Cancer Association of South Africa (CANSA)

Research • Educate • Support

Fact Sheet
on
Solar Radiation and Skin Cancer

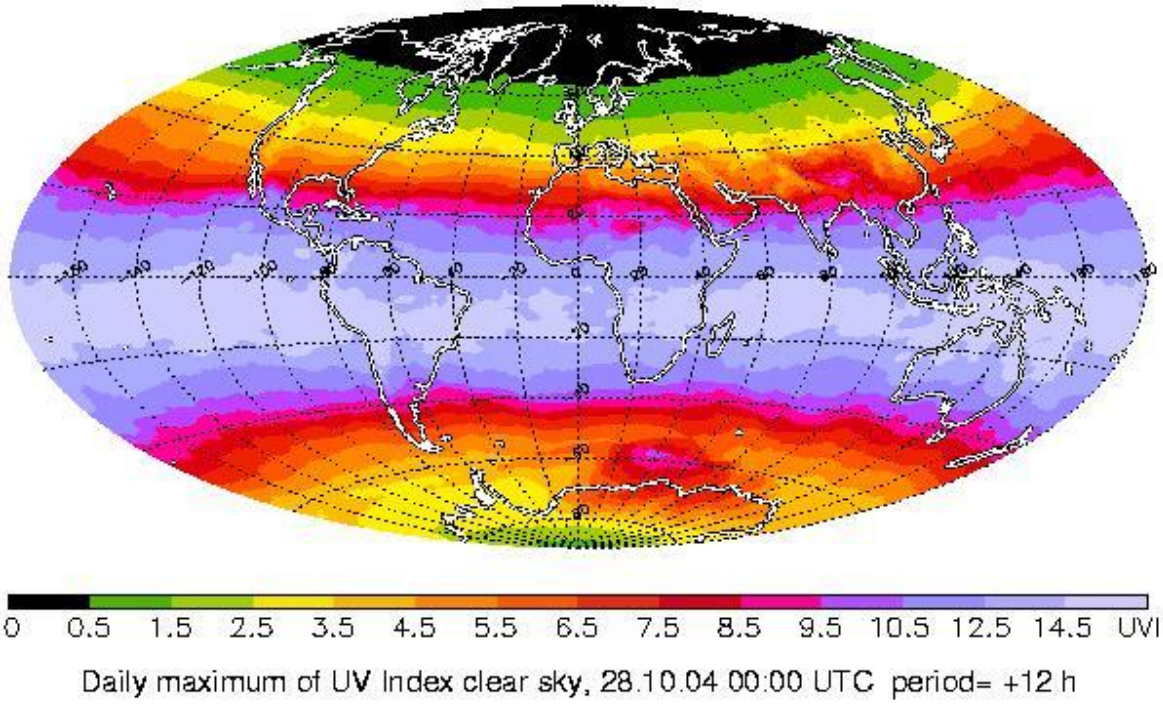
Introduction

Solar radiation is more than the light and heat that we perceive from the sun. The sun is a star and it produces energy in many forms, from perceptible heat, visible and invisible spectrums of light, radiation, and more. Life on earth would be impossible without the sun, but our atmosphere also protects us from the more dangerous aspects of solar radiation.

Humans tend to have a love-hate relationship with the sun. On the one hand, sunlight keeps us warm, creates food and shelter for us via plant life, and gives us light. On the other hand, as greenhouse gases trap more heat and the ozone layer allows more dangerous ultraviolet (UV) light through, the sun's rays can be distinctly dangerous (American Cancer Society). UV rays cause skin cancer in humans and animals, but can contrastingly improve other skin conditions like psoriasis (Psoriasis-Aid.Com). Humans need the sun biologically, as well, as it causes our bodies to produce vital Vitamin D (About.Com).

World Ultraviolet Radiation Map

[Picture credit – World UVR Map]



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The Sun is the centre of our galaxy both literally and figuratively. The sun is approximately 149 million kilometres away, sending its energy to the Earth in about 8 minutes. This energy is a combination of both light and UV rays. Known as a yellow dwarf star in the astronomy world, the sun is busy converting hydrogen to helium at its core by way of nuclear fusion. The result of this action is energy (Suntan.Com).

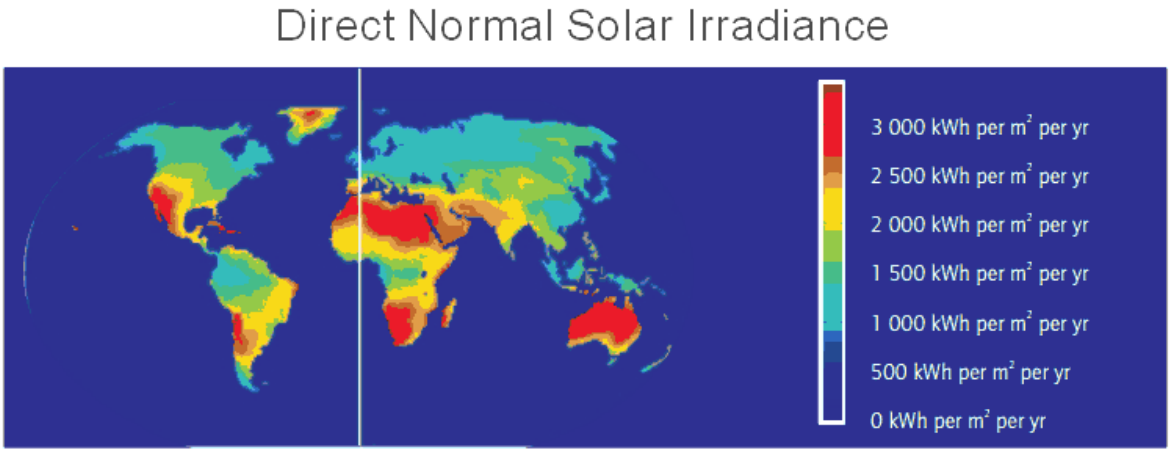
Solar radiation and sunlight make it possible for the earth to house life (NASA). The negative aspects of our relationship with the sun are primarily the result of human irresponsibility: we develop skin cancer when we ignore our bodies' signals to avoid sunlight, while we rather struggle with global warming because we have ignored the environmental concerns of our actions. When we do not give solar radiation the respect it deserves, we are literally playing with fire (Solarradiation.Net).

