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UV Index Measurement in Hong Kong

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What is UV Radiation?

The sun emits radiation of different wavelengths. Some of the radiation, such as those making up the colours of rainbow, have wavelengths to which our eyes respond. Beyond these wavelengths are radiation in the ultraviolet (UV) and infrared which our eyes cannot see.

UV radiation is of concern to us because unprotected exposure to it can **cause skin and eye damage.** UV radiation can be broadly subdivided into **UV-A, UV-B and UV-C**. Their main characteristics are shown in Table 1.

	UV-A	UV-B	UV-C
Wavelength (nanometer, nm)*	315-400	280-315	100-280
Absorption by the ozone layer	Penetrates the ozone layer	Mostly absorbed by the ozone layer	Almost all absorbed by the ozone layer
Amount reaching the Earth's surface	> 98% of UV radiation is UV-A	< 2% of UV radiation is UV-B	Negligible

*Definition based on International Commission on Illumination (CIE). ($1nm=10^{-9}m$)

Table 1 : Main characteristics of UV-A, UV-B and UV-C radiation

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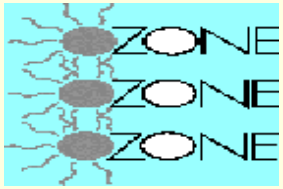
Effect of UV radiation

- overexposure in human may cause skin and eye injury, photokerato conjunctivitis (角膜炎), eye cataract (白內障) and skin cancer.

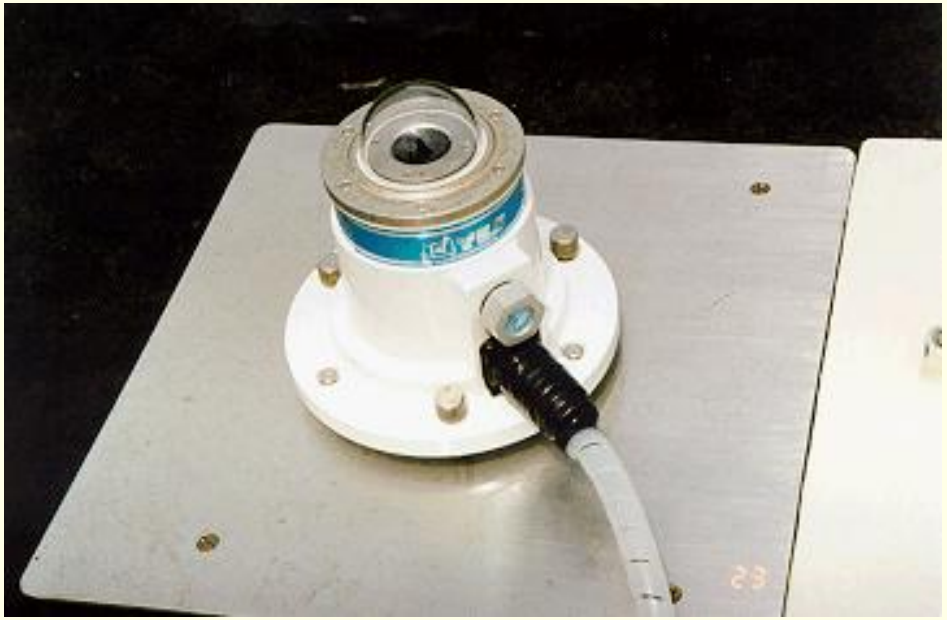
- induce photochemical reaction with vehicle exhaust gases and producing air pollutants

Factors affecting the ground-level UV intensity

	Factor	Influence on UV intensity at the Earth's surface
	Position of the sun which varies with time of the year, time of the day and the latitude.	The higher the sun's position, the higher the UV intensity.
	Amount of ozone in the atmosphere.	Ozone absorbs UV radiation. The more abundant the ozone in the atmosphere, the less the amount of UV radiation reaching the Earth's surface.
	Clouds and haze.	UV radiation is both absorbed and scattered by clouds and haze.
	Ground reflection.	Most natural surfaces such as grass, soil and water reflect less than 10% of UV. However, fresh snow strongly reflects (80%) UV. Sand also reflects 10-25% of UV.
	Altitude above the sea level.	The higher the altitude, the higher the UV intensity as the depth of the atmosphere and therefore the amount of ozone available to absorb UV radiation is reduced.

