Εργασίες στο μάθημα «Ατμοσφαιρική Ρύπανση»

Περιοδικό: **Atmospheric Chemistry and Physics (ACP)**

Web address: http://www.atmospheric-chemistry-and-physics.net/index.html

Οι εργασίες αναμένεται να παρουσιαστούν από τις 2/12 και μετά

Ώρες Φοιτητών: Δευτέρα και Πέμπτη 9-11

Αναλογεί μία εργασία σε 2-3 άτομα και έχει ως αντικείμενο την παρουσίαση των επιλεγμένων επιστημονικών εργασιών με σκοπό την εξοικείωση των φοιτητών με τις επιστημονικές δημοσιεύσεις, την αναζήτηση βιβλιογραφίας κτλ.

Συμπληρωματικό βοηθητικό εργαλείο για την αγγλική γλώσσα:
«Πολυγλωσσική βάση όρων της Ε.Ε»
http://iate.europa.eu/iatediff/SearchByQueryLoad.do?method=load

Επιλεγμένες επιστημονικές εργασίες
από το επιστημονικό περιοδικό ACP

1. Retrieving tropospheric nitrogen dioxide from the Ozone Monitoring Instrument: effects of aerosols, surface reflectance anisotropy, and vertical profile of nitrogen dioxide
   J.-T. Lin, R. V. Martin, K. F. Boersma, M. Sneep, P. Stammes, R. Spurr, P. Wang, M. Van Roozendael, K. Clémer, and H. Irie
   Atmos. Chem. Phys., 14, 1441-1461, 2014

2. Sensitivity of free tropospheric carbon monoxide to atmospheric weather states and their persistency: an observational assessment over the Nordic countries
   M. A. Thomas and A. Devasthale
   Atmos. Chem. Phys., 14, 11545-11555, 2014

3. Model-simulated trend of surface carbon monoxide for the 2001–2010 decade
   J. Yoon and A. Pozzer
   Atmos. Chem. Phys., 14, 10465-10482, 2014

4. Global carbon monoxide products from combined AIRS, TES and MLS measurements on A-train satellites
   J. X. Warner, R. Yang, Z. Wei, F. Carminati, A. Tangborn, Z. Sun, W. Lahoz, J.-L. Attié, L. El Amraoui, and B. Duncan
   Atmos. Chem. Phys., 14, 103-114, 2014

5. Summertime tropospheric-ozone variability over the Mediterranean basin observed with IASI
C. Doche, G. Dufour, G. Foret, M. Eremenko, J. Cuesta, M. Beekmann, and P. Kalabokas
Atmos. Chem. Phys., 14, 10589-10600, 2014

6. Photochemical roles of rapid economic growth and potential abatement strategies on tropospheric ozone over South and East Asia in 2030
S. Chatani, M. Amann, A. Goel, J. Hao, Z. Klimont, A. Kumar, A. Mishra, S. Sharma, S. X. Wang, Y. X. Wang, and B. Zhao
Atmos. Chem. Phys., 14, 9259-9277, 2014

7. Climatology of aerosol optical properties and black carbon mass absorption cross section at a remote high-altitude site in the western Mediterranean Basin
M. Pandolfi, A. Ripoll, X. Querol, and A. Alastuey
Atmos. Chem. Phys., 14, 6443-6460, 2014

8. Saharan dust aerosol over the central Mediterranean Sea: PM_{10} chemical composition and concentration versus optical columnar measurements
M. Marconi, D. M. Sferlazzo, S. Becagli, C. Bommarito, G. Calzolai, M. Chiari, A. di Sarra, C. Ghedini, J. L. Gómez-Amo, F. Lucarelli, D. Meloni, F. Monteleone, S. Nava, G. Pace, S. Piacentino, F. Rugi, M. Severi, R. Traversi, and R. Udisti
Atmos. Chem. Phys., 14, 2039-2054, 2014