Solar Radiation

Solar radiation is thermal radiation emitted from the surface of the sun, which is powered by nuclear fusion. It is radiant energy emitted by the sun which comprises mostly of electromagnetic energy. About half of the radiation is in the visible short-wave part of the electromagnetic spectrum. This is the part of light that can be seen by the human eye. The other half of solar radiation is mostly in the near-infrared part, with some in the ultraviolet (UV) part of the spectrum (WordIQ.Com).

Solar Radiation – Direct Normal Solar Irradiance

Below is a world chart indicating the direct normal solar irradiance. It provides information explaining why the Western/Northern Cape has such a high incidence of melanoma.



[Picture Credit: Direct Normal Solar Irradiance]

Classification of Electromagnetic Energy

The electromagnetic spectrum is divided into several parts:

- *Electric Power* – electric power covers the low-frequency, long-wavelength end of the spectrum. It is usually ducted along 2-wire and 3-wire transmission lines and is what we use to power up items in our homes.

- *Radio Waves* – radio waves are generally utilised by antennas of reasonable size, so their wavelengths range from hundreds of metres to about one millimeter. The different parts of the radio spectrum are called bands. Television (TV), mobile phones, wireless networking and amateur radio all use Radio Waves.

- *Microwaves* – microwaves are waves which are typically short. It is produced with Klystrom and Magnetron tubes. Microwaves are absorbed by molecules that have a dipole moment in liquids. In a microwave oven, this effect is used to heat food. Low-intensity microwave radiation is used in Wi-Fi. An average microwave oven in active condition is, in close range, powerful enough to cause interference with poorly shielded electromagnetic fields such as those found in mobile medical devices and cheap consumer electronics.

- *Infrared Radiation* – the infrared part of the electromagnetic spectrum covers three main parts:

    - Far-infrared
    - Mid-infrared
    - Near-infrared

- *Visible Radiation (Light)* - after infrared comes visible light. This is the range in which the sun and stars, similar to it, emit most of their radiation. The different colours that the human eye can see all have a different wavelength.

- *Ultraviolet (UV) Light* – this is radiation of which the wavelength is shorter than the violet end of the visible spectrum. Being very energetic, UV can break chemical bonds, make molecules unusually reactive or ionize them, in general changing their mutual behaviour. Sunburn, for example, is caused by the disruptive effects of UV radiation on skin cells, which can cause skin cancer by damaging the complex DNA molecules in the skin cells. The sun emits a large amount of UV radiation, which could quickly turn earth into a dead desert, but most of it is absorbed by the atmosphere's ozone layer before reaching the surface of the earth.

- *X-Rays* – hard X-rays (highest energy X-rays) are of shorter wavelength than soft X-rays (low energy X-rays). X-rays make it possible for us to 'see' through some things and not others, as well as for high-energy physics and astronomy. Black holes and neutrons emit x-rays, which enable us to study them.

- *Gamma Rays* – these are the most energetic photons, having no lower limit to their wavelength. They are useful to astronomers in the study of high-energy objects or regions and find a use with physicists thanks to their penetrative ability and their production from radio-isotopes (WordIQ.Com).

Health Effects of Ultraviolet Radiation

Small amounts of UV are beneficial for people and essential in the production of vitamin D. UV radiation is also used to treat several diseases, including rickets, psoriasis, eczema and

jaundice. This takes place under medical supervision and the benefits of treatment versus the risks of UV radiation exposure are a matter of clinical judgement.

Prolonged human exposure to solar UV radiation may result in acute and chronic health effects on the skin, eye and immune system. Sunburn (erythema) is the best-known acute effect of excessive UV radiation exposure. Over the longer term, UV radiation induces degenerative changes in cells of the skin, fibrous tissue and blood vessels leading to premature skin aging, photodermatoses and actinic keratoses. Another long-term effect is an inflammatory reaction of the eye. In the most serious cases, skin cancer and cataracts can occur.

Between 2 and 3 million non-melanoma skin cancers, e.g. basal cell carcinomas and squamous cell carcinomas, are diagnosed each year, but are rarely fatal and can be surgically removed. Approximately 130,000 malignant melanomas occur globally each year, substantially contributing to mortality rates in fair-skinned populations. An estimated 66,000 deaths occur annually from melanoma and other skin cancers.

Worldwide some 12 to 15 million people become blind from cataracts annually, of which up to 20% may be caused or enhanced by sun exposure according to WHO estimates. Furthermore, a growing body of evidence suggests that environmental levels of UV radiation may suppress cell-mediated immunity and thereby enhance the risk of infectious diseases and limit the efficacy of vaccinations. Both of these act against the health of poor and vulnerable groups, especially children of the developing world. Many developing countries are located close to the equator and hence, people are exposed to the very high levels of UV radiation that occur in these regions.

It is a popular misconception that only fair skinned people need to be concerned about overexposure to the sun. Darker skin has more protective melanin pigment, and the incidence of skin cancer is lower in dark skinned people. Nevertheless, skin cancers do occur with this group and unfortunately they are often detected at a later, more dangerous stage. The risk of UV radiation-related health effects on the eye and immune system is independent of skin type.

Global Burden of Disease from Solar Radiation

WHO has recently published a report entitled "Global burden of disease from solar ultraviolet radiation" that provides detailed estimates of UV-associated disease burden worldwide. Using established methodology and best available estimates on UV-related mortality and morbidity, this report estimates that annually around 1.5 mill DALYs (Disability-adjusted life years) are lost through excessive UV exposure. The report gives region, age and sex-specific estimates and includes detailed methodological considerations. A counterfactual zero population exposure to UV would generate a substantial burden of disease through diseases of vitamin D deficiency. This, however, is only a theoretical possibility since the large majority of people is casually exposed to UV radiation such that extremely low Vitamin D levels are rarely found (World Health Organization).

Grandi, C. & D'Ovidio, M.C. 2020.

