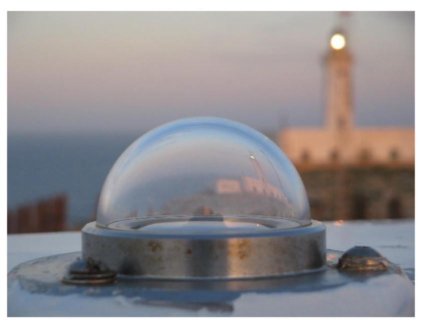
Long-term measurements with Brewer #123 on the island of Lampedusa



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Site and instrumentation

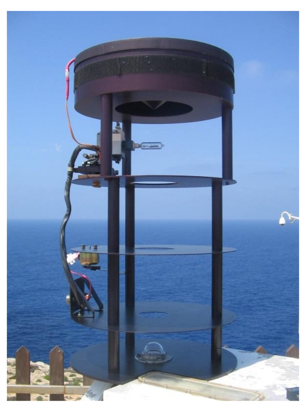
Brewer #123, model MKIII, was manufactured in 1995 and installed at the Station for Climate Observations on the island of Lampedusa (35.5°N, 12.6°E) in December 1997.

The station (http://www.lampedusa.enea.it) is equipped with a large set of instruments for the measurements of atmospheric composition, radiation budget, and meteorological parameters.





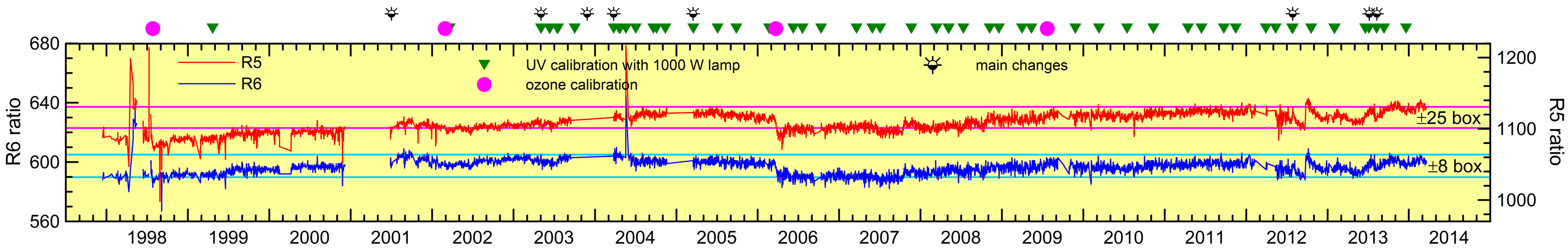






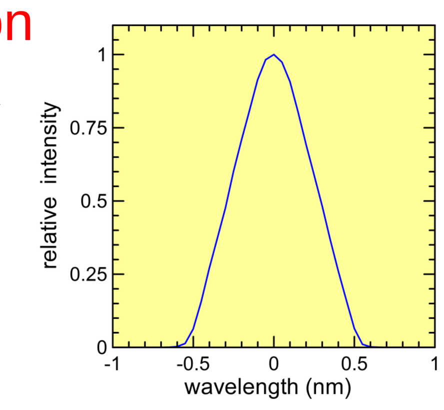

Long-term operation

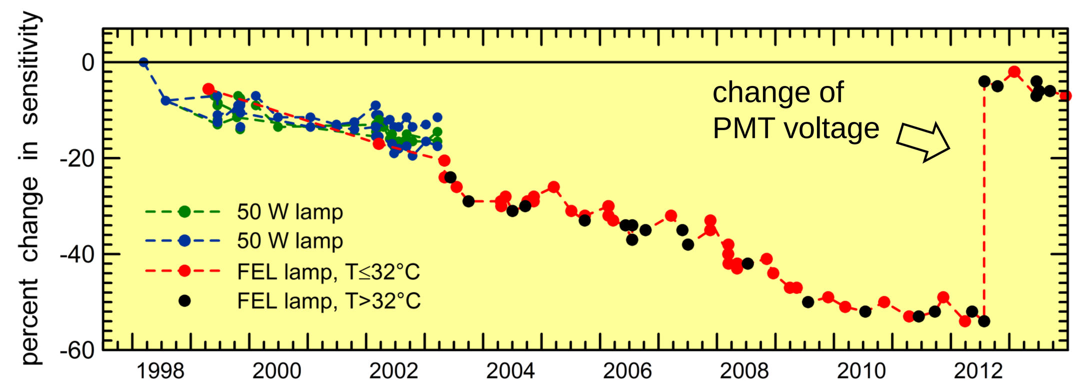
Evolution of the Brewer #123 R5 and R6 ratioes, dates of ozone and UV calibration, and of main instrumental changes occurring during the period 1998-2013.

