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Estimation of total ozone column using different pair of channels of a NILU-UV multifilter instrument

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The complete recovery of the ozone layer is expected by mid-century, but projections depend on the greenhouse scenario and the possible interaction with other atmospheric constituents. The availability of long-term series up to the present allowed us to assess the ozone variability. However, enlarging the ground-based network is a need in order to monitor accurately the foreseeable recovery of the ozone layer in the next decades.

Multifilter instruments can be used to complement the networks of Dobson and Brewer spectrophotometers with the aim to extend the ground-based ozone data sets. These instruments have been successfully used for two decades in ultraviolet (UV) monitoring networks, measuring global UV irradiance in several spectral channels. According to several authors, total ozone column (TOC) can be retrieved from global spectral UV measurements and also from narrowband global UV measurements by comparing the ratio of close wavelengths with significant different ozone cross sections against simulated ratios using a radiative transfer (RT) code. Stamnes-Dahlback method has been widely applied to multifilter radiometers but there still remain some unsolved discrepancies between the analyses of different authors regarding the pair of channels to use, even for studies involving the same instrument.

The objective of this work is to analyze the performance of several pairs of channels in order to obtain an accurate estimation of TOC using global UV irradiance as recorded by a NILU-UV instrument. In order to be independent from calibration and particular issues of the multifilter instrument, UV irradiance data will be measured by a reference Brewer spectroradiometer and subsequently weighted by the spectral response function of the NILU-UV instrument. This response function will be also applied to spectral UV irradiances derived from the SBDART RT code in order to obtain the simulated ratios. The pairs of channels tested are: 340/305, 340/312, 320/305 and 320/312, and their performance analyzed for several solar zenith angle (SZA) ranges. TOC estimations are compared against reference values provided by the same Brewer instrument but using direct solar measurements.

One-year data (2012) from the Brewer #150 (El Arenosillo, Spain) are used in this study. Only cloud-free days were selected in order to compare the TOC estimations with the reference TOC based on direct sun measurements.

The results from 340/305 and 340/312 ratios provide both optimum TOC values, with the same MBE (mean bias error)= -0.1% (sd=1.8). From this result, if experimental weighted irradiances are accurately measured by a NILU-UV, the use of any of both pairs will provide similar TOC values. Estimations obtained with the pair 320/305 could be also acceptable (MBE=-4.3%, sd=1.8) but the pair 320/312 greatly underestimates TOC reference values (MBE=-17.0%, sd=3.6).

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