"Near infrared or infrared A (IRA) accounts for over 40% of the solar spectrum (SS) and is able to reach subcutaneous tissue as well as the retina. Outdoor workers are occupationally exposed to solar radiation (SR), but the level of exposure may differ widely depending on the job performed, time spent outdoors, latitude, altitude, season, personal protection, etc. Until now, risk assessment and management for outdoor workers has focused on the prevention of both acute and long-term effects on the eye and the skin due to solar ultraviolet radiation (UVR) with little consideration of the other

components of the SS (a possible exception is represented by visible radiation with reference to the eye). A growing body of evidence coming from in vitro studies indicates that IRA is involved in cellular reactive oxygen species (ROS) production and may interfere with the respiratory chain in the mitochondria. Moreover, it can modulate gene expression and some metabolic pathways. The biological action of IRA is only partly attributable to a thermal mechanism, should it be also involved in photochemical ones. The cellular and molecular pathways affected by IRA are partly similar and partly different with respect to those involved in the case of visible ultraviolet A (UVA) and ultraviolet B (UVB) radiation. Consequently, the net effect of the SS is very difficult to predict at different levels of the biological organization, making more difficult the final balance of health risk and benefits (for the skin, eye, immune system, blood pressure, etc.) in a given exposure situation. Moreover, few in vivo studies and no epidemiological data are presently available in this regard. Investigating this topic may contribute to better defining the individual exposome. More practically, it is expected to bring benefits to the risk assessment and management for outdoor workers exposed to SS, contributing to: (1) better definition of the individual profiles of susceptibility, (2) more focused preventive and protective measures, (3) better implementation of the health surveillance and (4) a more effective information and training."

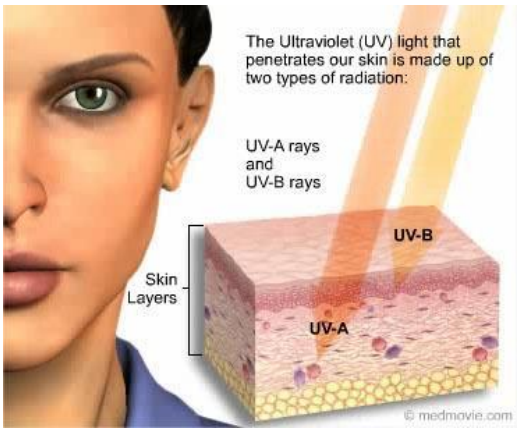
Ali, A., Khan, H., Bahadar, R., Riaz, A. & Asad, M.H.H.B. 2020.
"For several decades air pollution has been recognized to hit drastically the skin of human body. Air pollutants predominantly accountable for aging, oxidative damage, and inflammatory allergic reactions led to psoriasis, dermatitis, acne, and skin cancer owing to the impaired functions of DNA, proteins, and lipid biomolecules. Elevated air pollution and its detrimental effects along with variations in physiological parameters of the skin are verily the scaffold for anti-pollution assertions and could be recognized as markers. The present article encompasses the salient features of air pollution and UV radiations besides dreadful effects on human skin physiological parameters and some anti-pollution approaches."

Incidence of Skin Cancer in South Africa

According to the National Cancer Registry (2016) the following cases of skin cancer were histologically diagnosed in South Africa during 2016:

Group 2016	Type of Skin Cancer	Actual Number of Cases	Estimated Lifetime Risk	Total of All Cancers
All Males	Basal Cell Carcinoma	**8 263**	**1:16**	**21,15%**
All Females		**6 160**	**1:38**	**14,55%**
All Males	Squamous Cell Carcinoma	**4 285**	**1:39**	**10,95%**
All Females		**2 673**	**1:104**	**6,32%**
All Males	Melanoma	**951**	**1:183**	**2,92%**
All Females		**1 139**	**1:262**	**2,25%**

Please refer to the different Fact Sheets for information on the various skin cancers. They can be viewed at www.cansa.org.za.



[Picture credit – UVA & UVB Rays]

Ultraviolet (UV) radiation is electro-magnetic radiation of a wavelength shorter than that of the visible region (that which the human eye can see) of the electromagnetic spectrum. The name means 'beyond violet', violet being the colour of the shortest wavelengths of visible light.

The sun emits UV radiation in the UVA, UVB, and UVC bands, but because of absorption in the atmosphere's ozone layer most of the ultraviolet radiation that reaches the earth's surface is UVA (WordIQ.Com). In general, UVA contributes to the ageing of skin, DNA damage and possibly even skin cancer (Suntan.Com). It penetrates deeply and does not cause sunburn.

While ultraviolet B (UVB) rays, the main cause of sunburn, are the strongest in the summer, ultraviolet A (UVA) rays remain constant throughout the year. UVA rays account for up to 95 percent of the UV radiation reaching the Earth's surface. Although they are less intense than UVB, UVA rays are 30 to 50 times more prevalent, and go through glass, making sun protection necessary indoors as well as out.

A new study in 2010 by researchers at NYU School of Medicine found that UVA radiation damages the DNA in human melanocyte cells, causing mutations that can lead to melanoma. Melanocytes, which contain a substance called melanin that darkens the skin to protect it from the ultraviolet rays of the sun, are more vulnerable to UVA radiation than normal skin cells because they are unable to repair themselves efficiently (ScienceDaily).

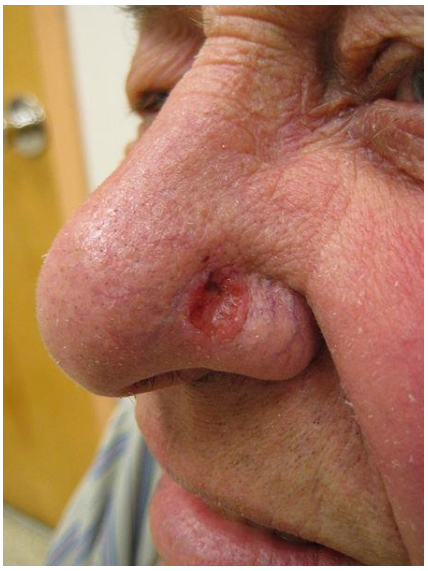
UVB radiation has been linked to skin cancers including melanoma. Researchers at The University of Texas M. D. Anderson Cancer Center have found that the risk of developing melanoma, the most deadly form of skin cancer, is only partially associated with exposure to ultraviolet B (UVB) radiation, the rays in sunlight that increase in summer and cause sunburn (ScienceDaily). The radiation ionises DNA molecules in skin cells and, thereby, damaging the DNA.

UVB radiation is also responsible for the formation of Vitamin D within the epidermis of the skin from pro-vitamin D3 (Meinhardt-Wollweber & Krebs).

South Africa has the second highest incidence of skin cancer in the world after Australia as far as Caucasians are concerned. The good news is that skin cancer can be prevented by respecting the sun. The three most common types of skin cancers are basal cell carcinoma (BCC), squamous cell carcinoma (SCC) and malignant melanoma (IOLNews).

