

Ultraviolet Radiation Index and Health: You owe Protect!



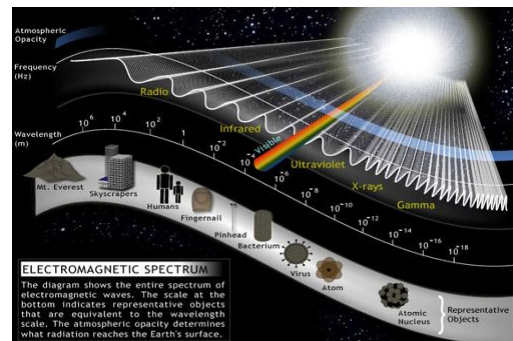
Would you know how to tell which ones the dangers to the if do expose daily in the sun? Had which are the effects cause by ultraviolet solar radiation to our skin and to our eyes? It was to answer these and other questions that we elaborate this matter so that you can have useful information to interpret and to use UVI for your protection. Moreover, you will have material about UV radiation effects on human health, as you protect, besides other subjects as artificial tanning and sun block.

What is Ultraviolet Radiation?

The Sun, the biggest nature radiation source, emits energy through a wavelength wide band (electromagnetic spectrum). The wavelength is measured by distance among propagation waves crests. How much smaller the wave length, larger the energy intrinsic quantity, that can be translated in penetration larger capacity.

The Ultraviolet Radiation (R-UV) is a small part of this radiation emitted by the sun. It just corresponds 7% from the total emitted by sun (between 100nm and 400nm), but we do not let deceive by numbers, because even in small quantities affects strongly the biological systems (plants and animals) and, thence, has fundamental great in the health, comfort and life quality of people.

Part of the ultraviolet radiation originating of the sun is absorbed by atmosphere, more specifically by ozone layer and the ultraviolet name is due to the fact of this radiation kind be next to the ghastrly band of the radiation by violet color, but, actually, is invisible to the human eyes.



And, being invisible, are many times carried to think we are not being exposed to it, when actually it is present in great intensities in the largest part of the day, over all in situated regions near to the tropics as Brazil's Case.

Types of Ultraviolet Radiation

The band of the electromagnetic spectrum that comprehends UV-R is subdivided in three different kinds: UVA, UVB and UVC. This differentiation gives regarding the wavelength band, being UVC with length of short wave and UVA with length of long wave.

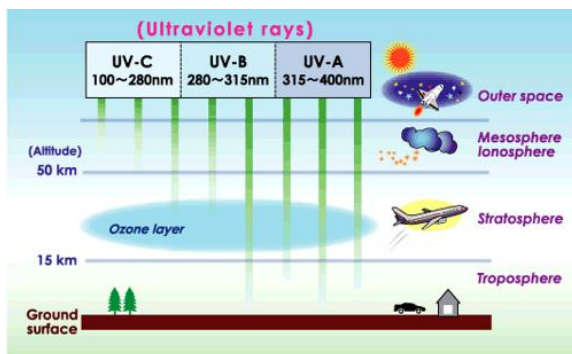
We will know a little more about each type of UV radiation.

UVA Radiation (wavelength between 315 and 400 nm). The atmosphere is very permeable to this radiation band. This way, good part of the UVA radiation that reaches to superior layer of the atmosphere gets crosses it with little decrease. It is very little absorbed by ozone layer. It penetrates deeply in the skin layers causing damages to our health.

UVB Radiation (wavelength between 280 and 315 nm). The ozone layer absorbs good part of the UVB radiation that arrives to earth. Even in small quantities can be substantially harmful to the health. It does not penetrate so deeply in the skin regarding to the UVA radiation.

UVC Radiation (wavelength between 100 and 280 nm). It is totally absorbed by ozone layer and isn't reason of still preoccupation. It is highly penetrant and harmful to the health, and we would have serious problems if reached to terrestrial surface.

The illustration below allows to observe the intensity with which UVA, UVB and UVC radiations reach to surface of our Planet.



Equipment for UV Radiation Measurement

There are two forms of if determine Ultraviolet Radiation (UV-R) level of that arrives to the earth surface.

The first uses instruments installed in the soil that measure directly UV-R quantity that is reaching earth surface. This mensuration kind informs us on UV-R quantity in a certain place. The number of instruments installed in the soil is limited not only by cost, but by access difficulty to many place in the globe and because UV-R quantity can vary a lot of a location by another. Various different instruments are available for R-UV direct mensuration, such as spectrophotometer, biometer, radiometer, among another.

The second form of measuring UV-R levels that reach the earth surface is through estimate with base in the ozone mensuration and of the cloud coverage, among other parameters, accomplished by satellites.

