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Aerosols optical properties and their effect on the UV solar irradiance at Uccle, Belgium

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Introduction

In this study, the effect of aerosols on UV irradiance reaching the ground and the single scattering albedo are derived, for the first time, at Uccle, Belgium. The results are compared with data from the Aerosol Robotic Network (AERONET).

Data and Methodology

- Measurements of ozone, UV (290-363 nm) and AOD (306.3, 310.1, 313.5, 316.8 and 320.1 nm) are provided from the Brewer#178 instrument at Uccle.
- UV data are corrected for the cosine effect
- Quasi-simultaneous AOD data from a collocated Cimel sunphotometer (AERONET) are used (max. time difference 3 min)
- Period of study July 2006 – May 2010
- UVSPEC code of the LibRadtran package is used to estimate the aerosol radiative forcing efficiency (RFE) in the UV and retrieve the aerosol single scattering albedo at the 5 UV wavelengths

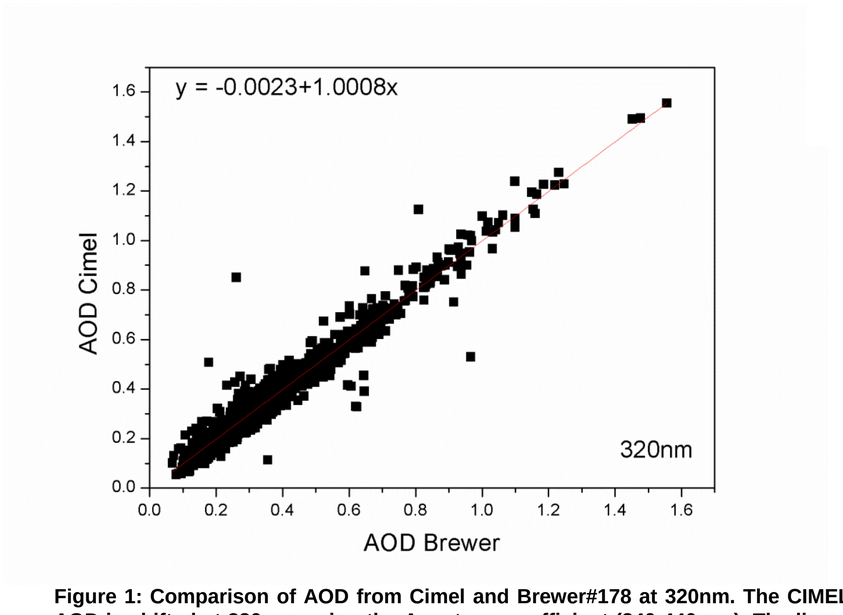

Figure 1: Comparison of AOD from Cimel and Brewer#178 at 320nm. The CIMEL AOD is shifted at 320 nm using the Angstrom coefficient (340-440 nm). The linear regression has an intercept=-0.0023 and slope=1.008, while the correlation coefficient is very high (0.97)