Οδηγίες παρουσίασης της ερευνητικής εργασίας

Τίτλος και συγγραφική ομάδα:
Comparison of satellite-derived UV irradiances with ground-based measurements at four European stations
A. Kazantzidis, A. F. Bais, J. Grobner, J. R. Herman, S. Kazadzis, N. Krotkov,
E. Kyro, P. N. den Outer, K. Garane, P. Gorts,6 K. Lakkala, C. Meleti, H. Slaper,
R. B. Tax, T. Turunen, and C. S. Zerefos

Μέρη παρουσίασης

Abstract
Introduction
Ground Based Measurements and Satellite Data
Instrument Related Differences
Comparison and results
Conclusions

Abstract

Comparison of satellite-derived UV irradiances with ground-based measurements at four European stations

A. Kazantzidis,[1] A. F. Bais,[1] J. Gröbner,[2] J. R. Herman,[4] S. Kazadzis,[1] N. Krotkov,[3,4] E. Kyrö,[5] P. N. den Outer,[6] K. Garane,[1] P. Görts,[6] K. Lakkala,[5] C. Meleti,[1] H. Slaper,[6] R. B. Tax,[6] T. Turunen,[5] and C. S. Zerefos[7]

Received 15 September 2005; revised 7 February 2006; accepted 8 March 2006; published 15 July 2006.

[1] Satellite-derived ultraviolet (UV) irradiances may form the basis for establishing a global UV climatology, provided that their accuracy is confirmed against ground-based measurements of known quality. In this study, quality-checked spectral UV irradiance measurements from four European stations (Sodankyla, Finland; Bilthoven, Netherlands; Ispra, Italy; and Thessaloniki, Greece) are compared with those derived from TOMS, based on the (version 8) data set. The aim of this study is to validate the TOMS UV irradiances and to investigate the origin of disagreements with ground-based data. Comparisons showed that TOMS overestimates summertime noon CIE-weighted irradiances from 6.6% at the high-latitude site of Sodankyla up to 19% for the three other sites. The influence of clouds and aerosols on the observed differences was investigated. For the other three sites (Bilthoven, Ispra, and Thessaloniki), TOMS overestimates the irradiance at 324 nm by almost 15% even under conditions with cloud optical depth of less than 5. For cloud-free days at Ispra and Thessaloniki, differences ranging between 3% and 20% are well correlated with aerosol optical depth.

[1] Satellite-derived ultraviolet (UV) irradiances may form the basis for establishing a global UV climatology, provided that their accuracy is confirmed against ground-based measurements of known quality. In this study, quality-checked spectral UV irradiance measurements from four European stations (Sodankyla, Finland; Bilthoven, Netherlands; Ispra, Italy; and Thessaloniki, Greece) are compared with those derived from TOMS, based on the (version 8) data set. The aim of this study is to validate the TOMS UV irradiances and to investigate the origin of disagreements with ground-based data.

Comparisons showed that TOMS overestimates summertime noon CIE-weighted irradiances from 6.6% at the high-latitude site of Sodankyla up to 19% for the three other sites. The influence of clouds and aerosols on the observed differences was investigated.

For the other three sites (Bilthoven, Ispra, and Thessaloniki), TOMS overestimates the irradiance at 324 nm by almost 15% even under conditions with cloud optical depth of less than 5. For cloud-free days at Ispra and Thessaloniki, differences ranging between 3% and 20% are well correlated with aerosol optical depth.

1. Introduction

[2] During the last decade, satellite observations from the Total Ozone Mapping Spectrometer (TOMS) have been extensively used in combination with radiative transfer or statistical models to derive UV irradiances at the ground [e.g., Herman et al., 1999; Krotkov et al., 1998; Krotkov et al., 2001]. Since 1978, satellite-derived UV products are available over the globe so that global climatology of surface UV irradiance could be established and possible trends could be examined.