How is UV Radiation measured?

- A widely used instrument for measuring the intensity of the UV radiation is the broadband UV sensor (寬波段紫外線儀).
- This type of sensor has a response which approximates the erythemal action spectrum (紅斑作用光譜曲線).
- The UV Index is obtained by multiplying the measured UV intensity by a conversion factor.

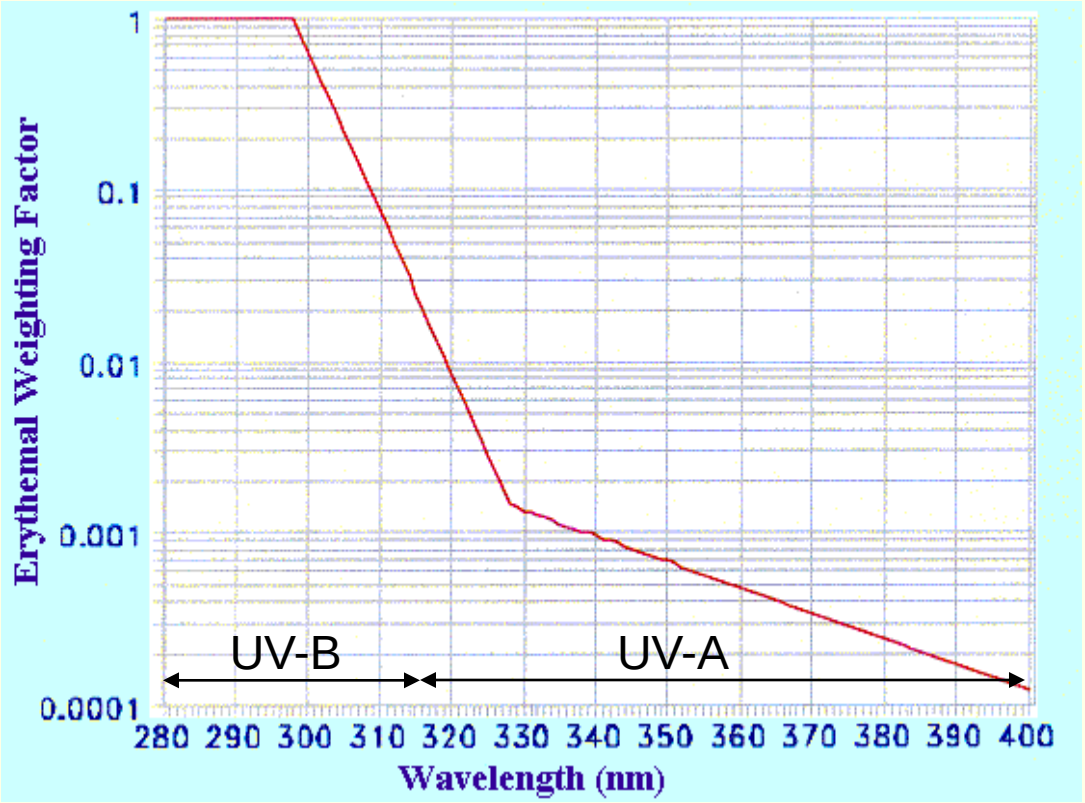


The Hong Kong Observatory's broadband UV sensor at its King's Park Meteorological Station

What is the UV Index?

The UV Index is a measure of the solar UV intensity at the Earth's surface relevant to the effect on human skin.

The skin-damaging UV radiation is governed by the erythemal action spectrum (red line in Figure 1). This spectrum has been adopted by the International Commission on Illumination (CIE) to represent the *average skin response over the solar UV spectrum*.



(Source : The International Commission on Illumination)

Figure 1 Erythemal action spectrum.