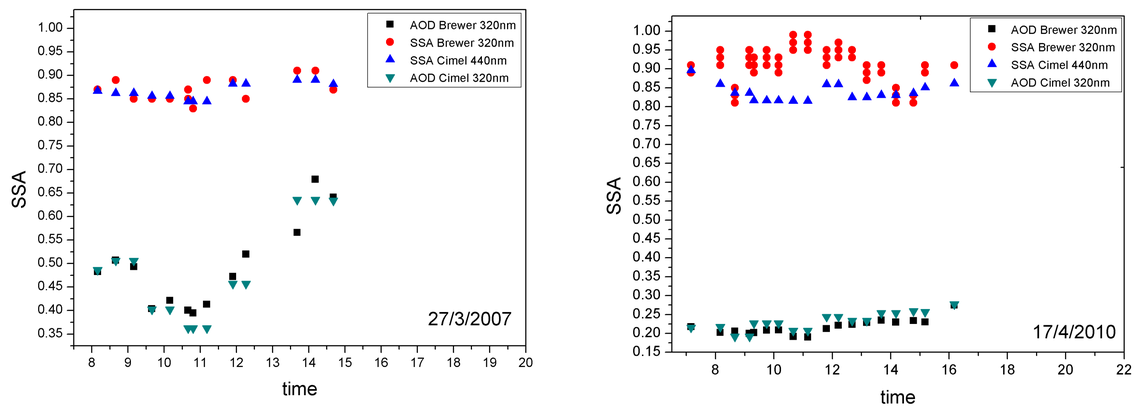

Figure 3: Aerosol single scattering albedo at 320nm, as derived from the model estimations for two days and comparison with the Cimel values. The Cimel values are at 440nm. The AOD values can also be seen in the graphs. The day on the left (27/3/2007) is described by high aerosol loads while the day on the right (17/4/2010) has lower AOD values. When the AOD is higher the range of the estimated ssa values decreases.

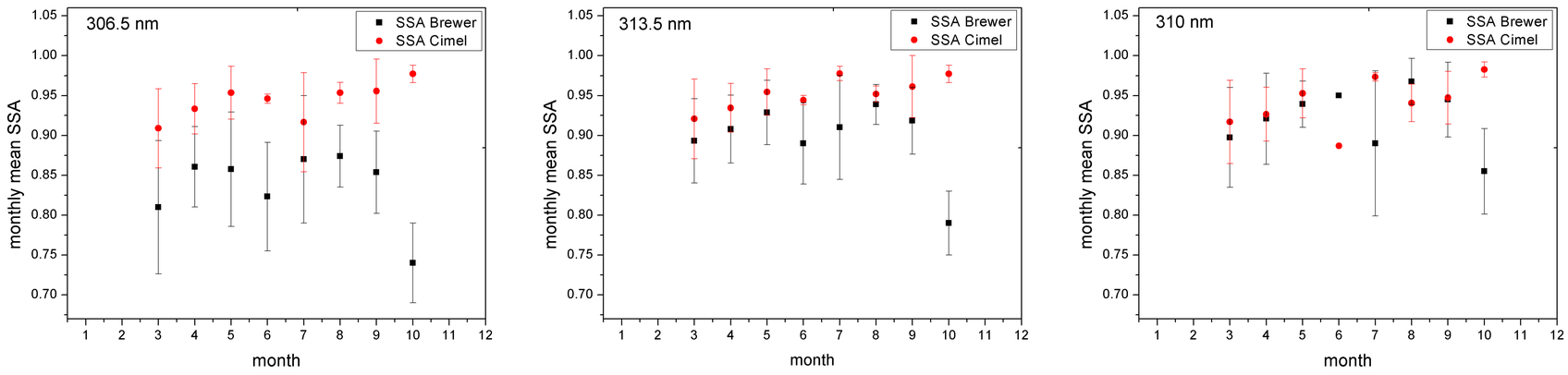

Figure 4: SSA monthly means from CIMEL at 440 nm and Brewer at 5 UV wavelengths (306.5, 310, 313.5, 316.5 and 320 nm). The monthly means were calculated taking into account the common measurements of the two instruments with AOD ≥ 0.4 and AOD difference lower than 5 %.

