UV Atlas version 2: What you get for your money

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Abstract. The purpose of the NIWA UV Atlas project is to produce maps and time series of parameters describing the UV radiation environment over New Zealand since 1960. This paper describes the new version 2 NIWA UV Atlas and outlines the improvements made from version 1. The second version of the UV Atlas, together with information on how to download and install it, is available at:

http://www.niwa.co.nz/services/uvozone/atlas

The package is free.

Data products

The data products made available through the UV Atlas include time series, at a number of locations, of clear-sky UV irradiances with a number of spectral weightings (see below), estimated true UV irradiances which include estimated effects of cloud cover, cloud cover modification values (1 for cloudless skies, less than 1 for cloud induced reduction of surface irradiances), modelled broadband radiation, measured broadband radiation, temperature, surface pressure, sea level pressure, humidity, and total column ozone. These are provided at hourly, daily, monthly and annual resolution, except for ozone which does not have data at hourly resolution. In addition, maps of clear-sky UV irradiances, estimated true UV irradiances, sea-level pressure, surface pressure, and total column ozone are available. These are provided at hourly, daily, monthly and annual resolution except for maps of estimated true UV irradiances which are provided only at hourly resolution and ozone maps which are provided only at daily, monthly and annual resolution.

New features

This second version of the UV Atlas includes a number of new features which are summarized below:

Additional climate stations: The first version of the UV Atlas included only climate data (temperature, sea-level pressure, and humidity) from the ~70 climate stations for which broadband radiation data were also available. In version 2, climate data from all climate stations within New Zealand are included. Note however that these data can only be plotted using the UV Atlas software and cannot be extracted to data files. For access to the climate data from the national climate data base, please visit the NIWA web page.

More than just erythemal irradiance: In addition to erythemal irradiance a number of other spectral weightings are now available for hourly clear-sky irradiance maps and for hourly, daily, monthly and annual time series of clear-sky UV irradiances at specific locations. The additional clear-sky irradiance products are:

- UV Index (UVI)

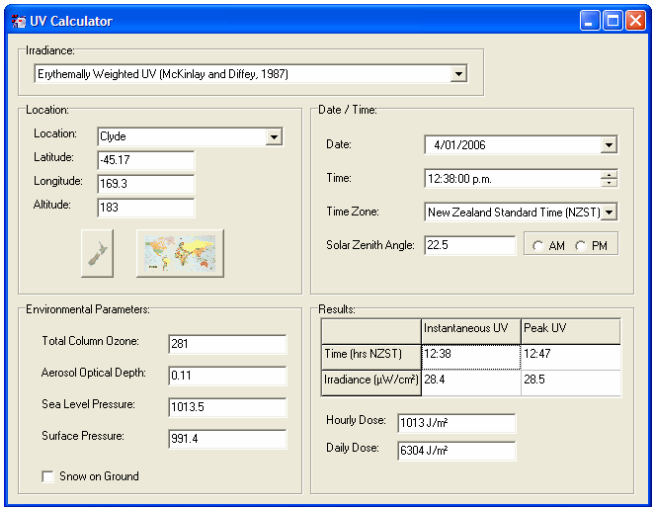

Figure 1: An example of the UV calculator.

- Plant damage weighted UV
- DNA damage weighted UV
- Plant Damage Weighted UV
- USC Skin Cancer
- UVB 280-315nm
- UVB 280-320nm
- Vitamin D synthesis

Daily, monthly and annual maps of these additional irradiance products are expected to be available shortly. Check the UV Atlas web site for planned future releases of these and other updates.

UV calculator: This version of the UV Atlas includes a calculator that can be used to calculate instantaneous UV irradiances, weighted with any of the spectral weightings detailed above, for user defined total column ozone, aerosol optical depth, surface pressure and solar zenith angle. If the ozone or aerosol optical depth is not known, these values are estimated from a climatology. If the surface pressure is not known, this is estimated from mean sea-level pressure (1013.25 hPa) and the location altitude. If the solar zenith angle is not known, the location latitude and longitude are set as well as the time, from which the solar zenith angle is calculated. A screen shot of the UV calculator is shown in Figure 1.

Improved animation: This version of the Atlas includes better animation of map data. When the start and end times for selected map data are different, the maps are shown as an animation that can be fully controlled by the user. Because it can take some time to generate the graphics for the maps, this version shows the Nth map while the $N+1$th map is being generated. An example of a single clear-sky irradiance map is shown in Figure 2.

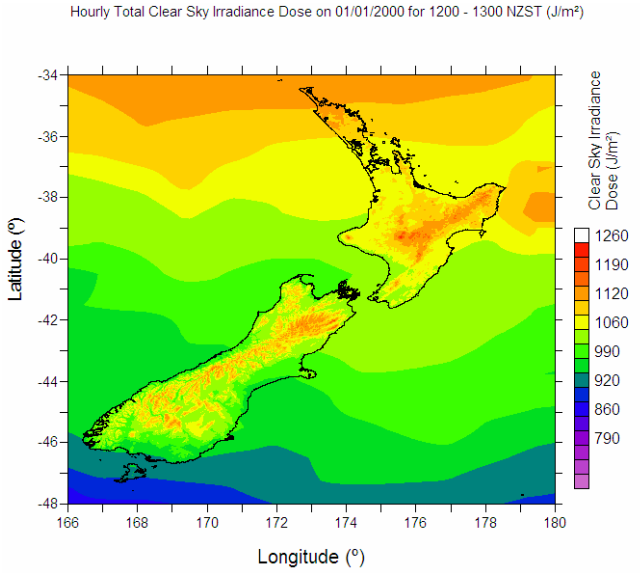

Figure 2: An example hourly total clear sky erythemal UV map.

