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Research paper



Ultraviolet Radiation Index Over Ota, Nigeria

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Abstract

The sun has been observed to emit radiation in three major wavelengths; visible light (400-700nm), infrared radiation (700-1000nm) and ultraviolet radiation (UV) (3.0-400nm). UV possesses a short wavelength, hence, it is more energetic when compared to radiation of longer wavelengths. Davis wireless vantage pro2 weather station was used to obatin the UV radiation data over Ota, Ogun State, Nigeria from May 2012 to December 2013. The research revealed that mean UV index was 5.37. The UV peak time was consistently 12 noon for year 2012, while it was found to be 1:00 pm in March and April for 2013. Thus, the study observed that UV index over Ota is in the moderate range.

Keywords: *Covenant University; Peak time; Ultraviolet radiation; UV index; Radiation*

1. Introduction

The sun has been a major source of power over the years. Solar energy is harnessed and converted to other energy forms by plants and animals. Solar radiation has been observed to lie in three major wavelengths; the visible light that is seen, the infrared radiation that is felt as heat, and the UV (ultraviolet radiation) that can not be felt or seen. UV radiation has shorter wavelength than visible light in the EM (electromagnetic) spectrum. Short wavelength radiation which include gamma rays, X-rays and ultraviolet, have the highest energy and penetrating power, thus, can be very dangerous. Over exposure to these forms of radiation can adversely affect the human health; killing a large number of cells of the body and consequently leading to the malfunction of some organs in the human body. Despite the fact that UV radiation is needed in low quantities as it is a good source of vitamin-D which is generally important for healthy bones (Lucas et al., 2006), it is noted that skin cancer, malignant melanoma, and cataract etc. are some of the consequences of being overly exposed to radiation (Usikalu et al., 2012, USEPA 2006, Usikalu et al., 2014). Seasonal changes affect the intensity of the UVB (ultra-violet radiation B). UV intensity tends to be greatest at summer months as the cloud cover is lesser. Cloud cover reduces UV levels, but this depends on the thickness of the cloud cover as it is possible to burn on a cloudy day, even if it does not feel warm. The sun's rays are strongest at the equator, where the sun is most directly overhead and UV rays must travel the least distance through the atmosphere. Nigeria, being one of the countries located around the equator makes her a good location to observe the adverse effects of UV radiation to human health. Hence, this work monitored the UV radiation over Covenant University, Ota.

2. Methodology

The Data used for this research work was obtained from a Davis Wireless Vantage Pro2 weather station, manufactured by Davis instruments, Hayward, California, U.S. The instrument was installed at the rooftop (15m above sea level) of the physics Department, Covenant University, Ota, Nigeria with geographical coordinates 6.7ºN, and 3.23ºE. The instrument was installed above so as to reduce interference of the information or data gotten from the atmosphere. This data enables us to forecast, determine and diagnose the behavioural characteristics of all accumulated data. This instrument collects atmospheric information over a particular geographical area. This information include the UV index, UV dose, amount of rainfall, rainfall accumulation, wind direction, wind speed etc. which are all combined in one package called the Integrator Sensor Suite (ISS). The data from the automatic weather station spanned the years 2012 and 2013 for the indexes of UV per second within that time. For the purpose of simplicity and compressibility, the daily average data obtained was converted to monthly average. It was computed by taking the UV average for the total number of days in a month.