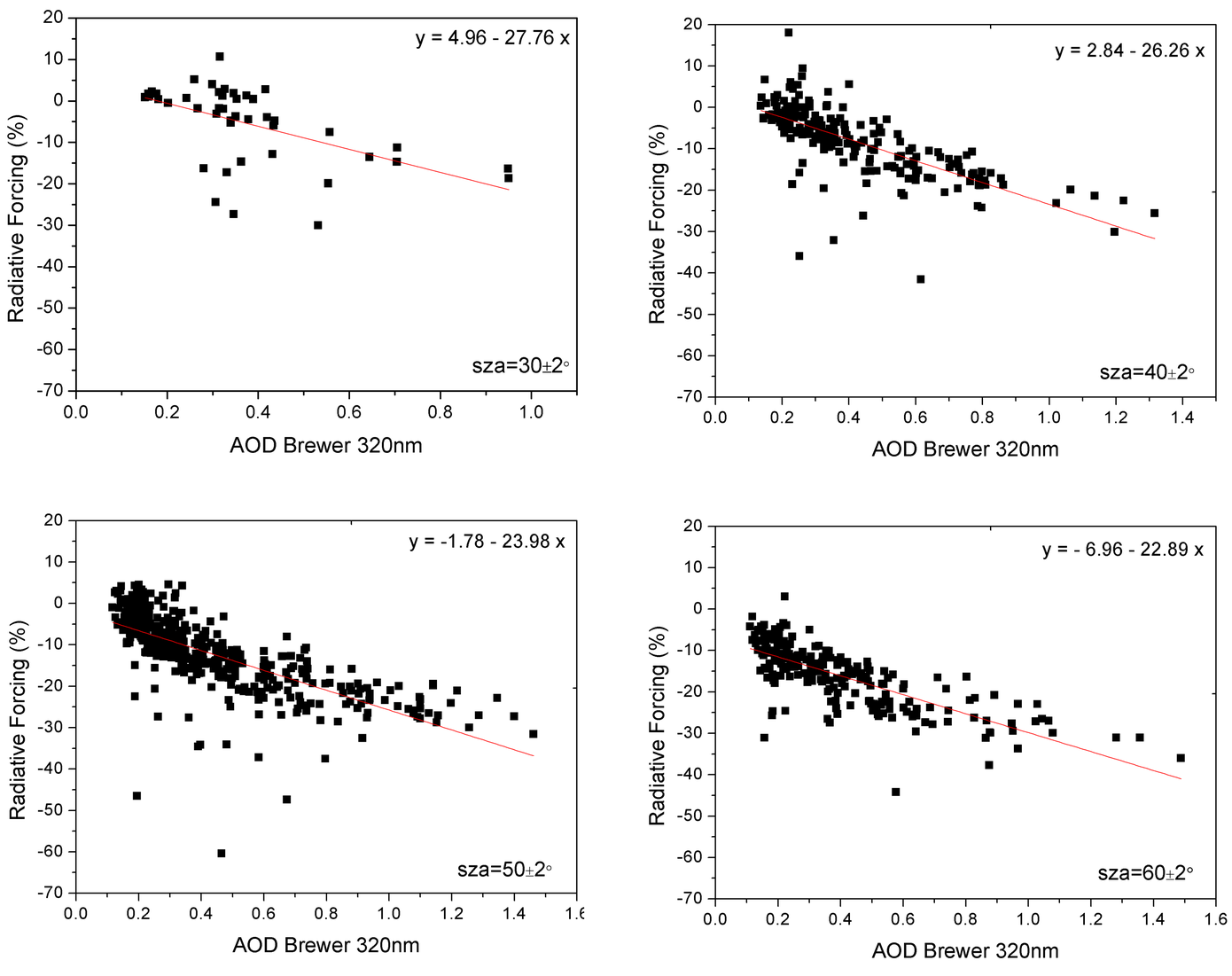

Figure 2: Aerosol radiative forcing (RF) (%) in the 300-360 nm range as a function of the solar zenith angle (sza). The RFE, given by the slope, ranges from -27.76 to -22.89 % per unit of AOD at 320 nm. There is an indication of an decrease of the RFE (absolute values) with the sza, probably due to the increase in the atmospheric path.

Conclusions

- AOD data retrieved at UV wavelengths from the Brewer#178 DS measurements, usng the Langley Plot Method are in good agreement with the Cimel values, with a correlation coefficient of 0.97 (Fig.1)
- The aerosol effect is studied for the first time at Uccle. RFE values at 300-360 nm range from -27.76 to -22.89 % per unit of AOD at 320 nm, indicating a dependence on the sza of the measurement. In the UVB part, 300-315 nm (not shown here), RFE ranges from -25.68 to -20.36 % per unit of AOD at 313.5 nm. (Fig.2)
- The SSA retrieval methodology is applied to UV-B wavelengths and the accuracy of the retrieved values increases with the aerosol load. (Fig.3)
- The agreement in the monthly SSA means is better as the wavelength increases, with the 320 nm estimated values ranging from 0.84 in October to 0.97 in August. (Fig.4)
- The highest SSA values are observed in the beginning of spring and end of summer at all 5 wavelengths. (Fig.4)

Acknowledgements

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