The choice of which mensuration instrument use will depend, mostly, of the application that obtained information will have: Research, monitoring, divulging of UV index to the population, industry, etc.



Instruments of UV direct measurement.



Indirect forms of UV measurement.

What is Ultraviolet Index?

The Ultraviolet Index (UVI) was developed by American Meteorological Service (NWS) and by Environmental Protection Agency (EPA), both of United States in 1994.

UVI is a UV radiation intensity measure, important to the effects on human skin, reaching the surface of the earth. It represents the daily maximum value of the ultraviolet radiation. That is, at period regarding the solar noon, the maximum intensity horary of solar radiation.

As cloud coverage is something very dynamic and variable, UVI is always presented for a condition of clear sky. That is, for cloud absence that, in most cases, represents the radiation maximum intensity.

Actually is a simple form of quantify the intensity of ultraviolet radiation, avoiding the energy units employment, what could complicate its comprehension and to limit its use.

So, it facilitates that people through a number can plan their outdoors activities, of manner to avoid excessive exposure to the UV radiation and, consequently, decrease the risks of suffering their novice effects.

To quantify this intensity, it was adopted a scale of entire numbers for the UV index variable from 1 to 15, being **indicative smaller values of low intensity and larger values for high intensities.**

According to World Health Organization (WHO) recommendations, these values are grouped in intensity categories, as shows the table below.

CLASS	ULTRAVIOLET INDEX
LOW	< 2
MODERATE	3 a 5
HIGH	6 a 7
VERY HIGH	8 a 10
EXTREME	> 11

But, Why to Create an UV INDEX?

We know that each person owns a kind of different skin and in sight of this has distinct sensibility. A Negro, for example, can get more time exposed in the sun without running risks than a person of clear skin.

We can imagine the intensity as if went radiation doses. Thus, different people (kinds of skin) must expose to these doses by a time period, otherwise run the risk of have serious problems of health.

Because of this, the most correct form to speak on UV index is associate it to its specific type of skin and, from there onwards, checks which quantity of "safe" time that you can to expose in the sun without running risks of suffering burns or more serious lesions.

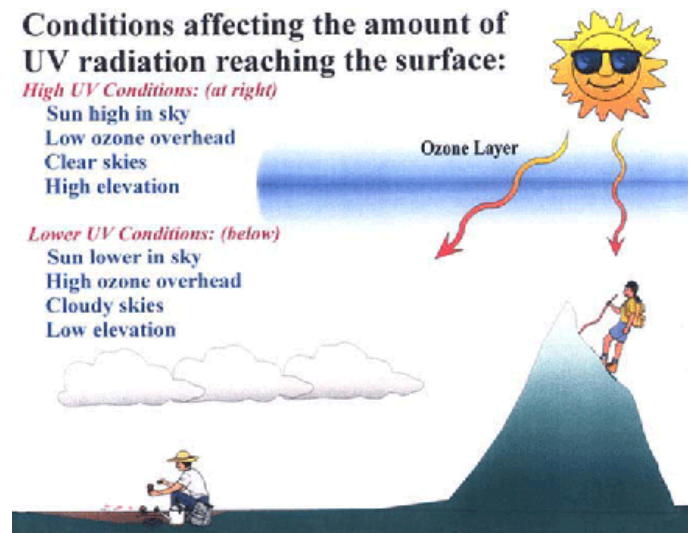
Therefore, the UV index serves to alert about the need to protect us to execute outdoors habitual activities, since excessive exposure owns ranks varied of risks, due to its effect in skin and in eyes.

Do you know how UVI is calculated?

The UV radiation levels that reach the earth surface can vary depending on several factors. Each one of the factors below can increase its risk of an excessive exposure and consequently affect its health. This way, they are essential for UVI Calculation.

- 🌐 **Stratospheric Ozone Layer:** Gas ozone concentration in the high atmosphere.
- 🌐 **Altitude:** In high altitudes are subject to doses more elevated of UV radiation.
- 🌐 **Time of Day:** From 10 a.m. and 4 p.m., when the sun is more 'high' in the sky, the UV radiation intensity is larger.
- 🌐 **Season:** Winter's days, the UV radiation is a little smaller compared to the summer's days.
- 🌐 **Surface or Soil Coverage:** Snow and sand reflect much radiation and can increase very to exposure to the UV rays.
- 🌐 **Cloudiness:** The clouds percolate part of the UV radiation, but must care us same in cloudy days.
- 🌐 **Geographical Location:** Tropical regions are subject to UV radiation doses very larger than tempered regions.

