

Surface UV radiation monitoring based on GOME and SCIAMACHY



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Tropospheric Emission Monitoring Internet Service

<http://www.temis.nl/uvradiation/>

(ESA-DUP project)

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- UV radiation monitoring
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UV radiation



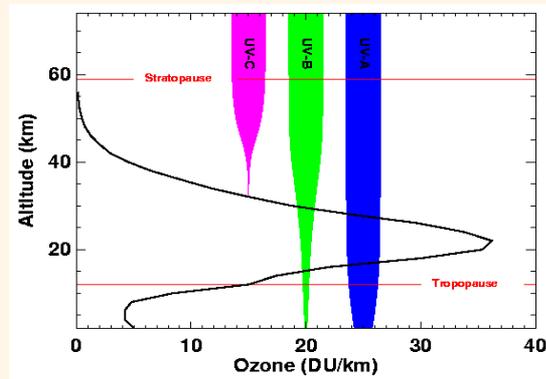
- UV-A: 320-400 nm
- UV-B: 280-320 nm
- UV-C: 200-280 nm

Absorption by ozone and oxygen in atmosphere is wavelength dependent.

UV irradiance at surface:

- UV-A: 94%
- UV-B: 6%
- UV-C: 0%

Biological effects of UV are wavelength dependent



==> important to monitor UV radiation

Action spectra



Relative wavelength dependency of biological effects

Erythema:

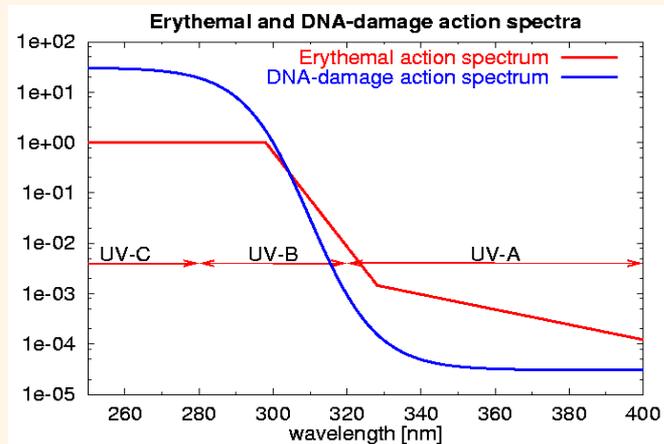
280 – 400 nm

DNA-damage:

256 – 370 nm

Erythematous UV irradiance at the surface:

- UV-A: 17%
- UV-B: 83%



UV index



Integration of UV irradiance weighted with an action spectrum gives the dimensionless UV index: a measure for the effective UV irradiance reaching the surface at a given moment.

Parametrisation by *Allaart et al.* (2003)

of the erythemal UV index: $UVI = UVI(TOC, SZA)$

TOC = total ozone column in Dobson Units

SZA = solar zenith angle in degrees

based on groundbased measurements at De Bilt and Paramaribo.

Similar parametrisation made for the DNA-damage UV index.

Clear-sky UV index at local solar noon



Total ozone column data from GOME and SCIAMACHY is assimilated in a chemistry transport model, which is driven by ECMWF forecast meteorology, provides global ozone field data at local solar noon.

====> *Clear-sky UV index at local solar noon – global field*

TEMIS algorithm contains corrections for:

- ground elevation
- surface albedo
- varying Earth-Sun distance

(Correction for aerosols is preliminary.)

Daily UV dose



$$UVD = \int UVI(TOC, SZA(t)) \cdot A(t) \cdot dt \quad [kJ/m^2]$$

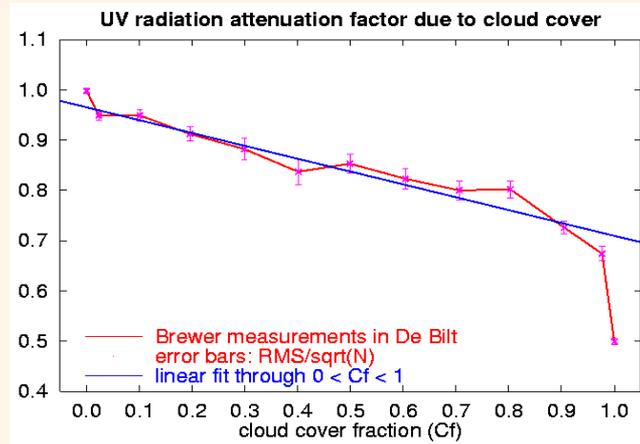
Cloud info from:

METEOSAT

- Europe
- daily
- 1-hourly
- ▶ yesterdays dose

ISCCP database

- world-wide
- monthly average
- 3-hourly
- ▶ monthly average dose



Validation of daily erythemal UV dose for Europe



Preliminary validation using groundbased UV measurements in the EDUCE database, which provides the erythemal UV dose rate (in J/m^2s) via the BASINT tool.

