



Measurements of Trace Gases (NO₂, SO₂, HCHO, O₃) Amounts Using a Brewer Double Monochromator in Direct Sun Mode

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O₃, NO₂, HCHO, and SO₂ column amounts were measured daily for the past two years by using a modified double-Brewer spectrometer in direct-sun mode. A “bootstrap” solar irradiance method of solar calibration has enabled the Brewer spectrometer to detect NO₂, HCHO, and SO₂ with a sensitivity of approximately 0.4 DU relative to the cleanest days in the data record. This sensitivity was obtained using the standard Brewer direct-sun observation method that used spectral under-sampling. Reprogramming the Brewer for spectral over-sampling (e.g., taking data at 0.1 nm intervals with an instrument of 0.55 nm resolution) substantially improves the sensitivity. The method for obtaining the column amounts uses a modified DOAS (spectral fitting) technique having the advantage that measured direct sun slant-column amounts can be accurately converted into vertical column amounts without needing to know the height distribution or making the unlikely assumption of horizontal homogeneity, especially problematic in urban areas. The method described in this study can be applied to the worldwide Brewer network to obtain global distributions of pollution related trace gas amounts. Measurements of NO₂ show that estimates of aerosol absorption properties from Cimel sunphotometers or shadowband instruments can have major errors if NO₂ absorption is neglected in polluted areas.