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Impact of Atmospheric Factors on Ultraviolet Radiation Levels for Basra city – Iraq

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Abstract

This work aims to analyze the correlation between ultraviolet radiation reaching the earth in Basra city – Iraq with the daily maximum temperature and relative humidity. We use atmospheric data available online and employ the Spearmen Rank Order Correlation (SROC) analysis technique. We find a significant strong positive correlation between the ultraviolet radiation level and daily maximum temperature, and we find a significantly strong correlation inverse between the ultraviolet radiation level and daily relative humidity. The results can serve as public guidance when exposed to sunshine in the city.

Keywords

Correlation relation, Ultraviolet radiation, Daily maximum temperature, Relative humidity, (SORC).

1. Introduction

. Solar radiation is the main source of energy on Earth: it varies from one month to another and from time to time in a day. Ultraviolet light refers to electromagnetic radiation between the visible and X-ray spectrums (wave length band; 100-400 nm) [1] . Ultraviolet radiation constitutes about 8.73% of solar spectrum in outer space [2,3] ; however, a small part of the UV spectrum, predominantly in the wavelength band (315 – 400 nm) reaches the Earth`s surface, the remaining larger part is absorbed by Ozone and Oxygen [ 2 ,4-6 ] .The ultraviolet radiation index ( UVI ) is an international standard used to describe the level of UV radiation at a place on the Earth`s surface [7] . The indicator ranges from 0 to +11 , and indicates the level of exposure to this radiation. The UVI is an important vehicle to alert people about the

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need to use sun protection.

The UV radiation reaching the Earth`s surface has some harsh biological. Ecological and physical effects, typical of short-wave radiation, and, as such, its Spatial and temporal availability is of significance to a wide range of disciplines [8-9]. In particular, on the human health level, the UV in sunlight is a major source of Health hazards leading to diseases such as malignant melanoma, which kills thousands of people all around the world each year [3]. On the other hand, insufficient sunlight expose can eventually result in vitamin D deficiency, leading to a range of serious health problems [10]. Natural, such as atmospheric, and individuals, such as clothes and protection measures, can influence human exposure to UV light. A large number of studies have analyzed the relationships of UV light intensity and natural or individual factors for particular places [11-13].

Iraq , a middle eastern country that suffers strong sunshine and high-temperature levels throughout the year .An analysis of the correlation between UV radiation intensity and atmospheric factors (temperature and relative humidity) has been given, for example, by [14] They have used Spearman Rank Order Correlation (SROC) techniques and data for the UV radiation intensity and atmospheric factors available from the European center for Medium-Range Weather Forecasts (ECMWF) of six different monitoring stations spread all over the country. In Nasiriyah, to the south of Iraq, there was a strong positive relationship between the monthly mean of temperature and the monthly mean of UV radiation (R =+ 0.8) , while there was a strong inverse relationship between the monthly mean of relative humidity and the monthly mean of UV radiation (R = - 0.8).

The city of Basra (Table. 1) is the most- southern city in Iraq. N It stands as the center of oil and Gas industries. It thus suffers a high level of pollution and has witnessed an increase in it cancer incidence and mortality rates since 2005 [15]. In an earlier work [16], we had derived a regression relation between UV and Global radiation in Basra city. The aim of the present work is to analyze the effects of atmospheric factors (temperature and relative humidity) on the UV index in Basra city – Iraq.

Table .1; Longitude, Latitude and Elevation of Basra city – Iraq

Basra City	Longitude(ºE)	Latitude(ºN)	Elevation(meter)
	47.7738	30.5258	5

2. Methods

The strength of association between pairs of variables can be measured using Spearman Rank Order Correlation statistics (SROC) statistics [17]. The Spearman Correlation Coefficient (R) qualifies the strength of the association between the variables. (R) varies between -1 and +1.

If we have N pairs of scores (x, y) of the variables x and y, R is given by:

$$R = \frac{A}{\sqrt{BC}}$$

Where

$$A = N\sum xy - (\sum x)(\sum y)$$
$$B = B(x) = N\sum x^2 - (\sum x)^2$$
$$C = B(y)$$

Data for daily UV index (UVI), maximum temperature (T) and relative humidity (H) for Basra city is available on line (http:// Weatheronline.Co.Uk). We have extracted the three variables for the day 15 of each month of the previous year 2021. This data is summarized in table .2

The P-value is the probability of being wrong in concluding that there is a true association between the variables. The smaller the P-value, the greater the probability that the variables are correlated .Traditionally, you can conclude that the independent variable can be used to predict the dependent variable when $P < 0.05$ Available, is an online electronic algorithm for instant calculation of P-value (http:// Vassarstats.net/tabs-r.html).

