IRS2012-265-1
International Radiation Symposium 2012
Dahlem Cube, Berlin, Germany, 06 – 10 August 2012

Two decades of spectral UV measurements at Sodankylä

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The Finnish Meteorological Institute (FMI) was among the first institutes to monitor UV radiation at high northern latitudes, in areas where spring-time polar stratospheric ozone loss was observed. Spectral UV measurements were started in 1990 at the FMI Arctic Research Centre at Sodankylä. There, due to stratospheric dynamics, the natural variability in UV radiation is high, especially in springtime. The variability is enhanced by the influence of the ground snow cover, whose amount and duration vary from year to year. Atmospheric conditions in Finland are challenging for UV measurements: e. g., most of the measurements are performed at a high solar zenith angle (SZA), most of the time the sky has changing cloud cover, and temperatures below freezing occur during wintertime. In order to achieve high-quality UV time series for scientific analyses, proper quality control (QC) and quality assurance (QA) procedures have to be followed.

In this work, the spectral UV time series 1990-2011 of Sodankylä has been re-evaluated and homogenized. The data have been corrected with respect to known error sources using laboratory characterizations and theoretical approaches. Methods for the cosine correction, the temperature correction and calculation of long-term changes in spectral responsivity were applied. The results showed that the actual cosine correction factor of the Brewer at Sodankylä can vary between 1.08-1.13, depending on the sky radiance distribution and wavelength. The temperature characterization showed a linear temperature dependence between the instrument's internal temperature and the photon counts per cycle. The long-term spectral responsivity was calculated using the time series of several lamps, and it was scaled to the irradiance scale of the Aalto University for the whole measurement time-period.

Erroneous measurements were identified by using various QA tools including comparison with reconstructed UV dose rates, synchronous broadband UV dose rates and global radiation, and clear sky model calculations. An independent assessment of the data quality was obtained from the routine analysis tools of the European UV Data Base (EUVDB). The quality of the instrument was also assessed by solar comparison with other independent instruments during international campaigns. The Brewer showed good stability and the differences between the Brewer and the portable reference spectroradiometer QASUME have been within 5 % during 2002-2010. The features of the spectral UV radiation time series at Sodankylä were analysed for the time period 1990-2011. Ozone was the dominant factor affecting UV radiation during the springtime, whereas clouds played a more important role during the summertime.