

## 1 Abstract

UV irradiance and actinic flux are calculated using two different approaches; (A) a well established TOMS cloud reflectivity method [1]; and (B) a new method, based on total ozone from TOMS and cloud parameters from ISCCP. Both products show good agreement between each other, and with ground-based measurements.

## 2 Methods

**A. TOMS-based method.** Surface radiation is calculated by scaling the cloudless sky value with a wavelength-independent factor  $\gamma$  which is derived from the TOMS reflectivity according to [1], [3]:

$$E = \gamma \cdot E_{\text{clear}}$$

**B. ISCCP-based method.** Radiation is calculated using cloud fraction and cloud optical depth from the ISCCP D1 data set [5]. Broken clouds are considered with the independent pixel approximation [4], [3]:

$$E = (1 - c) \cdot E_{\text{clear}} + c \cdot E_{\text{cloudy}}$$

where  $c$  is the cloud fraction, and  $E_{\text{clear}}$  and  $E_{\text{cloudy}}$  are the irradiances for cloudless and totally cloud-covered sky, calculated using the TUV radiative transfer model [2]. The snow cover information of the ISCCP D1 data is used to estimate the correct surface albedo. In both methods, cloudless sky irradiance is calculated using TOMS total ozone.

## 3 Results

Fig. 1 shows good agreement in the erythemal irradiance calculated using both methods. While the TOMS-based method provides a quick way to calculate surface irradiance and even actinic flux or  $j$ -values (Fig. 2) [3], the ISCCP-based method might be of advantage for certain applications because: (1) some extra uncertainty is introduced when using TOMS reflectivity to calculate the actinic flux [3];

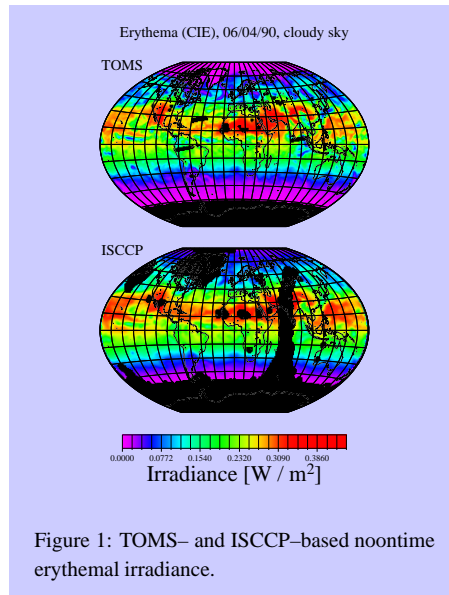


Figure 1: TOMS- and ISCCP-based noontime erythemal irradiance.

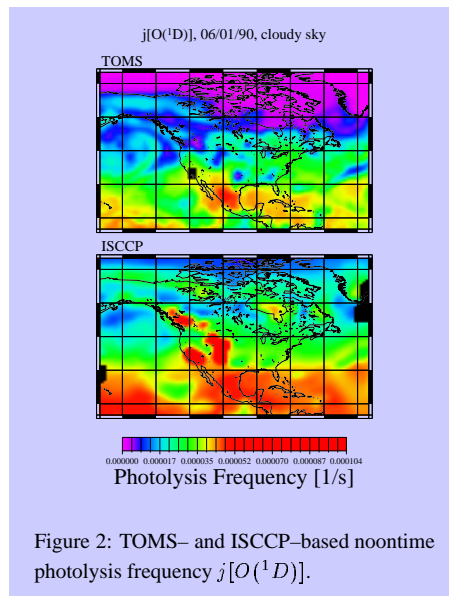


Figure 2: TOMS- and ISCCP-based noontime photolysis frequency  $j[O(^1D)]$ .

(2) the ISCCP data distinguish between clouds and surface albedo; (3) the ISCCP data include information about the vertical layering of the clouds; and (4) the time resolution of the ISCCP data is higher.

The ISCCP D1 data are available in steps of 3 hours, thus allowing the calculation of diurnal variations. Here, nine data points, equally spaced in time and centered around local noon, are sufficient to calculate daily doses with an accuracy of 1% compared to a calculation with high time resolution. Fig. 3 shows a pronounced diurnal variation of cloudiness, which can only be obtained from the ISCCP data.

A comparison of the TOMS-based data with ground-based measurements from the World Ozone and UV data center (WOUDC) shows good agreement (Fig. 4). A systematic difference of 5–10% is expected because most of the measured data were not corrected for the cosine error of the entrance optics.

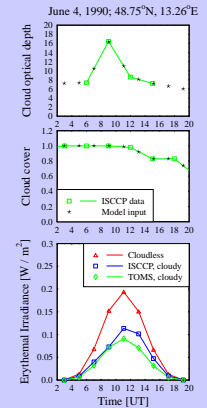


Figure 3: Diurnal variation.

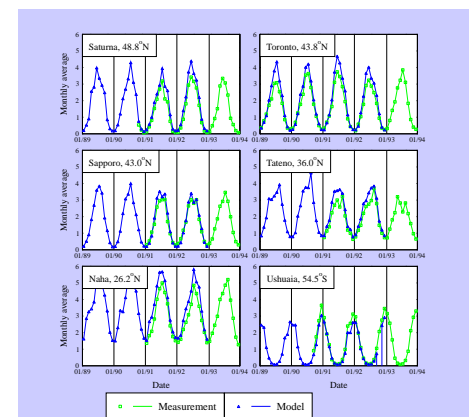


Figure 4: Model calculations and measurements of averaged daily erythemal irradiation.

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