Skin Cancer

There are three (3) most common types of skin cancers:



Basal Cell Carcinoma - Basal cell carcinoma, or basal cell skin cancer, is the most common form of cancer. Most skin cancers are basal cell cancer.

Basal cell carcinoma starts in the top layer of the skin called the epidermis. Most basal cell cancers occur on skin that is regularly exposed to sunlight or other ultraviolet radiation. This includes the top of your head, or scalp.

Basal cell skin cancer is most common in people over age 40. However, it occurs in younger people, too.

[Picture Credit: Basal Cell Carcinoma]

One is more likely to get basal cell skin cancer if one has:

- Light-coloured or freckled skin
- Blue, green, or grey eyes
- Blond or red hair
- Overexposure to x-rays or other forms of radiation
- Many moles
- Close relatives who have or had skin cancer
- Many severe sunburns early in life
- Long-term daily sun exposure (such as the sun exposure people who work outside receive).

Squamous Cell Carcinoma - Squamous cell carcinoma (SCC) is the second most common type of skin cancer. It begins in the squamous cells, which are found in the upper layer of the epidermis (skin). Fortunately, SCC is curable in 95% of cases if detected early.

[Picture Credit: Squamous Cell Carcinoma]

SCC primarily develops in fair-skinned, middle-aged and elderly people who have had long-term sun exposure. SCCs may also occur where skin has suffered certain kinds of injury: burns, scars, long-standing sores, sites previously exposed to X-rays or certain chemicals (such as arsenic and petroleum by-products). In addition, chronic skin inflammation or medical conditions that suppress the immune system over an extended period of time may encourage development of the disease. Finally, those who have been diagnosed with skin cancer previously are at a greater risk of recurrence. There are numerous less common risk factors for SCC as well (About.Com).

Malignant Melanoma - Malignant melanoma currently accounts for approximately 1% of all cancer deaths. However, the worldwide incidence of melanoma is increasing at a faster rate than any other neoplasm, with the exception of lung cancer in women.

[Picture credit – Melanoma]

South Africa has one of the highest incidences, if not the highest, of malignant melanoma in the world as far as Caucasians are concerned (at least similar to that of Australia). To date, we do not have accurate statistics, but the 2009 figure for the Cape is 69 new cases per year per population of 100 000 Caucasians, compared to 65 per 100 000 for Australia. This translates to one in 1 429 people developing a malignant melanoma. From 1990 to 1995, this figure was 22,2 per 100 000 for females and 27,5 per 100 000 for males. In the period 2000 – 2003, this rose to 33,5 per 100 000 for females and 36,9 per 100 000 for males (South African Melanoma Advisory Board).

Melanoma can affect all ethnic and racial groups; however, the typical melanoma patient has a fair complexion and a tendency to sunburn rather than tan, even after a brief exposure to sunlight. Although there is no conclusive evidence that exposure to sunlight is causally related to the development of melanoma, lesions are most commonly found on sun-exposed areas of the body. Other epidemiologic risk factors include the occurrence of a previous melanoma and an afflicted first-degree relative (parent or sibling) (Cancer News).

There is a definite link between the occurrence of breast cancer and melanoma. A link has recently also been established between certain prostate cancers and melanoma.

Shin, D.W. 2020.
"The skin protects our body from various external factors, such as chemical and physical stimuli, microorganisms, and sunlight. Sunlight is a representative environmental factor that considerably influences the physiological activity of our bodies. The molecular mechanisms and detrimental effects of ultraviolet rays (UVR) on skin have been thoroughly investigated. Chronic exposure to UVR generally causes skin damage and eventually induces wrinkle formation and reduced elasticity of the skin. Several studies have shown that infrared rays (IR) also lead to the breakdown of collagen fibers in the skin. However, several reports have demonstrated that the appropriate use of UVR or IR can have beneficial effects on skin-related diseases. Additionally, it has been revealed that visible light of different wavelengths has various biological effects on the skin. Interestingly, several recent studies have reported that photoreceptors are also expressed in the skin, similar to those in the eyes. Based on these data, I discuss the various physiological effects of sunlight on the skin and provide insights on the use of phototherapy, which uses a specific wavelength of sunlight as a non-invasive method, to improve skin-related disorders."

Spot the Spot
Check your skin carefully every month by doing a mole check - ask a family member or friend to examine your back and the top of your head. If you notice any of the warning signs, see a doctor or dermatologist immediately.

Warning Signs
The following A B C D E warning signs apply:

A-symmetry - a mole or mark with one half unlike the other - common moles are round and symmetrical
B-order irregularities - scalloped or poorly defined edges - common moles have smooth and even borders
C-olour variations and inconsistency – tan, brown, black, red, white and blue - common moles are usually a single shade of brown or black
D-iameter - larger than 6 mm
E-volving – changes in shape, colour or border of a mole

[Picture Credit: ABCDE Warning Sings]

High Risk Exposure
Everyone is at risk of getting skin cancer, although people with darker skins are less susceptible because their skin contains more natural melanin that protects against sun damage. People with fair skin, especially those with red hair, moles or skin spots as well as people with a personal or family history of skin cancer, or who play sport outdoors, work in the sun or spend a lot of time driving, are considered high-risk.

At least 80% of sun-induced skin damage occurs before the age of 18 and only manifests later in life. Therefore, it is imperative to take special care of children in the sun, whether it is at the pool, on the beach, at play or at school. Babies younger than one year should never be exposed to direct sunlight. When it comes to protecting the young ones, mothers of babies and toddlers; educators and caregivers can play an important role.

Skin Types
People of skin of colour comprise the majority of the world's population and Asian subjects comprise more than half of the total population of the earth.
The most obvious ethnic skin difference relates to skin colour which is dominated by the presence of melanin. The photoprotection derived from this polymer influences the rate of the

skin aging changes between the different racial groups. However, all racial groups are eventually subjected to the photoaging process.

Generally Caucasians have an earlier onset and greater skin wrinkling and sagging signs than other skin types and in general increased pigmentary problems are seen in skin of colour although one large study reported that East Asians living in the U.S.A. had the least pigment spots.

Changes in skin biophysical properties with age demonstrate that the more darkly pigmented subjects retaining younger skin properties compared with the more lightly pigmented groups. However, despite having a more compact stratum corneum (SC) there are conflicting reports on barrier function in these subjects. Upon a chemical or mechanical challenge the SC barrier function is reported to be stronger in subjects with darker skin despite having the reported lowest ceramide levels. Barrier function relates to the total architecture of the SC and not just its lipid levels.

