Atmos. Chem. Phys., 6, 2177-2191, 2006
www.atmos-chem-phys.net/6/2177/2006/

Effects of column density on I_2 spectroscopy and a determination of I_2 absorption cross section at 500 nm

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Abstract. The use of ro-vibronic spectra of I_2 in the region of 543 nm to 578 nm as reference spectra for atmospheric Differential Optical Absorption Spectroscopy is studied. It is shown that the retrieval of atmospheric column densities with Differential Optical Absorption Spectroscopy set-ups at FWHM at and above 1 nm depends critically on the column density, under which the used reference spectrum was recorded. Systematic overestimation of the comparatively low atmospheric column density of I_2 of the order of 13% is possible. Under low pressure conditions relevant in laboratory studies, the systematic deviations may grow up to 45%. To avoid such effects with respect to field measurements, new reference spectra of I_2 were determined under column density of the order of 10^{16} cm^{-2} close to that expected for an atmospheric measurement. Two typical configurations of Differential Optical Absorption Spectroscopy, which use grating spectrometers, were chosen for the spectroscopic set-up. One spectrum was recorded at similar resolution (0.25 nm FWHM) but finer binning (0.035 nm/pixel) than previously published data. For the other (0.59 nm FWHM, 0.154 nm/pixel) no previously published spectra exist. Wavelength calibration is accurate to ±0.04\,nm and ±0.11 nm respectively. The absorption cross section for the recordings was determined under low column density with an accuracy of ±4% and ±3% respectively. The absolute absorption cross section of I_2 at 500 nm (wavelength: in standard air) in the continuum absorption region was determined using a method independent of iodine vapour pressure. Obtained was σ_{I_2} (500 nm)=$(2.18_6 \pm 0.02_1 \cdot 10^{-18}$ cm^2 in very good agreement with previously published results, but at 50% smaller uncertainty. From this and previously published results a weighted average of σ_{I_2}(500 nm)=$(2.19_1 \pm 0.02)\cdot 10^{-18}$ cm^2 is determined.

Final Revised Paper (PDF, 449 KB) | Supplement (18 KB) | Discussion Paper (ACPD)

Citation: Spietz, P., Gómez Martín, J., and Burrows, J. P.: Effects of column density on I_2 spectroscopy and a determination of I_2 absorption cross section at 500 nm, Atmos. Chem. Phys., 6, 2177-2191, 2006. Bibtex | EndNote | Reference Manager