

1 Introduction

The Royal Meteorological Institute of Belgium performs spectral UV measurements with Brewer spectrophotometers at two stations:

- Uccle, Belgium (50°48'N, 4°21'E, 100 m asl): with Brewer#016 since 1990 and Brewer#178 since 2002
- Utsteinen, Antarctica (71°95'S, 23°35'E, 1372 m asl) (at the Belgian research station Princess Elisabeth): with Brewer#100 since 2011 (measurements only during austral summer)



Figure 1. Brewer#016 (on the right) and Brewer#178 (on the left) at Uccle.

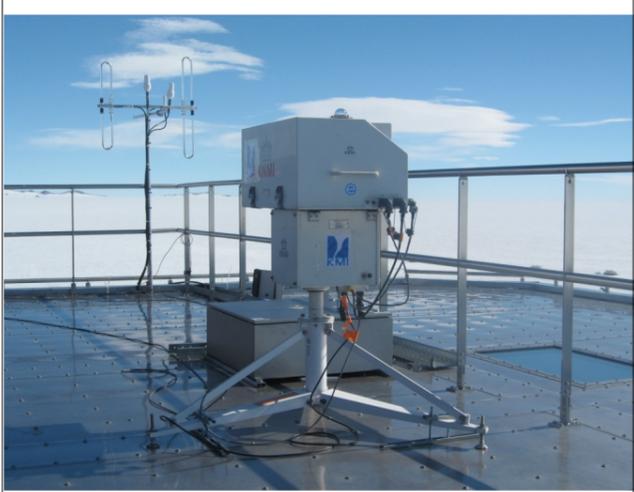


Figure 2. Brewer#100 at Utsteinen.

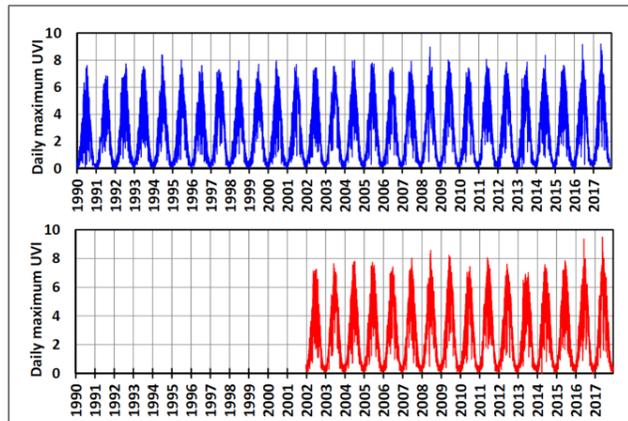


Figure 3. Time series of maximum daily UVI at Uccle measured with Brewer#016 (upper panel) and Brewer#178 (lower panel).

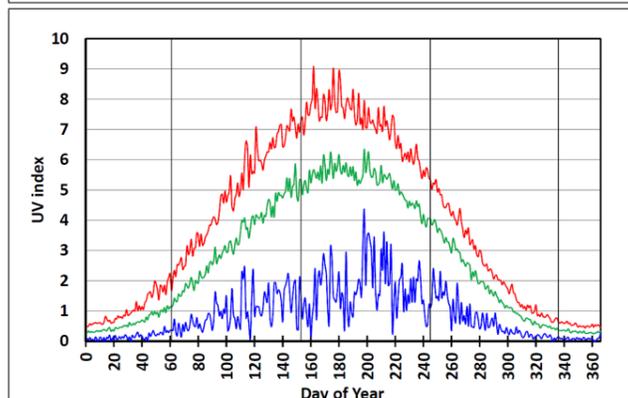


Figure 4. Minimum (in blue), maximum (in red) and mean (in green) UVI for each day of the year (based on Brewer#016 maximum daily UVI measurements between 1990-2018). The vertical lines separate the different seasons.

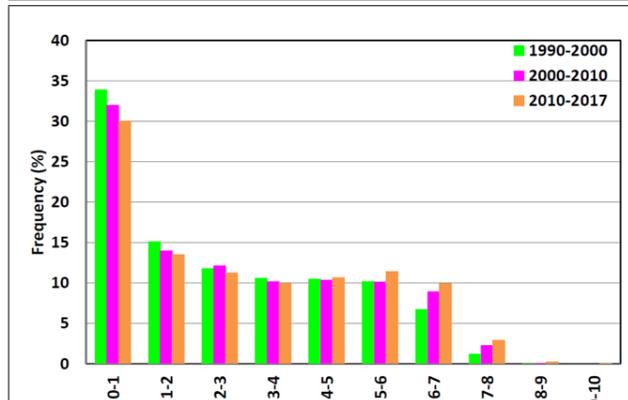


Figure 5. Change in frequency of occurrence of daily maximum UVI over time (based on Brewer#016 data).

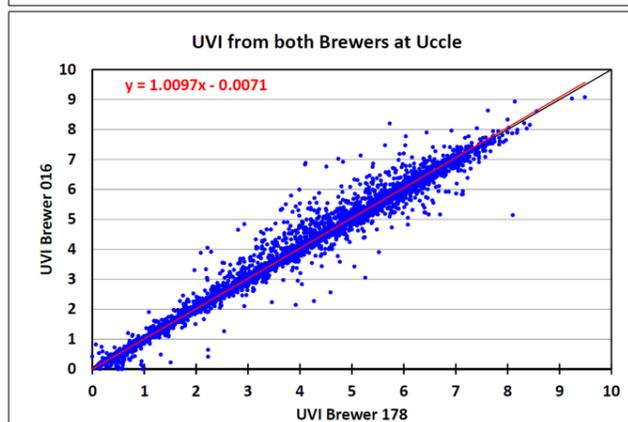


Figure 6. Scatterplot of Brewer#016 versus Brewer#178 daily maximum UVI data.