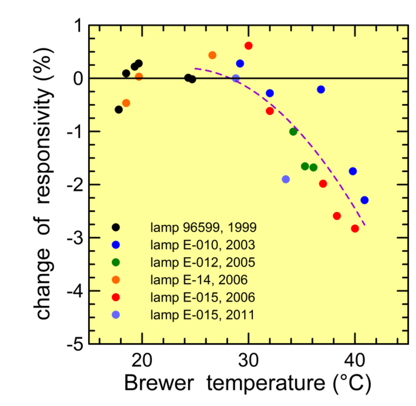


Instrument characteristics and ultraviolet irradiance calibration

The Brewer in Lampedusa is calibrated for UV irradiance using a NIST/NOAA field calibrator [Early et al., 1998] and 1000 W FEL NIST traceable lamps. The FEL lamps are used in the horizontal position and are calibrated at CUCF/NOAA. Fifty-four independent calibrations, each using at least 3 different lamps, were carried out since 1999. UV irradiance data are corrected for the cosine response of the diffuser (measured during a QASUME intercomparison). The FWHM of the slit function is 0.57 nm at 325 nm. The overall sensitivity decreased by about 38% in the period 1999-2012, and almost returned to the original 1998 value when the PMT high voltage was increased in late 2012. The sensitivity shows a seasonal dependency, suggesting a temperature dependence of the Brewer responsivity. Measurements of reference lamps irradiance were used to study the temperature dependence. The sensitivity shows a negligible dependence up to 30°C, and decreases at higher temperatures, reaching a 2.5 % reduction at 40°C.

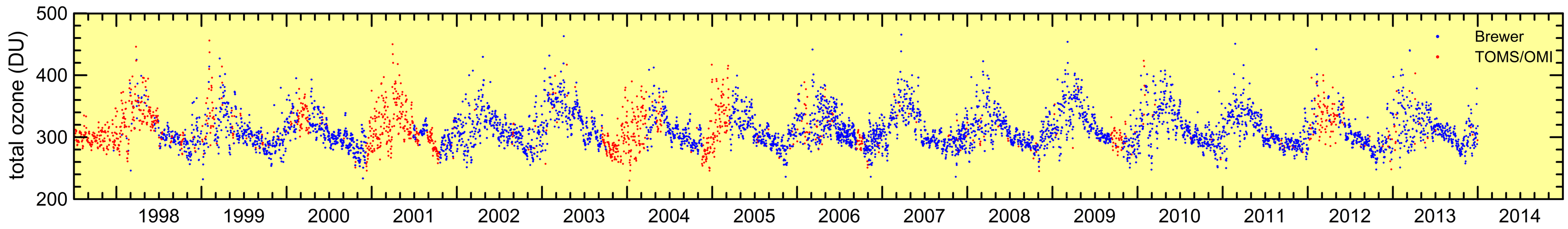






Total ozone

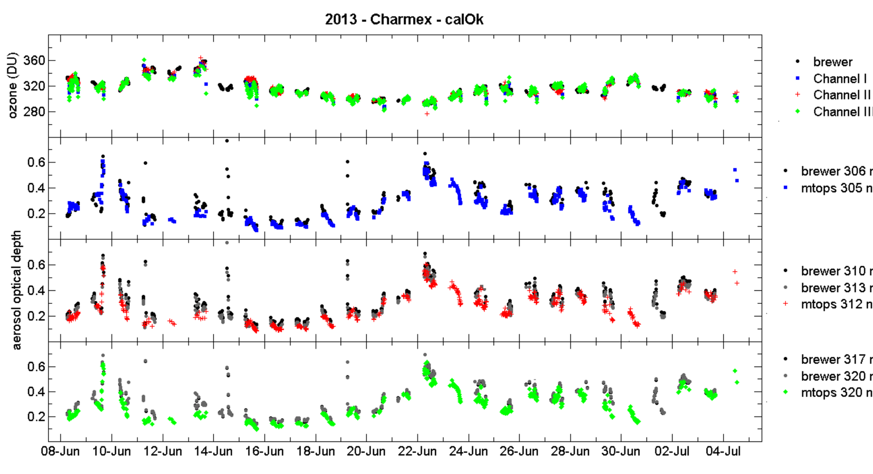
Evolution of the daily total ozone at Lampedusa in the period 1998-2013. TOMS/OMI data (red dots) are shown when no Brewer data (blue dots) are available.