Asian skin is reported to possess a similar basal transepidermal water loss (TEWL) to Caucasian skin and similar ceramide levels but upon mechanical challenge it has the weakest barrier function.

Differences in intercellular cohesion are obviously apparent. In contrast reduced SC natural moisturising factor levels have been reported compared with Caucasian and African American skin. These differences contribute to differences in desquamation but few data are available.

One recent study has shown reduced epidermal Cathepsin L2 levels in darker skin types which if also occurs in the SC could contribute to the known skin ashing problems these subjects experience.

The frequency of skin sensitivity is quite similar across different racial groups but the stimuli for its induction shows subtle differences. Nevertheless, several studies indicate that Asian skin may be more sensitive to exogenous chemicals probably due to a thinner SC and higher eccrine gland density. There is still more to learn and especially about the inherent underlying biological differences in ethnic skin types (Rawlings).

The most commonly used scheme to classify a person’s skin type by their response to sun exposure in terms of the degree of burning and tanning was developed by Thomas B. Fitzpatrick*, MD, PhD (Fitzpatrick).

One can use the following skin-type charts for self-assessment of one’s skin type by adding up the score for each of the questions that have been answered. At the end there is a scale providing a range for each of the six skin-type categories. Following the scale is an explanation of each of the skin types. One can quickly and easily determine which skin type one has.

Genetic Disposition of Skin

Score	0	1	2	3	4
What is the colour of your eyes?	Light blue, Grey, Green	Blue, Grey, Green	Blue	Dark Brown	Brownish Black
What is the natural colour of your hair?	Sandy Red	Blond	Chestnut / Dark Blond	Dark Brown	Black
What is the colour of your skin (non-exposed areas)?	Reddish	Very Pale	Pale with Beige tint	Light Brown	Dark Brown
Do you have freckles on unexposed areas of your skin?	Many	Several	Few	Incidental	None

Total Score for Genetic Disposition of Skin: _____

Reaction of Skin to Sun Exposure

Score	0	1	2	3	4
What happens when you stay in the sun too long?	Painful redness, blistering, peeling	Blistering followed by peeling	Burns sometimes followed by peeling	Rare burns	Never had burns
To what degree do you turn brown?	Hardly or not at all	Light colour tan	Reasonable tan	Tan very easy	Turn dark brown quickly
Do you turn brown within several hours after sun exposure?	Never	Seldom	Sometimes	Often	Always
How does your face react to the sun?	Very sensitive	Sensitive	Normal	Very resistant	Never had a problem

Total Score for Skin Reaction to Sun Exposure: _____

Tanning Habits

Score	0	1	2	3	4
When did you last expose your body to sun (or artificial sunlamp / tanning cream)?	More than 3 months ago	2-3 months ago	1-2 months ago	Less than a month ago	Less than 2 weeks ago
Did you expose the area to be treated to the sun?	Never	Hardly ever	Sometimes	Often	Always

Total Score for Tanning Habits: _____

Add up the total scores of the three (3) sections to determine your Skin Type Score.

Skin Type Score – Fitzpatrick Skin Type

Score	Skin Type
0 - 7	**I**
8 - 16	**II**
17 - 25	**III**
25 - 30	**IV**
Over 30	**V - VI**

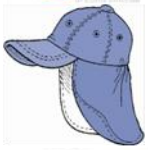
The Six Fitzpatrick Skin Types

Below is a description of the six (6) Skin Types according to the Fitzpatrick Skin Type Scale:

Skin Type I:
Highly sensitive, always burns, never tans. Example: Red hair with freckles

Skin Type II:
Very sun sensitive, burns easily, tans minimally. Example: Fair skinned, fair haired
Caucasians

Skin Type III:
Sun sensitive skin, sometimes burns, slowly tans to light brown. Example: Darker
Caucasians.



Skin Type IV:
Minimally sun sensitive, burns minimally, always tans to moderate brown. Example: Mediterranean type Caucasians, some Hispanics.

Skin Type V:
Sun insensitive skin, rarely burns, tans well. Example: Some Hispanics, some
Blacks

Skin Type VI:
Sun insensitive, never burns, deeply pigmented. Example: Darker Blacks (Fitzpatrick Skin)

Pictures of Skin Types According to the Fitzpatrick Skin Type Scale

[Picture Credit – Fitzpatrick Skin Types]

Reducing the Risk for Skin Cancer – The CANSA SunSmart Message
To prevent skin cancer, CANSA advocates the following:

- Avoid direct sunlight between 10:00 and 15:00 when the sun's rays are most dangerous. Stay in the shade or under an umbrella as much as possible

- UV rays reflect off cement, water, sand, glass and grass and can therefore cause sunburn in the shade. UV rays are not the same as heat. You can get overexposed even in cool weather - so take care on windy or overcast days

- Cover up by wearing thickly-woven hats with wide brims and loose-fitting clothes, made of tightly-woven, fabric that is cool, but will block out harmful UV rays. Look out for UV protective swimsuits and beach wear as UV radiation can penetrate fabric. Swimwear and umbrellas bearing the CANSA Seal of Recognition should also be part of your protection kit

- Always apply a sunscreen, preferably with a Sun Protection Factor (SPF) between 20 and 50 – preferably SPF 30 to 50 for fair to very fair skin. Apply the sunscreen generously to all exposed skin areas. It is preferable to always use a sunscreen bearing the CANSA Seal of Recognition (CSOR). Always apply sunscreen 20 minutes before going outside into the sun. Re-apply regularly (at least every two hours), after towel-drying, perspiring or swimming. Apply it liberally to all exposed skin; including the back of the neck, tips of ears, arms, feet and hands. The use of sunscreen lotion is not a license to 'bare all' in the sun. Go under cover whenever possible, to ensure that you are SunSmart while out in the sun

- Protect the eyes by wearing sunglasses with a UV protection rating of UV400

- Look out for the manufacture or expiry date on the sunscreen package. Sunscreen usually expires two (2) years after date of manufacture

