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The UV Index in Zacatecas City

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Abstract: The UV Index is a measure of the intensity of UV radiation on the Earth's surface and an indicator of its ability to produce skin lesions, which serves as an important vehicle to raise awareness in the population and warn people of the need to take protective measures when exposed to UV radiation [1]. Ultraviolet (UV) rays they are invisible to the human eye and are classified according to their wavelength. It should be noted that the shorter the wave, the more intense is the energy of the solar rays. They are divided into three types: UVA, UVB and UVC. UVB radiation is the main cause skin cancer. The objective of this research is to quantify the UV Index in Zacatecas city. The methodology consisted in collecting ultraviolet radiation (UVB) data in the period from January 1 to December 31, 2018, using a 501-A Biometer from Solar Ligth, installed in the Zacatecas_04 solarimetric station belonging to the System National of Solarimetry, located in Building E6 of the UAZ Siglo XXI Campus. Later the data was transformed into the UV Index using the conversion factor of 2.332 (Med/h to W/m² to IUV). The results that were obtained in the span of time evaluated had a 26.14% moderate UV Index, 4.01% very high UV Index and 0.02% UV Index extremely high. Exposure to UVB begins most intensely from 10:00 am to 2:00 pm. Concluding, that the average height above sea level of Zacatecas city, coupled with the low presence of atmospheric aerosols allow UVB is high and when converted to UV Index in the evaluated period is high.

Key words: Index UV, Zacatecas, biometer

1. Introduction

The Zacatecas city is located at a 22°46´18" N Latitude and 102°34´31" O Longitude. The average altitude is 2460 m snm. The climate is temperate, with precipitation mainly in summer, with precipitation Annual Average of 400 mm. The average temperature is 12°C.

Strong in winter are common winds that accentuate the thermal sensation, in the city the majority of the commerce is centered and around it find the little industry of the state. The work carried out by García et al. on irradiance in the city of Zacatecas from 2007 to date found that the potential of solar energy as an alternative source of energy It is excellent, which also leads to reflection. What is ultraviolet radiation like in this region? Market Stall that if the solar potential is high, therefore, the radiation is high in all its wavelengths including the ultraviolet region.

Ultraviolet (UV) rays are invisible to the human eye and are classified according to their wavelength. It should Note that the shorter the wave, the more intense the energy from the sun's rays. These are divided into three types: UVA, UVB and UVC. UVA rays have a long wavelength, between 320 and 400 nm, which pass through the atmospheric layers and are increasingly filtered to a lesser extent by the ozone and clouds. They affect the Earth's surface throughout the day. These penetrate into the deep layers of the skin, activating the production of melanin and causing tanning, but when penetrating the skin, this type radiation destroys collagen which gives elasticity to the skin and cause premature aging, blemishes and precancerous lesions. UVB rays are medium wavelength rays that are in the range 280 to 320 nm. These are largely absorbed by the ozone layer and moderately blocked by the clouds, but nevertheless reach the earth's surface. The most intense schedule for this type of radiation is between 10:00 a.m.

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and 4:00 p.m. When interacting with the human body, this type of radiation penetrate the upper layer of the skin causing burns and blisters. Therefore the UVB radiation is the main cause of skin cancer. Lastly, UVC rays are rays of short wave that ranges between 200 and 280 nm, are potentially dangerous and extremely aggressive for humans. They do not reach the earth's surface because they are absorbed and retained by the ozone layer.

Ultraviolet radiation and the damage it causes in humans [2]. The largest organ of the human body is the skin, for an adult the approximate surface is 2 m^2 and his weight is very close to 5 kg. Solar radiation is one of the most important factors that damage the skin, mainly the ultraviolet. Exposure to light causes degenerative, allergic changes, immunosoppressors and carcinogens [3]. Ultraviolet radiation corresponds to only a small part of the solar spectrum. However, it can produce significant changes in some biological functions, this is due to the high energy possessed by its photons. These changes can manifest as severe damage to living things, such as DNA replication failures, skin lesions, premature skin aging, etc. (Fig. 1).

The OMS, recommends the protection system for the five different levels of radiation which occurs in Table 1, which was taken up by Olarte et al. (2015) and is taken as support for this work [4].

