The Effect of Dust on Global Ultraviolet Solar Radiation in the Range (0.290 – 0.385 μ*m*) Reach Basrah City 30.5°N

H. A. AL- Eidane

Department of Physics , College of Education ,University of Basrah

hsalh2005@yahoo.com

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Abstract

In this paper, The global ultraviolet radiation was measured and recorded on an hourly basis in Basrah (latitude 30.5°N, longitude 47.5° E) during the period 1999 / 2000. The global ultraviolet radiation (U.V) was measured by an Epply ultraviolet radiation (photometer) (0.290 – 0.385*um*)[1].

Intensity variation of global daily ultraviolet radiation throughout the year and the effect of dust on daily total ultraviolet radiation were investigated. It was found that the highest ultraviolet radiation levels are received during June and that the daily total ultraviolet is approximately lower by 28.07% during dusty days. From measurements carried out, it was found that, on average, 3.05% of the monthly – daily global radiation received is ultraviolet radiation.

Key words: Ultraviolet, Solar Radiation, intensity Curves. Basrah.

1- Introduction

Solar radiation has great influence on the planet Earth .Besides being the original source of all forms of energy on earth, the radiation produce effects which are of direct interest to human beings, animals, and plant .The ultraviolet solar radiation in the outer atmosphere covers the range of wavelengths from the lower visible, at approximately 0.4μm, down to X-ray, beginning at about 0.03μm. Out of the range the ultraviolet radiation with wavelengths (λ) less than 0.29μm is absorbed mainly by the ozone layer [2]

The ultraviolet radiation (U.V), which compromises 8.73% of the extraterrestrial solar radiation (solar spectrum), can be divided into three bands. UV-A covers the (0.40-0.32μm) wavelength range, UV-B covers the (0.32-0.29μm) and UV-C covers the (0.29-0.20μm) wavelength range[4-7].

Of the three UV bands, we receive on the earth surface only UV-A and UV-B. The UV-C component is removed by absorption through the protective ozone layer (O_3),[2-7]. The ultraviolet radiation reaching the earth's surface is therefore in the range o.29< λ <0.385μm. This spectrum causes important effects on the earth .For instance, the ozone in the upper atmosphere is produced by photochemical reaction due to the presence of the ultraviolet solar radiation .Shorter wavelength ultraviolet and X-ray radiation from the sun ionize air in the upper atmosphere ,producing the ionosphere used for radio communication [5-8].

Since scatter is inversely proportional to the fourth power of wavelength (Rayleigh scattering), consequently the UV-B component is subject to the greatest atmospheric scattering and the amount of solar UV-A radiation reaching the earth's surface is enormously greater in magnitude than that of UV-B. In addition, UV-A is partially absorbed by the ozone layer while UV-A is transmitted . The beneficial are damaging effects of UV-A and UV-B radiation on humans, the ecosystem, animals, plants, and material are many [2-4].In recent years the problem of depletion of ozone later, apparently due to the extensive use of the chlorofluorocarbons and the emission of hydrocarbon from automotive vehicles, cause a great concern among scientists, researchers, and environmentalists. Depletion of the ozone layer allows more U.V radiation to reach the earth surface, thus increasing the rate of skin cancer, plastic deterioration, undesirable chemical reaction in commercial chemical plants and other undesirable effects [6].

2- Experimental part

The U.V solar radiation (0.295-0.385μm) received on a horizontal surface were recorded at 60-minute intervals in Basrah (30.5^o N); their mean hourly values are used in the analysis of the present work. The received amount of U.V radiation at any location depend on solar zenith angle, atmospheric ozone content overhead, and transparency of the atmosphere[1].

A study was conducted from January 2000 to December 2000 during which U.V radiation data in the range 0.29 to 0.385 μm was measured by an Epply ultraviolet radiation (photometer).

3- Result and discussion

The global ultraviolet solar radiation was measured in the City of Basrah (30.5^{o}N latitude, 47.5^o E longitude) for the period Jun – December 2000[1]. The daily intensity variations of global solar ultraviolet radiation as a function of time was selected for a clear atmospheric day from six months of the year are represented in Fig.(1).As mention before, U.V radiation measurement was collected continuously.