3. Results and discussion

Table 1 showed the UV index, which is use to categorize the degree of Ultra-violet radiation over over a particular area. The UV Index describes the daily likely levels of the intensity of UV rays. The higher the UV index the more dangerous the radiation to the health. This helps in forecasting the time of the day in which it is dangerous to be outdoors or exposed to the ultraviolet radiation. It is advisable not stay outddor around noon. Excessive exposure to high index ultra-violet radiation can adversely affect some parts of the body such as, skin or eyes. Table 2 displayed the average time of the month in 2013 where we have the highest UV index with respect to its exposure level. The exposure level of this table gives us a correlation to the seasonal variation of the UV radiation, where the DJF (December, January and February) months give an average of 'Moderate' and MAM (March, April and May) months give an average exposure level of 'very high'. Figure 1 and 2 is the graphical representation of the average hourly UV index for year 2012 and 2013 respectively. Highest UV index (6.92) was observed in the month of May at 12:00 in 2012, while highest

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value (6.74) for 2013 was recorded in March. Figure 3 showed the result of comparison of the two years, it was found that there is high correlation between them. It was also observed that UV index is lower when the amount of rainfall high and this period falls within June, July, and August (JJA). This is due to the thick cloud cover that is always present in the atmosphere during the JJA months. Cloud cover absorbs most of the UV radiation before it reaches the earth. Therefore it is a relatively safe time of the year for outdoor activities and risk is minimal during this season. UV index observed was consistently at its peak in the MAM (March, April and May) months because during these months, there is little or no cloud cover.

Table 1: UV index numbers and their respective exposure levels

UV INDEX NUMBER	EXPOSURE LEVEL
3 TO LESS	LOW
3-5	MODERATE
5-6	HIGH
6-8	VERY HIGH
8-10	EXTREME
11^{+}	EXTREMELY HIGH

Table 2: Peak time per month for 2013

Month	Time	Peak UV	Exposure Level
Jan	12:00	3.48	MODERATE
Feb	12:00	4.39	MODERATE
Mar	13:00	6.74	VERY HIGH
Apr	13:00	6.36	VERY HIGH
May	13:00	6.55	VERY HIGH
Jun	12:00	4.71	MODERATE
Jul	12:00	3.96	MODERATE
Aug	12:00	4.54	MODERATE
Sep	12:00	5.32	HIGH
Oct	11:00	5.46	HIGH
Nov	11:00	5.83	HIGH
Dec	12:00	4.35	MODERATE

