observed using UV light meter model: UV-340A. The instrument can measure low range of 1999 uw/cm2 and high range of 19990 uw/cm2 with accuracy + or − 4%FullScale +2 digits. UV radiation reading were taken every half an hour and sum of these values is taken as daily total value.

The following empirical models were used to estimate the daily global radiation.

$H/H_O = 0.0460 + 0.1429 S - 0.0106 S^2$ (For August) ………………………………….(1)
$H/H_O = -0.1274 + 0.1500 S - 0.0715 S^2$ (For September)……………………………(2)
$H/H_O = 0.2885 + 0.0328 S - 0.0003 S^2$ (For October) …………………………………(3)
$H/H_O = 0.2613 + 0.0363 S$ (For November)…………………………………………………..(4)
$H/Ho = 0.1697 + 0.0593S - 0.0012S^2$ (For December)…………………………………………(5)

The daily data of ultraviolet and global solar radiation at Chennai are illustrated in fig.1 &2 . Fig 3 shows the relationship between computed and observed values of UV radiation. MBE value is an indication of the average deviation of the computed values from the corresponding observed data and can provide information on long term permance of the model,the lower MBEthe better is the long term model calculation. A positive MBE value indicates the amount of overestimation in the computed UV. RMSE provides information on the short term permanance which is a measure of variation of computed values from the corresponding observed data and can provide information.

(i) Mean Bias Error (MBE) defined as

$MBE = (1/N) \sum (I-P)$

Where N denotes the total number of observations, P is the observed value and I is the computed value
(ii) Root Mean Square Error (RMSE) defined as

$RMSE = [(1/N) \sum (I-P)^2]^{1/2}$
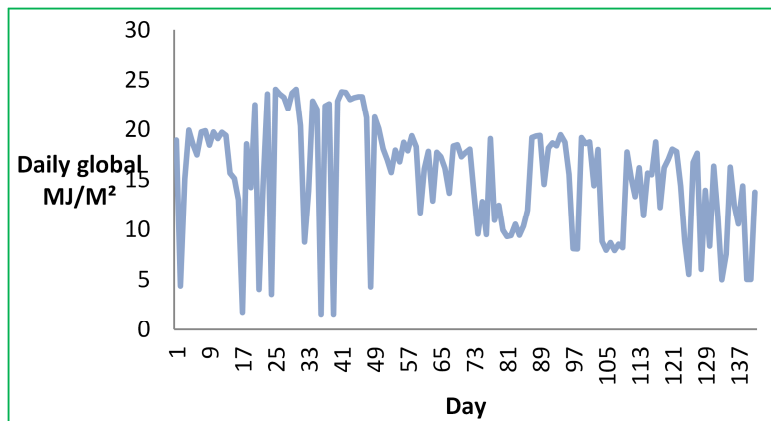(iii)$MAPE = [\sum(I-P/P)/Nx100]$

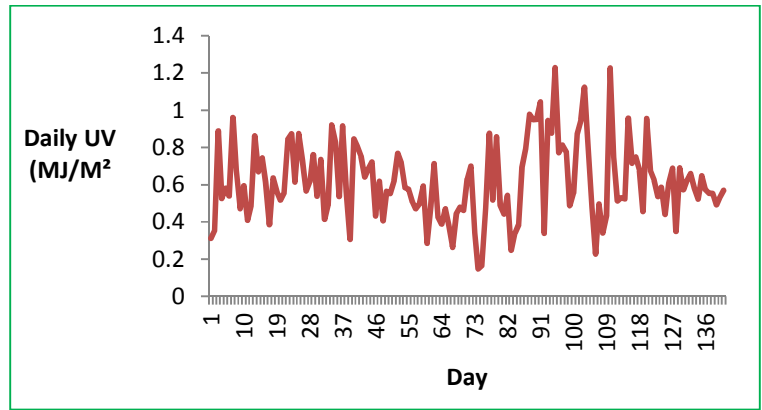**Fig. 1: Daily value of Global radiation**

Fig. 2: Daily value of UV radiation

Empirical Formula of Ultraviolet Solar Radiation Investigated over Chennai:
Many types of correlation were tried to find out the best fit between Global and UV data. The best of the relationship was observed in Linear Correlation.[9,10]
UV radiation = a(Global radiation) + b ……………………………………………(1)

where a and b are regression coefficients which depend on the weather parameters of the location. The values of a and b are 0.0157 and 0.3721.The obtained values for correlation coefficient was 0.942498
Verification of the empirical equation
Accordingly the empirical relationship investigated (equation 1) becomes
UV radiation = 0.0157(Global radiation)+0.3721…………………………………(2)