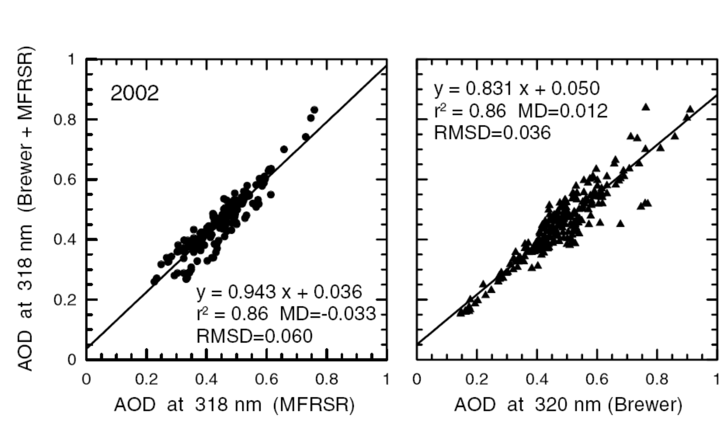
Aerosol optical depth retrieval

The UV aerosol optical depth, AOD, is derived from Brewer observations using the following methods.

1. The AOD is derived from the direct sun ozone observations by applying a calibration based on Langley plots [Marenco et al., 2002; Sellitto et al., 2006].
2. Calibrated UV global irradiances are combined with measurements of direct-to-global radiation ratio made with a UV multifilter rotating shadowband radiometer (MFRSR) [di Sarra et al., 2008].



Comparison of ozone and AOD measurements made with Brewer and Microtops during the ChArMEx campaign in summer 2013.

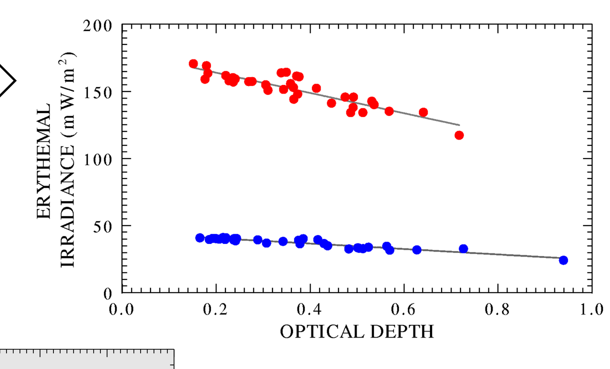


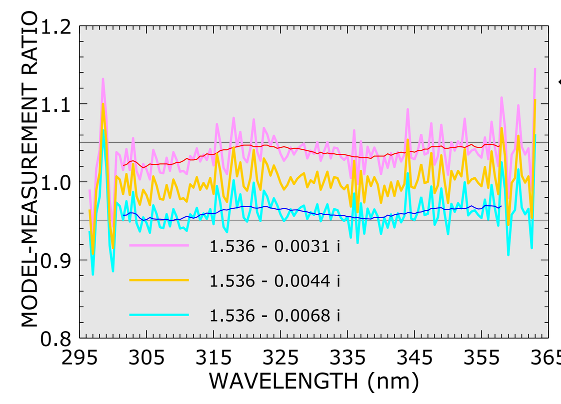
Comparison of AOD measurements made with Brewer, MFRSR, and combined Brewer/MFRSR observations [di Sarra et al., 2008].