The illustration next show as each factor acts decreasing or increasing to UV radiation incidence.



Source: www.dermatology.cdlib.org.

For a same region, the factors that contribute to increase or to decrease the UV radiation incidence are basically **the time of day, season, cloudiness** and **surface type** (or soil).



IUV Calculation

All these characteristics mentioned before are carried in account as entrance parameters at computational model used to UVI Calculation. The spectral irradiances (energy quantity by area unit and by wavelength) are calculated from the entrance parameters: Ozone quantity (evaluated according to the surface level regarding the sea level), sun position, kind surface and clouds and aerosols coverage.

This spectral irradiance is pondered by answer of the human skin to the ultraviolet radiation, named Action Spectrum Erythemic. That spectrum corresponds to the biological "answer" of human skin to this kind of radiation. Once pondered, by irradiance - now called from Erythemal Irradiance - is integrated in the spectral interval between 280 and 400nm (UVB and UVA).

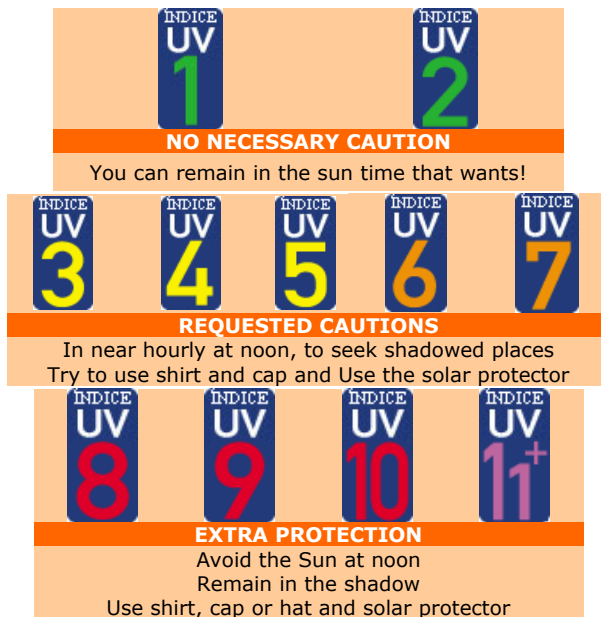
Mathematically has that:

$$IUV = C \int_{280nm}^{400nm} E_{\lambda} \epsilon_{\lambda} d\lambda$$

Where E_{λ} is spectral irradiance in the surface ($W/m^2/nm$), ϵ_{λ} is action spectrum Erythemal and **C** is the constant of equivalent conversion to $40 W/m^2$.

Thus, UVI nothing more belong than a format simplified by presentation of irradiance Erythemal. Each UVI unit corresponds to 25 mW/m² of energy.

Interpretation of the UVI Value



UV-R Effects on the Skin

The reactions of the human skin to the exposure to UV-R can be classified as acute (immediate) or chronic (long time). The acute reactions, like burnings, tan and production vitamin D, develop and disappear quickly; while the chronicles, like skin photo-aging and cancer, have gradual appearance and long time.

The difference between both reactions is due to, mostly, historical of person exposure and to the different wavelengths of UV-R, once that UVB-R is about 1,000 times more "aggressive" than UVA-R. This difference makes with that UVA-R have a contribution of only 15 to 20% in the responsible energy quantity by burning.

UV-R Effects on the Eyes

Of the same way that ultraviolet radiation can cause damages to the human skin, also can cause or to intensify problems and diseases on the eyes.

By and large, the excessive exposure to any type of radiation can carry to some type of prejudice to the eyes health. Table below presents, according to the radiation spectrum, a summary on these possible problems:

Spectrum	Affected Tissue	Absortion Place	Type of Damage
UVC/UVB	Cornea	Epithelium	Photochemical: Photoqueratite and córnea opacities.
UVB/UVA	Crystalline Lens	Nucleus	Photochemical: Catarata.
Visible	Retina	Epithelium pigmentary	Thermal: Vision decrease.
		Haemoglobin	Hemorrhage intraocular.
IRA	Retina	Pigment blemish	Changes in the color perception.
		Epithelium pigmentary	Thermal: Vision decrease.
IRB	Cristalline Lens	Epithelium	Catarata.
		Epithelium	Opacities.
IRC	Cornea	Epithelium	Superficial Burnings.

Source: Adapted of Vergaz, 2001.



Solar Protector

The current solar protectors are more resistant to the water and to the sweat. Should apply a generous quantity, 30 minutes before leaving home, and reapplies it to each 1 or 2 hours, mostly during sun peak horary and more frequently after swimming or exercise.

