Time series of daily erythemal UVB doses at Uccle Belgium

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1 Introduction

We investigate the relative impact of ozone, aerosol and clouds on daily erythemal UV doses. The daily dose of total solar radiation is used as a proxy for cloud effects.

2 Data

Following data obtained at the Royal Meteorological Institute in Uccle, Belgium (50°48'N, 4°21'E) are used:

- **Daily UV dose** (1990 - May 2008) measured with Brewer instrument 016. Calibration level maintained with 50 W lamps on a monthly basis and with 1000 W lamps during intercomparisons (1994, 2003, 2006, 2008), and an additional comparison with the quasume unit [Gröbner *et al*., 2004];
- **Daily dose of total radiation** (1990 - May 2008) from the meteorological observations with pyranometers;
- **Daily means of total Ozone** (1990 - May 2008) from the Brewer instrument 016, calibrated in 1989, 1994, 2003, 2006, 2008 against the travelling standard 017 and continuously compared with the co-located Dobson instrument 40 and Brewer instrument 178 (since 2001);
- **Daily mean Aerosol Optical Depths at 320 nm** (1990 - March 2007) on clear days from the direct sun observations of Brewer instrument 016 with the algorithm developed by Cheymol and De Backer [2003].

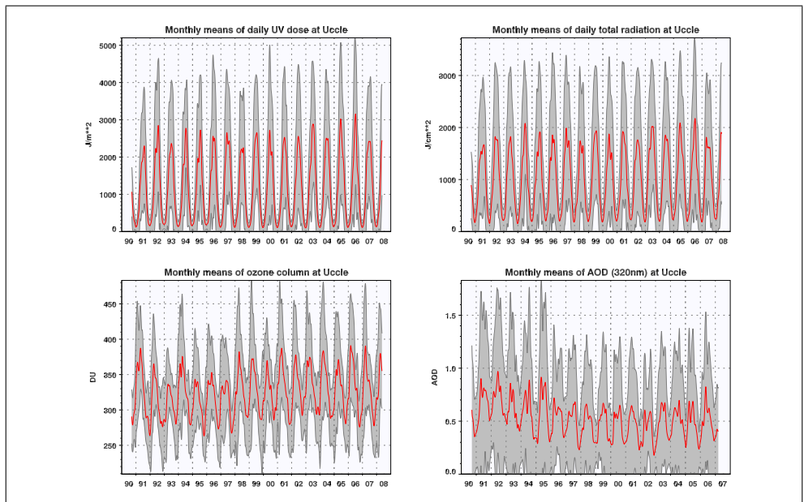

Figure 1. Time series of the monthly mean values of the daily UV dose, the daily dose of total radiation, the ozone column and the AOD at 320 nm at Uccle.

The running monthly mean values of the different parameters (Fig. 1) all show a yearly cycle, but also large year-to-year differences. Therefore trends and correlations will be calculated for the relative deviations from the long-term yearly cycle for each parameter.

3 Method

- Calculate running monthly means (Gaussian filter with $\sigma = 30$ days);
- Deseasonalise time series by subtracting long term yearly cycle;
- Calculate trends of relative deseasonalised time series;
- Calculate correlation coefficients between different parameters;
- Calculate modification factors between the different parameters (=percentage change of UV dose, per percent change of correlative parameter).

4 Trends

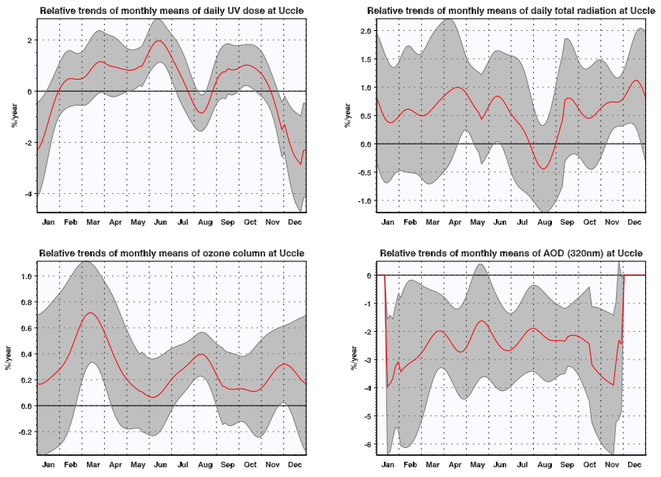

Figure 2. Seasonal trends of the daily UV dose, the daily dose of total radiation, the ozone column and the AOD at 320 nm at Uccle.

A positive trend in the UV doses is seen in June, while a negative trend is found in August (Fig. 2). A similar changeover (positive trends in late spring, negative in August), although less significant is seen for the total radiation. Note that total ozone trends are positive all over the year, but most significant during March and August. The trend of AOD in the UV is always negative and shows no distinct seasonal pattern.

5 Correlations and modification factors

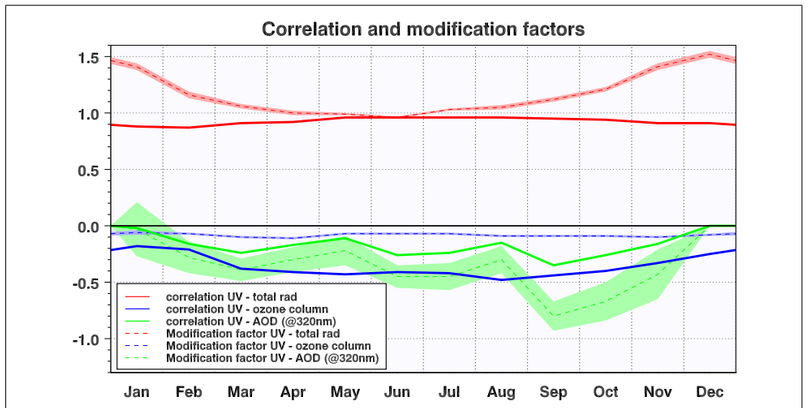

Figure 3. Seasonal correlation coefficients and modification factors (percent change in UV dose per percent change in correlative parameter) for the relation between daily UV doses and total radiation, ozone column and AOD in the UV respectively. The shaded areas are the 1σ error estimates for the modification factors.

A clear correlation is seen between the daily UV doses and the global radiation throughout the year. The anticorrelation with the ozone column is most pronounced during August. The anticorrelation (and modification factor) with the AOD in the UV (only available during clear days) is most important in September.

Conclusions

A positive trend of about 2% per year in UV daily doses at Uccle for the period 1991-2008 is observed during the month June, while during August a negeative trend of -1% per year is seen. For the other months the trend is statistically insignificant.

The daily UV doses show high correlation coefficients (mostly higher than 0.9, except during winter) with the daily sums of global solar radiation. The corresponding modification factor is about 1% / % in summer and up to 1.5% / % in winter. This indicates that the same factor is influencing the daily UV dose and total radiation at Uccle. Probably it is the cloud cover.

The anticorrelation with total ozone is highest during August (reaching -0.48 but with low modification factors). The anticorrelation with the AOD in the UV is still smaller (between 0.02 and 0.35), but its modification factor is in general larger.

References

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