Other studies

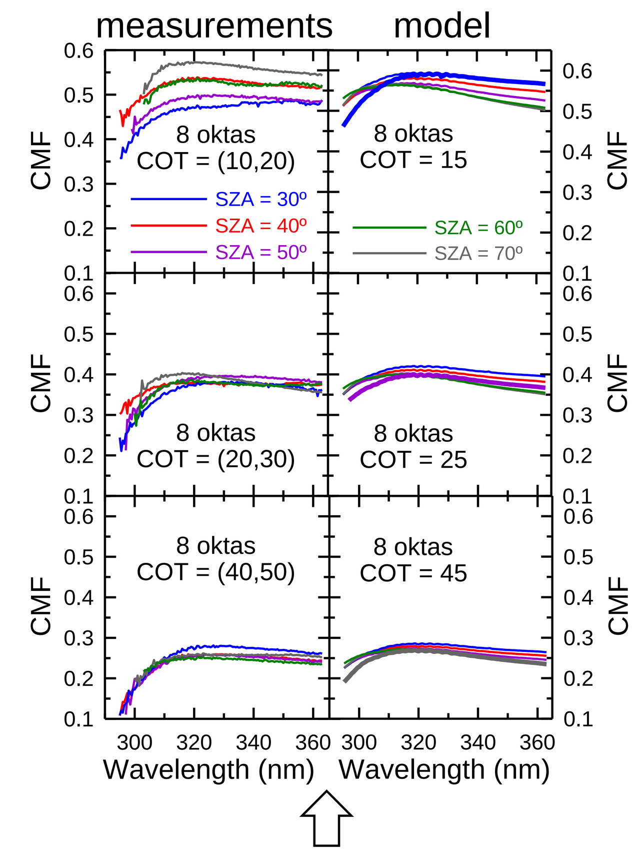
Brewer measurements were used in several studies combining observations and radiative transfer modeling to quantify the effects of aerosols [e.g., di Sarra et al., 2002; Meloni et al., 2003] and clouds [Mateos et al., 2011] on UV radiation.

Dependence of the erythemal irradiance on the aerosol optical depth at 30 and 60° solar zenith angle [di Sarra et al., 2002].





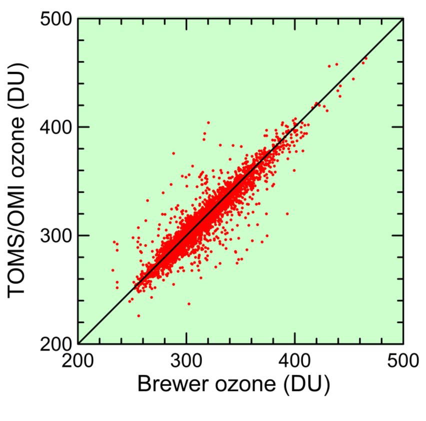
Determination of the desert dust refractive index based on the closure on the spectral UV irradiance [Meloni et al., 2003].

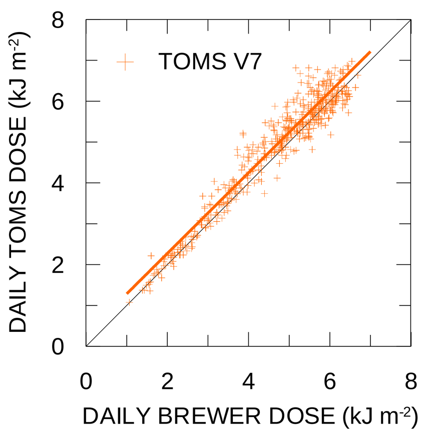


Measured and modeled cloud modification factor for different values of solar zenith angle and cloud optical thickness (COT) [Mateos et al., 2011].

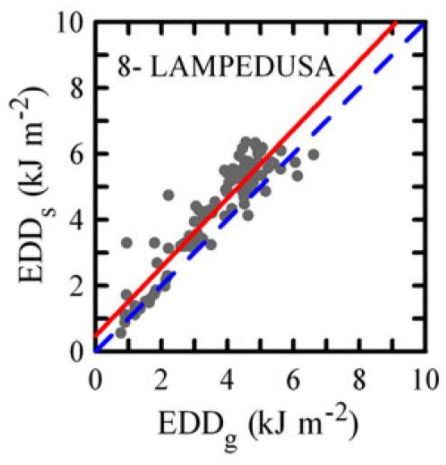
Satellite vs. Brewer observations

Total ozone and UV observations from satellites were verified against the surface Brewer measurements. The graph below (left) show the scatter plot of total ozone determinations over the period 1999-2013, which includes TOMS and OMI data. Retrievals of the daily erythemal dose from TOMS and OMI were compared with those obtained from the Brewer observations [Meloni et al., 2005; Arola et al., 2009; Mateos et al., 2013], showing a significant aerosol effect on the satellite retrieval.





Comparison of TOMS (left) and OMI (right) estimates of the daily erythemal dose versus those from the Brewer [Meloni et al., 2005; Mateos et al., 2013].



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