Roy et al. (1998), used SRM spectroradiometers to measure ultraviolet solar radiation, due to the high rates of skin cancer since the mid-1980s [5]. Diffey

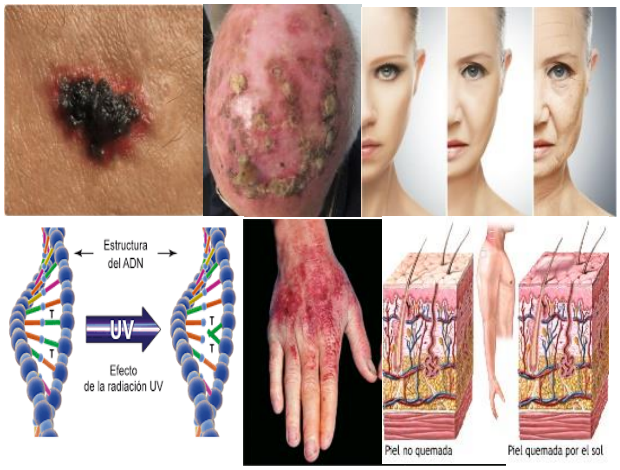

Fig. 1 The interaction of RUVs and the human body [2].

Table 1 OMS recommended sun protection system [4].

UV Index	Protection	Sunscreen action
0-2	Low	Minimum sun protection. More than an hour exposed to sunlight. I know requires gloves and sunscreen.
3-5	Moderate	Take precautions. Wear a hat, sun protection glasses if exposure to the sun for 45 minutes or more.
6-7	High	Protection is required such as hat, glasses and protective cream sun, for skin damage caused by exposure for more than 30 minutes. Reduce sun exposure time between 11:00 and 16:00 hours.
8-10	Very High	Extreme caution is required. Wear a hat, glasses and cream sun protection, otherwise the skin may be damaged and burns if exposed to sunlight for more than 20 minutes. Avoid solar radiation between 11:00 and 16:00.
> 11	Extreme	Take all necessary precautions. Damage and burns on the skin without being protected they appear in minutes. Avoid the sun exposure between 11:00 and 16:00.

presented in his I work the biological effects of UV radiation, using an optically filtered xenon arc lamp or fluorescent lamps to simulate the UV component of sunlight in order to control the experimentation [6].

Vallejo D. Luís (2003), presented a study of the Ultraviolet Index (IUV) in Chile. In addition, he explained the physical meaning of the IUV, as well as the main factors that affect it [7]. Pinedo et al. (2006) [8], carried out an analysis of the ultraviolet spectral irradiance recorded in the city of Zacatecas. To obtain the spectra, a Bentham radiometer was used. The measures they showed relatively high levels of ultraviolet irradiation [8].

2. Material and Methods

Ultraviolet radiation (UVB) data were obtained in the period from January 1 to December 2018. A 501-A Biometer from Solar Ligth was used to measure UVB (Fig. 2), which is installed in the Zacatecas_04 solarimetric station of the National Solarimetric

Fig. 2 Solar ligth 501-A biometer.

System, located in the Building E6 of the UAZ Siglo XXI Campus. Data was recorded on a Campbell Scientific CR-3000 datalogger, they take every two seconds and are recorded every minute (the average). Then the data is transformed into the UV Index using the conversion factor of 2,332 UVB (1 MED/h = 0.0583 W/m² and 1 IUV = 0.025 W/m²). They are then averaged by the hour, by the day, by the week, and by the month. They are analyzed and interpreted results obtained.

3. Results and Discussion

In Fig. 3, the distribution of the UV Index in the period from January 1 to December 31 2018 registered at the UAZ Siglo XXI Campus. According to the O.M.S. classification, the following percentages throughout the period: Low 50.84%; Moderate 26.14%; High and 18.01%; Very high 4.01% and Extreme 0.02%.

The Fig. 4 shows the average UV Index per hour in the evaluated period. It is observed that the form geometric figure, has a negative bias. The incidence of UVB radiation starts at 6:30 am and It ends at approximately 7:30 p.m. Exposure to UVB radiation with greater intensity is between 10:00 am and 2:00 pm.

