U.S. ENVIRONMENTAL PROTECTION AGENCY

SunWise Program

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How is the UV Index Calculated?

In the US, the UV Index is computed using forecasted ozone levels, a computer model that relates ozone levels to UV incidence (incoming radiation level) on the ground, forecasted cloud amounts, and the elevation of the forecast cities. Certain other countries also use ground observations.

The calculation starts with measurements of current total ozone amounts for the entire globe, obtained via two satellites operated by the National Oceanic and Atmospheric Administration (NOAA). These data are then used to produce a forecast of ozone levels for the next day at various points around the country. A model is then used to determine the amount of UV radiation reaching the ground from 290 to 400 nm in wavelength (representing the full spectrum of UV wavelengths), using the time of day (solar noon), day of year, and latitude. As an example, assume the following UV levels for each wavelength are predicted for a given location (these are totally made up numbers, and not even the ratios represent reality):

Wavelength	Incidence
290nm	10
350nm	20
400nm	50

This information is then weighted according to how human skin responds to each wavelength; it is more important to protect people from wavelengths that harm skin than from wavelengths that do not damage people's skin. The weighting function is called the McKinlay-Diffey Erythema action spectrum. For illustration purposes only (these numbers are **not** correct), assume 290nm radiation causes three times as much damage as 350nm radiation and five times as much damage as 400 nm radiation. Then, if in some unit 290nm UV radiation did 15 units of damage, 350nm radiation would do 5 units and 400 nm radiation would do 3 units. At each wavelength, multiply the actual incoming radiation level by the weighting:

Wavelength	Incidence	Weight	Result
290nm	10	15	150
350nm	20	5	100
400nm	50	3	150

These weighted irradiances are totalled, or integrated, over the 290 to 400 nm range resulting in a value representing the total effect a given day's UV radiation will have on skin. For our example, the total is 400.

These estimates are then adjusted for the effects of elevation and clouds. UV at the surface increases about 6% per kilometer above sea level. Clear skies allow 100% of the incoming UV radiation from the sun to reach the surface, whereas scattered clouds transmit 89%, broken clouds transmit 73%, and overcast conditions transmit 31%. If we assume that the example location is at 1 kilometer in elevation, and that there will be broken clouds, then the calculation is:

400 x 1.06 x 0.73 = 309.5

Once adjusted for elevation and clouds, this value is then scaled (divided) by a conversion factor of 25 and rounded to the nearest whole number. This results in a number that usually ranges from 0 (where there is no sun light) to the mid teens. This value is the UV Index. Thus, the UV Index for the example city would be:

309.5 / 25 = 12.4, rounded to 12

Currently, the computation of the UV Index does not include the effects of variable surface reflection (e.g., sand, water, or snow), atmospheric pollutants or haze.

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