PHOTOACOUSTIC SPECTROSCOPY OF THE O_2 A-BAND IN SUPPORT OF REMOTE SENSING

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Accurate spectroscopic models are required for remote sensing missions that use spectroscopic methods to interrogate atmospheric composition. The oxygen A-band (762 nm) is utilized for determination of air mass, solar pathlength and surface pressure in remote sensing applications due to the uniform concentration of molecular oxygen throughout the atmosphere and the spectral isolation of the band. NASA's OCO-2 satellite seeks to retrieve atmospheric carbon dioxide concentrations with an accuracy of 0.25%, placing stringent demands on our knowledge of the A-band spectral parameters. Current limitations in the A-band spectroscopic models, primarily from the treatment of line mixing (LM) and collision induced absorption (CIA), remain a significant source of error in carbon dioxide column retrievals. LM is manifested as an intensity exchange due to collisional population transfer between closely spaced energy levels while CIA appears as a broad, weak continuum absorption feature arising from transient dipoles induced by molecular collisions. Photoacoustic spectroscopy, a zero-background technique with a large dynamic range, is an ideal method to observe these effects which become increasingly prominent at elevated pressures. We have developed a high precision (SNR 10,000), broadband photoacoustic spectrometer for recording full A-band spectra at room temperature over a wide range of pressures (300-3000 Torr). Intensity exchange due to LM is observed in these unsaturated, high SNR spectra, and the weak baseline CIA profile can be extracted without interferences from instrumental background effects. Results from multispectrum fits of this data with non-Voigt line shapes showing insufficiencies in current A-band models will be presented.