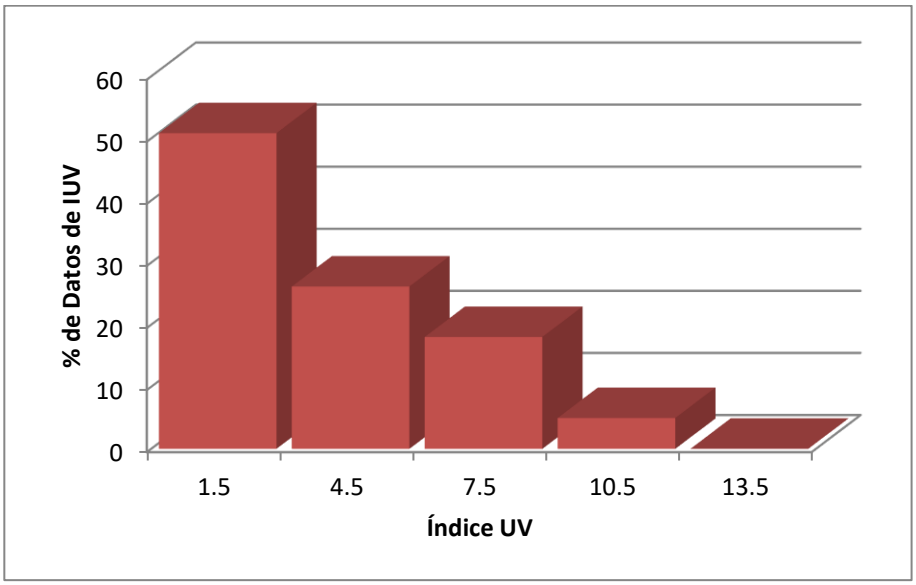

Fig. 3 Distribution of the UV Index in the period from January 1 to December 31, 2018.

In Fig. 5, September 9 is shown, in which the highest UV Index was presented in the evaluation period. The maximum reached in the reading was at 12:34 pm with a value of 14.27.

The Fig. 6 presents the monthly average UV Index of UV radiation. It is observed that from February on increases until reaching a maximum in May, decreasing until September.

According to Vallejo (2003), UV radiation increases with altitude because the amount of absorbers in the atmosphere decreases with height. The measurements made by He demonstrated that UV radiation increases between 6% and 8% per 1000 m [7]. Based on what above, implies that the height above sea level of Zacatecas city must contribute to increasing UV radiation above 8%.

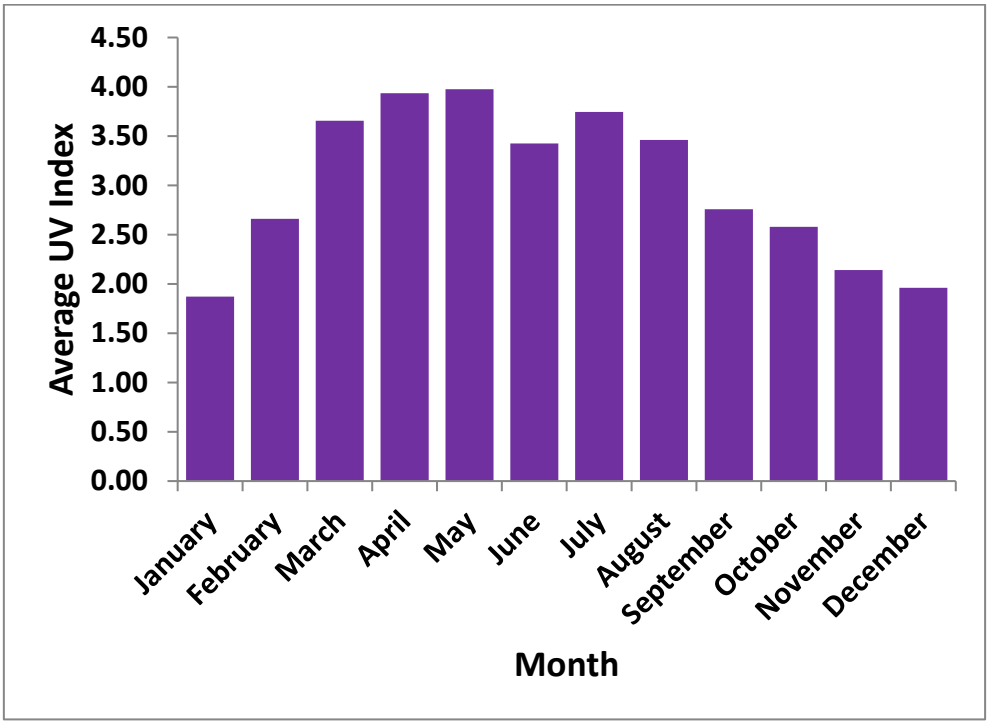

Fig. 4 Average UV index per hour in the period from January 1 to December 31, 2018.