- Once opened, sunscreen should NOT be used for longer than one (1) year

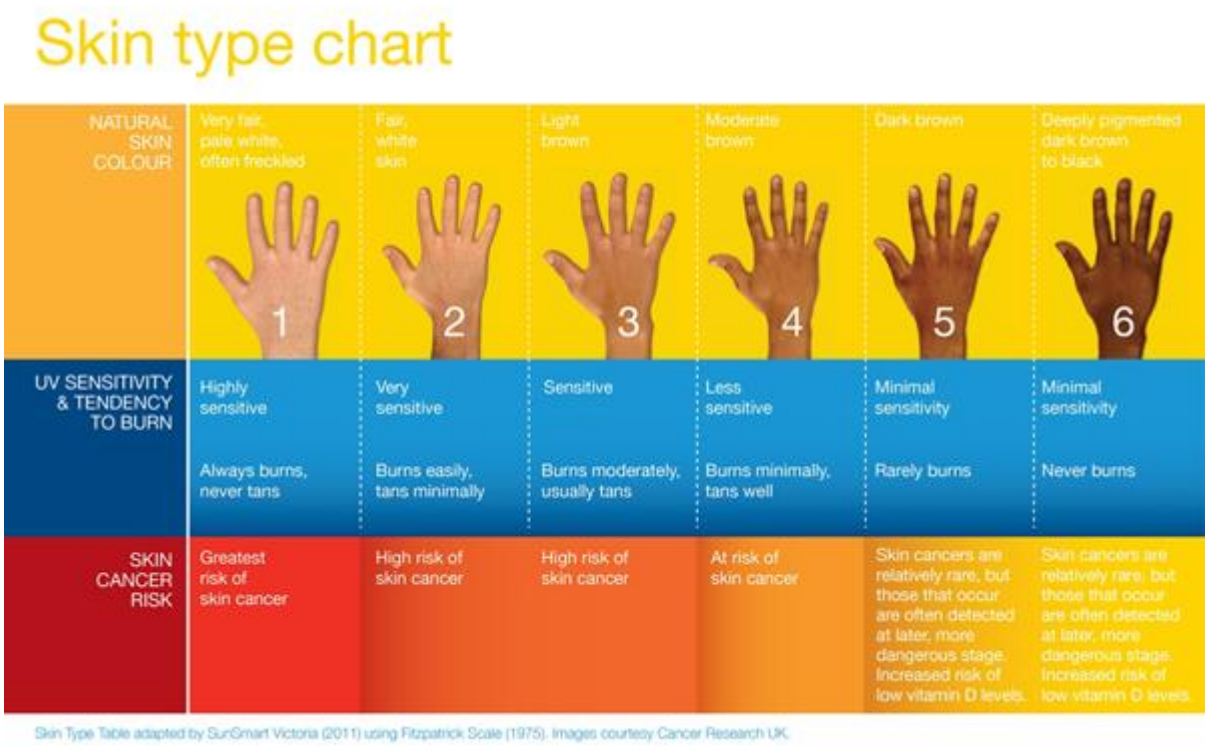
- Avoid sunlamps and tanning beds

- Take special care to protect children - babies younger than one year should never be exposed to direct sunlight

- Check your skin regularly for changes, unusual marks or moles. An annual medical examination should include a skin check. Ask a friend to check your back, top of your head and the back of your legs for spots or changes you may not notice yourself

CANSA's SunSmart campaign takes place during the summer months (November to February) and includes talks and exhibitions as well as visits to schools, holiday resorts and beaches in South Africa.

Skin Type Chart Showing Skin Cancer Risk



(Skin Type Chart Skin Cancer Risk).

Sun Beds and Tanning Booths are not Safe

It has been proven through recent research findings that there is a relationship between the use of sun beds and malignant melanoma as well as other non-melanoma skin cancers. Sun beds predominantly emit UVA and UVB both which can cause damage in the DNA of skin cells (Cancer Research UK).

The mutagenic properties of UVA in humans have been confirmed in several studies. The possibility that indirect DNA damage induced by UVA could play a major role in melanoma occurrence is underlined by reports of multiple cutaneous melanomas developing in patients genetically highly susceptible to oxidative agents (IARC, 2005).

Sun beds and tanning booths deliver concentrated UVA radiation to unprotected skin and should be avoided at all costs, as it ages skin more rapidly while putting you at risk of developing skin cancer. According to Professor Werner Sinclair, a dermatologist associated with the University of the Free State: “In general, one can state that the use of an artificial tanning booth will double the melanoma risk of any particular individual.”
An IARC Working Group has classified UV-emitting tanning devices as “carcinogenic to humans” (Group 1) (IARC).

The Meaning of a Sun Protection Factor (SPF)
The SPF 'Sun Protection Factor' listed on a container of sunscreen is a measure of how well the product protects one's skin from the sun's shorter-wave ultraviolet B (UVB) radiation. Technically, it is the ratio of how long one could spend in the sun before burning when one is protected by sunscreen, compared to when one does not have that protection. A common mistake is applying too little sunscreen, which can drastically reduce the effectiveness of the product. About 30g (a palm full) of sunscreen is recommended to cover the entire body, and it should be applied half an hour before sun exposure. One should reapply every two hours if staying outdoors for a long period of time. Applying sunscreen properly is one of the essential recommendations to lower one's risk of developing skin cancer (About.Com).

Here is how SPF – or Sun Protection Factor – works. If it takes five (5) to ten (10) minutes for your unprotected skin to start turning red, using an SPF 20 sunscreen theoretically prevents reddening twenty (20) times longer – about one hour and forty minutes to three hours twenty minutes (two hours on average). Most sunscreens with an SPF of 20 or higher do an excellent job of protecting against UVB.

All sunscreens bearing the CANSA Seal of Recognition (CSOR) have broad spectrum protection abilities, meaning they protect against ultraviolet A rays (UVA) and ultraviolet B rays (UVB). The CSOR is a guarantee that the manufacturers of these UV protective products have complied with the strict set of criteria developed by CANSA.

Sun Protective Clothing and Ultraviolet Protection Factor (UPF)
Sun protective clothing is clothing specifically designed for sun protection and is produced from a fabric rated for its level of ultraviolet (UV) protection. A novel weave structure and denier (related to thread count per inch) may produce sun protective properties. In addition, some textiles and fabrics employed in the use of sun protective clothing may be pre-treated with UV-inhibiting ingredients during manufacture to enhance their effectiveness.

In addition to special fabrics, sun protective clothing may also adhere to specific design parameters, including styling appropriate to full coverage of the skin most susceptible to UV damage. Long sleeves, full-length trousers, skirts, and dresses, and full collars are common styles for clothing as a sun protective measure.