Ability to include more than one time series on a plot: This version of the UV Atlas includes significantly improved plotting of time series. It is now possible to plot more than one time series on a single plot. An example is shown in Figure 3 where total column ozone (red) is plotted against the left Y axis together with daily clear-sky erythemal dose (green) plotted against the right Y axis. The close anti-correlation between the daily total column ozone and the erythemal UV dose is clear.

Data update facility: Updates of data files, both for time series and for map data, can now be made through the *Data Update* menu. The program acts as an FTP client which connects to an FTP server on which regularly updated data files will be made available. Only files for which updates are available are shown and the user can specify which data files should be updated. This version of the UV Atlas can still make use of the original version 1 CD of data so that users not wanting to use data beyond 2001 can still make use of the original CD of data.

Data availability reports: The availability of the various data products can now be displayed graphically. An example of such a display is shown in Figure 4.

Online help: More extensive on-line help is now available. The online help also serves as a user manual for the program.

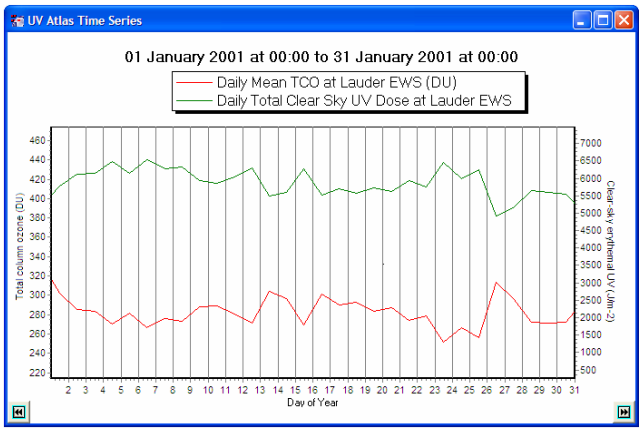

Figure 3: An example of two different data products plotted on the same plot.

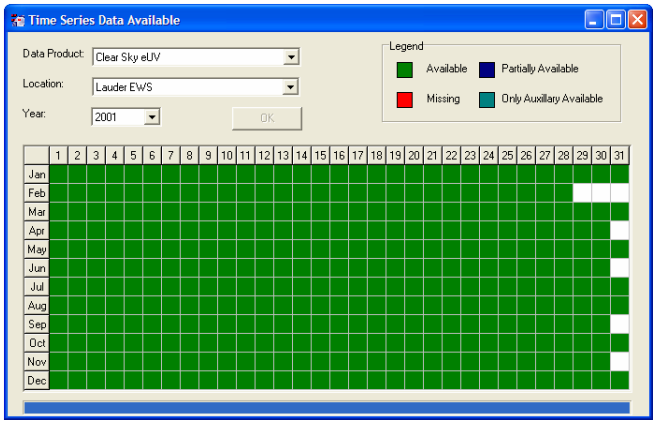

Figure 4: The window showing the availability of clear-sky erythemal UV estimates for Lauder for 2001.

gram.

A number of additional improvements and changes have been made to the data display software, not all of which have been detailed here. Improvements have also been made to the underlying data e.g. the total column ozone data are extracted from the new version 2.0 NIWA assimilated total column ozone data base described in Bodeker et al. [2005].

The method used to estimate surface UV irradiances

The primary output from the UV Atlas is estimated true surface UV irradiances in the presence of clouds, calculated as follows:

$$E_{true} = E_{model} \times A_{sza} \times (I_{meas}/I_{model})^{Psza} \quad (1)$$

where E_{model} is the modelled clear-sky UV (see below), I_{meas} is the measured broadband radiation, I_{model} is the modelled clear-sky broadband radiation and A_{sza} and P_{sza} are solar zenith angle dependent coefficients derived from plots of E_R ($=E_{meas}/E_{model}$) against I_R ($=I_{meas}/I_{model}$) at Lauder, where E_{meas} is the measured UV [*Bodeker and McKenzie*, 1996]. E_{model} is calculated using a radiative transfer model, with ozone and surface pressure as inputs. I_{model} is also calculated from a radiative transfer model, with surface pressure, temperature and humidity as inputs. The aerosol loading for both models was specified as:

$$\beta = 0.03\times(\cos(2\pi*Day/365))+0.08 \quad (2)$$

where Day is the day of the year. The value modifying E_{model} to produce E_{true} is called the cloud cover modification factor (CMF):

$$CMF = A_{sza} \times (I_{meas}/I_{model})^{Psza} \quad (3)$$

Within the display software, UV irradiances for are calculated from a 4 dimensional lookup table (solar zenith angle, surface pressure, total column ozone and aerosol loading) of erythemal UV irradiances, and for products other than erythemal UV are then modified with a 2 dimensional (solar zenith angle and total column ozone) perturbation table.

References

Bodeker G.E. and R.L. McKenzie, An algorithm for inferring surface UV irradiance including cloud effects, Journal of Applied Meteorology, 35, no. 10, 1860-1877, 1996.

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