It is interesting to note a drop of 44% between the highest hourly intensity 57Wh/m^2 recorded in 19 June, and lowest intensity 32Wh/m^2 measured in 5 December. A reduction of 59% in the measured daily total global U.V radiation was calculated between the two days by integrating over their intensity curves.

In Fig.(2) the intensity variations of global solar U.V radiation as a function of time of day for three consecutive dusty days and a clear atmospheric day are represented.

In comparison to the measured daily total global U.V radiation on a clear day (19 June) an attenuation of 28%, 26.3%, 29.9% in the amount of daily total radiation was calculated for 20 June ,12 June and 27 June, respectively. Thus, the daily total global ultraviolet radiation is lower on average by 28.07% during dusty days.Table (1) shows the measured maximum and minimum total monthly-daily global and global ultraviolet radiation for each month from 1st January 2000 to 31th December 2000. It also tabulates the calculated ultraviolet and global month means and their ratios. It can be seen that the ultraviolet monthly means varied between 67.5 Wh/m^2 and 630Wh/m^2. The highest amount of U.V radiation was received during June, which constituted 4.07 % global radiation whereas the lowest was received in December and constituted 1.9 % of global radiation .The minimum month-daily ultraviolet mean was recorded during December (cloudy day) 36Wh/m^2 and the maximum was recorded in June 710Wh/m^2.

Unfortunately, ultraviolet data from other parts of the hemisphere were not available to be compared with data collected in Basrah.

Over a year the ultraviolet radiation constituted on average 3.05 % of global radiation .In outer space, ultraviolet radiation between (0.290 to 0.385μm) represent 6.8% of solar radiation [3]. Most of the 3.75% loss in the received incoming global solar ultraviolet radiation is probably due to scattering and absorption through the atmosphere. Furthermore, we can see from table (1) that the highest ultraviolet radiation levels ware received during June and the lowest in December.

The ozone level (Z) in the atmosphere can be calculated for an equation given by van Henklon [4]. This equation considers the ultraviolet of ozone level with the time of year and the geographical location.

$$Z=287.69+14.85 \sin (0.9865(D-30))$$

Where D is day number of the year (1 for 1st January). The variation in the ozone level from day to day through the year is shown in Fig. (3).

It is interesting to note the discrepancy, which we cannot explain at this point, between the calculated ozone level (Z) maximum on 29 April (day=121), minimum on 30 October (day=304)) and the measured ultraviolet daily-monthly radiation means (highest during June, lowest in December), where ozone absorption is strongly dependent on ozone level and wavelength.

In addition, the atmospheric constituents concentrations (dust particles and aerosols) in Basrah are higher during summer than winter, where scattering dominates absorption by ozone for λ <310 [4-6].