A number of fabrics and textiles in common use today need no further UV-blocking enhancement based on their inherent fibre structure, density of weave, and dye components, especially darker colours and indigo dyes. Good examples of these fabrics contain full percentages or blends of heavy-weight natural fibres like cotton, linen and hemp or light-weight synthetics such as polyester, nylon, spandex and polypropylene. Natural or synthetic indigo-dyed denim, twill weaves and canvas are also good examples. However, a significant disadvantage is the heat retention caused by heavier-weight and darker-coloured fabrics.

As sun protective clothing is usually meant to be worn during warm and humid weather, some UV-blocking textiles and clothing may be designed with ventilated weaves, moisture wicking and antibacterial properties to assist in cooling and breathability.

UPF (Ultraviolet Protection Factor) represents the ratio of sunburn-causing UV without and with the protection of the fabric, similar to SPF (Sun Protection Factor) ratings for sunscreen. While standard summer fabrics have UPF ~6, sun protective clothing typically has UPF ~30, which means that only 1 out of ~30 units of UV will pass through (~3%).

What 'Broad-Spectrum' Means with Reference to Sunscreens

Broad-spectrum sunscreens protect the skin from both UVA and UVB rays. The current South African Standard makes provision for protection against UVA and UVB radiation in a ratio of 0.4/1. Recent research, however, has found an increased correlation between UVA exposure and the onset of malignant melanoma, as well as non-optimal UVA protection provided by existing sunscreens in terms of the total UVA radiation spectrum and the photo stability of many critical sunscreen chemicals leading to a worldwide demand for sunscreen with improved UVA protection properties.

About Clinical Trials

Clinical trials are research studies that involve people. They are conducted under controlled conditions. Only about 10% of all drugs started in human clinical trials become an approved drug.

Clinical trials include:

- Trials to test effectiveness of new treatments
- Trials to test new ways of using current treatments
- Tests new interventions that may lower the risk of developing certain types of cancers
- Tests to find new ways of screening for cancer

The South African National Clinical Trials Register provides the public with updated information on clinical trials on human participants being conducted in South Africa. The Register provides information on the purpose of the clinical trial; who can participate, where the trial is located, and contact details.

For additional information, please visit: www.sanctr.gov.za/

Medical Disclaimer

This Fact Sheet is intended to provide general information only and, as such, should not be considered as a substitute for advice, medically or otherwise, covering any specific situation. Users should seek appropriate advice before taking or refraining from taking any action in reliance on any information contained in this Fact Sheet. So far as permissible by law, the Cancer Association of South Africa (CANSA) does not accept any liability to any person (or his/her dependants/estate/heirs) relating to the use of any information contained in this Fact Sheet.

Whilst the Cancer Association of South Africa (CANSA) has taken every precaution in compiling this Fact Sheet, neither it, nor any contributor(s) to this Fact Sheet can be held responsible for any action (or the lack thereof) taken by any person or organisation wherever they shall be based, as a result, direct or otherwise, of information contained in, or accessed through, this Fact Sheet.

References and Consulted Sources

ABCDE Warning Signs
http://www.parkercenter.net/could-this-be-skin-cancer

About.Com
http://nutrition.about.com/od/askyournutritionist/f/sunlight.htm
http://skincancer.about.com/od/skincancerbasics/a/Squamous.htm
http://skincancer.about.com/od/glossary/g/SPF_sunscreen.htm

Ali, A., Khan, H., Bahadar, R., Riaz, A. & Asad, M.H.H.B. 2020. The impact of airborne pollution and exposure to solar ultraviolet radiation on skin: mechanistic and physiological insight. *Environ Sci Pollut Res Int.* 2020 Aug;27(23):28730-28736.

American Cancer Society
http://www.cancer.org/Cancer/CancerCauses/SunandUVExposure/skin-cancer-facts

Basal Cell Carcinoma
http://www.bing.com/images/search?q=free+illustration+basal+cell+carcinoma&view=detail&id=80F2FDBF8D34B1DA89638FF0A0B82981ECAFDE15&first=91&FORM=IDFRIR

Bureau of Air Quality, Department of Environmental Protection
http://maine.gov/dep/air/ozone/uvrad.htm

Canadian Centre for Occupational Health and Safety
http://ccohs.ca/oshanswers/phys_agents/ultravioletradiation.html
http://www.ccohs.ca/oshanswers/diseases/skin_cancer.html

Cancer News
http://www.cancernews.com/articles/melanomas.htm

Cancer Research UK
http://info.cancerresearchuk.org/cancerstats/types/skin/sunbeds/

Centers for Disease Control and Prevention
http://www.cdc.gov/niosh/topics/uvradiation/

Department of Health and Mental Hygiene, Maryland
http://fha.maryland.gov/cancer/cancerplan/

Department of Health and Ageing, Australia
http://www.skincancer.gov.au/internet/skincancer/publishing.nsf/Content/fact-uv

Direct Normal Solar Irradiance
https://sites.google.com/site/e4poor/solar/6

Earth Observatory, NASA
http://earthobservatory.nasa.gov/Features/UVB/

Elmets, C.A. 2011.
http://dermatology.jwatch.org/cgi/content/full/2011/1104/1

Fitzpatrick Skin Types
https://www.google.co.za/search?q=pics+skin+types&hl=en&rlz=1G1LENN_ENZA491&prmd=imvns&tbm=isch&tbo=u&source=univ&sa=X&ei=poNNUNnEN-i30QXe2YH4Bg&ved=0CCAQsAQ&biw=1366&bih=613]
Fitzpatrick, T.B. 1988 The validity and practicality of sun reactive skin types I through VI. Arch Dermatol 124; 869-871.

Fitzpatrick Skin.
http://www.hollywoodtansatlanta.com/The_Fitzpatrick_Skin.pdf

Grandi, C. & D'Ovidio, M.C. 2020. Balance between Health Risks and Benefits for Outdoor Workers Exposed to Solar Radiation: An Overview on the Role of Near Infrared Radiation Alone and in Combination with Other Solar Spectral Bands. Int J Environ Res Public Health. 2020 Feb 20;17(4):1357.

Health Physics Society
http://hps.org/hpspublications/articles/uv.html (Accessed on 2011-11-09).