The observed data of global solar radiations are introduced in equation 2 to calculate the corresponding values of UV radiation. The estimated data of ultraviolet solar radiation were compared with corresponding observed data. The results are illustrated by fig.(3). & Fig.(4)
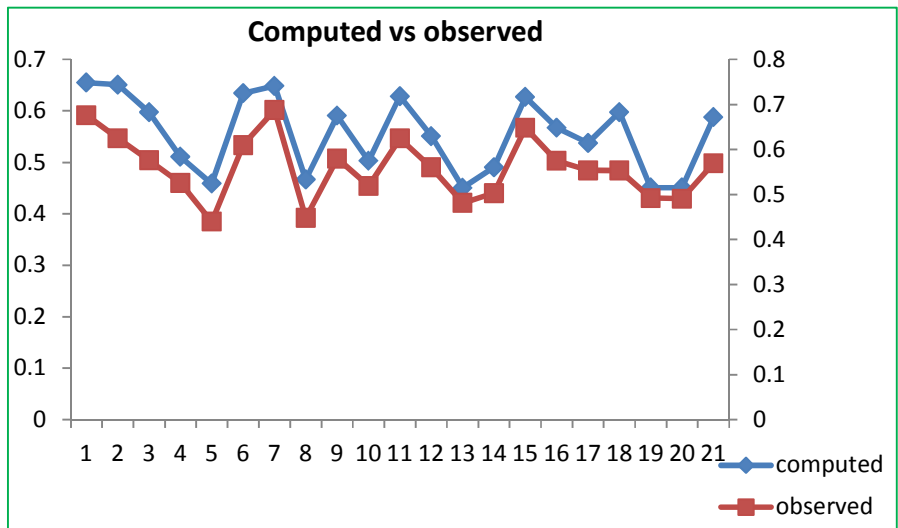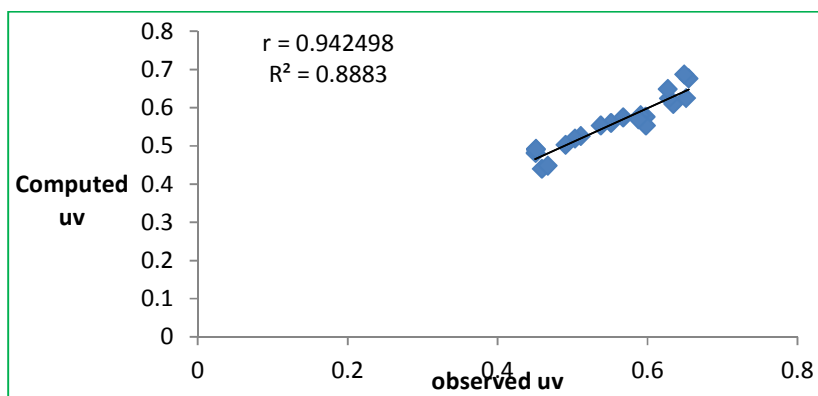

Fig. 3: observed vs computed values of UV

Fig. 4: Scatter plot of observed and computed UV data

From the figure it can be seen that the estimated values of UV solar radiation are in agreement with the observed values.

Table 1: shows the errors (MBE,RMSE and MAPE) between the observed and computed UV Radiation

MODEL	a	b	MBE	RMSE	MAPE
LINEAR	0.0157	0.3721	0.003996	0.02449	3.96799

3.0 Conclusions:

The daily values of UV radiation and daily global horizontal solar radiation (300-280nm) at Chennai have been analyzed in this study. The linear regression equation

Ultraviolet radiation =0.0157(Global radiation) +0.3721

can calculate the UV radiation on any date when sunshine hours is available. Assessment of the UV radiation variability and trend is of considerable interest because of the environmental and health risk caused by an increase in this radiation whereas the UV measurement network is sparingly distributed and the UV data series are short

References:

1) Ahmed Abdel Hady(1999), 'Global And Ultraviolet Radiation Over Kuwait',Qatar University Science Journal,Vol.18,p.37-44
2) A.A. Trabea, and I.Salem,(2001),'Empirical Relationship for Ultraviolet Solar Radiation Over Egypt' Egypt.J.Sol.Vol.24,No.(1).
3) I.Foyo-MORENO, J.VIDA AND L.ALADOS-ARBOLEDS,(1998),' A simple all weather model to estimate ultraviolet solar radiation(290-380nm)',Journal of Applied Meteorology, Vol.38,p.1020-1026.
4) I.Foyo-moreno,J,Vida and L.AlAdos-Arboledas(1998), 'Ground based Ultraviolet(290-385nm) and Broadband Solar Radiation Measurements in souther-Eastern spain' International journal of Climatology Vol. 18,p.1389-1400.
5) Al-Aruri,S.D.,Rasas,M.,Al-Jamal,K and Shaban,N. (1998),'An assessment of global ultraviolet solar radiation in the range(0.290-0.385)mm in Kuwait' Solar energy,Vol.41, p.159-164.
6) Khogali A. and Al-Bar,O.F.(1992) 'A study of solar ultraviolet radiation at Makkah Solar station' Solar energy ,Vol.48, p.79-87
7) I.Foyo-moreno,J,Vida and L.AlAdos-Arboledas,(1998), 'Ground based Ultraviolet(290-385nm) and Broadband Solar Radiation Measurements in souther-Eastern spain', International journal of Climatology Vol. 18 p.1389-1400.
8) V.Sivamadhavi &R.Samuel Selvaraj,(2012) 'Robust regression technique to estimate the globl radiation' Indian journel of Radio & Space Physics,vol.41,p.17-25.
9) H.A. Basset(2007), 'The global and UV-B Radiation over Egypt ' Atmosfera 20(4),p.341-358.
10) Al-Aruni S.D.Rosas,Al-Jamal,K,Shaban (1988)'Assesment of global Ultraviolet Solar radiation in the range (0.290-0.385µm) in Kuwait'. Solar energy Vol.41,p.159-1162.