Cloud-reflected radiation

SIR—A recent study of instantaneous solar radiation[1,2] has shown that anomalously high radiation levels may occur on the Earth's surface during partly cloudy conditions. Values of instantaneous radiation exceeding even extraterrestrial levels are associated with reflections from cloud edges to positions which otherwise have a clear view to the Sun. Here we report measurements of increased ultraviolet radiation associated with cloud reflection.

Conventional integrated hourly or daily solar radiation measurements inherently involve the averaging of successive instantaneous events and the consequent loss of the short-term behaviour such as the bimodal clear/cloudy radiation pattern[1]. Therefore, the full extent of radiation increases resulting from cloud reflection can only be appreciated on the basis of instantaneous radiation measurements. Figure 1 shows measurements of instantaneous global radiation during a clear-cloudy transition. The increase in radiation level just before the rapid drop results from additional radiation reflected from the cloud edge before the cloud passes between the solar sphere and the pyranometer. Radiation levels of up to 1,780 W m^{-2} have been recorded in this manner. The existence of such high terrestrial radiation values in excess of extraterrestrial levels (1,370 W m^{-2}) may seem surprising at first. But the principle of conservation of energy is not violated as the high radiation values constitute local atmospheric concentrations of the solar radiation.

Measurements of instantaneous ultraviolet radiation during periods of elevated radiation levels attributable to cloud reflection have been carried out. In Fig. 2, values of the ratio of cloud-reflected ultraviolet radiation to clear-sky ultraviolet radiation at wavelengths of 350 and 400 nm respectively, are plotted as a function of the corresponding ratio for broadband solar radiation. The results shown in Fig. 2 are for a 3-hour interval and are typical of measurements taken over a 1-year period. In all cases the increase in ultraviolet radiation due to cloud reflection is approximately linearly related to the corresponding increase in broadband solar radiation. As seen from Fig. 2,

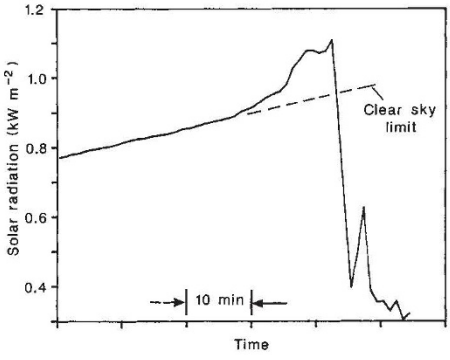

FIG. 1 Variation of incident solar radiation during a clear–cloudy transition.

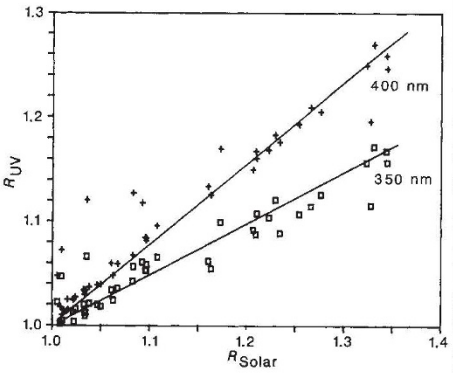

FIG. 2 Correlation between cloud reflection enhanced ultraviolet at 350 and 400 nm and broadband solar radiation. R_{UV} and R_{Solar} are, respectively, the ratios of cloud-reflected ultraviolet and solar radiation to the corresponding clear-sky values. Broadband solar radiation measurements were made using a Kipp and Zonen CM10 pyranometer with thermal response correction[3].

the ultraviolet radiation concentration decreases with decreasing wavelength. This behaviour results from scattering at cloud water droplets which becomes more forward directed with decreasing wavelength[4], resulting in greater ultraviolet cloud transmittance and less radiation reflection due to multiple scattering. Although the increase in the level of ultraviolet radiation due to cloud reflection is less than that for broad-band solar radiation, the increases measured are of significance in view of the predicted increase in cloud cover associated with the build-up of greenhouse gases and the importance of ultraviolet radiation to biological processes.

The radiation concentration strongly depends on the cloud type. Large cumulus clouds with cloud edges several kilometres high are likely to produce strong radiation concentrations. Hence, the intensity of the radiation concentration will depend on the clouds and climate of the location of investigation[5]. For comparison, in tropical Townsville, Australia, peak radiation values as high as 2,020 W m^{-2} have been measured with a photovoltaic pyranometer. The effect of atmospheric radiation concentrations may be more significant than is widely believed.

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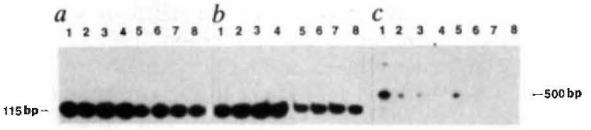
More false-positive problems

SIR—Sarkar and Sommer have reported in Scientific Correspondence[1] the use of ultraviolet irradiation as a sterilization technique for the control of contamination in the polymerase chain reaction (PCR), but their procedure does not deal with all the problems. First, they introduce true target DNA and *Taq* DNA polymerase after irradiation, which will produce the same level of sporadic false-positive PCR signals even though all the contaminating carryover molecules in the other PCR reagents are sterilized. Second, their conclusion that the oligonucleotide primers for the PCR retain their full functional integrity after irradiation is not warranted. Primer damage which leads to a compromise in signal sensitivity can be evaluated only when the PCR amplification is limited so that the concentration of product is maintained well below PCR plateau concentrations. Finally, the critical nature of the size and sequence specificity of the PCR product being inactivated was not addressed. Here, we elaborate only on the last point.



Effect of PCR product length on UV sterilization of PCR products. Two PCR products were examined: a 115mer (Ou *et al.*[6]) and a 500mer (kit N801–0055, Perkin-Elmer Cetus). PCR templates were irradiated for 0 min (lanes 1 and 5); 5 min (lanes 2 and 6); 20 min (lanes 3 and 7); 30 min (lanes 4 and 8), amplified for 30 cycles and analysed by PAGE and autoradiography. In panels *a* (115mer template), *b* (plasmid template) and *c* (λ DNA template). Lanes 1–4 and 5–8 correspond to 10^5 and 10^3 copies of PCR template molecules, respectively. Detection sensitivity with our PCR procedure is at least 100 copies. Experimental details available from authors upon request.

Pyrimidine dimers undoubtedly contribute to ultraviolet-induced sterilization by functioning as termination sites during the extension reactions of the