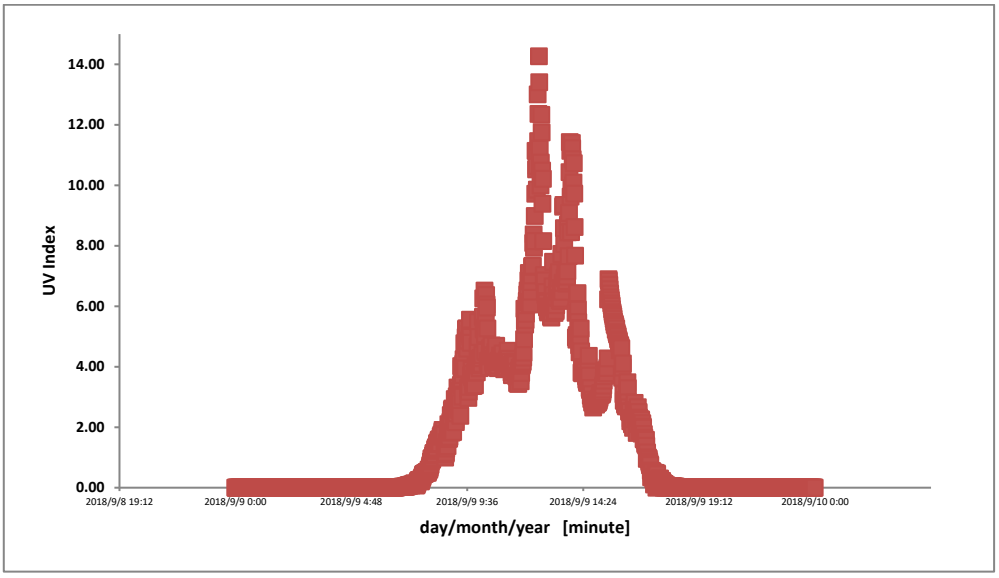

Fig. 5 UV index chart for September 9, 2018.

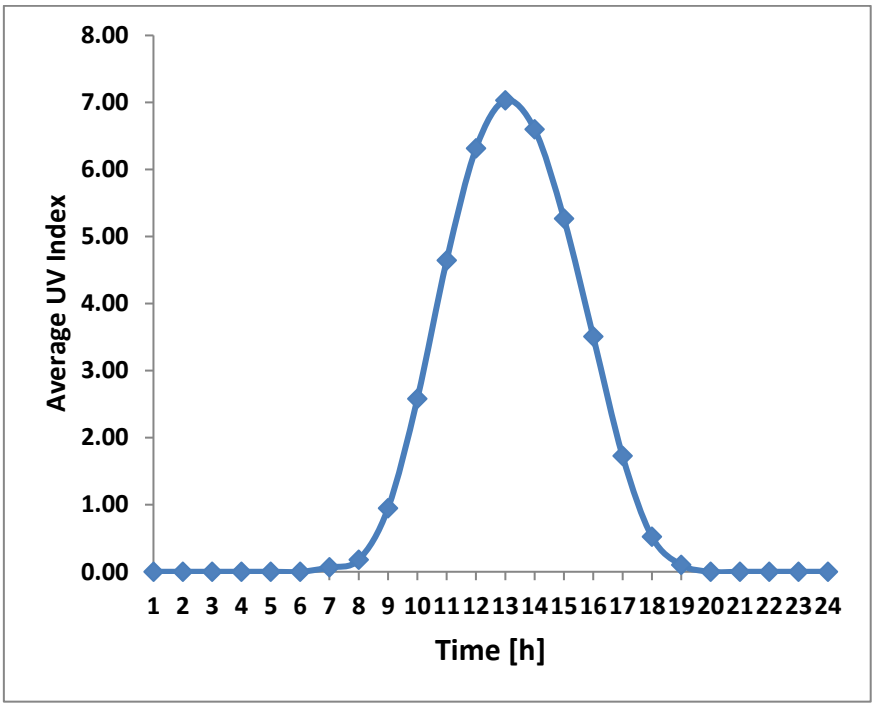

Fig. 6 Average monthly UV index of UV radiation received per day.

4. Conclusion

The clearing of the sky, the low presence of atmospheric aerosols, the average height above sea level of the city of Zacatecas, the UV Index throughout the evaluated period is from Moderate to High. The months with the highest UV index are from March to July, although extreme instantaneous values are presented in May, June and September close to solar noon. According to the O.M.S. preventive protection (hat, long sleeve, hat and in some cases glasses, in addition to sunscreen) and the population must be informed to take the necessary and sufficient care. Every effort should be made to ensure that the population reduce the time of unnecessary sun exposure between 11:00 and 16:00.

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