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Simplified Stray Light Correction for Solar Measurements using Array Spectrometers

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Diode array spectrometers have become increasingly popular for numerous applications in atmospheric research such as solar spectral measurements. Stray light remains one of the biggest challenges for solar measurements in the UV spectral region, where the irradiance drops by several orders of magnitude due to ozone absorption. We present a simplified stray light matrix correction method for array spectrometers that is specifically tailored for solar spectral measurements. The method does not require elaborate instrument characterization, nor extensive equipment such as a tuneable laser. A stray light distribution function based on a single laser line measurement (from a blue laser pointer) is approximated by a Gaussian function and an offset. This function involves three parameters only and is the basis for the stray light correction matrix. One cut-off filter is then used to adjust the offset parameter such that stray light corrected data are spectrally flat and around zero below the cut-off wavelength. The offset also accounts for the IR-contribution and has to be adjusted individually for each type of spectrum. For solar spectra, ozone provides a natural cut-off filter. The offset is further optimized using a single reference spectrum from a collocated calibrated double-monochromator spectroradiometer. We then use this instrument for an extensive validation of the stray light correction by intercomparison of solar spectra under various sky conditions. An agreement of 5% for wavelengths down to 307 nm and solar zenith angles smaller than 70° is achieved.