Abstract

QUALITATIVE AND QUANTITATIVE FEATURES OF THE TERRESTRIAL SOLAR ULTRAVIOLET RADIATION ENVIRONMENT

by

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Terrestrial solar ultraviolet (uv) radiation is an important factor in a wide variety of biological phenomena and medical situations. As a result, it is desirable to have available qualitative and quantitative information about terrestrial solar uv. This information may be obtained either by computer calculation or direct measurement.

The various geometrical, astronomical and atmospheric factors which influence terrestrial solar uv are reviewed. In the sunburn region ($\lambda < 320$ nm) scattered, or D-component radiation will equal or exceed the direct, or I-component radiation at almost all times of the day and during most of the year. As a result, computations of terrestrial uv must include a calculation of D-component radiation using an appropriate theory, i.e. one that includes the absorption, by ozone, of both direct and scattered uv radiation.

Global radiation (I+D) spectra and times to produce a minimal erythema have been computed for representative conditions.

A uv dosimeter whose spectral sensitivity approximates the erythemal (sunburn) response of human skin would provide a measure of the erythemal effectiveness of the uv radiation present at the time of measurement. Three photosensitive glasses were investigated as erythemally effective uv dosimeters.

Thermoluminescent (TL) phosphors are small in size which makes them especially suited for in-vivo studies and personnel dosimetry. In addition, they require no electronics at the site of measurement and operate unattended. Investigations on the use of transferred TL in natural calcium fluoride (CaF_2:nat) as a uv dosimeter were carried out under both daylight and artificial illumination.

The spectral sensitivity of transferred TL was found to be such that if the CaF_2:nat phosphor is used in a subtraction mode using a sharp cutoff filter, the dosimeter spectral sensitivity is similar to the erythema action spectrum of untanned human skin. Exposure times greater than 5 minutes in midday, mid-September sun produced a nonlinear response in the phosphor TL as a result of the bleaching of transfer TL peaks. This effect was shown to be eliminated through use of neutral density filters.

Using CaF_2:nat phosphors, measurements of terrestrial solar uv have been carried out. These are compared to computed estimates based on atmospheric constituent data. Obtaining current values for the various atmospheric constituents (e.g.ozone) is discussed. The comparision of measured TL currents and minimal erythema times is discussed with regard to future improvement of CaF_2:nat as a thermoluminescent dosimeter of terrestrial solar uv.

General features of the terrestrial solar uv radiation environment are also presented.

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