TEMIS algorithm, using METEOSAT cloud cover information, performs the integration by way of summing 10-minute intervals.

Hence, for comparison the EDUCE/BASINT dose rate is integrated over 10 minutes for each measurement.

EDUCE = European Database for UV Climatology and Evaluation
(<http://www.muk.uni-hannover.de/EDUCE/>)

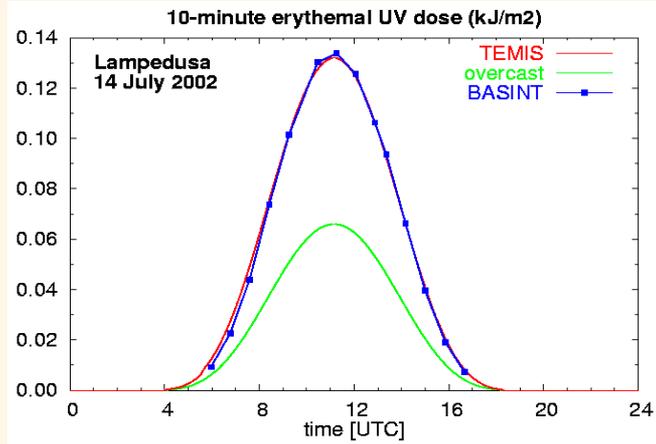
Validation of daily erythemal UV dose for Europe



METEOSAT:
(almost) completely
cloud-free day at
Lampedusa

Daily dose in kJ/m^2 :
TEMIS = 4.86
BASINT = 4.83
Clear-sky = 4.86
Overcast = 2.43

Lampedusa data:
thanks to Alcide di Sarra



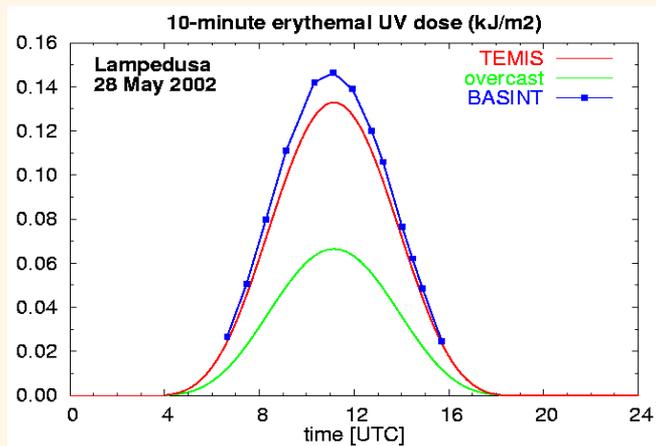
Validation of daily erythemal UV dose for Europe



METEOSAT:
(almost) completely
cloud-free day at
Lampedusa

Daily dose in kJ/m^2 :
TEMIS = 4.84
BASINT = 5.31
Clear-sky = 4.85
Overcast = 2.42

Lampedusa data:
thanks to Alcide di Sarra



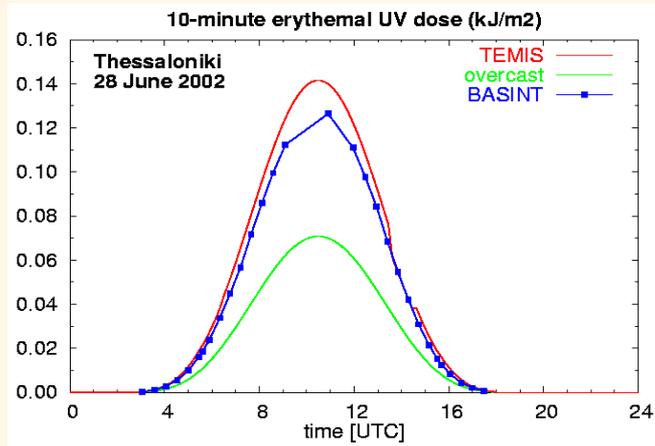
Validation of daily erythemal UV dose for Europe