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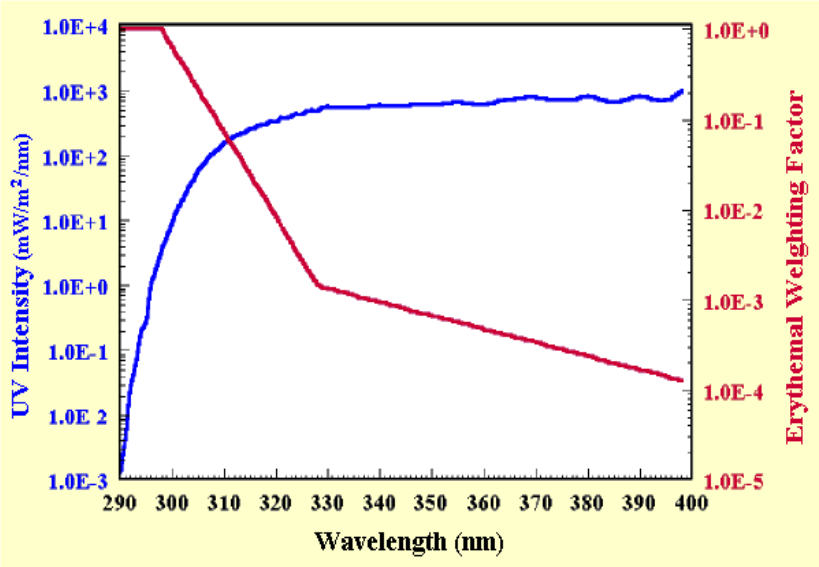
How is the UV Index calculated?

The standard way to calculate the UV Index recommended by the World Meteorological Organization (WMO) and the World Health Organization (WHO) is :

- measure the intensity of solar UV radiation at different wavelengths up to 400 nanometre (blue line in Figure 2),
- multiply these UV intensities by the weighting factors at the corresponding wavelengths in the erythemal action spectrum (red line in Figure 2) to reflect the human skin's response to each wavelength,
- sum up the products above to obtain the total erythemally weighted UV intensity in milliwatt per metre square, i.e. area under the red line in Figure 3,
- multiply the total erythemally weighted UV intensity by 0.04 to obtain the UV Index.

(Source : The National Oceanic and Atmospheric Administration)

Figure 2 Measured UV intensity across the solar UV spectrum and the erythemal action spectrum.



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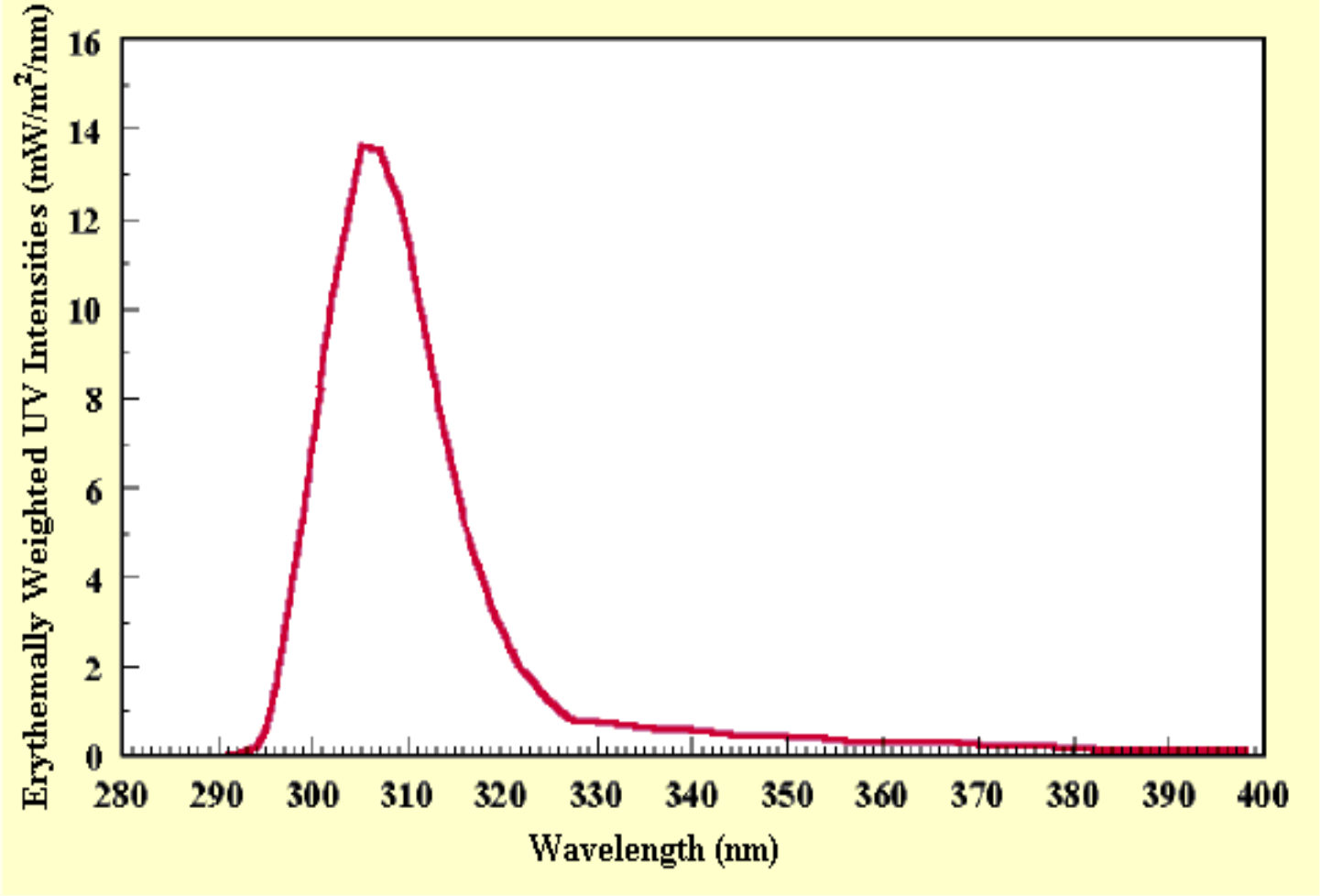