Table.2; daily maximum temperature (T), relative humidity (H), and UVI for day 15 of each month of year 2021.

Month	T ºC	H %	UVI
1 Jan.	22.3	68.6	4
2 Feb.	30.6	40	5.7
3 March	28	33.3	7.1
4 April	31.1	29.3	9.1
5 May	42	22.1	11.1
6 June	48.9	18.6	10.9
7 July	48	20	11.4
8 August	46.9	20.7	10.9

9 Sept.	42	22.1	9.4
10 Oct.	42	25.7	6.9
11 Nov.	24.9	40	4.3
12 ec.	24	60	3.1

3. Results and Discussion

We use data in Table.2 and employ the theory outlined in the previous section to obtain the results summarized in Table.3 below:

Table.3: Results

Relation	SROC		SLR	
	Correlation	R	Interp.	P-value
T vs. UVI	High Positive	+ 0.8895	Linear	0.0001
RH vs. UVI	High Inverse	- o.885	Linear	0.0001

Thus, the results clearly show a significant strong correlation between UVI and daily maximum temperature, and show a significant strong correlation inverse between UVI and daily relative humidity.

To see how these results reflect the facts on ground, we plot the three variables on a single frame (Fig.1).

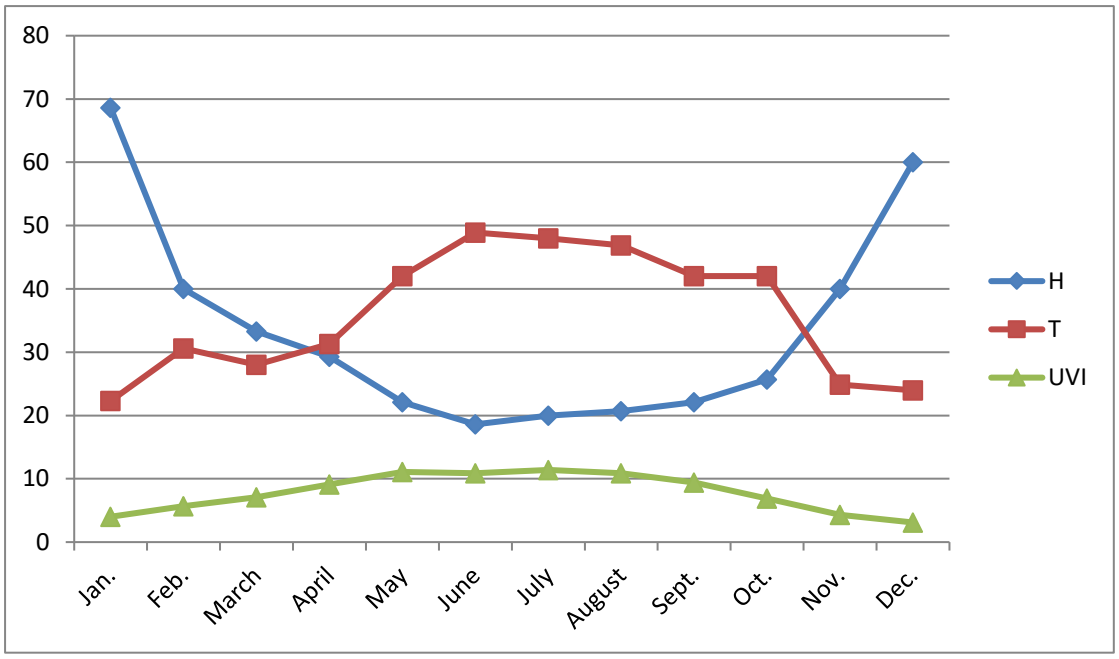

Fig.1: Variation of daily maximum temperature (T), daily relative humidity (H), and UVI, all for the middle of each month of 2021.

The figure shows that the year can be divided into two main periods. The first, the "dry period" (DP), that, roughly speaking, may extend from the middle of April to the end of October. It is a period of lower humidity but higher temperature.Thus; this period shows higher ultraviolet radiation levels and contains the peak of the year.
The remaining period is the "wet period"(WP) which is a period of higher humidity but lower temperature. Thus, it shows lower ultraviolet radiation level including the minimum of the year. People in Basra city should be aware of these facts to reduce any undesired side effects on public health associated with exposure to sun light.

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