IARC – International Agency for Research on Cancer
http://www.iarc.fr/en/publications/pdfs-online/wrk/wrk1/ArtificialUVRad&SkinCancer.pdf
http://www.iarc.fr/en/media-centre/iarcnews/2009/sunbeds_uvradiation.php

IOLNews
http://www.iol.co.za/news/south-africa/skin-cancer-rises-among-black-south-africans-1.389849
(Accessed on 2011-11-24).

Irish Cancer Society
http://www.cancer.ie/sunsmart/ultraviolet.php
http://www.cancer.ie/sunsmart/detection.php
http://www.cancer.ie/sunsmart/sunbed.php

Ley, R. & Reeve, V.E. 1997. Chemoprevention of ultraviolet radiation-induced skin cancer. *Environ Health Perspect*. 105(Suppl 4): 981-984, June.

MedlinePlus
http://www.nlm.nih.gov/medlineplus/ency/article/000824.htm

Meinhardt-Wollweber, M. & Krebs, R. 2012. A computational model for previtamin D3 production in skin. Photochemical & Photobiological Sciences, 11: 731-737.

Melanoma
http://www.bing.com/images/search?q=free+images+melanoma&view=detail&id=9BDD5B8602500694B50252FDCB2891F7BF4B986C&qpvt=free+images+melanoma&FORM=IDFRIR

Melanoma.Com
http://melanoma.com/uv_radiation.html

NASA Goddard Space Flight Center
http://imagine.gsfc.nasa.gov/docs/science/know_l1/emspectrum.html

National Institutes of Health
http://www.nih.gov/researchmatters/february2011/02072011melanoma.htm
http://www.cancer.gov/clinicaltrials/learningabout/what-are-clinical-trials
http://www.cancer.gov/about-cancer/treatment/clinical-trials/what-are-trials

National Aeronautic and Space Administration (NASA)
http://missionscience.nasa.gov/ems/10_ultravioletwaves.html
http://www-istp.gsfc.nasa.gov/stargaze/Sun1lite.htm

Navy Environmental Health Center. 1992. Ultraviolet Radiation Guide.
http://www-nehc.med.navy.mil/downloads/ih/UVDOC.pdf

OncoLink
http://www.oncolink.org/experts/article.cfm?c=3&s=28&ss=125&id=2342

Psoriasis-Aid.Com
http://www.psoriasis-aid.com/psoriasis/sun_exposure_and_psoriasis.html

Queensland Health, Queensland Government, Australia
http://access.health.qld.gov.au/hid/SkinHealth/SunSafety/ultravioletRadiation_ap.asp

Rawlings, A.V. 2006. Int J Cosmet Sci. 2006 Apr;28(2):79-93. doi: 10.1111/j.1467-2494.2006.00302.x.

ScienceDaily
http://www.sciencedaily.com/releases/2005/12/051224100902.htm
http://www.sciencedaily.com/releases/2010/07/100701103415.htm

Shin, D.W. 2020. Various biological effects of solar radiation on skin and their mechanisms: implications for phototherapy. *Anim Cells Syst (Seoul).* 2020 Aug 20;24(4):181-188.

Skin Type chart Skin Cancer Risk
https://www.cancersa.org.au/information/a-z-index/what-is-skin-cancer

Solarradiation.Net
http://www.solarradiation.net/

South African Melanoma Advisory Board
http://www.melanoma.co.za/D_doccnr_MFS.asp

Squamous Cell Carcinoma
http://www.bing.com/images/search?q=free+images+squamous+cell+carcinoma&view=detail&id=BC45F8372B4F9BB72A61397D9EE2BD757FF1E986&qpvt=free+images+squamous+cell+carcinoma&FORM=IDFRIR

SunSmart Australia
http://www.sunsmart.com.au/ultraviolet_radiation
http://www.sunsmart.com.au/ultraviolet_radiation/the_health_risks

Suntan.Com
http://www.suntan.com/?factssun

United States Nuclear Regulatory Commission
http://www.nrc.gov/about-nrc/radiation/around-us/uses-radiation.html

University of Washington, Environmental Health and Safety
http://www.ehs.washington.edu/rsononion/uvlight.shtm

US Environmental Protection Agency
http://www.epa.gov/sunwise/doc/uvradiation.html
http://www.epa.gov/sunwise/uvandhealth.html

US Food and Drug Administration
http://www.fda.gov/Radiation-EmittingProducts/RadiationEmittingProductsandProcedures/Tanning/ucm116425.htm

UVA & UVB Rays
http://www.google.co.za/imgres?hl=en&sa=X&rlz=1T4LENN_enZA490ZA490&biw=1366&bih=613&tbm=isch&prmd=imvns&tbnid=sFIMGHRCoaVorM:&imgrefurl=http://www.fda.gov/Radiation-EmittingProducts/RadiationEmittingProductsandProcedures/Tanning/ucm116425.htm&imgurl=http://www.fda.gov/ucm/groups/fdagov-public/documents/image/ucm116427.jpg&w=369&h=304&ei=wPxGUL-MMMG3hQeeioDoAw&zoom=1&iact=hc&vpx=267&vpy=140&dur=2922&hovh=204&hovw=247&tx=155&ty=113&sig=107310304455409594391&page=1&tbnh=130&tbnw=166&start=0&ndsp=21&ved=1t:429,r:1,s:0,i:75].

Wikipedia
https://en.wikipedia.org/wiki/Sun_protective_clothing

WordIq.Com
http://www.wordiq.com/definition/Visible
http://www.wordiq.com/definition/Solar_radiation http://www.wordiq.com/definition/Electromagnetic_spectrum
http://www.wordiq.com/definition/Infrared
http://www.wordiq.com/definition/Ultraviolet
http://www.wordiq.com/definition/Suntan

http://www.wordiq.com/definition/Sunburn
http://www.wordiq.com/definition/Sunlight
http://www.wordiq.com/definition/Thermal_radiation
http://www.wordiq.com/definition/Pyranometer
http://www.wordiq.com/definition/Actinometer

World Health Organization
http://www.who.int/uv/faq/uvhealtfac/en/index.html
http://www.who.int/uv/en/
http://www.who.int/uv/health/en/
http://www.who.int/uv/sun_protection/en/
http://www.who.int/uv/intersunprogramme/en/
http://www.who.int/uv/faq/uvhealtfac/en/index1.html
http://www.who.int/uv/uv_and_health/en

World Health Organization
http://www.who.int/uv/health/en/

World UV Map
http://www.gse-promote.org/gallery/UV/dwd_forecast.htm