2.2 UV index at Utsteinen

Fig. 7 shows the UVI time series measured with Brewer#100 at Utsteinen. Measurements at the station are only performed during austral summer, explaining the gaps in the time series.

Fig. 8 shows for each day of the year, the minimum, maximum and average UVI and Fig. 9 presents the frequency distribution of UVI observed over austral summers between 2011-2018. Almost 90% of the observed maximum UVI values are between 3 and 8.

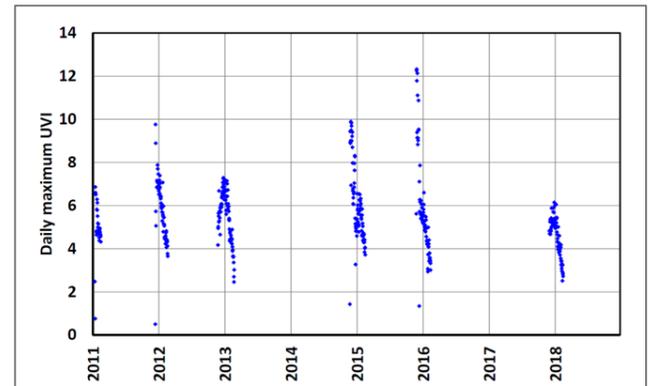


Figure 7. Time series of maximum daily UVI at Utsteinen measured with Brewer#100.

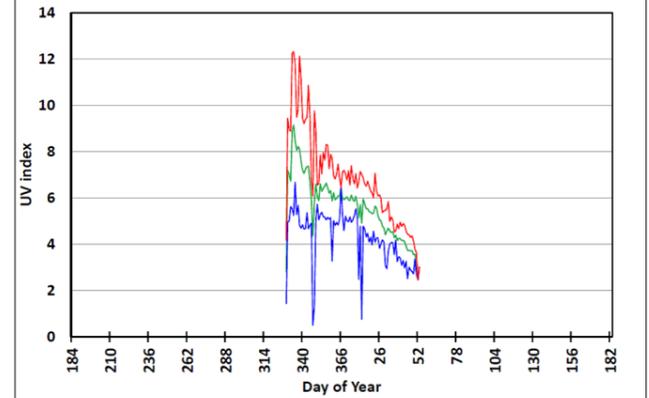


Figure 8. Minimum (in blue), maximum (in red) and mean (in green) UVI for each day of the year (based on Brewer#100 measurements between 2011-2018).

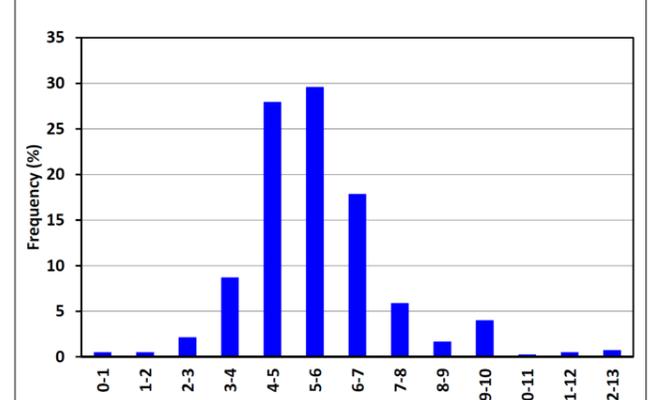


Figure 9. Frequency distribution of daily max UVI at Utsteinen between 2011-2018.

2 Analysis of the UV index

2.1 UV index at Uccle

From the diurnal UV index (UVI) values, the maximum daily values are determined. The UVI time series for both Brewers are shown in Fig. 3. A significant positive trend (based on monthly anomalies) is present in both time series: +6% (+/- 1%) per decade for Brewer#016 and +5% (+/- 1%) per decade for Brewer#178. The yearly cycle in UVI is clearly visible in Fig. 3 and Fig. 4 (which shows for each day of the year, the minimum, maximum and average UVI).

At Uccle, 32% of the observed daily maximum UVI are lower than 1 for the 1990-2017 period and values higher than 6 are rather sparse (11%). Fig. 5 shows the change in frequency of occurrence of UVI values over three time periods: 1990-2000, 2000-2010 and 2010-2017. It can be seen that higher UVI values (above 6) have become more frequent over the last 'decade'.

The maximum daily UVI values from both Brewers have been compared (Fig. 6) and show a good agreement with a correlation coefficient of 0.99. On average, the values of Brewer#178 tend to be slightly higher than those of Brewer#016.

There is a difference between the different measurement campaigns: especially during the 2014-2015 and 2015-2016 seasons, higher UVI values (> 8) are observed in 17% of the cases. However, during the 2012-2013 and 2017-2018 season, maximum UVI values were clearly lower (respectively 7.3 and 6.1). This can be explained by the temporal behavior of the total ozone column over the Antarctic. Seasons with higher UVI are influenced by a more pronounced ozone hole and by the spatial relocation of its remainder during spring and summer. Over the other seasons, the total ozone amount was higher and more stable.

3 CONCLUSIONS

The UV index at Uccle has increased over the 1990-2018 time period. A significant positive trend is present in the data of both Brewers. Higher values have become more frequent over the last decade.

The UVI values observed at Utsteinen are higher than the ones at Uccle. Almost 90% of the observed values is higher than 3. Measurements at Utsteinen are however only available during austral summer.

At Utsteinen, seasons with a more pronounced ozone hole are characterized by higher UVI values.