(Source : The National Oceanic and Atmospheric Administration)

Figure 3 Total erythemally weighted UV intensity. (Area under the red line)

What does the UV Index mean?

The UV Index and the corresponding exposure level as categorized by the World Health Organization are shown in the table below.

UV Index	Exposure Level
0 - 2	Low
3 - 5	Moderate
6 - 7	High
8 - 10	Very High
≥ 11	Extreme

(Source : The World Health Organization)

The higher the UV Index, the more likely the damage to skin.

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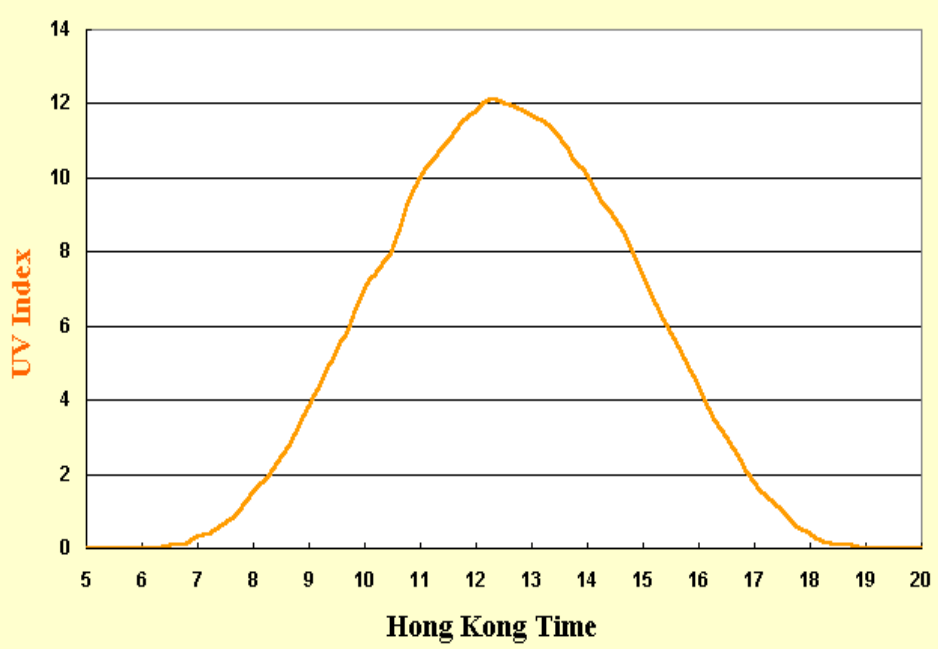
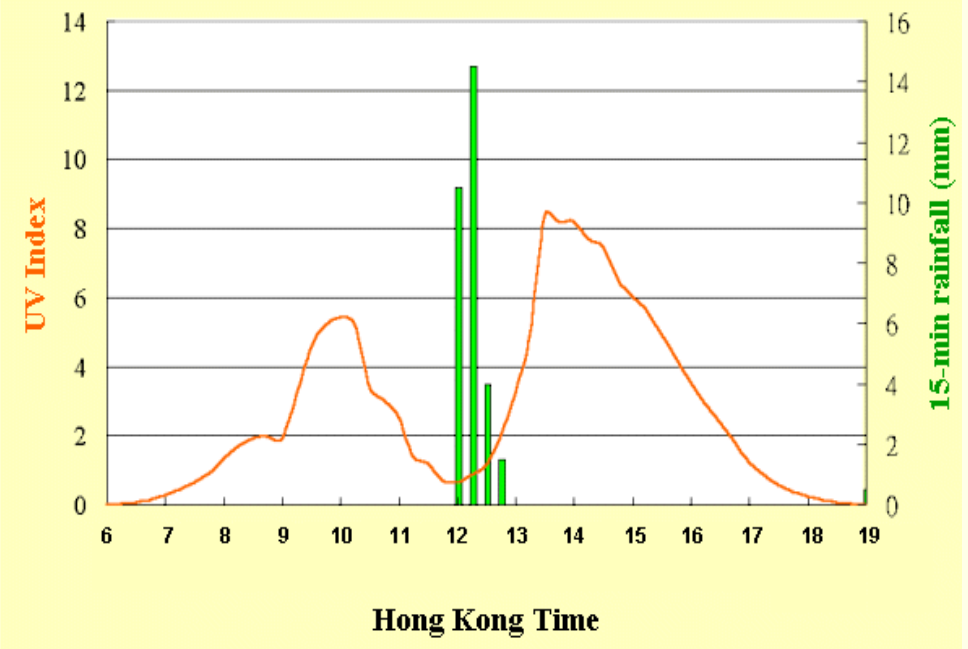
Diurnal variation of UV Index





Diurnal variation of UV Index on a sunny day with some 12 hours of sunshine.

Diurnal variation of UV Index on a day with showers and sunshine. (The showers around noon on that day drove down the UV Index but it rose to the level of 8 to 9 in the afternoon when the showers eased off.)

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Maximum UV Indices in other locations

Location	Typically observed maximum UV Index
Alishan (about 2.4 km above mean sea level) in Taiwan	14
Chilton, near London in U.K.	8
Heng Chun in southern Taiwan	13
Hong Kong	15
Lauder in southern island of New Zealand	12
Mauna Loa (about 3.4 km above mean sea level) in Hawaii, U.S.A.	20
Melbourne in Australia	10
Mexico city in Mexico	13
Miami in Florida, U.S.A.	11
Perth in Australia	14
San Diego in California, U.S.A.	11
Taipei in Taiwan	11
Toronto in Canada	10

Comparison of the maximum UV Indices.

Protective Measures against UV Radiation

To reduce the harm from UV radiation, the most important thing is to minimize direct exposure of the skin and the eyes to sunlight.

On days when the UV Index is high, you should avoid staying outdoors for prolonged periods. If you must be out in the sun, take the following precautions:

Check what the latest UV Index is.

Seek shade under a tree.

Use an umbrella.

Wear long-sleeved and loose-fitting clothing.

Wear a broad brim hat.

Wear UV blocking sunglasses.

Use a broad-spectrum sunscreen lotion blocking both UVA and UVB (with a Sun Protection Factor (SPF) of 15 or above for UVB). Apply liberally and reapply after swimming or sweating.

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