The protector should be used in all parts of the exposed skin in the sun, including ears, costa, shoulders, posterior regions of the knees and legs.

We have to have in mind that the solar protectors do not serve so that you 'be more time in the sun'. Use it as protection agent and always avoids exposing at the Sun excessively. It is important to use, besides solar protector, other protection options: t-shirts, hats and to seek for shadow.

What is SPF?

SPF is the acronym for "Sun Protection Factor". It indicates how long you can get safely exposed at the sun, regarding the case of do not use any kind of protection. That is, if SPF is equal to 8 means that using product correctly you can expose a period of 8 times longer than if did not use any protection.

Studies show that generally people do not apply correctly the solar protectors. Do not forget: The minimum factor of adequate protection is SPF 15 where should be applied generously 30 minutes before exposure at the Sun. The product should be reapplied every two hours.

Artificial Tanning

UVA radiation (UVA-R) can penetrate in more deep layers of the skin, causing direct damages to the blood vessels, reducing the skin elasticity and of the collagen. So, UVA-R is main responsible by premature aging of the skin, causing laxity, wrinkles and stains.

Moreover, also can cause cornea inflammations and retina damages, decrease number of immunological cells of the organism and, according to some studies, also can cause skin cancer.

The tanning chambers are a source of UVA-R more powerful than the sun, intensifying harmful effects caused by that type of radiation. Thus, the best form of protect us, and do not spend money, is to avoid that tanning type and to follow advices of the sun protection.

Myths & Facts

MYTH	The tan by the sun is healthy. Tanning you are protected of the harmful effects of the sun	FACT	The tanning corresponds to a defense's skin mechanism against the ultraviolet rays. Any change in the skin color is a damage signal
MYTH	You does not suffer solar burn in cloudy days	FACT	The solar burn is possible in cloudy days. About 80% of the ultraviolet radiation can penetrate through clouds little dense
MYTH	The ultraviolet radiation in the winter is not important	FACT	The intensity of the ultraviolet radiation in the winter is little minor, however is enough to cause serious damages to the skin
MYTH	The solar protector protects you so much that you can take sun-bath by more time	FACT	The solar protector should not be used to increase time of exposure at the sun, but to increase the protection for an inevitable exposure
MYTH	If you do intervals during the sun-bath, you will not suffer burns	FACT	The exposure to the ultraviolet radiation has an accumulative effect
MYTH	If you do not feel the hot sunbeams, you will not suffer solar burn	FACT	The solar burn is caused by ultraviolet rays, that cannot be felt. The heat sensation is caused by infrared rays
MYTH	The skin cancer only occurs in the parts of the body that are continually exposed at the sun	FACT	The melanoma generally occurs in the back (man) and legs (women) that are exposed local intermittently at the sun
MYTH	The skin cancer only happens in people with very clear skin	FACT	The skin cancer commonly occurs in people who tan before burning

If you want to know more (in Portuguese):

CPTEC/INPE. Radiação Solar, Camada de Ozônio e Saúde Humana. <http://satelite.cptec.inpe.br/uv/>.

Programa Sol Amigo. Programa de educação continuada em saúde, que tem como objetivo ensinar as pessoas a se protegerem adequadamente da exposição excessiva ao sol <http://solamigo.com.br>.

LEPA/DMET/IGEO/UFRJ. Página sobre Radiação UV da Universidade Federal do Rio de Janeiro <http://www.indiceuv.ufrj.br>.

SBD. Portal da Sociedade Brasileira de Dermatologia o Índice Ultravioleta e a Prevenção do Câncer de Pele. <http://www.sbd.org.br/campanha/cancer/ultravioleta.asp>

Laboratório de Ozônio/INPE. Página que apresenta estudos da Camada de Ozônio e da radiação Ultravioleta. <http://www.dge.inpe.br/ozonio>.

Os Perigos dos Raios Ultravioletas. Matéria sobre os efeitos nocivos da R-UV sobre a saúde humana - *Revista Super-Saudável*, 5, 30-31, 2001. Link: http://satelite.cptec.inpe.br/uv/documentos/Super_Saudavel.jpg.

DSA/CPTEC. Projeto de Monitoramento e Previsão do IUV e Conteúdo de Ozônio (Guia do usuário). http://satelite.cptec.inpe.br/uv/documentos/UVSIM_leiam_e.pdf.

CORRÊA, M. P., 2003. **Índice Ultravioleta: Avaliações e Aplicações.** São Paulo, 247p. Tese (Doutorado em Ciências), DCA/IAG/USP. Link: http://satelite.cptec.inpe.br/uv/documentos/Tese_mpcorr_ea.pdf.