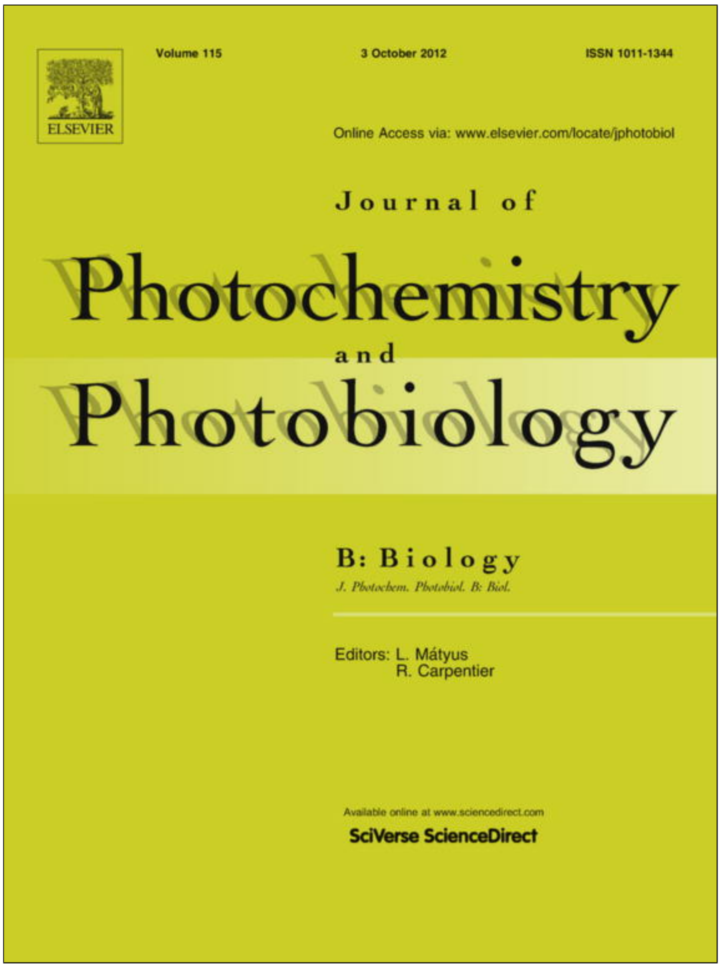
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UV index values and trends in Santiago, Chile (33.5°S) based on ground and satellite data

Sergio Cabrera [a,*], Adriana Ipiña [b], Alessandro Damiani [c], Raul R. Cordero [c], Rubén D. Piacentini [b,d]

[a] Universidad de Chile, Facultad de Medicina, Instituto de Ciencias Biomédicas, Programa Biología Celular y Molecular, Santiago, Chile
[b] Instituto de Física Rosario (CONICET – Universidad Nacional de Rosario), Rosario, Argentina
[c] Departamento de Física, Universidad de Santiago de Chile, Santiago, Chile
[d] Facultad de Ciencias Exactas, Ingeniería y Agrimensura, Universidad Nacional de Rosario, Rosario, Argentina

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ABSTRACT

We report on the surface UV index (UVI) variations in Santiago (Chile) a city with high air pollution and complex surrounding topography. Ground-based UV measurements were continuously carried out between January 1995 and December 2011, by using a multi-channel filter radiometer (PUV-510). Ground-based measurements and satellite-derived data retrieved from the Total Ozone Mapping Spectrometer (TOMS), the Ozone Monitoring Instrument (OMI), and the Scanning Imaging Absorption spectroMeter for Atmospheric CHartographY (SCIAMACHY), were compared. We found that satellite-derived UVI products largely overestimate surface UVI. Our ground-based UVI measurements were significantly lower than TOMS-derived UVI data: (46.1 ± 6.3)% (in the period 1997–2003), and OMI-derived UVI data: (47.0 ± 6.3)% (in the period 2005–2007). Clear-sky SCIAMACHY-derived UVI were found to be also nearly systematically greater than ground-based UVI measurements in the period 2002–2011. An exceptionally long period of clear skies between December 2010 and January 2011 was used to test further satellite-derived UVI data; in the whole period, OMI and SCIAMACHY data were 53.1% and 38.3% greater than our ground-based measurements, respectively. These differences are presumably due to aerosol load associated with the local pollution and the complex topography surrounding Santiago. In addition, linear regression allowed us to estimate trends that we use for forecasting. Methodological details are provided below.

1. Introduction

The UV index is a basic indicator of the risk of exposure to solar radiation. It is defined as the solar erythemal irradiance (which considers the erythemal action spectrum as a weighted function of the solar UV irradiance) multiplied by 40 m^2/W, in order to have values from 0 to 20 (and even greater, see Cede et al. [1] and [2]). It is measured employing broadband instrument, multi-channel filter radiometers or spectroradiometer [3].

The reduction of the total ozone column in middle and high latitudes of the Earth in recent decades mainly due to chlorofluorocarbons [4] produced a mean increase of this erythemal irradiance, which is represented by the RAF (Radiation Amplification Factor) variable [5]. However, other atmospheric variables such as aerosols, trace gases (O_3, SO_2, NO_2), clouds and ground reflectivity influence the behavior of solar UV radiation at the Earth's surface [6,7]. In particular, in cities such as Santiago, (33.43°S, 70.67°W, 640 m asl.) characterized by high concentrations of contaminants [8,9], the actual UV index can be profoundly different from the expected value.

Santiago is located in a narrow band of land (of about one hundred km), limited on the west by the Coast Range (with maximum altitudes of about 2100 m) and the Pacific Ocean and on the east by the Andes Range, whose peaks are above 5000 m (the highest, Aconcagua, at 32.65°S, 70.03°W, reaches 6959 m). Its climate is semi-arid with frequent cloudless days during dry summers and variable cloud cover conditions in winter. The complex topography in this area produces a particular situation with respect to air movement, reducing advection and consequently increasing the time spent by contaminants in the atmospheric boundary layer of Santiago, especially during winter (June, July and August). [10,11].

Recently Zhou et al. [12,13] considered satellite grid cell extension of data and the anisotropy of the albedo reflectance in high mountains regions as possible factors that influence the satellite data. Therefore a detailed investigation of the time evolution of the solar erythemal irradiance (directly related to the UV index as indicated above) in Santiago represents an extremely interesting

* Corresponding author. Address: Independencia 1027, Postal Code 6530499, Santiago, Chile. Tel.: +56 2 978 6476; fax: +56 2 7355580.
E-mail address: scabrera@med.uchile.cl (S. Cabrera).

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