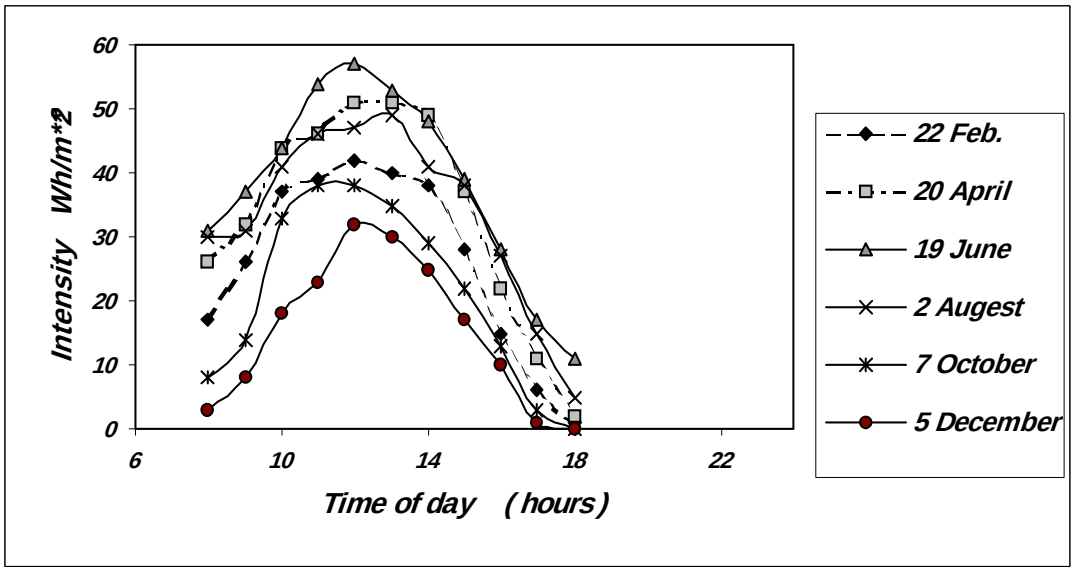

Fig.(1): Global solar ultraviolet radiation as a function of Time day for six months during year 2000 .

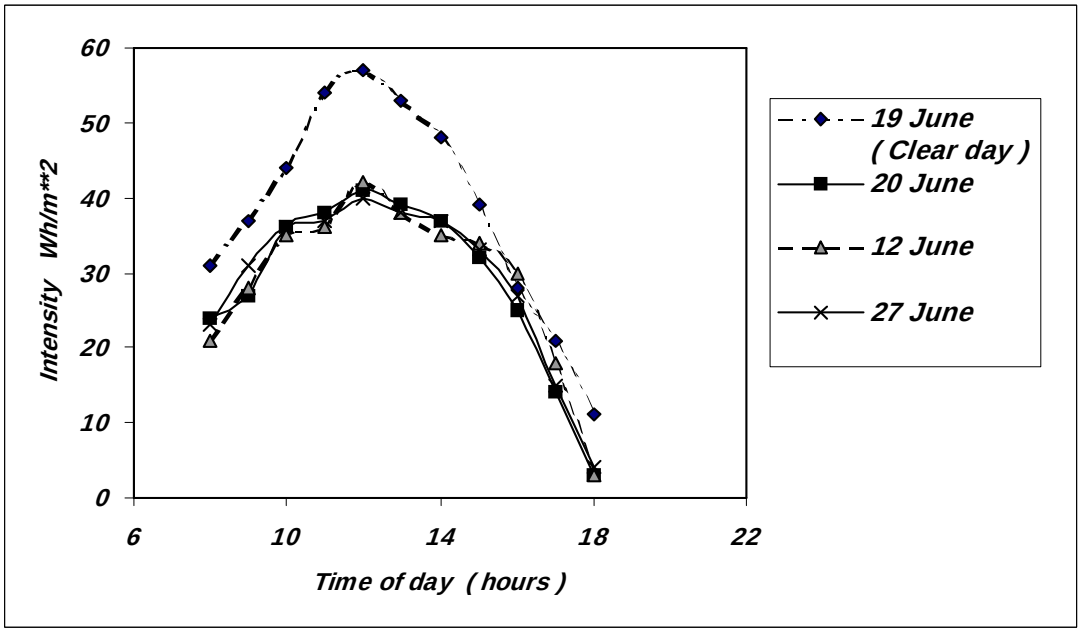

Fig.(2): Global solar ultraviolet radiation as a function of time day for a clear day June 19, and three dusty days 12,20and 27 June.

