Instructions for using the web-based TUV Quick Calculator

Wavelength: All wavelengths are in nanometers (nm) measured in vacuum.

Start: shortest wavelength

End: longest wavelength

Increments: Number of equal-sized subdivisions of the range End-Start.

However, setting this to -156 will default to a wide grid (120.00 – 735.00 nm) with 156 non-uniform intervals optimized for rapid photolysis calculations at any altitude.

Important note: Users should ensure that the selected wavelength range (Start, End) is appropriate to their problem. Different photolysis reactions occur in different wavelength bands. Some examples:

UV-C (200-280 nm): many stratospheric photolysis reactions

UV-B (280-315 nm): many tropospheric photolysis reactions, e.g. $O_3 \rightarrow O(^1D)$; $H_2O_2 \rightarrow 2OH$.

UV-A (315-400 nm): tropospheric $HONO \rightarrow OH + NO$; $NO_2 \rightarrow NO+O(^3P)$ (up to 420 nm).

Visible (400-700 nm): $O_3 \rightarrow O(^3P)$; $NO_3 \rightarrow NO_2+O$

Input Option 1: User-specified geographic location and time/date. The code computes the appropriate solar zenith angle and Earth-Sun distance. Note:

> Latitudes: positive North of equator, negative South of equator
>
> Longitudes: positive East of the Greenwich meridian, negative West of the Greenwich meridian

Input Option 2: User specifies the solar zenith angle, and the annual average Earth-Sun distance is used. To avoid inconsistencies (e.g. overhead sun at the poles), options 1 and 2 cannot be invoked at the same time.

Other input parameters:

Ozone column, in Dobson Units (du), vertical, from ground (even if above sea level) to space. The US Standard Atmosphere O_3 is used to specify the shape of the vertical profile but the total column is re-scaled to the value selected here by the user.

Surface albedo: Assumes a Lambertian reflection (isotropic radiance) Values for snow can reach 0.90-0.99, but otherwise values at UV wavelengths are in the range 0.02-0.20 depending on the precise surface.

Ground elevation: The elevation of the ground, in km above mean sea level.

Measurement altitude: The altitude in the atmosphere for which results are requested. This should not be confused with the ground elevation. For example, if you have measurements made from an airplane, flying at 6 km above the ground, and the surface is at 1.5 km, then you will want to request results for a measurement altitude of 7.5 km asl.

Clouds: You can specify a single cloudy layer (homogeneous, horizontally infinite).

Cloud Optical Depth: vertical optical depth of the cloud.

Cloud base, top: base and top of cloud, in km (asl)

In this simple web-based calculator, you may specify only one cloud layer. The optical depth is assumed to be independent of wavelength (white clouds). The cloud single scattering albedo is set to ssa = 0.9999 and the asymmetry factor is 0.85, both independent of wavelength. More detailed changes may be made by downloading the fortran source code and editing subroutine setcld.f, wherein users can add clouds to any layer, and allow wavelength-dependent optical depth, single scattering albedo, and asymmetry factor (e.g. calculated from Mie theory).

Aerosols: The typical continental mid-latituide aerosol profile from Elterman (1967) is used, and can be scaled by a user-specified optical depth at 550 nm.

Optical Depth: total extinction (absorption + scattering) at 550 nm, vertical, from ground to space.

Single Scattering Albedo (S-S alb), assumed independent of wavelength.

Alpha (Angstrom exponent), gives wavelength dependence of optical depth, by multiplying the 550 nm value by (550 nm/wavelength, nm)**alpha.

Sunlight: You can choose which of 3 components of sunlight contribute to your output:

Direct beam = direct solar beam

Diffuse down = down-ward propagating scattered radiation (diffuse sky light)

Diffuse up = up-ward propagating scattered radiation (diffuse light from below)

Note that the internal radiative transfer calculation includes coupling among all three components. The option here only affects which components are provided to the output. Examples: Use (Direct beam; Diffuse down; Diffuse up):

(1, 1, 1) for actinic flux and photolysis coefficients that include radiation from all directions.

(1, 1, 0) for spectral irradiance or actinic flux measured with a zenith-pointing instrument

(0, 0, 1) for up-welling irradiance or actinic flux measured with a nadir-poining instrument.

(1, 1, -1) for net irradiance.

(1, 0, 0) for direct beam only, e.g. solar beam incident at the top of the atmosphere if the measurement altitude is set to 80 km (top of model).

The full FORTRAN code allows users considerably more flexibility including loops for multiple calculations, arbitrary vertical distribution of aerosols, clouds, ozone, and

You may download the full FORTRAN code from:

https://www2.acom.ucar.edu/modeling/tuv-download

OUTPUT OPTION 1 (for Atmospheric Science)

Select one or both:

Molecular photolysis frequencies (109 photoreactions)

Spectral actinic flux

[Default: all directions of sunlight (1, 1, 1)]

OUTPUT OPTION 2 (for Biology)

Select one or both:

Weighted irradiance (27 weighting functions)

Spectral irradiance

[Default: only down-welling radiation (1, 1, 0)]

Last modified by S. Madronich, 9 August 2016