**Record: 1**

**Title:** Sunshine on a Cloudy Day.

**Authors:** Schoonmaker, David

**Source:** American Scientist; May/Jun2006, Vol. 94 Issue 3, p217-217, 1p

**Document Type:** Article

**Subject Terms:** CLOUDS
ULTRAVIOLET radiation
METEOROLOGY
LIGHT -- Scattering
REFRACTION
RADIATION

**Abstract:** The article discusses how clouds can sometimes increase, rather than reduce, levels of ultraviolet (UV) radiation. Clouds are better at blocking visible light than UV. Investigators have known that clouds can have paradoxical effects on incident UV radiation. Studies suggest that reflection off the sides of cumulus clouds is one mechanism by which UV radiation can become focused. Study authors have also postulated that refraction and scattering of direct and diffuse radiation could result in markedly increased cloud enhancement of UV. Cloud conditions that include cirrus clouds thin enough not to completely obscure the solar disk, along with lower-altitude cumulus clouds may lead to UV storm.

**Lexile:** 1250

**Full Text Word Count:** 802

**ISSN:** 00030996

**Accession Number:** 20580263

**Database:** MAS Ultra - School Edition

**Section:** SCIENCE OBSERVER

## Sunshine on a Cloudy Day

**Clouds sometimes increase, rather than reduce, levels of ultraviolet radiation**

At one time or another, most of us have proved empirically, and painfully, the old mother's tale that it's possible to get sunburned on a cloudy day. On average, clouds do reduce the amount of ultraviolet A and B radiation that reaches the Earth's surface and our skin, but it far from stops the damaging rays. Indeed, clouds are generally better at blocking visible light than UV.

Unfortunately, the average can, in some cases, be a pretty bad deal. Investigators have known since 1964 that clouds can have paradoxical effects on incident UV radiation. In more than a dozen studies since then, every data set includes at least some examples of what is known as cloud enhancement of UV. For people hoping to avoid skin photoaging and cancer, this can be a confounding characteristic. How much increase in radiation? It depends how you look at it.

Although the mechanisms aren't yet entirely clear, the degree of enhancement can be significant. Forrest Mires III with the Sun Photometer Atmospheric Network and John Frederick with the University of Chicago reported in a 1994 Nature article measurements of UVB at the Mauna Loa Observatory. as much as 29.8 percent above modeled clear-sky levels. In various other studies, the range has been reported as a few percent up to 50 percent. Some of the most prolific authors on the subject are Jeff Sabburg and Alfio Parisi at the University of Southern Queensland and Michael Kimlin at the Queensland University of Technology. According to Sabburg, "In our latest research [soon to appear in the Journal of Atmospheric Research], we use new equipment and refine our methodology, and the highest UVI [an index of skin reddening] enhancement we found was 25 percent."

But those values are with respect to expected clear-sky UV. Compared with the level of attenuation usually seen when clouds are present, such measurements can actually be 50 to 75 percent higher than predicted, says Sabburg. And therein lies a conundrum for those who work or recreate out doors and depend on UV forecasts. No national forecast based on the World Health Organization's numerical scale for UV takes enhancement into account. Indeed, although several mention the possibility on their Web sites, the calculations instead assume that clouds reduce UV exposure. The U.S. National Weather Service and Environmental Protection Agency, for example, figure 89 percent transmission for scattered clouds, 73 percent transmission for broken clouds and 32 percent transmission for overcast conditions.

So how do we get more rather than less? Several studies suggest that reflection off the sides of cumulus clouds is one mechanism by which UV radiation can become focused. Sabburg and Joe Wong (then with the University of Southern Queensland) have also postulated that refraction and scattering of direct and diffuse radiation could result in markedly increased enhancement. Thus cloud conditions that include cirrus clouds thin enough not to completely obscure the solar disk, along with lower-altitude cumulus clouds, may lead to the perfect UV storm.

Just how common is cloud enhancement? The various studies have found that between 1.4 and 8 percent of all measurements show cloud enhancement compared with clear-sky values, depending on geographic location, but as many as 25 percent of those made on partly cloudy days may show it. Most often the enhancement lasts for 10 minutes or less--not a concern for the sun worshiper--but it has been known to persist for an hour.

The problem, of course, is predicting something that is influenced by systems as dynamic as clouds. A model was developed in 1974 that accounts reasonably well for observed results. The trouble is, just for starters one must know the fraction of the sky covered and the cloud optical depth--not characteristics that are predictable well in advance. As Sabburg says, "Our research is more aimed at measured, rather than forecast, UVI, but I think it would be almost impossible to predict these cases."

He does think, however, that authorities should do more to educate the public on the subject. Asked whether he wears sunblock on cloudy days, he replied "Yes! Unless it is overcast and the sun is not producing shadows--that is, it is not visible in some form--and there is no chance of the sun shining through broken patches of the cloud cover, I am still very conscious of the effects of UV." Bottom line: On a perfectly clear day, that UV forecast is likely to be quite accurate. Add condensed water vapor to the atmospheric mixture, though, and the outlook can become, well, cloudy.

PHOTO (COLOR): Ultraviolet radiation can be enhanced well above clear-sky values on cloudy days, especially when there are cirrus and cumulus clouds in the sky.

~~~~~~~~

By David Schoonmaker
~~~~~~~~