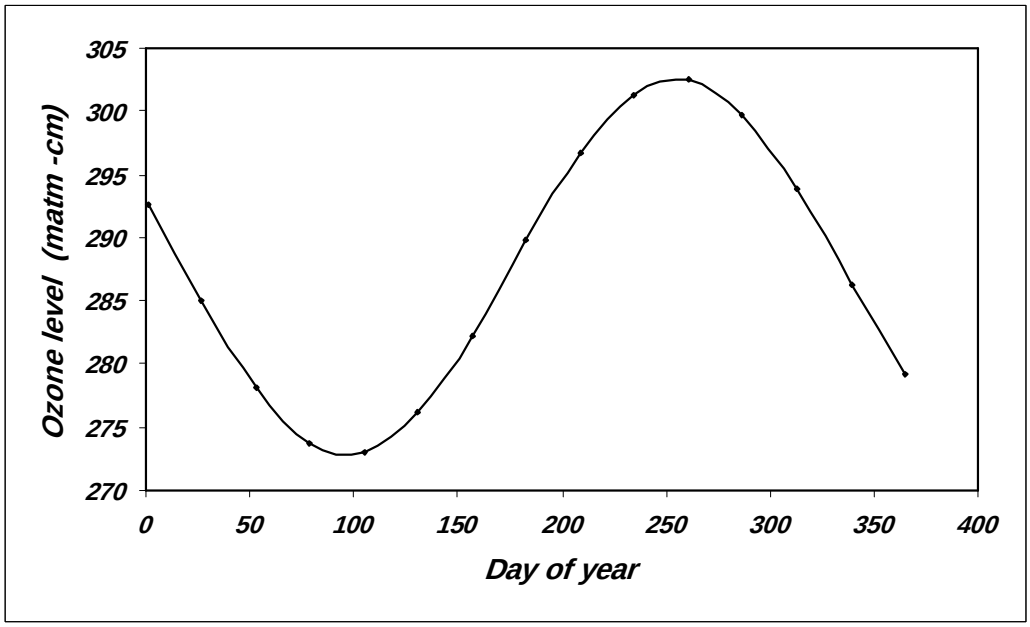

Fig.(3) : Ozone level in the atmosphere as a function of time of year

Table (1) Monthly – daily global and global Ultraviolet solar radiation means

Month/ 2000	*Global Radiation Gb kw h/m²*			*Ultraviolet Radiation U.V Kw h/m²*			*U.V mean*
	mean	*Min.*	*Max.*	*mean*	*Min.*	*Max.*	*Gb mean*
January	4.29	2.854	5.175	0.112	0.092	0.24	0.026107
February	5.43	1.66	6.845	0.213	0.139	0.32	0.039227
March	7.724	4.303	8.683	0.291	0.21	0.366	0.037675
April	11.035	7.673	13.015	0.412	0.272	0.42	0.037336
May	12.68	9.387	14.943	0.48	0.276	0.598	0.037855
June	15.45	13.46	15.99	0.63	0.519	0.71	0.040777
July	12.69	7.874	14.257	0.37	0.163	0.446	0.029157
August	12.54	11.71	14.11	0.323	0.291	0.382	0.025758
September	11.52	9.613	12.94	0.284	0.218	0.338	0.024653
October	8.99	6.193	10.856	0.219	0.122	0.276	0.02436
November	5.34	1.038	8.141	0.131	0.041	0.195	0.024532
December	3.515	0.76	6.099	0.067	0.036	0.15	0.019061
Yearly Mean	9.267			0.29433			3.05%

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تأثير الغبار على الاشعة فوق البنفسجية للاشعاع الشمسي في مدى (0.290 µm – 0.385) لمدينة البصرة 30.5^0 .

حســـــين علي خضر العيداني

قسم الفيزياء – كلية التربية – جامعة البصرة

hsalh2005@yahoo.com

المستخلص:

في هذا البحث ، قيست وسجّلت الأشعة فوق البنفسجية الساعية الواصلة لمدينة البصرة (خط طول 30.5^o شمالاً ، 47.5^o شرقاً) خلال الفترة بين 1999 و2000 بواسطة جهاز (Epply ultraviolet radiation (photometer للطول الموجي 0.290 µm – 0.385) .

وجد ان اختلاف شدة الاشعة فوق البنفسجية الواصلة يومياً وخلال السنة تتأثر بالغبار خلال اليوم . اذ وجد ان اكبر قيمة للاشعة فــوق البنفسجية تصل الى الارض في شهر حزيران وتتأثر بالغبار حيث تصل تقريباً نسبة 28.07% باليومة الواحد ، كما قيس معدل الاشعة بتأثير الغبار خلال الشهر وتصل الى 3.05% منها.