METEOSAT:
(almost) completely
cloud-free day at
Thessaloniki

Daily dose in kJ/m²:
 TEMIS = 5.32
 BASINT = 4.82
 Clear-sky = 5.38
 Overcast = 2.69

Thessaloniki data:
thanks to Alkis Bais



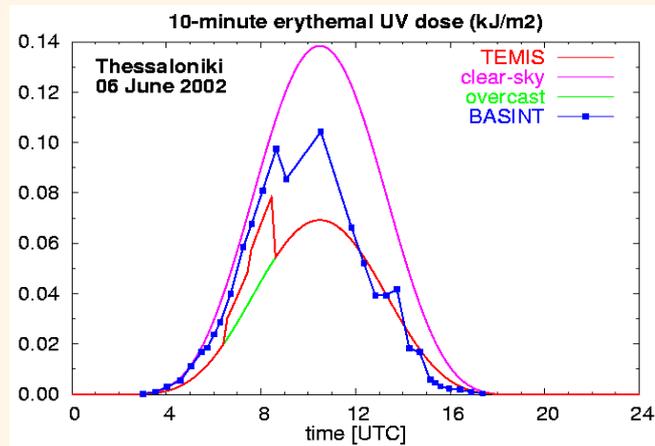
Validation of daily erythemal UV dose for Europe



METEOSAT:
almost fully
clouded day at
Thessaloniki

Daily dose in kJ/m²:
 TEMIS = 2.81
 BASINT = 3.55
 Clear-sky = 5.21
 Overcast = 2.61

Thessaloniki data:
thanks to Alkis Bais



TEMIS data service – GOME



<http://www.temis.nl/uvradiation/GOME/>

Data sets	Clear-sky UV index	Daily UV dose
<i>Europe</i>		
Daily data	Aug. 1995 – May 2003	Aug. 1998 – May 2003
Monthly averages	Aug. 1995 – May 2003	Aug. 1998 – May 2003
Climatologies	Aug. 1995 – May 2003	Aug. 1998 – May 2003
Yearly averages & extrema	1996 – 2003	1999 – 2002
<i>Whole world</i>		
Daily data	Aug. 1995 – May 2003	(not available)
Monthly averages	Aug. 1995 – May 2003	Aug. 1995 – Sep. 2001
Climatologies	Aug. 1995 – May 2003	Aug. 1995 – Sep. 2001
Yearly averages & extrema	1996 – 2003	1996 – 2000

For both the erythemal and the DNA-damage data products.

TEMIS data service – SCIA



<http://www.temis.nl/uvradiation/>

SCIAMACHY near-real time service:

- Clear-sky erythemal UV index at local solar noon, a forecast for today and for a few days ahead.
- Daily erythemal UV dose for Europe, using the 1-hourly METEOSAT cloud cover information, for yesterday.

SCIAMACHY data archive:

- Daily erythemal UV dose for Europe: Jan. 2004 to present.

Starting the data archive in Jan. 2003 requires ozone column data starting in Dec. 2002. But data for Dec. 2002 and Jan. 2003 is not complete yet: this awaits (re)processing by ESA.

Conclusions



As a support to UV radiation monitoring, TEMIS provides the erythemal and DNA-damage UV index and UV dose.

For the GOME period (Aug. 1998 – May 2003) in the form of a data archive, with monthly averages, climatologies, etc.

Based on SCIAMACHY observations, there is an operational near-real time forecast of the erythemal UV index world wide, and for Europe the erythemal UV dose.

A preliminary validation of the erythemal UV dose shows good agreement between the TEMIS algorithm and groundbased UV measurements in the EDUCE database.

Outlook



<http://www.temis.nl/uvradiation/>

- Maintenance of the GOME data archive.
- Continuation of the SCIAMACHY near-real time service.
- Setting up data archive for SCIAMACHY, in the same manner as the GOME data archive.
- Implement an improved aerosol correction in the TEMIS algorithm.
- A more detailed validation of the erythemal UV dose.
- Implement the use of cloud cover information from Meteosat Second Generation (MSG) satellites for the UV dose.
- Investigate whether UV index and UV dose can be given separately for UV-A and UV-B.
- Possibly apply more action spectra.