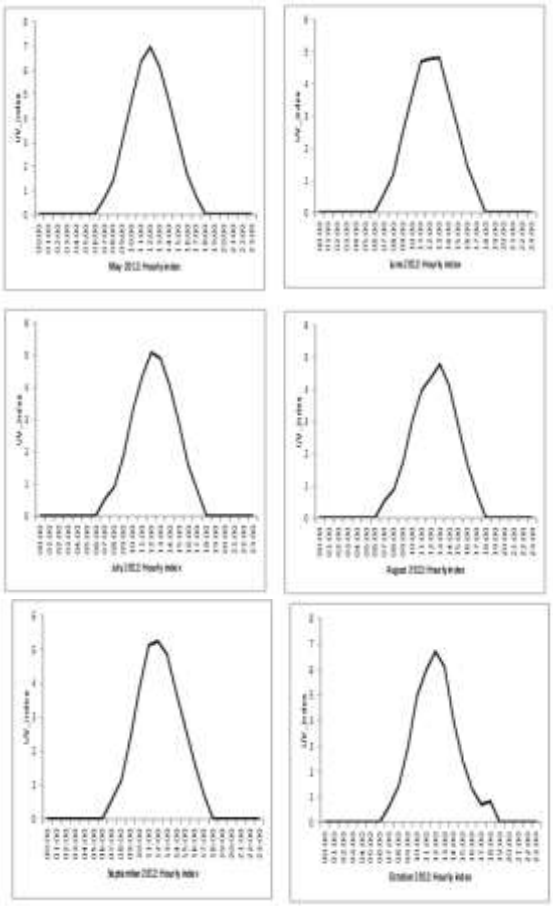


Figure 1: Hourly average of UV index for 2012

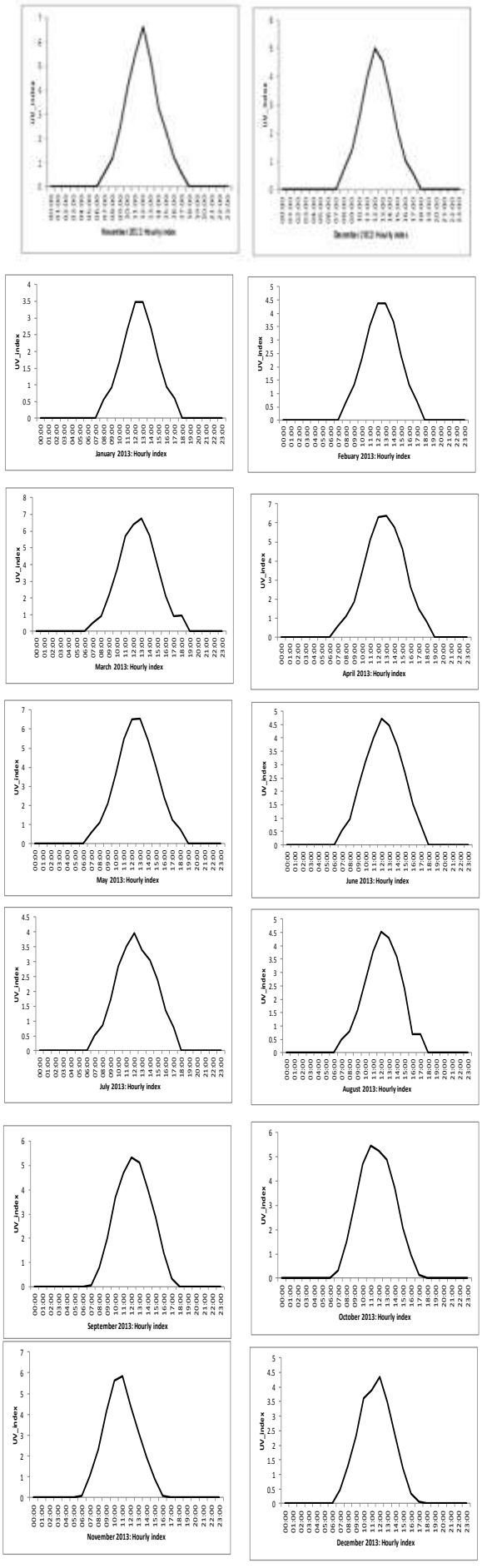


Figure 2: Hourly average of UV index for 2012

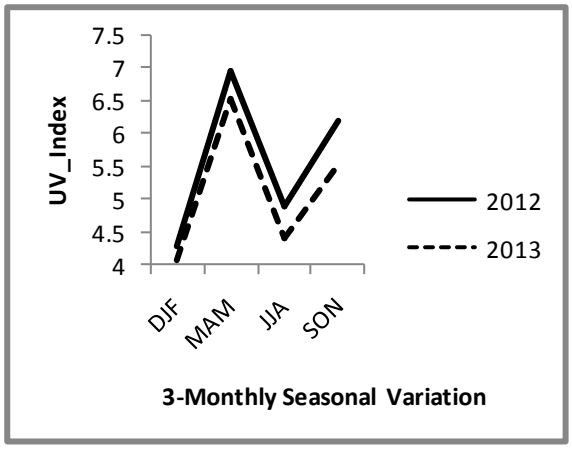


Figure 3: Correlation of Seasional Variation

4. Conclusion

The UV Index is a useful tool in taking steps to reduce exposure to solar UV radiation, but its effectiveness depends on how well the information is communicated to the public. We observed that sun's UV rays are strongest between 11 a.m. and 1 p.m. The study therefore come up with the following recommendations for protection against UV during periods with high UV index: Generously apply sunscreen with SPF of at least 15 to all exposed skin in order to provide a broad- spectrum protection from both ultraviolet A (UVA) and ultraviolet B (UVB) rays. Reapply every two hours, even on cloudy days, and after swimming or sweating. Wear protective clothing such as long sleeve t-shirts, pants, hats and sunglasses where possible, these will help protect you away from the direct contact of the sun.

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