Method for producing the COST 726 maps and illustration of the result

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The maps are obtained by direct fully coupled radiative transfer modelling of the cloudless surface UV, on which the cloud modification factor is then applied.

The resulting maps have a spatial resolution of 0.05 x 0.05 deg., even if most of the input data are at a 1 x 1 deg. resolution. The covered area extends from 25.5 W to 35.5 E and from 30.5 N to 80.5 N.

The higher spatial resolution allows better taking into account the effects of altitude.

The first step is therefore to transport input data to the finer spatial grid.
The digital elevation model is the GTOPO30 of USGS. The altitude, originally on a 30” grid, is averaged in each 0.05 deg. cell

AEROSOL OPTICAL THICKNESS

The 1x1 deg. MODIS/AERONET AOT map is corrected for altitude:

$$AOT = \frac{AOT_{nc}}{(\text{altitude}[\text{km}])^{1.65}}$$  if altitude > 1 km
The UV surface albedo at 0.05 deg. resolution is empirically inferred from ERA40 snow depth and sea ice cover data at 1deg. resolution.
The COST ozone map at 1deg. resolution is interpolated on the 0.05 deg. grid.
Because of the large number of calculations to be performed, the surface downwelling irradiance is obtained by multiple interpolation in a Look Up Table (LUT); running the RT code is not practicable.

LUT (sza, ozone, AOT, UV albedo, altitude, spectral weighting function)

The LUT was pre-computed with the LibRadtran/UVspec code* for sets of discrete values of the input parameters.

The LUT contains the downwelling surface irradiance weighed for the erythemal effect (CIE87) and at 7 wavelengths with a 5 nm FWHM triangular slit function (295, 300, 305, 310, 315, 330 and 360 nm). This allows to compute the doses corresponding to an arbitrary action spectrum.

The downwelling surface irradiance is computed every half hour and the daily doses are then obtained by integration (on time).

EXAMPLE OF A CLOUD FREE MAP

Cloud free erythemal daily dose on March 21st 1958

Erythemal daily dose on March 21st, 1958

Erythemal daily dose [kJ/m²]
The UV cloud modification factor is applied on the cloud free map.
March 21st 1958: Erythemal + 7 wavelengths

CIE87
Erythemal daily dose on March 21st, 1958

295 nm
Map at 295 nm for March 21st, 1958

300 nm
Map at 300 nm for March 21st, 1958

305 nm
Map at 305 nm for March 21st, 1958

310 nm
Map at 310 nm for March 21st, 1956

315 nm
Map at 315 nm for March 21st, 1956

330 nm
Map at 330 nm for March 21st, 1958

360 nm
Map at 360 nm for March 21st, 1958
A FEW NUMBERS ABOUT THE DATA SET

The maps have been produced for each day from January 1st 1958 to August 31st 2002; there isn’t any missing day.

16,314 days x 8 = 130,512 maps.

Each map is 1220 columns (W-E) by 1000 lines (S-N).

If kept in a 4 bytes floating point format, each map is a 4,880 kB file, the total data set amounts to 635,898,560 kB (~640GB).
The COST daily dose maps do capture the correct spatial pattern at the European scale. Below is a comparison with a map produced from METEOSAT data (July 1st 1997).
MONTHLY AVERAGE MAPS

April 1958

Average erythemal daily dose in April 1958, COST726

July 1958

Average erythemal daily dose in July 1958, COST726
Monthly average maps themselves averaged over the 45 years of the data set. Useful as a reference and to document the systematic geographical patterns.
SYSTEMATIC GEOGRAPHICAL PATTERNS

April

March

August

May

Average (1958–2002) erythemal daily dose in April/March/August/May

Average erythemal daily dose [kJ/m²]

Average erythemal daily dose [kJ/m²]
YEAR TO YEAR VARIABILITY

DEVIATION OF THE MONTHLY AVERAGED ERYTHEMAL DAILY DOSE WITH RESPECT TO THE 1958–2002 MEAN (MARCH)

Difference with respect to multi-year mean [%]
YEAR TO YEAR VARIABILITY

DEVIATION OF THE MONTHLY AVERAGED ERYTHEMAL DAILY DOSE WITH RESPECT TO THE 1958–2002 MEAN (JULY)

Difference with respect to multi-year mean [%]
TWO EXAMPLES

Total Column Ozone

March 1961

Average total column ozone in March 1961, COST226

Excess/deficit in erythemal dose

July 1980

Average total column ozone in July 1980, COST226

CMF

Average cloud modification factor in March 1961, COST226

Average cloud modification factor in July 1980, COST226
ERYTHEMAL vs. “VITAMIN D”

“Vitamin D” weighed

March 10 2000

July 10 2000

Ratio “Vitamin D” / Erythemal

Total Column Ozone

Total column ozone on March 10 2000

Total column ozone on July 10 2000
ANOTHER VIEW OF THE DATA SET

Time series of the erythemal daily dose in Warsaw
Thank you  Dziękuję  Danke  Merci  Dank u  Dêkuji
Ευχάριστω  Tak  Tänan  Kiitos  Köszönöm  Grazie
Takk  Obrigado  Multumesc  Grazcha  Dakujem  Gracias
Tack  Спасибо  Tapadh leat  Diolch yn fawr  Ekerrik asko
Trugarez  Gràcies  Durdaladawhy  Grazia  Dankon  Tanke
Mèrczi  Kali' sso'rlta-ssu  Ei De gra  Dilan  Dank  Gura mie ayd
Ek dank auk schoin  Koutai  Dankscheen  Mercé  Gestena Nais
Giitit itt  Takkâ  Spässep  Grassias  Thenk ye  Thenks  Aiteh
Djeelsha grawsta  Grazzi  Engraziel  Dankeschee  Ganta  A dank aych