[3] Validation of satellite UV estimates with groundbased measurements is a complicated task, since the spatial distribution of solar UV irradiance received at the ground is mainly controlled by the variability of total ozone and clouds and therefore may vary strongly from place to place. Other parameters, such as aerosols, air pollution, and local weather patterns, are also capable in modifying the UV field. Except from ozone, the impact of all these factors is more or less localized, producing a different UV field at locations even a few kilometers apart. Hence ground-based measurements are not always representative of a typical satellite measurement pixel (TOMS ground FOV 50 km in nadir). The daily averaged UV reduction factors due to clouds derived from ground-based pyranometer data and satellite measurements was examined by Matthijsen et al. [2000] and Williams et al. [2004]. They showed that a good correspondence between space-born and ground-based UV reduction factors can be achieved when combining several ground-based stations per satellite grid cell. Comparisons of TOMS UV estimates with ground-based measurements showed that in summertime the TOMS retrievals overestimate UV radiation, with some exceptions over a few unpolluted sites [e.g., Eck et al., 1995; Fioletov et al., 2002; Fioletov et al., 2004; McKenzie et al., 2001].

[4] In this study, noon spectral irradiances from the latest (version 8) TOMS UV retrieval algorithm were compared with ground-based spectral measurements at four European stations, representing different geographical and environmental conditions. The influence of cloud and aerosol variability on the bias is examined.

2. Ground-Based Measurements and Satellite Data

[5] The four European stations that were used in this study are listed in Table 1, with information on the instrumentation, the data availability, and characteristic details for each station. The stations extend from 40.6N to 67.4N and correspond to different cloud and aerosol regimes. We used ground-based measurements for the time period 1991– 2003, when data from the TOMS instruments on Earth Probe (1996–2003) and Nimbus 7 (1978–1993) satellites were available. Only summer (May through September) data were analyzed to avoid the problems of the TOMS algorithm in distinguishing between snow cover and clouds at Sodankyla, [Fioletov et al., 2004; Kalliskota et al., 2000]. Snow depth observations from FIS site have been also used to exclude days with snow-covered surface. The SHICrivm algorithm was applied to all spectra, to correct for any wavelength shifts and to exclude spectra with nonnatural spikes or distortions in spectral shape [Slaper et al., 1995].

Table 1. Information on Measurement Sites at the Ground and Instruments Used in This Study

Site/Country	Instrument ID	Latitude, °N	Longitude, °E	Altitude, m	Instrument Type	Number of Days	Site Characterization
Sodankyla, FI	FIS	67.4	26.6	179	MKII Brewer #037	963	Remote
Thessaloniki, GR	GRT	40.6	22.9	60	MKIII Brewer #086	689	Urban
Ispra, IT	ISP	45.8	8.6	214	MKII Brewer #066	1185	Rural
Bilthoven, NL	NLR	52.1	5.2	9	Dilor 2.XY.50	977	Rural

3. Instrument-Related Differences

An overview of the comparisons results is presented in Table 2, which shows percentage differences of spectral irradiances at selected wavelengths measured by the local instruments from those measured by the TRS. The data used in these comparisons were measured at solar zenith angles, which cover a range representative for the data that are used for the comparisons with TOMS estimates. Since a direct comparison of the four spectroradiometers that were used in this study was not possible, their differences against the well-calibrated and maintained traveling instrument were used to demonstrate the level of agreement among them.

The four instruments agree to within 6% at 305 nm and 8% at 324 nm. The two double monochromator spectroradiometers (GRT and NLR) have a rather constant bias with the traveling spectroradiometer. These differences are mainly due to the different calibration standards to which each instrument traces its calibration. The wavelength dependence of the other two instruments (3% for FIS and 4% for ISP), which are both single monochromators, could be caused partly by stray light in the UVB wavelengths and the weak sensitivity at the high wavelengths. Nevertheless, with the exception of FIS, these differences are rather small compared to the bias of these instruments with TOMS

Table 2. Percentage Differences, %, Between Instruments at Selected Sites and the Traveling Reference Spectroradiometer at Selected Wavelengths[a]

		Differences to TSR, %		
Instrument ID	Campaign Years	305 nm	310 nm	324 nm
FIS	2003	5.9	5.0	3.1
GRT	2002	4.3	4.1	3.8
ISP	2003	0.0	−1.5	−4
NLR	2002, 2003, 2004	1.8	1.8	2.0

[a]Average differences are presented for sites where more than one comparison campaigns exist.

4. Comparison and Results

Mean percentage differences between ground-based measurements at the four sites and the corresponding TOMS estimates for noon irradiances at 305, 310, 324 nm and for erythemal irradiance are presented in Table 3. The differences for Sodankyla are considerably lower (by about 12%) compared to the differences at the other three sites, probably as a result of lower tropospheric aerosol abundances over this high-latitude site and it is in agreement with relevant studies [e.g., Arola et al., 2005; McKenzie et al., 2001].

[10] At all sites, the differences decrease with increasing wavelength. This is consistent with that expected from small errors in the determination of O3 and SO2 columns and aerosol optical depth that show up primarily at the shorter wavelengths. The standard deviation decreases with decreasing latitude being almost 10% higher in Sodankyla compared with that at Thessaloniki, mainly as an effect of differences in cloudiness, which increases from south to north in the summer months that are considered in this study.

[11] The absolute differences between TOMS-derived and ground-based UV irradiances that are presented here agree with results from similar studies that were conducted for other locations in the northern hemisphere. McKenzie et al. [2001] reported that measurements of daily CIE erythemal dose at two European sites (Garmisch-Partenkirchen, Germany, and Thessaloniki, Greece) are 20–30% lower than the TOMS estimates, while measurements in Toronto,
Canada, are lower by only 15%.

Table 3. Mean Percentage Difference With Standard Deviation (in Parenthesis) Between Ground Measurements and Satellite UV Estimates

Site Name	Differences Between TOMS and GB Derived Irradiances (%)			
	305 nm	310 nm	324 nm	CIE
Sodankyla (FIS)	11.6 (26.6)	7.8 (26.0)	5.1 (26.5)	6.6 (26.1)
Bilthoven (NLR)	22.4 (21.0)	20.1 (20.1)	14.3 (21.4)	19.1 (20.7)
Ispra (ISP)	21.5 (23.7)	18.5 (22.7)	13.0 (23.2)	18.3 (23.1)
Thessaloniki (GRT)	21.9 (16.4)	16.7 (16.2)	11.7 (16.6)	18.6 (16.3)

5. Conclusions

[21] In this study, spectral UV irradiances measured by four UV spectroradiometers at different sites in Europe at local noon for the summer months from 1990 to 2003 are compared with those calculated from TOMS v8 data. The four locations cover a wide range of aerosol and cloudiness regimes. Comparison of the ground-based instruments with a traveling reference spectroradiometer during the period 2002–2004 revealed that the four instruments agree to with 6% in the UV-B wavelength range.

[22] Average biases between TOMS estimates and ground-based measurements are in agreement with previous validation studies. At the three sites (Ispra, Bilthoven, and Thessaloniki), TOMS overestimates the summertime UV irradiances at 305, 310, and 324 nm and CIE dose by 21%, 18%, 13%, and 18.5%, respectively. Average differences are considerably lower by almost 12% at the remote site of Sodankyla in north Finland, while the variability is higher by about 10%, mainly because of the presence of more clouds

References

Cede, A., E. Luccini, L. Nunez, R. D. Piacentini, M. Blumthaler, and J. R. Herman (2004), TOMS-derived erythemal irradiance versus measurements at the stations of the Argentine UV Monitoring Network, *J. Geophys. Res.*, *109*, D08109, doi:10.1029/2004JD004519.

Eck, T. F., P. K. Bhartia, and J. B. Kerr (1995), Satellite estimation of spectral UVB irradiance using TOMS derived total ozone and UV reflectivity, *Geophys. Res. Lett.*, *22*, 611–614.

Fioletov, V. E., J. B. Kerr, D. I. Wardle, N. Krotkov, and J. R. Herman (2002), Comparison of Brewer ultraviolet irradiance measurements with total ozone mapping spectrometer satellite retrievals, *Opt. Eng.*, *41*(12), 3051–3061.